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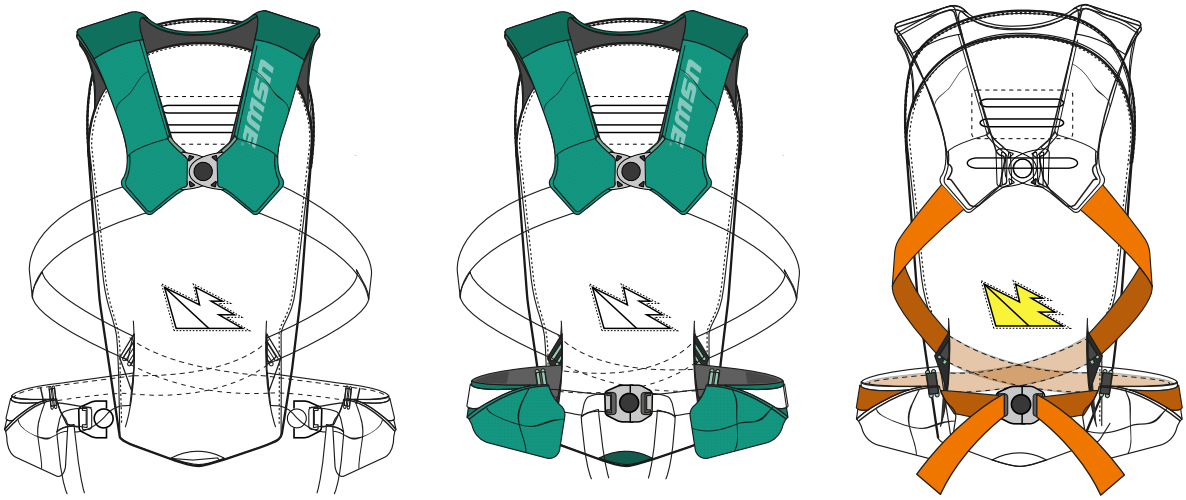

UPAC - The backpack which always fits

Development of a reliable and user friendly backpack for alpine skiing and snowboarding.

Master of Science Thesis in the Master Degree Program, Industrial Design Engineering.

OLLE JOHANNESSON

CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden 2018

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Abstract

A backpack is one of the most important objects for a freeride skier or snowboarder and is used to carry a lot of essential items needed for a safe and joyful experience on the mountain. However, in order for the backpack to facilitate for such experience, it needs to face the skiers and snowboarders want and needs. Freeride skiers and snowboarders tend to put high demand on their equipment in order to improve their skiing and snowboarding skills and therefore, companies need to create products which will accommodate for these demands. Designing products which will suit the skier and the actual skiing activity is one thing, but to include activities around the skiing activity is equally important. To further map these activities and to investigate how the user interacts with a backpack during these activities was one of the main objectives during this project. How to further develop a backpack which would simplify for these activities and provide the user with a close to spine fit, with maximum freedom of movement was the main goal during the product development process.

The project was divided into several phases containing problem identification, ideation and concept development. The problem identification phase was conducted in the intended context at a ski resort and included several user-focused research methods such as observations, interviews and focus groups, with the aim of creating an understanding of the user and backpack relationship. To meet the findings from the problem identification phase, the ideation phase was further divided into two parts. The first part was aiming on developing partial backpack solutions which would simplify for all of the critical user journey steps. The second part included combinations of these partial solutions and was conducted with the aim of creating a coherent design, in which all of the backpack parts would be working together as one.

The final concept is named UPAC and is a freeride backpack suitable for skiers and snowboarders who doesn't want their equipment to interfere with the skiing or snowboarding activity. UPAC consists of two main systems including all of the backpack parts, developed to simplify for all of the critical steps of the user journey, at the same time as it is reliable during the skiing activity. UPAC is equipped with a unique *few-steps* attachment system which will guarantee a great fit in every situation.

Keywords: backpack, skiing, snowboarding, back protector, product design, industrial design, usability, fabric

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This master thesis project is a collaboration between Chalmers University of technology and the backpack company USWE. I would like to thank everyone who has been involved in one way or another and a special thanks goes to Jörgen Gustafsson from USWE who provided me with great backpack development knowledge and useful tips regarding methods to use when working with fabric as a prototyping material, which was totally new for me.

Secondly I would like to say thank you to all skiers and snowboarders who participated in the interviews and focus groups during my visit in Åre and also to my freeride friends who attended the questionnaire and provided the project with important qualitative input. Without you I would have been fumbling in the dark during the early phases of the project.

Thank you Janine Romby and Hanna Svedman for joining me during my prototyping workshops and for providing me with access to your studios, both in Åre and Gothenburg.

Gothenburg 07 June 2018
Olle Johannesson

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Introduction

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1.1 Background

The alpine ski sport includes skiers and snowboarders, visiting 5479 ski resorts all over the world, (Skiresort Service International, 2018). A lot of statistics can be found regarding the amount of visitors, traveling to these ski resorts each year. However, if analyzing the ski and snowboarding market of the United States of America, there was 21,5 million unique skiers and snowboarders in 2016. Furthermore, these visitors did spend approximately 592 million USD on equipment. Including ski hardware, clothes and assessors such as backpacks (Statista, 2016). If further study the Swedish market, SkiStar is the leading ski resort company and decided in 2017 to invest 282 MSEK on their ski resorts for the upcoming season in 2018 (Skistar, 2017). A sport of this size, does attract a lot of people from different backgrounds with various skiing skills, values and needs.

In this study it was found that 14 % of all skiers and snowboarders are carrying a backpack and if this number would go for the whole skiing and snowboarding market, it can only be imagined how many skiing specific backpacks that can be found on the market. Yet, the majority of those, possesses the same functions, sometimes focusing more on looks than on the usability and context of use. This furthermore indicates that there is a need for new user friendly backpack solutions, which could facilitate the backpack usage and support the skiers experience.

1.2 USWE

USWE is a Swedish company, focusing on creating backpacks for action sports. They are mainly developing backpacks for mountain bikers, motor cross cyclists and runners with a focus on a bounce free experience, meaning that USWE never would allow for the equipment to be in the center of attention or interfering with the activity itself. Their *Action Packs* consists of an unique *one attachment point* suspension system, which might be applied to backpacks used for different kind of high performance sports (USWE, 2018). To add to the list of action sports, USWE are looking at the alpine skiing scene in which the company has little or no experience. This project will therefore be conducted in order for USWE to gain enough experience to enter the alpine skiing and snowboarding market and provide its users with a suitable product.

1.3 Freeride backpack

A freeride backpack is an backpack suitable for skiers and snowboarders who likes to go outside of the slope in to the deep powder. These people tend to put high demand on their equipment and would never allow for a piece of equipment to interfere with the skiing or snowboarding activity. A freeride backpack does often include a shoulder and hip belt suspension system and got room for avalanche equipment. In this report, some skiing and backpack terms will be used and the glossary below includes commonly used terms in the world of skiing and snowboarding. This is followed by a collage which explains the main parts of a free ride backpack, including the most common partial solutions, currently used by backpack companies, see figure 1.

- **Freeride**
  This skiing and snowboarding activity (also called *off-piste)* is performed outside of restricted skiing areas, usually in a lot of snow. Back-country skiing is often included in the freeride sector and includes hiking and climbing to areas not reachable by lifts.
- **Slope**
  This is the main part of a resort were skiing or snowboarding activities is performed within marked areas.
- **Powder**
  This is a word used for newly-fallen snow, often appreciated by the freeride skier and snowboarder.

Shoulder and chest strap

Lightly padded shoulder straps with Adjustable sternum strap

Pocket for drinking system

Removable bottle holder

Reverse system

Hip belt

Wide transferring to narrow hip-strap

Narrow hip-strap

Wide hip-strap

adjust vertically suitable for different body hight

Safety Leg Loop

Pockets

Removable hip belt

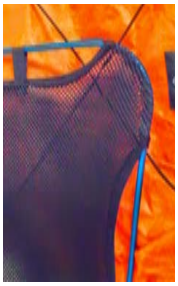
Back-Panel constructions

Molded padding with channels for vent and snowshedd

Protector

Size adjustable

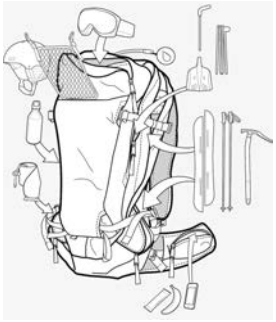
Aluminum frame



Wooden core

Packing gear possibilities

Interior



Exterior

Figure 1. Currently used backpack solutions.

1.4 Purpose & Aim

The main project purpose is to gain a deeper understanding of which backpack features skiers and snowboarders are looking for when searching for a new freeride backpack. When and if a user further on finds the right backpack, the aim is to find these users and evaluate the relationship between the user and backpack. Another aim is to evaluate what the current freeride backpack market is lacking or is in need of. The gained knowledge will then be used and translated into a USWE backpack solution which further will be developed to improve on the users overall skiing experience. The user focused design process will ensure that USWE will be able to provide the market with a competitive first edition alpine skiing and snowboarding backpack, which has its focus on Usability, Function and Fit.

1.5 Target group

The skiing and snowboarding sport consists of a wide variety of backpack users. However, this project will be focusing on experienced skiers and snowboarders form the age of 15, who prefer skiing outside of the restricted skiing area. These kind of users can be seen as critical users as they most often do put higher demand on their equipment. When designing for the critical users, the final result will also catch the regular skiers attention, which moreover becomes the secondary target group.

1.6 Limitations

Several backpack companies currently does offer backpacks with integrated air bag systems, which is beneficial during the event of an avalanche. However, these backpacks are expensive and does attract a narrow range of users. Since this project was initiated with the aim to develop USWEs first ever alpine skiing and snowboarding backpack, a wider target group was wanted. Therefore, the decision of excluding the airbag feature was believed to be in favor for both the project and final concept. Likewise, since the aim was to develop a competitive product for the freeride market, financial aspects in sense of material and manufacturing was disregarded within reasonable boundaries and believed to be a question suitable for further work.

1.7 Project process

This project was divided into three phases including; *problem identification*, *developing partial solutions* and *combining final partial solutions*. These phases will therefore be presented as chapters throughout this paper. The ideation and evaluation methods used during each phase was selected to fit each part of the product development process and will be presented throughout the report, during each phase. A summary consisting of the phase result will further be presented before entering a new phase. Thus, by looking at the results from each phase, the reader will get a fast overview of the project phases.

Project questions:

- *Are the freeride backpacks found on the market today, designed to optimize the skier and snowboarders day on the mountain?*
- *How can a alpine skiing backpack be designed to simplify and improve on the skiers experience?*

Problem identification phase

2

This phase of the project was divided into two different parts. The first part contained a web and store based research. The second part included five tests conducted at the ski resort Åre and was designed to identify the skiers user journey which was used to find the critical steps during which the user interacted with the backpack, (Wikberg Nilsson, 2015).

2.1 Web based research

A web based research was conducted in order to provide the project with knowledge regarding the market and its leading backpack companies. The focus was put on what these companies are highlighting in their designs, but also on what the market seemed to be lacking. This research activity was further conducted in order to analyze how different parts of a freeride backpack is constructed today and which solutions that currently are available and appreciated by the user. This information was collected from multiple webshop sites, guides, magazines and test reviews.

Figure 2 illustrates the most common backpack aspects, mentioned by some of the freeride backpack companies as an attempt to attract customers. Several of the backpacks found on the market today does provide the user with a good fit and a lot of performance, just as promised by the companies. However, when evaluating the usability, most freeride backpacks was hard to understand and didn't always felt developed to simplify the user experience.

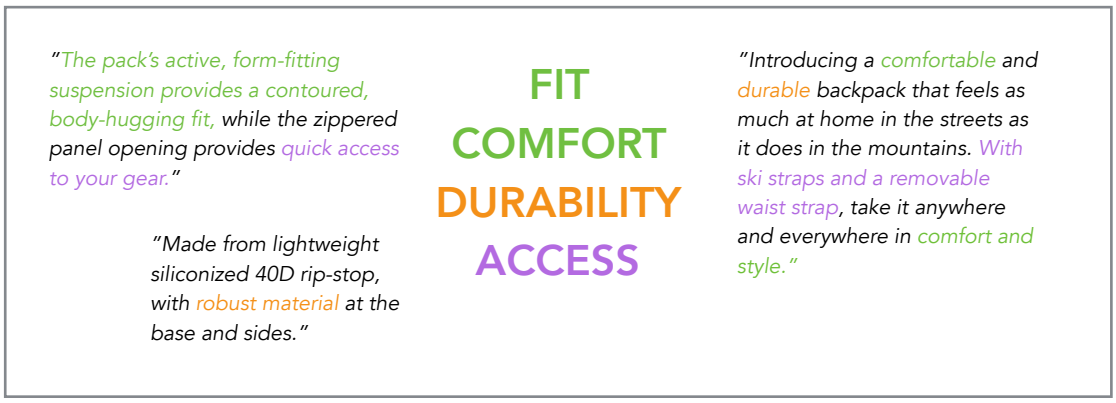


Figure 2. Market focus.

The backpacks was analyzed one at a time with focus on the partial solutions explained in previous chapter. To find and map which solutions that were most frequently used by other companies, the backpacks were divided into different groups and backpacks containing the same type of solutions ended up in the same group. Figure 3 illustrates how the majority of the backpack companies are using the same type of back panel design. The same goes for the suspension system constructions shown in figure 4. To early on provide the reader with knowledge regarding backpack parts and terms, a significant part of the web based research result was presented already in the background of this paper, see figure 1.

Figure 3. Grouping backpanel.

Figure 4. Grouping suspension system.

The web based research furthermore indicated on the opportunity to design a unique backpack, standing out from its opponents. This could be done both by developing new solutions, but also by developing already existing, less frequently used solutions and designs. However, in order to further evaluate different freeride backpack solutions, these had to be tested in reality and not only analyzed through the computer screen.

2.2 Store based testing

At this stage, the aim was to evaluate partial backpack constructions and to further evaluate the simplicity of certain backpack features. Since the aim was to develop a product containing a great fit and not only functionality it was important to analyze different suspension system solutions. This was found to be particularly important in a complex situation where several parts of a product is involved in the same solution.

The main reason for this testing was to pinpoint advantages and disadvantages with the suspension system design and to investigate how the hip belt was connected to the backpack in different ways. It was found that all hip belts which followed the shape of the human torso at the same time as it possessed a starting point not to far out on the backpack, would result in a better close-to-body fit, see figure 5. However, if the attachment point started too far out on the backpack, the design would not enclose the users body in a successful way, which was assumed to affect the fitting experience, see figure 6.

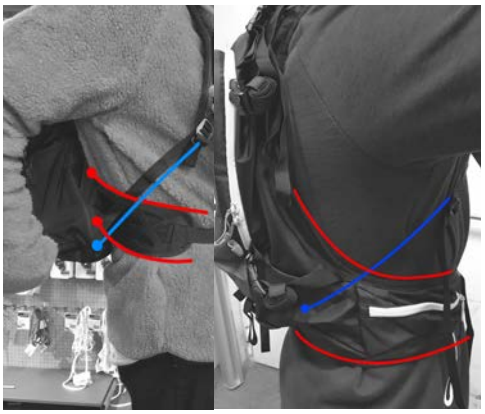


Figure 5. Better close to body fit.

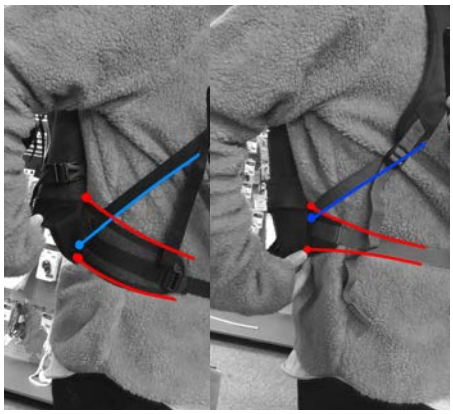


Figure 6. Less nice close to body fit.

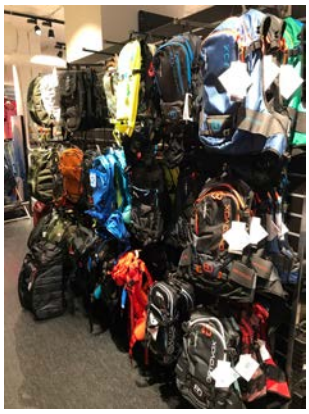


Figure 7. Backpack ocean.

Secondly, the store based testing was conducted to investigate how different backpacks was displayed next to each other, see figure 7. It was found that a wall stacked with freeride backpacks in most cases consisted of the same brands, with similar design language and shapes. When Furthermore comparing two backpacks next to each other it was more or less impossible to determine which backpack that would satisfy the freeriders requirements in the best way. This result provided the project with a question regarding how to design a backpack which could be found as interesting by the user and at the same time show the user how the different backpack parts and solutions would contribute to a joyful skiing experience.

2.3 Part 2 - User focused study

The second part of the problem identification phase included four different tests conducted at the ski resort Åre, Sweden. The focus of the *Backpack evaluation* test was to evaluate the backpack fit and different backpack partial solutions such as the suspension system was evaluated. The o*bservations* Included over a 1000 skiers and snowboarders at six different locations, with focus on identifying backpack users and their actions during different situations. *The Interviews* was aiming on gaining insight regarding the backpack-user relationship. Finally, the *Focus groups* included three test persons who was told to perform different hiking activities. The following questions was set in order to accomplish the wanted outcome.

- How many people are using backpacks while skiing?
- What are the main reason(s) for using a backpack?
- Which backpack features does users value the most?
- How does the user interact with the backpack during a day at a ski resort?
- Which are the most important backpack parts?
- What does users think their backpacks are lacking?

2.4 Evaluating freeride backpacks

In order to gain backpack skiing and snowboarding experience, the first test included evaluation activities of both USWE and competitor backpacks. To really put the backpacks up to test, a focus group consisting of three persons including the writer himself was evaluating the backpacks on the mountain, in the real context of use, see figure 8. The test persons was told to test and analyze the following while riding down the slopes.

Regarding the suspension system:

- fasten and unfasten attachments
- tighten and untighten straps
- backpack movement and interference while riding.

Regarding the fit:

- how the bag behave while riding
- freedom of movement.

Figure 8. Backpack evaluating.

During the test, all test persons were asked to fasten and unfasten the attachment points. Also the tightening action of different systems were evaluated. One test person mentioned *"this was hard to attach and adjust with gloves on, I think I have to take them off"*. Figure 9 and 10 illustrates how different users struggles with the attachment and tightening actions.

Figure 9. Attachment point with gloves.

Figure 10. Tightening action.

Regarding the backpack geometry and freedom of movement comments like; *"I like the fact that the backpack has got a slim profile, so that it does not disturb my skiing"* or *" its too wide, which affects my skiing"*, was frequent, see figure 11. Regarding the suspension system, constructions which moved the chest strap attachment point towards the center of the chest was gaining several positive comments and one participant mentioned that; *"this suspension system hold the bag in place and feels good on my body and does not disturb my skiing"*. *Figure* 12 illustrates this kind of suspension system, which in this case was a USWE suspension system.

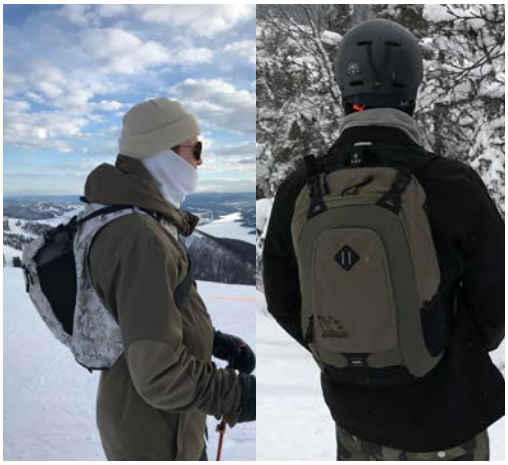


Figure 11. Slim vs wide profile.

Figure 12. USWE suspension system in skiing situation.

Figure 13. Six steps to prepare backpack.

All participants also mentioned the high amount of tightening steps to be a struggle as the tightening steps forced the participants into removing their gloves, see figure 13. In detail, the steps of action was to remove gloves, fasten the chest attachment point, tighten the chest straps, fasten the waist strap attachment point one, fasten the waist strap attachment point 2 and finally tighten the waist strap. As this action needed to be performed several times during one single run, it was found hard for the users to gain a great fit for every skiing or snowboarding situation.

2.5 Observations

The second test was performed at several different locations on the mountain and was conducted in order to map the skier´s journey during the day. To find all of the critical points, the observation was divided into three different focuses; *carrying gear to the slope*, *going in the seat lift* and *hiking & resting*. While conducting these structured observations, statistics regarding the amount of people using backpacks came as a bonus (Thomas, 2017). The main reason for this to be seen as considerable was due to that it could identify the amount of potential customers and further on point out at what locations these users preferred to ski. At the top of the mountain, where people mainly skied the off-piste, it was found that a larger amount of people used a backpack compared to locations where people mainly skied the slope. This further on showed that the freeride users are more frequent backpack users. As the target group was set to be those exact kind of skiers, this result was assumed to be in favor for this project. In total, 135 out of the 965 observed skiers and snowboarders where using a backpack, which is about 14%. Next step in the observation was to find these 14 % and ask questions regarding their relation to their backpacks.

2.5.1 Carrying gear to slope

The first observation was conducted in order to identify how people were carrying their equipment to the ski area. The observation included all skiers and snowboarders but focused on those who carried a backpack. Figure 14 illustrates some of the observed people and how the majority of them carried heavy skis and snowboards. Seven different ski carrying techniques was found during the observation, which is presented in figure 15. As illustrated in this table, 77 out of the 100 observed users was carrying their skis on one shoulder which further was assumed to be the most common short distance carrying technique. Furthermore, 100 % of the snowboarders where carrying their board horizontally at waist level.

Figure 14. Carrying equipment to the slopes.

Carrying technique	Amount of users
Right shoulder	47
Left shoulder	30
Both shoulders	1
Waist level, right side	10
Waist level, left side	6
One ski in each hand	4
Holding vertical	2

Figure 15. Ski carrying technique.

Backpack users who walked by this first location was believed to mainly consist of two type of skiers; those who carried slalom skis made for the slope and those carrying freeride skis made for the off-piste. The carrying techniques amongst slalom skiers matched well with the overall result shown in figure 15, meanwhile 10 out of 10 freeriders carried their skis on their right or left shoulder. Furthermore indicating that this was how the project target group decided to carry their skis to the skiing area. This was found to be the case even for users who was in possession of a backpack containing a ski carrying system. Further on, analyzing the backpack usage, it was found that 7 out of 10 freeride skiers did not tighten the backpack´s suspension system while walking to the skiing area.

2.5.2 Going in the chair lift

The second observation was conducted on backpack users at the bottom and top of a chair lift. In order to analyze how the user interacted with, and was affected by the backpack during this part of the user journey, video recording was used as a tool. This tool was further necessary since a large amount of people was passing by, facing the observer only for a few seconds. While observing these videos, the following questions was considered:

Entering the chair lift:

- Does the user let the backpack stay on, or is it removed?
- Does the backpack interfere with the activity?

Getting off the chair lift:

- Does the user struggle the most if the backpack is kept on, or if it is removed?
- How does the user put on and attach the backpack before skiing down the mountain?

Two main ways of interacting with the backpack was found during this observation, including users who kept the backpack on and those who removed it. More than 80 % of the observed users kept the backpack on while entering the chair lift. This was assumed to be due to the amount of disadvantages caused by removal of the backpack, listed in the lower left and right corner of figure 16.

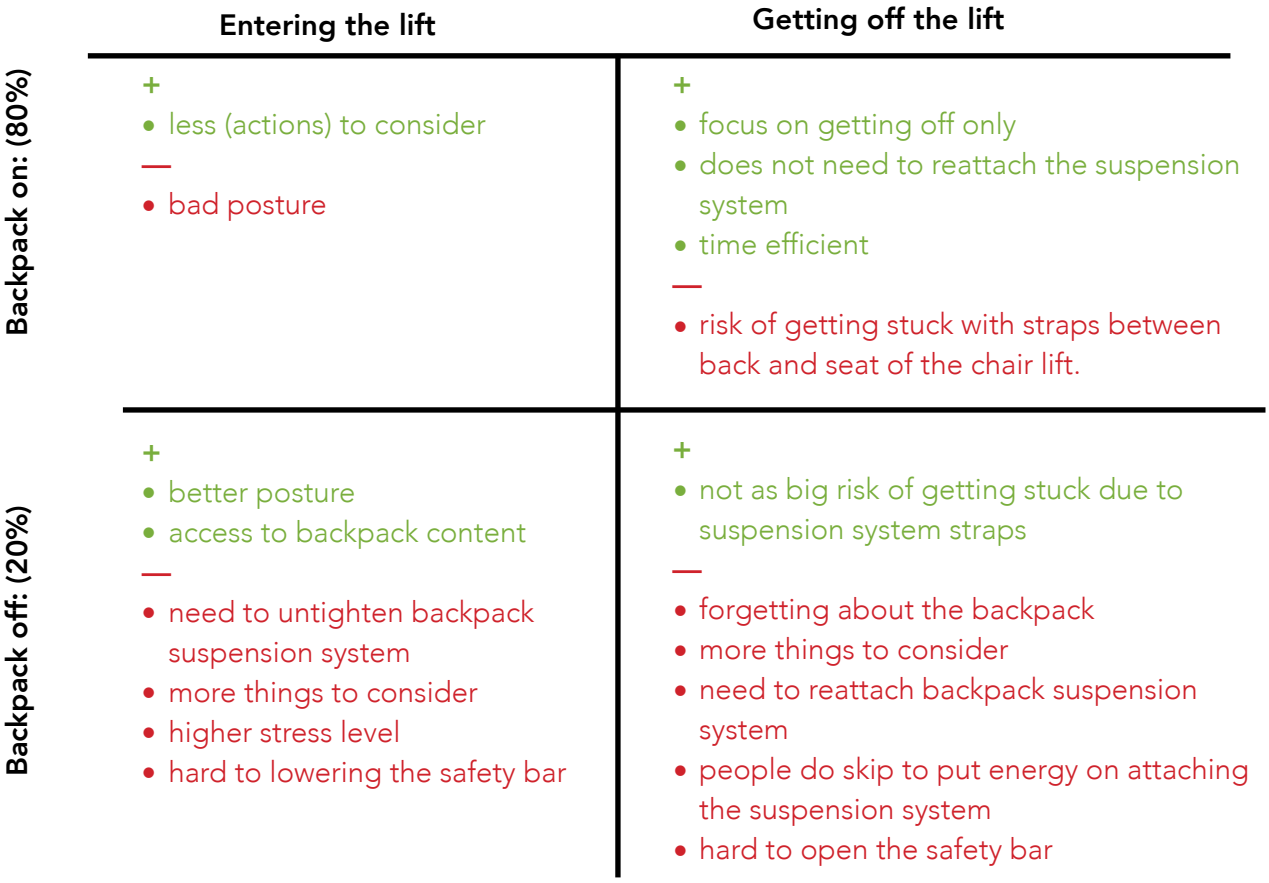


Figure 16. Backpack on or backpack off?

However, if the user decided to keep the backpack on while entering the chair lift, it was found to be hard for the user to find the right posture. The fact that the backpack interfered with the chair was found to be one significant disadvantage for the user, illustrated in figure 17 and upper left corner in figure 16.

Figure 17. Backpack affects user posture.

When observing backpack users getting off the chair lift, it was found that those who removed their backpacks did struggle while managing both backpack and poles, and at the same time getting of in a safe and secure way, see figure 18. However, users who kept the backpack on, was allowed to put all focus on trying to get off in an effortless way, see figure 19. Furthermore, during these observations, the researcher had the opportunity to talk to a chair lift host who mentioned some problems involving the backpack and chair lift activity. She mentioned that she sometimes has to push the emergency stop for reasons linked to a tricky backpack situation, which mainly occurs when people forgets the backpack on the chair, or get stuck due to long backpack straps. The chair lift host furthermore mentioned that a backpack is a obstacle when the safety bar is opening, see the right column of figure 16.

Figure 18. Divided user focus.

Figure 19. Focus on getting off.

2.5.3 Hiking and resting

The third observation was conducted with the aim to map the skiers hiking habits and took place both on the bottom and top of a 30 minute hiking track. Just as during the first observation, several users decided to carry the skis on their shoulders, without using the integrated backpack carrying system. However, those who took the time to mount their skis on their backpack was allowed to use their poles as support when hiking the track, see figure 20. When further observing backpack users at the top of the track, it was possible to snap up some discussions related to the hike and the difficulty of putting on the right amount of clothes. It was observed how these users interacted with the different compartments of their backpacks when removing or changing clothes,

see figure 21. In several cases, if changing one piece of clothing the user was forced to unload and reload all the items in the backpack, causing time loss and snowy equipment.

Figure 20. Attached equipment.

Figure 21. User changing clothes.

2.6 Speed interview

The speed interview was designed to fit the context in which the participants often were in a hurry to start skiing down the mountain. It was early on found that it was hard to identify problems during an interview like this. This was assumed to be due to the fact that many of the participants had a close relationship to their backpack and had spent a lot of time finding that specific one. Therefore, focus was put on what people liked regarding their freeride backpacks and not only on the problems. The interview was conducted in a structured way, containing four questions, designed to collect fast answers. The questions was designed to guide the respondents towards the backpack topic, but further allow for discussions around it (Thomas, 2017). However, the researcher was guiding the participants to stay within the topic, which was considered important when trying to collect the wanted qualitative data (Lantz, 2013). The guiding questions were as followed:

- How often do you carry your backpack when skiing?
- What is your main reason for carrying a backpack when skiing?
- What is the best feature of your backpack?
- Do you miss any features on your backpack?

The reason for the first question was to introduce the respondent to the topic, meanwhile the remaining ones was designed to gain insight regarding the interaction between user and backpack. Figure 22 shows the people who attended the speed interview.

Figure 22. People attending the speed interview.

The most interesting analysis made from the first question was that most of the participants did use their backpacks during most of their skiing days. The participants did use their backpacks during several different situations on the mountain, which shows that the backpack should fit all those different situations and not only be designed to fit the off-piste experience. To face the question regarding the user and backpack interaction, a user requirement analysis was conducted (Wikberg Nilsson et al., 2015). It was found that both freeride skiers and snowboarders did value the same things in a backpack, as well as the reason for carrying a backpack was similar and will further on be presented in the phase result. What these users liked regarding their backpacks was most often stated to be the reason for why they had bought the backpack in the first place. It was however found that features which were important for many of the participants, was mentioned to be badly designed or a missing feature to others. These missing features was further explained as something which was affecting activities around the actual skiing experience, such as complicated suspension system designs, parts which was hard to understand or operate and bad design decisions such as irritating straps and bad compartment sectioning, see list below and for full list, see **appendix I**.

Reason for using a backpack:
- avalanche equipment, liquid and ski carry opportunities.

Best features:
- the fit, the shape, compartment sectioning and no strap flutter.

Missing features and distractions:
- equipment carrying solutions, less strap flutter, a more slim shape, a better compartment sectioning.

2.7 Hike with focus group

This test aimed on evaluating the ski and snowboard carrying activity and included two hikes, one shorter and one longer. To gain as much user insights as possible, the focus group was performed within a small group of three participants. Stated by Krueger et al. (2015) a smaller focus group often results in better involvement amongst all of the participants, which also was proven to be the case during this test. One of the hikes lasted for 10 minutes and was an off-slope hike which is popular amongst most skiers and snowboarders who is in search of easy access powder. During the short distance hike, none of the test persons decided to attach their equipment on the backpack, see figure 23. This was mentioned to be due to the short walking distance and time loss that the attachment would have taken. Non of the participants found the short distance carrying activity to be a problem, neither something they enjoyed.

Figure 23. Short distance carrying solutions.

Figure 24. Long distance carrying solutions.

The second hike lasted for half an hour and this time the participants attached their gear to their backpacks, see figure 24. Since the aim of the focus group was about to invite for a discussion amongst the participants, the researcher acted facilitator (Thomas, 2017). To further keep the discussion going, video recording was used as a tool. However, if one of the participants mentioned something of interest, the researcher implemented the five - second pause technique. The pause gave the other participants the opportunity to evaluate what just had been said and further evaluate on that topic (Krueger et al., 2015). Two main topics was discussed during the attachment activity:

- how to perform the mounting activity with gloves on, see figure 25
- how to put on the backpack after attaching the snowboard, see figure 25.

Figure 25. Difficulties.

Figure 26. Observing video.

When further on observing the video, it showed a large amount of less user friendly activities performed by the user, which resulted in bad postures, see figure 26. The fact that the test persons where silent during the test, further showed that the participants had to concentrate hard on such an easy task.

2.8 Web based targeted questionnaire

During the speed interview, users did explain the compartment sectioning as an important factor of the backpack. However, due to time constraints, it was difficult to gain enough insight regarding the backpack loading activity during these interviews. Therefore, in order to evaluate differences in how a backpack is loaded and if this activity is changing depending on the skiing situation, a questionnaire was constructed. In order to allow for facts as well as attitudes, the following open questions was sent without alternatives (Thomas, 2017).

1. *What is for you, the most important factor/ feature regarding a freeride backpack?*
2. *What items do you place in the backpack before a regular day at the ski resort?*
3. *What items do you place in the backpack before a short hike, about 30 min?*
4. *What items do you place in the backpack before a longer hike, 1 hour or more?*

The respondents consisted of 15 experienced freeride skiers and snowboarders and the reason for this selection was to immediately face the intended target group. The first question above, was addressed to add certitude to the earlier steps of the problem identification phase since this was a question assumed to be of high importance. Below is a list of the most interesting user insights collected from the questionnaire.

- Different users are carrying a lot of different items.
- Sometimes the bag is filled with larger items and sometimes not.
- There is no intended place for a camera in today´s skiing backpacks.
- Different items are used more or less frequently and during different occasions.
- Some items are in need of fast access once a critical situation appears.

The amount of items brought for a regular skiing day or shorter hike was about 10 - 15 items and 15 - 20 items for a longer one. Therefore focus was further put on the differences between a short hike (maximum 1 hour) and a longer hike (up to full day). The yellow post-its in figure 27 represents items brought by the user during a shorter hike and the green post-its in figure 28 represents items brought to a longer hike, in addition to the yellow items. It was further found that the additional items brought for the longer hike, mainly consisted of larger items. So to gain a realistic sense regarding size, all items where collected and placed in groups depending on type of skiing, see figure 29 and 30.

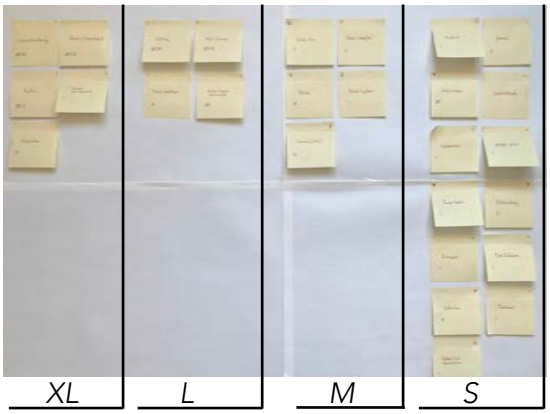


Figure 27. Items brought during a day at the slopes or shorter hike.

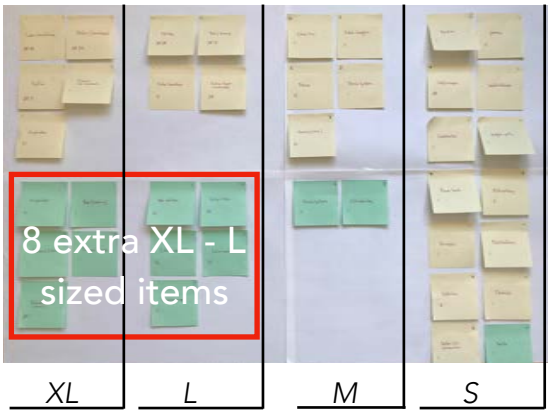


Figure 28. Items brought during a longer hike.

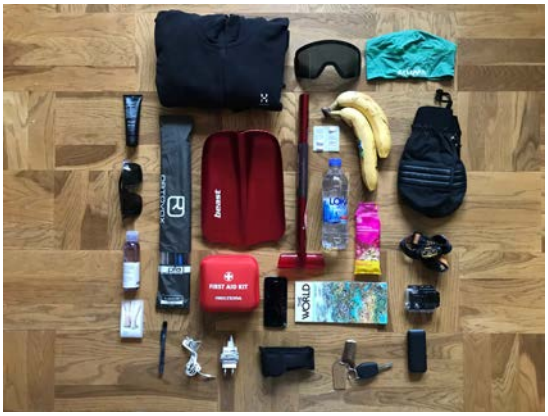


Figure 29. 30 min hike items in real size.

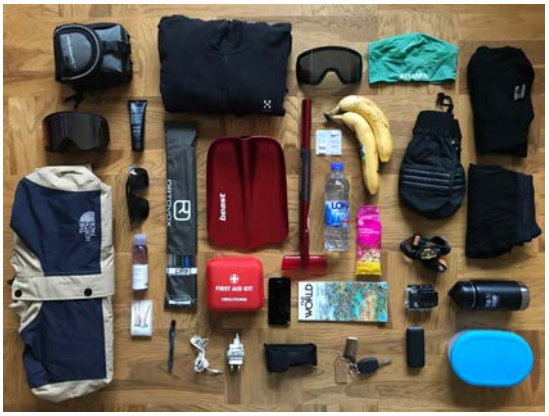


Figure 30. 1 hour hike items in real size.

In order to use the result from the questionnaire in the upcoming ideation phase, all items needed to be further divided into groups. In order to separate items from each other and to group others together, the three following critical factors was stated as important; size of item, level of tolerance and level of access. Figure 31, 32 and 33 illustrates the grouping activity.

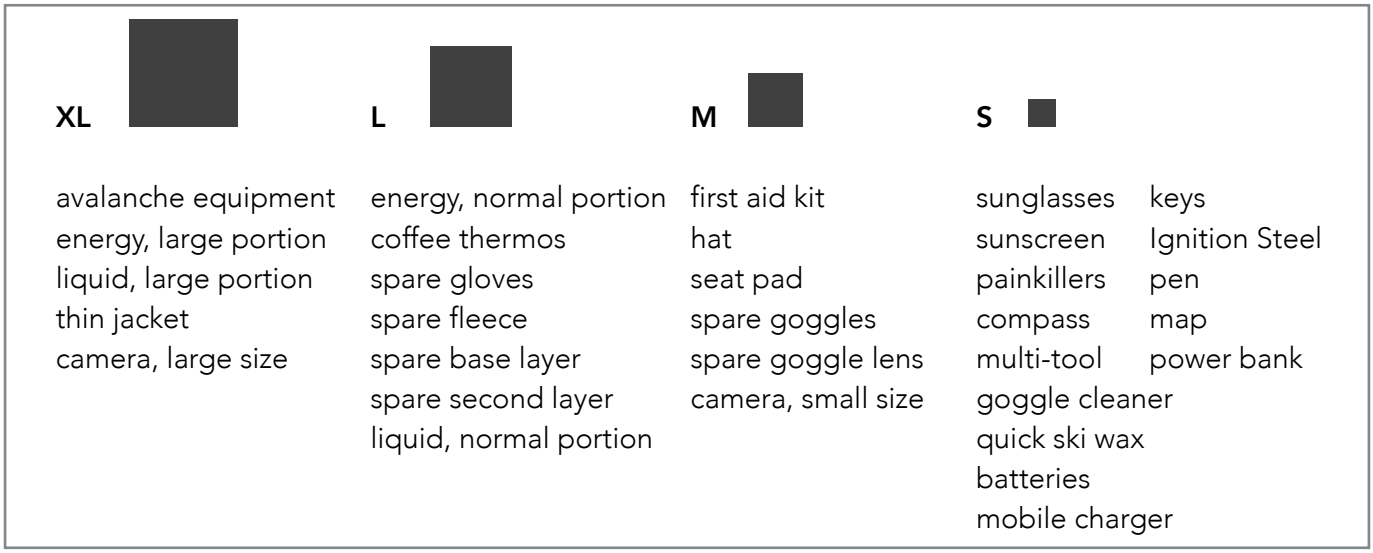


Figure 31. Size of item

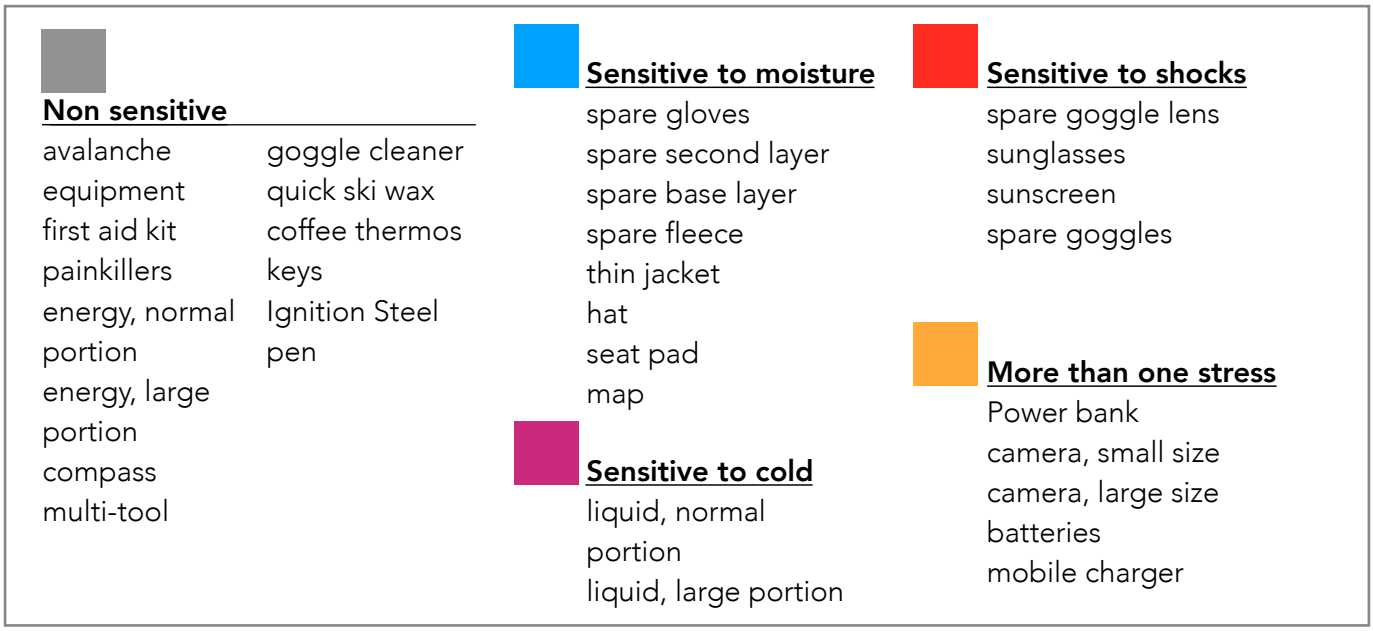


Figure 32. Level of tolerance

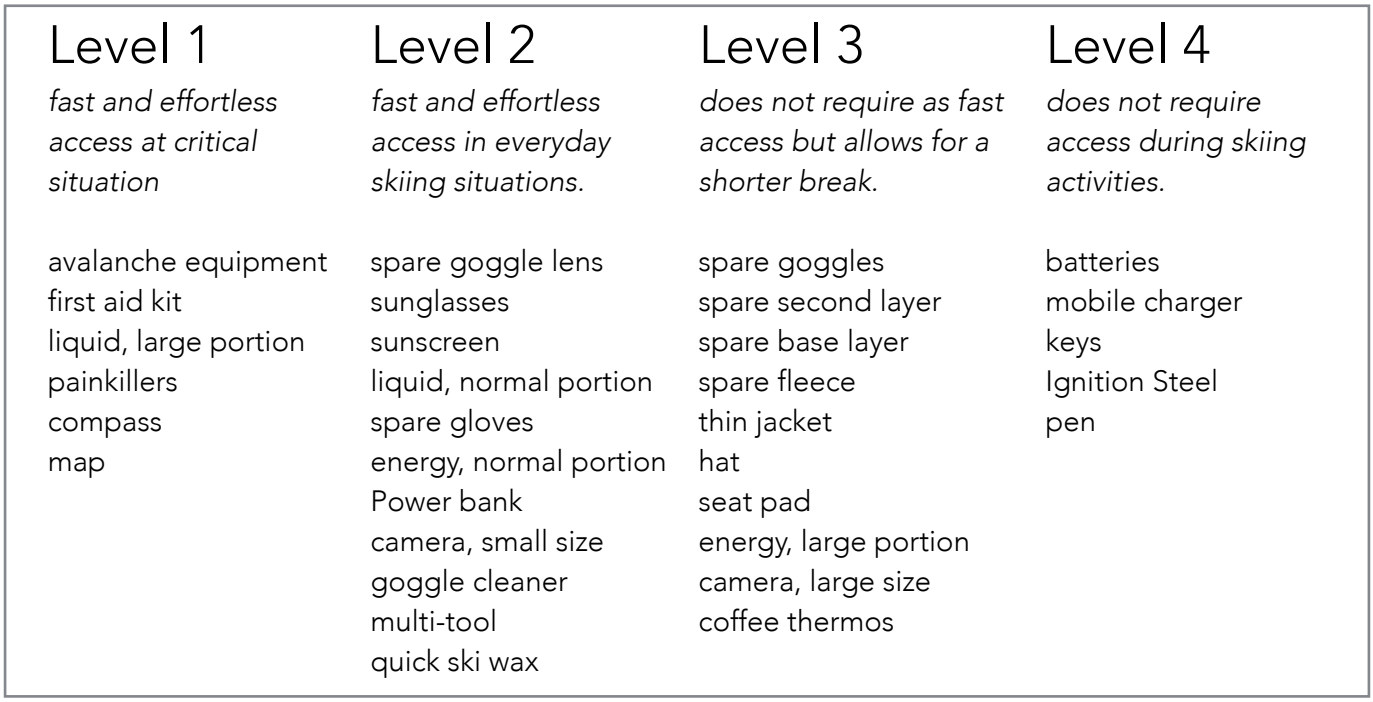


Figure 33. Four levels of access.

2.8.1 Item grouping

After dividing the items into different groups depending on these four factors, all items would off course occur in several different groups together with different items. This made it hard to divide the items into different backpack compartments and therefore the items needed to be grouped even further. The next step was conducted to analyze how the different items within the different groups could be combined in order to evaluate possible backpack placement and upcoming compartment breakdown ideation. This process will be further on explained in the *developing partial solution* phase.

2.9 Problem identification phase - Result

The result from the problem identification phase is divided into three parts. The first part includes a summary of the user insights regarding the main reason for carrying a free ride backpack and most important factors with it. The second part will be presented as a user journey, including all critical steps during a day at the ski resort. The last part will explain all backpack parts including user insights and design guidelines.

2.9.1 Why a backpack

Both skiers and snowboarders who attended the different user tests during the problem identification phase did value similar things when searching for a new freeride backpack. The two lists below illustrates user insights regarding the most important backpack factors and was further on used in the development phases as a guideline which helped the researcher with decision making.

Reason for using a backpack	Most important factors
1. Avalanche equipment, mainly: - shovel - probe - ice pick **2. Hiking possibilities** Carrying system for skis or snowboard and equipment such as: - helmet - poles - jacket - water bottle - snow shoes **3. Water** **4. Spare clothes** mainly gloves and extra second layer shirt **5. Energy**	**1 .Freedom of movement** - mainly arm and head movements **2. Fit** - size - suspension system - adjustment solutions **3. Simplicity** - nothing more than necessary - no flickering straps **4. Compartment breakdown** - fast access to safety equipment - breakdown for simple and easy organize items - openings to provide overview **5. Robust** - reliable in all situations **6. Carry equipment possibilities** - skis / snowboard **7. Back protector** - provide a close to back fit

2.9.2 The User journey

All activities found during the user tests in Åre, Sweden was mapped in a user journey, including all of the critical user and backpack interaction steps. The skiers user journey can be divided into three parts in which the user interacts with the backpack in one way or another, see list below. How the backpack is used during the preparation part, skiing part and activity part during one day on the mountain is listed and illustrated below.

Part 1 - preparation part

Prepare and load the backpack
User needs to:
- make sure to bring all equipment
- organize all items for easy and fast access
- place items to gain even weight.

Carrying equipment to the slope
User needs to:
- carry skis or snowboard a short distance.

Entering / going in / stepping off the chair lift
User needs to:
- decide to remove or keep backpack on
- not jam other skiers
- put down the safety bar without getting stuck with backpack
- make sure to possess a good posture
- access backpack content
- get off in a secure and effortless way
- reattach backpack before skiing.

Part 2 - skiing part

Skiing or snowboarding
User needs to:
- focus on skiing without getting disturbed by the backpack
- access items needed during a quick pause.

Part 3 - activities on the mountain

Attach equipment before a hike
User needs to:
- attach skis or snowboards while the backpack is placed on the ground
- attach helmet and jacket
- put backpack back on as it is heavily loaded.

Hiking with equipment
User needs to:
- keep balance while carrying a heavy load
- sometimes remove and put backpack back on while resting
- access interior backpack content, even though equipment is attached on the exterior carrying system.

Critical situations on the mountain
User needs to:
- understand the backpack during a stressed out situation
- rapidly access safety gear
- remove wet clothes and put on dry ones
- secure interior and exterior equipment in case of crashing.

The user journey steps can furthermore be mapped in to a single freeride run, including most of the activities listed above. This single run journey illustrates that most of the steps in the journey involves backpack interaction, see figure 34. Some steps occurred only once, thus others such as the chair lift activities occurred several times during one single run, see the double lined lines in figure 34. However, looking at all activities further shows that the actual skiing isn't the only activity which the backpack should consider.

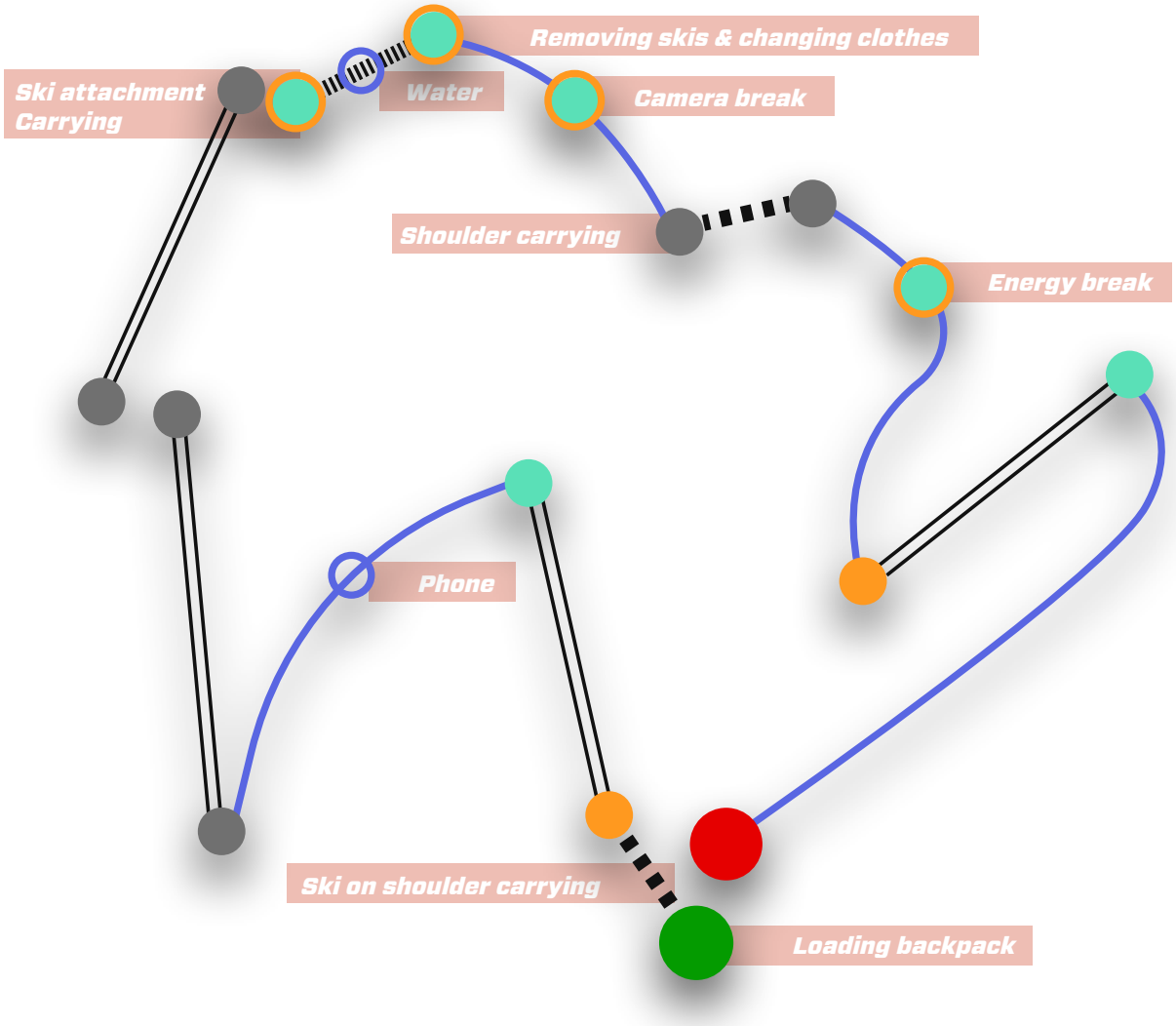


Figure 34. Freeride, single run journey.

2.9.3 Backpack Parts

Since the users had a lot of different requirements regarding their backpacks it was found in favor for the upcoming ideation part to state a set of guidelines including the following main backpack parts:

- suspension system
- back plate
- pack geometry
- carrying system for external equipment
- carrying system for interior equipment.

Suspension system

As this part is closely and frequently interacting with the user, it should not interfere with the freedom of movement or the overall skiing experience. The fact that the user was forced to over and over again put on, attach, tighten, and adjust several parts of the suspension system during one single skiing run, was found to be one of the most important results regarding the user and suspension system interaction. The following guidelines should be considered when designing a suspension system for freeride backpacks:

- be adapted for both skiers and snowboarders
- use minimal amount of steps to sit tight
- perform and function in all situations and conditions
- not force the user to remove gloves while operating system
- be simple and fast to attach and tighten
- minimize the amount of flickering straps.

Backplate

During the different tests of this phase, the backplate was found to rarely be in the center of attention. However, the backplate did have a significant role when analyzing the *close to body fit* criteria mentioned by a large amount of the participants in the tests. Therefore, in order to make the user feel secure, the backplate needs to follow the following guidelines:

- follow the spine of the user for a close fit
- include protection.

Pack geometry

Just as for the suspension system, the freedom of movement was found to be the most important factor when evaluating the shape of the actual pack. Gained both from the *evaluating backpacks* test and *speed interviews* was that backpacks which were designed to have a slim fit did fulfill the freedom of movement criteria, better than the ones which were wider and deeper. Another advantage with a slim profile was found during the observations as most users decided to keep their backpacks on while entering the chair lift. Users who did possess a slim profile backpack had a easier time finding the right chair lift posture. The pack geometry should consider the following guidelines:

- allow for arm movements - 360 °
- keep a slim profile
- prevent all equipment from ending up in the bottom of the backpack
- contribute to a slim fit.

Carrying system for external equipment

Two type of carrying activities was found during the focus group hike and observation activities. The first one was performed by users who went for a longer hike and the second by users who was walking shorter distances. The first one is the one which today is successfully solved by several backpack companies. Different ski carrying solutions was found during both parts of the problem identification phase, but not one single solution seemed to be working better than another. The second activity included shoulder carrying of skis and waist carrying of snowboards during shorter hikes. It was found that no current freeride backpack included a good solution for carrying skis and boards shorter distances. Which furthermore meant that the ordinary skier, who does not go for

the longer hikes, rarely utilizes the backpack when carrying their skis. To successfully develop a ski carrying system for a freeride backpack it should consider the following:

- be simple to understand
- allow for fast attachment of skis or snowboard
- allow for different sized skis and snowboards
- simplifies the carrying activity regardless hiking distances.
- not force the user to remove gloves while operating system
- allow for helmet carrying
- simplify the action of putting on backpack after attaching equipment
- allow for maximum freedom of movement when walking with poles
- allow backpack to be placed in the snow, as skis or board are mounted.

Carrying system for interior equipment
Since the task of carrying items is the main reason for carrying a backpack, the interior carrying system was one of the most important part for many test persons. It was found that users interacted with the interior compartments several times during one single run. Therefore, it would be preferably for a backpack to accommodate for a compartment sectioning which would make it easy for the user to find, unload and reload an item in the backpack as well as contribute to a stable even load. To make this possible, the following guidelines should be taken in to consideration:

- allow for several opening options
- possess a compartment sectioning breakdown for 15-30 items
- contain compartments suitable for different sized items
- contain compartments accessible during different situations on the mountain
- perform and function in all conditions
- guide the user in how to load and remove an item.

Developing partial solutions

3

This phase mainly included ideation, testing, evaluation and prototyping methods and was conducted in order to generate loads of ideas regarding partial solutions of the backpack. This phase was aiming to provide the project with design decisions regarding each part of the backpack, thus not complete designs but partial solutions. Phase two was based on user insights, the user journey and the backpack parts, presented in the result of the problem identification phase. Since fit and function was essential throughout this phase, a lot of iterating between different type of methods was conducted. A typical working procedure looked like; *sketch all possible solutions, evaluate towards user wants and needs, develop that solution, create a rapid prototype, test and evaluate that one and finally go forward or start over*. This is presented in two steps. One which focuses on the early ideation based on the user journey and one step including further development regarding each part of the backpack.

3.1 Ideation based on user journey

Since the last phase did end up in a user journey, the decision to base the first ideation on the user journey was assumed to be the next logical step. To further conduct this ideation the designer sat up an morphological matrix (Wikberg Nilsson et al., 2015). This was necessary to allow for partial development without having to be concerned by the complexity of all backpack parts combined. To start this ideation, the following three steps were combined until all of the user journey steps had been covered, see figure 35.

Step 1:
Focus on one step of the user journey:

- prepare and load the backpack
- carry equipment to the slopes
- entering / going in / stepping of the chair lift
- skiing or snowboarding
- attach equipment before a hike
- hiking with equipment
- critical situations on the mountain.

Step 2:
Pick the parts of the backpack which is affected by the chosen user journey step:

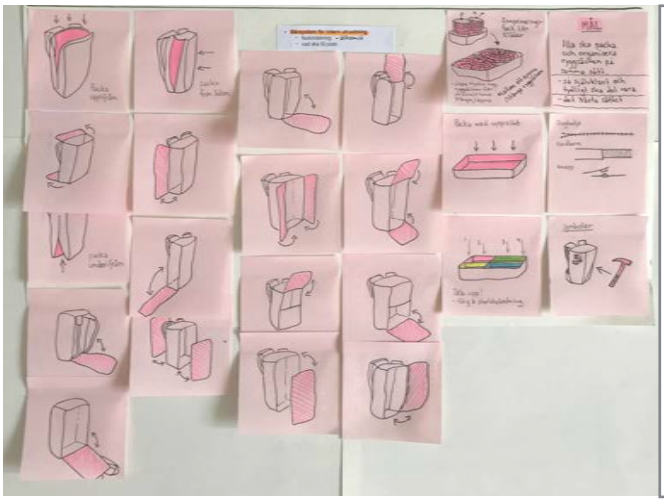
- suspension system
- back plate
- geometry
- carrying system for external equipment
- carrying system for interior equipment.

Step 3:
Letting all design ideas focus on what the user wants and need. Further analyze the different solutions by using these wants and needs as guidelines.

- freedom of movement
- the fit
- simplicity
- compartment breakdown
- robust
- carry equipment possibilities
- back protector.

Figure 35. Three steps to start the ideation.

The following figures 36 and 37 illustrates two out of seven conducted user journey bases ideation sessions, including the preparation and hiking steps. For full ideation process and early partial solutions, see **appendix II**.

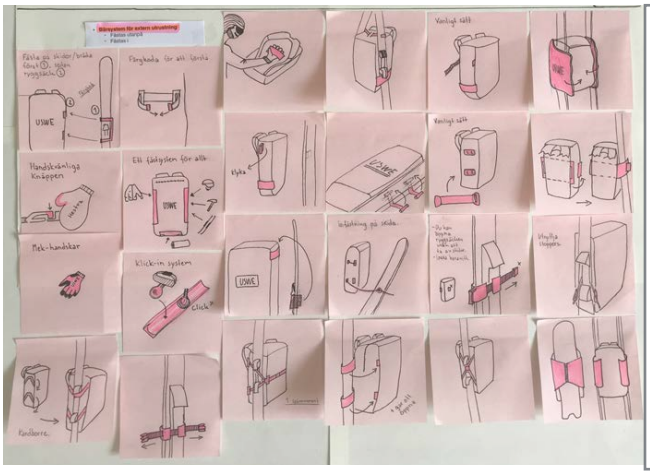


User journey step:
Prepare and load the backpack 1
focus: opening.

Backpack part:
carrying system for interior equipment

User wants & needs:
simplicity
compartment breakdown
carry equipment possibilities

Figure 36. Prepare and load the backpack 1.



User journey step:
Attach equipment before a hike

Backpack part:
carrying system for external equipment

User wants & needs:
carry equipment possibilities
simplicity
Robust

Figure 37. Attach equipment before hike.

This early ideation process resulted in a large number of partial backpack design solutions. As this ideation method was focusing on one of the user journey steps, but several parts meant that one part of the backpack could include different solutions for each and one of the user journey steps. Resulting in even more ideas for the different backpack parts. Therefore, next step of the ideation phase was to combine all solutions depending on the different part of the backpack. For example, looking at all suspension system solutions elaborated from all of the user journey steps. This was furthermore conducted in order to evaluate all the solutions gained during the morphological method and to make sure that all backpack parts would consider all steps of the user journey.

3.2 Ideation based on the following backpack parts:

- suspension system
- back plate
- pack geometry
- carrying system for external equipment
- carrying system for interior equipment.

3.2.1 Suspension system

Early on in the ideation phase it was realized that the suspension system was a major part involved in all situations of the user journey, as well as included in most of the user criterias. Therefore, this part of this paper will be addressing the suspension system development process including ideation, prototyping, testing and analyzing.

Early design decisions

The most essential design detail in the current USWE suspension system is the ”X-shape” formed over the users chest, see figure 38. As it was of importance to keep this design detail, the main challenge throughout the development phase was to make this design fit to the freeride context. Therefore the USWE suspension system was evaluated in regards to how suitable it would be for a larger backpack and heavier load. As explained in previous phase the suspension system needed to contribute to a close to spine fit. But while evaluating the current USWE suspension system, it was shown that it did not fulfill this criteria, see figure 39. Therefore, the first assumption made, was that the attachment point needed to be placed further down on the users chest, see figure 40.

Figure 38. The "X-shape".

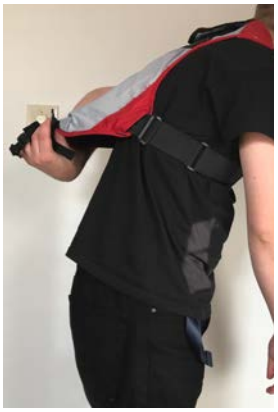


Figure 39. Lower backplate part moves to much.

Figure 40. Moving attachment point.

Except the *X-look*, size and position of the waist strap was further evaluated. Together with the design decisions explained above, a decision regarding a reinforced waist strap founded the upcoming sketching session. As it was important to keep the current USWE design language the current suspension system was used as a backdrop while sketching, see figure 41.

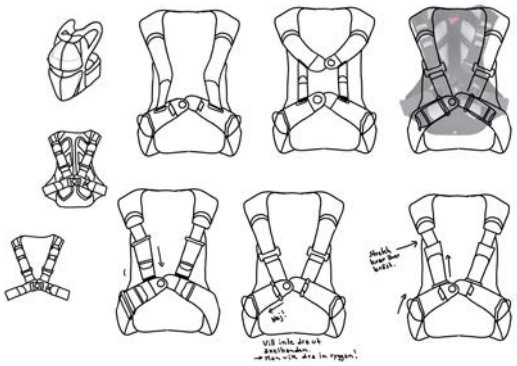


Figure 41. Overlay sketches of suspension system.

Figure 42. Modifying actual backpacks into prototype.

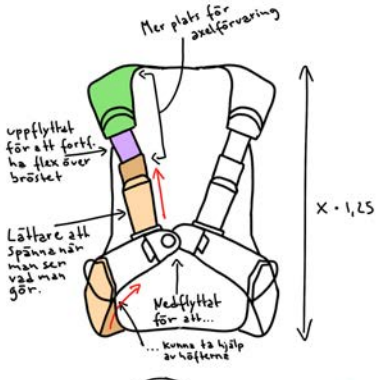


Figure 43. Design used for next step.

Since a number of USWE backpacks where available during the project, it was easy to simply modify these into mock-ups and to try the early design solutions as they arose, see figure 42 (Wikberg Nilsson et al., 2015). Furthermore, since the fit was in focus, the prototype testing was essential during the entire ideation phase. During the testing it was found that the moved attachment point and a reinforced waist strap was the most important modifications which would benefit the fit and suit the context of use. Figure 43 illustrates the designs which had the right fit as well as the right USWE look and therefore brought to the next step.

Partial funktion testing

To be able to test this suspension system solution in the right context, one complete backpack prototype needed to be constructed. However, since fit was the main focus, the prototype was addressing the suspension system and not the pack itself. To strengthen the design and to make it strong enough to carry a snowboard, the researcher received help from an former textile design student in Åre, see figure 44.

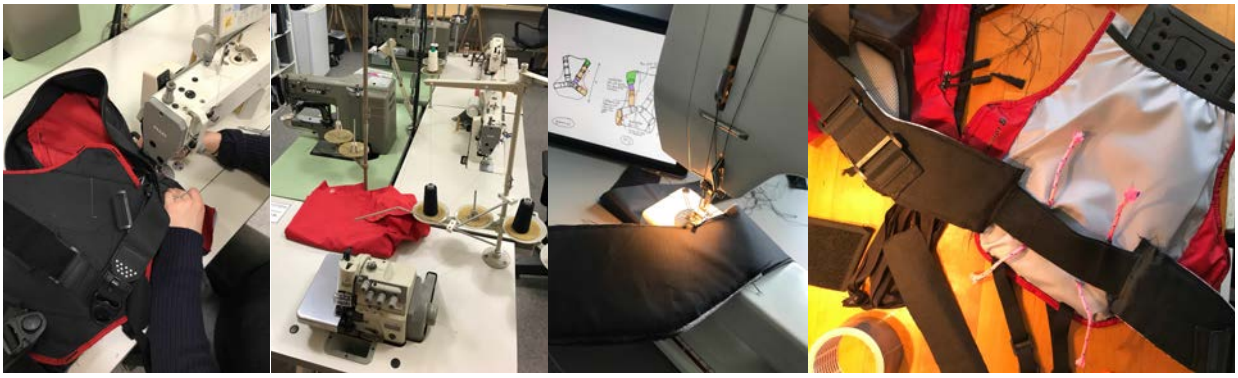


Figure 44. Final prototype touches at the textile studio in Åre.

The prototype was tested in the actual context at the ski resort Åre which provided the test team with perfect conditions, suitable for a true hiking experience. The conditions did put high pressure on the design solution, furthermore indicating the importance of testing a prototype in the intended context, see figure 45. During the test, several critical steps of the user journey such as attaching equipment, hiking with equipment and riding, was staged.

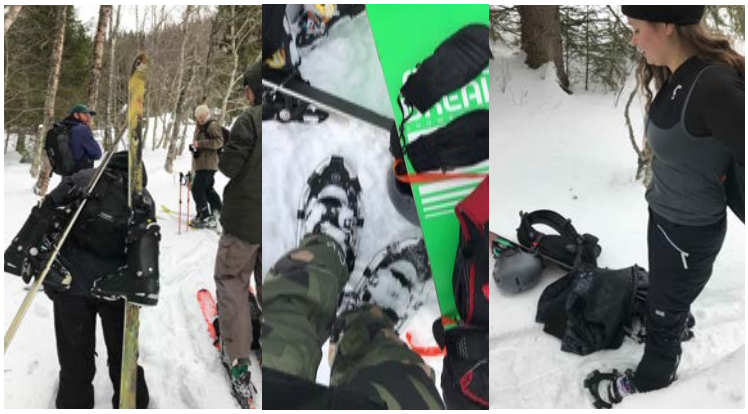


Figure 45. Testing an early prototype in Åre.

Figure 46. Backpack out of position.

Figure 47. Moved attachment point.

During the test, the prototype was performing as assumed during the actual ride down the mountain, including pressure points on the right place and a close to spine fit. But when conducting the snowboard carrying activity, the backpack moved out of position, see figure 46. This was later on assumed to be due to the *one attachment point* design. The entire load of the backpack was put on this point only and not spread out over the upper and lower part of the suspension system, see figure 47. Regardless this unwanted outcome, this activity was important for the following steps of the project. In addition to earlier stated suspension system guidelines, a new one indicating that a suspension system is in need of two attachment points was added. This further on resulted in the question stated below, as well as an additional part to the suspension system development process.

- *How can the suspension system be designed with two attachment points but still be as simple as possible, with as few steps as possible for the user?*

Further development

The first step of the further suspension system development process was to simply add a waist strap to the already existing USWE suspension system, see figure 48. The second idea, involved a solution which joined the upper and lower part of the suspension system, see figure 49. Together with the USWE crew, these two design ideas was evaluated towards the suspension system guidelines. In suggestion number 1 was found to be easy to implement and provided the design with a robust feel. However, the "X-shape" was interfered by the hip belt and the overall design was assumed to look a bit heavy and complex. Although suggestion number 2 consisted of two attachment point it gave the impression of having only one. The joined design contributed to the "X-shape" which further contributed to the simplicity of the design.

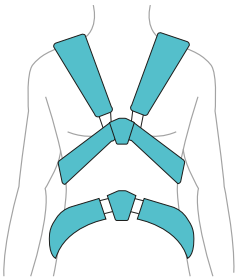


Figure 48. Suggestion 1, Adding hip belt.

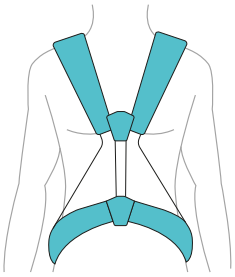


Figure 49. Suggestion 2, joining the upper and lower part of the system.

Suggestion number 2 allowed for an ergonomic placement of the suspension system pockets. The idea for this occurred when the researcher investigated pocket placement on a regular jacket. It was found that the pockets were placed in an ergonomic and user friendly way, see figure 50. However, if wearing a backpack, these pockets would no longer be accessible for the user, but instead be provided with less accessible suspension system pockets, see the red areas in figure 51 and 52. Therefore to ensure usability, the pocket design of the jacket was transferred from the jacket to the suspension system, indicated by the green areas in figure 51 and 52.

Figure 50. Ergonomic pocket design.

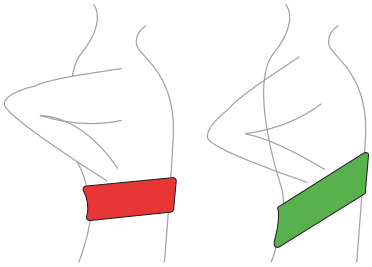


Figure 51. Ergonomic pocket design.

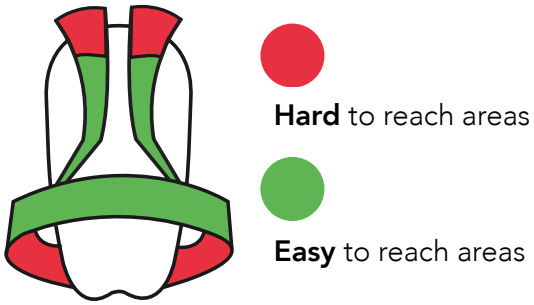


Figure 52. Reachable areas.

To further develop suggestion number 2, an ideation session, with focus on develop alternative tightening solutions was conducted, see figure 53. Once again, the designs were discussed together with the USWE team and evaluated in regards to the amount of tightening steps.

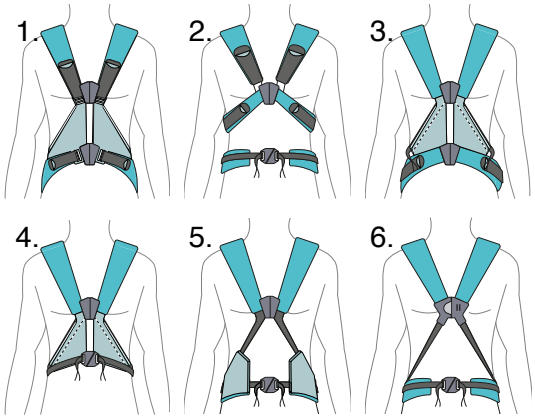


Figure 53. developing tightening solutions.

This time, design number 5 and 6 in figure 53 gained the most positive reaction. Even though they included two attachment points, these designs only included one tightening action, which will be further on explained in the two last phases of this paper. Design number 5 furthermore included two suspension system pockets, attached both to the chest strap and hip belt. While evaluating this design, it was realized that the pockets would interfere with the adjustment of the one tightening step solution. Therefore design 6 was chosen for further development.

Include the entire user journey

During the first step of this phase it was found that the suspension system could help the user during short distance hiking activities. The green parts in figure 54 illustrates some early ideas which was assumed to improve on the hiking activity, including three basic design changes, implemented to the suspension system. Figure 55 shows an early material construction suggestion for the shoulder strap. In order for the skis to stay on the shoulder strap, the idea was to provide the strap with a non-slip padded patch, illustrated with grey in figure 55. The yellow part is a memory foam, designed to prevent the shoulder straps from sliding out of position. The blue part is made of a cushioning material with the task of evening out the backpack weight. Finally the black patch is as explained made for ski on shoulder carrying activities. Explained in previous phase, it was found that snowboarders carried their boards in waist level during short distances. Therefore, similar to the skier, a solution integrated in the suspension system was developed. But this time as a attachable solution, including a wire with hooks.

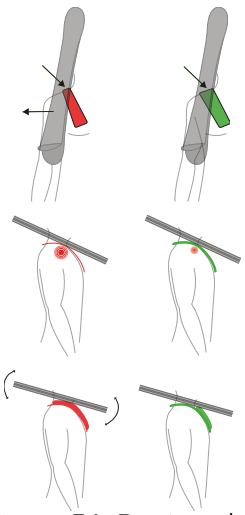


Figure 54. Design decisions for carrying ski on shoulder strap.

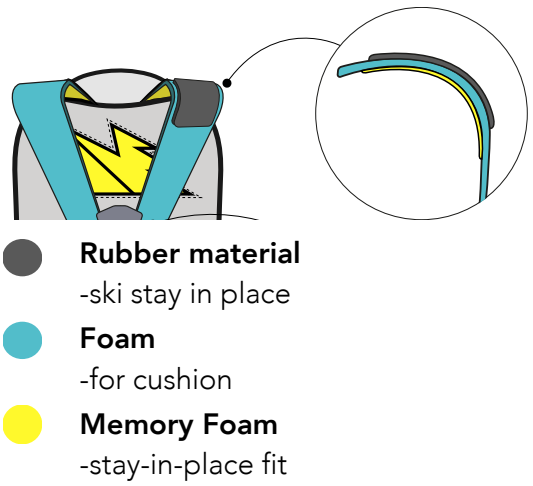
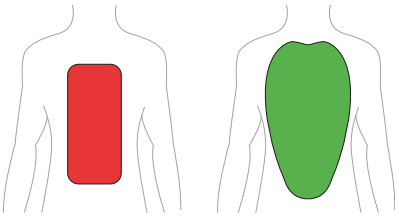


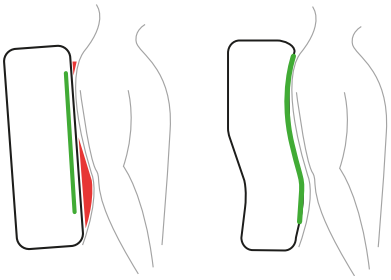
Figure 55. Shoulder strap materials.

3.2.2 Back plate

During the Ideation based on the user journey, the back protector was in the background of the backpack construction and did not affect that many critical steps of the journey except the actual skiing. However, two main design decisions could be determined, see figure 56.



In this design:
The full length back protector will be as much part of the product as the actual bag itself. It will no longer just be a part of the bag.



In this design:
The back protector will also perform as the back plate of the backpack and thereby sit close to the spine, for maximum protection.

Figure 56. Design decisions regarding the back plate.

Together with USWE it was decided to keep the collaboration with the current pack protector supplier, Sas-Tec. In order to find the right protector, several different protectors was evaluated in regards to size and shape, see figure 57. While analyzing the different protectors, the aim was to find the one which would provide the backplate with the right shape. The chosen back protector was assumed to fit this criteria and so on play a considerable part of the backplate and backpack, see figure 58. Furthermore ideas regarding how to create awareness was developed with the aim to provide the user with trust regarding the back protector performance. Except providing the backplate with its shape and so on an higher involvement in the design, the protector was going to show its existents for the user and not stay hidden, see figure 59.

Figure 57. Evaluated back protectors.

Figure 58. Protector - a part of the backplate shape.

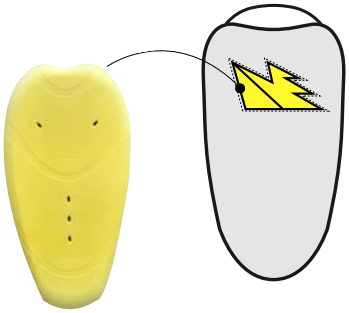
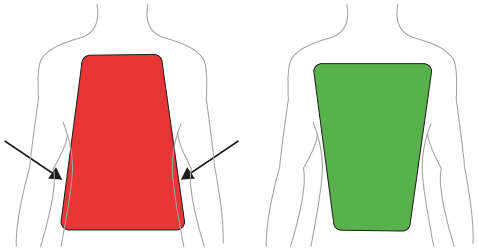


Figure 59. Be transparent.

3.2.3 Pack geometry

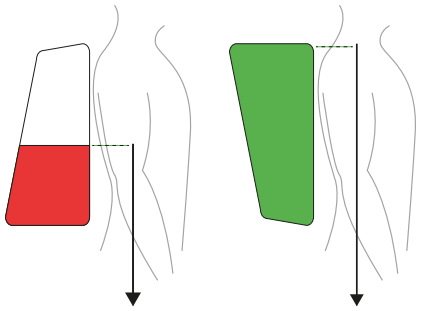
This part of the backpack will be called "pack" during the rest of this paper and refers to the shape of the backpack part in which the user stores his or her equipment. When developing the pack, focus was put on how to prevent the backpack from interfering with the the freedom of movement during skiing activities. The basic shape decisions, illustrated with green in figure 60, was found to be essential when developing an optimized shape for a freeride backpack.

This design will:
- affect the freedom of movement and so on affect the users skiing performance.



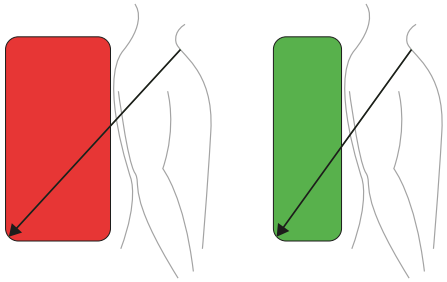
This design will:
- follow the human shape and allow for full body movement.

This design will:
- create an unbalanced loading wight.



This design will:
- distribute the wight of the load so that the whole body will carry the load.

This design will:
- affect the balance



This design will:
- even the load and so on improve on the balance.

Figure 60. Basic shape decisions.

As these basic shapes was established, the further work was addressing the basic design of the pack. Just as during the development of the suspension system, the USWE design idiom was essential when developing the shape of the pack. Therefore a USWE design language form analysis was conducted and repetitive design patterns such as lines and curves was found, see figure 61. These findings were further used while developing the design language of the pack. The design marked as number 1 in figure 62 used inspiration from one of the USWE design patterns, see number 1 in figure 61. The same comparison goes for number two and three in both figures.

Figure 61. USWE form analysis.

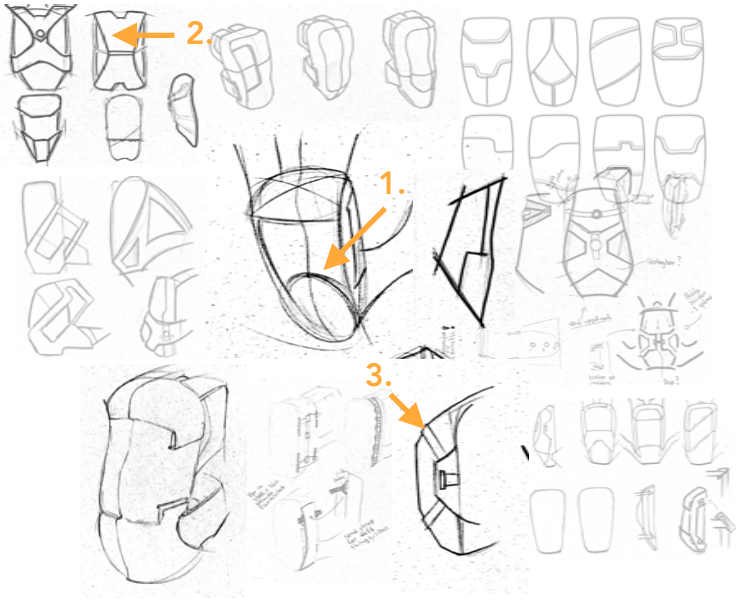


Figure 62. Sketching USWE style.

By combining the optimized basic shapes together with the developed design language, further design ideation was conducted. The soft curves, illustrated by number 2 and 3 in figure 61, was used as inspiration when developing the patch design of the pack, see figure 63. The 3-patch design language, illustrated by number 1 in figure 61 and 62 furthermore provided the development process with the shapes illustrated in figure 64.

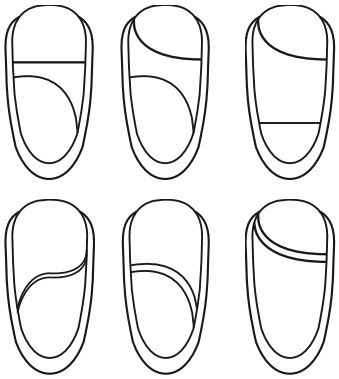


Figure 63. Developing USWE design language.

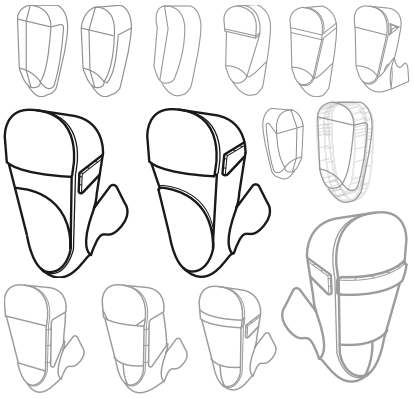


Figure 64. 3-patch design language.

3.2.4 Carrying system for interior equipment

Explained in the problem identification phase, all items carried by the user was divided into groups depending on type of skier, size, level of tolerance and level of access. To further decide on how to combine and place different items in an efficient way, several mapping activities was conducted. First of, explained in figure 65, all items was divided under the level of access. Meaning how fast different items needed to be reached. The table also illustrates how large one compartment is in relation to each other and a larger color box, means a larger backpack compartment. 13 main compartments can be seen in the table, all with different level of access and tolerance. But since a goal from previous phase was to create a backpack with a simple to use compartment breakdown, the amount of compartments needed to be reduced and grouped even further.

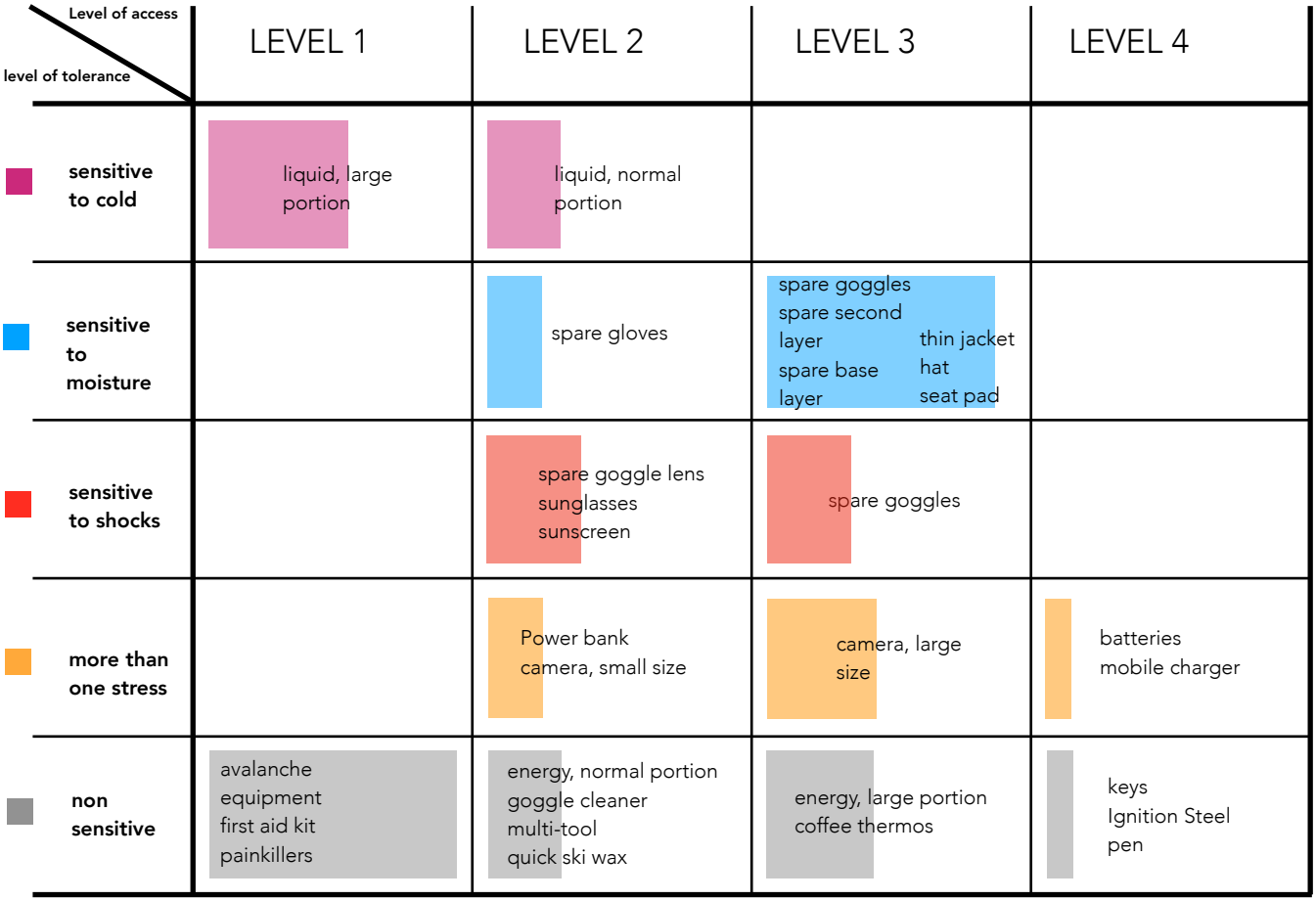


Figure 65. Item breakdown.

Managing compartment

Next step was to move the compartments within the level of tolerance but between the level of access, see figure 66. This was done after analyzing figure 65 above in which the main compartments in level of access level number 2, consisted of items sensitive to shocks. Therefore, illustrated by figure 66, the items sensitive to shocks was moved over from level of access 3 and 4 to level of access 2. This item swap within tolerance level was conducted for all of the items until the compartments where broken down even further, see figure 67.

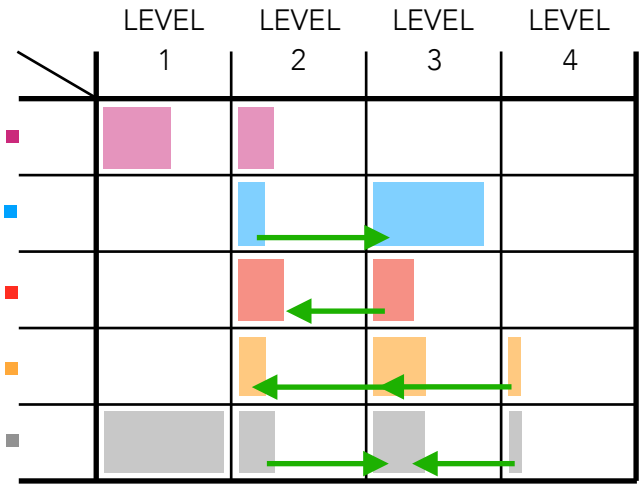


Figure 66. Managing departments among tolerance level.

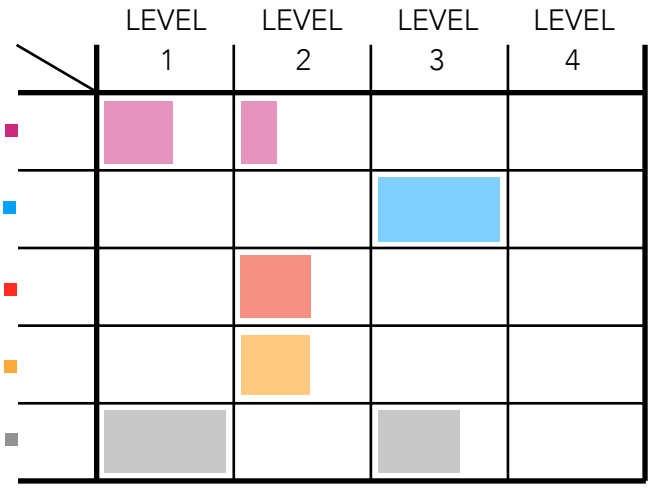


Figure 67. Managing departments among tolerance level - result.

The same procedure was then conducted within the level of access but between the level of tolerance, see figure 68. The compartment breakdown ended up in five main backpack compartments and placed in the form of an backpack, see figure 69. The non sensitive access level 1 compartment was placed far out on the backpack since the including items are non sensitive, but in need of fast access. The second level 1 compartment was placed close to the users back since the including items were sensitive to cold. Access level 2 compartment was placed on top since the including items were sensitive to shocks and other stresses. Finally, the level 3 compartment was placed in-between the other compartments since the including items were sensitive to moisture and not in need of fast access.

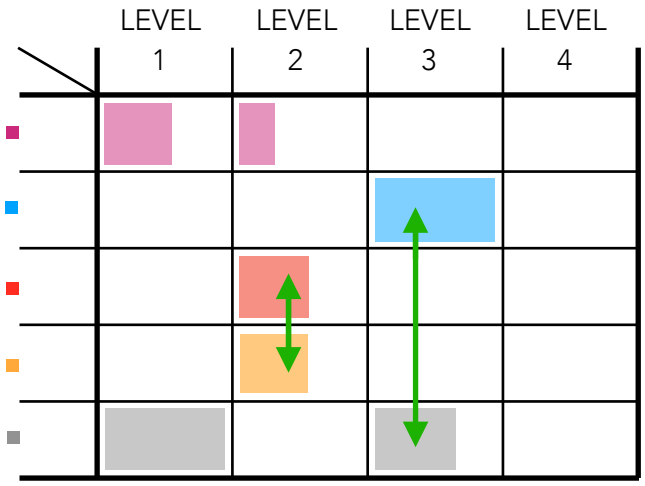


Figure 68. Managing departments among access level.

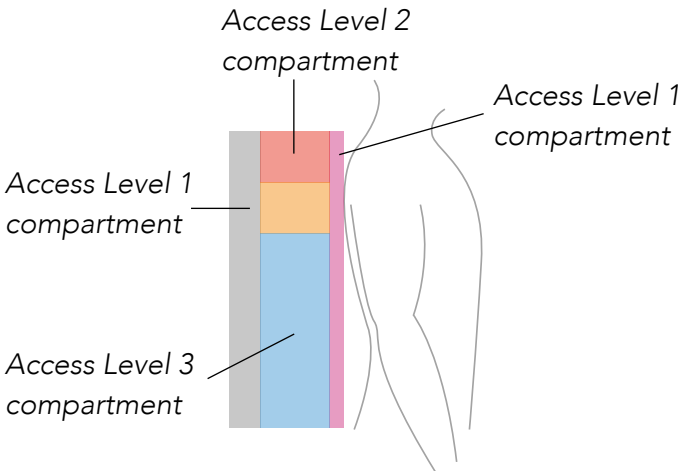


Figure 69 - Compartment placement.

The problem identification phase showed that the user, during some occasions, needed more space than for a usual skiing day. To furthermore prevent the need of several backpacks, an add-on compartment was developed, see figure 70. During a discussion with USWE it was found that the front placement was the most optimal one. This to not interfere with the rest of the backpack features and arm movement, see figure 71.

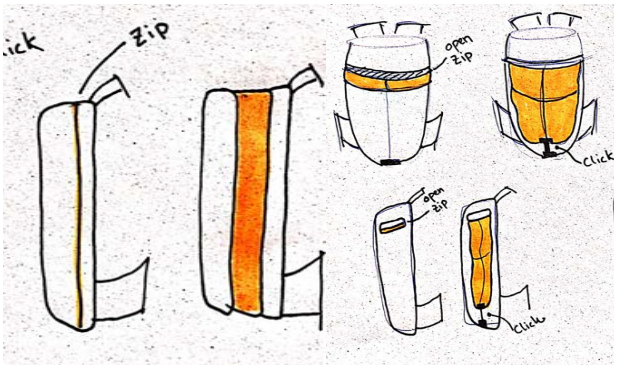


Figure 70. Add-on development.

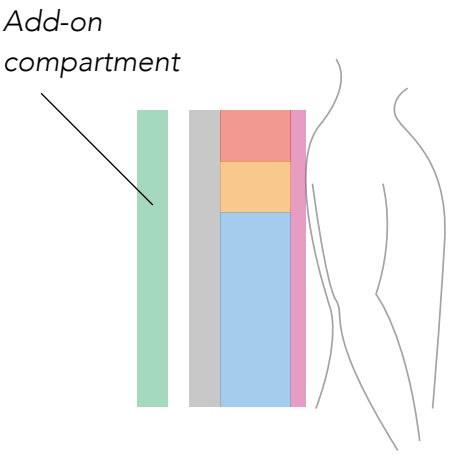
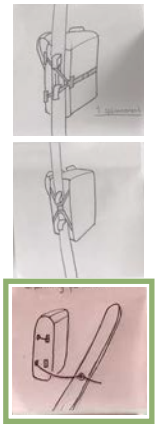


Figure 71. Add-on placement.

3.2.5 Carrying system for external equipment

The first ideation regarding this user journey activity resulted in a lot of ideas, rather than design decisions. Therefore, illustrated in the lists below, these ideas was evaluated in regards to the guidelines presented in previous phase. The green boxes indicates solutions which fulfilled the criteria.

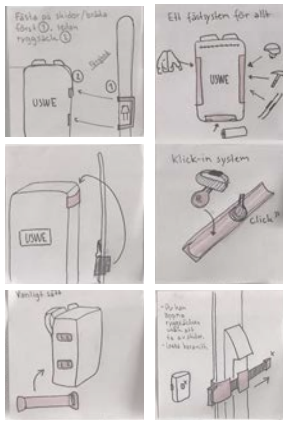
One step



Advantages
- less steps
- less straps

Concept 1

Ski first



Advantages
- less time placed in the snow
- no straps on the backpack

Disadvantages
- loose parts
- many steps for the user
- time consuming

Minimal

Advantages
- no attachment points
- simple to use with gloves on
- fast

Disadvantages
- less robust
- less stable

Concept 2

Fold

Advantages
- full access to backpack content
- less tightening actions needed
- no straps
- no interference with the skiing activity

Concept 3

External carrying concepts

As prototype testing was performed in parallel to sketching and ideation, the concept evaluation could be conducted during the actual development itself. Therefore, presented below is both the concept development and evaluation.

Concept 1 - One step

The first development phase of concept number 1 focused on how to create a ski carrying system by using only one tightening mechanism. The wire system BOA was assumed to contribute to reducing the amount of steps. To further ensure a stable load, the tightening wheel placement and wire direction, was developed, see sketches in figure 72. The outcome of this is illustrated with orange and blue in figure 72. Furthermore, during a discussion session with USWE this concept was assumed as difficult and too expensive to implement to the final backpack design. It was mentioned that such a complex system implemented for a less frequently used part was an improper priority.

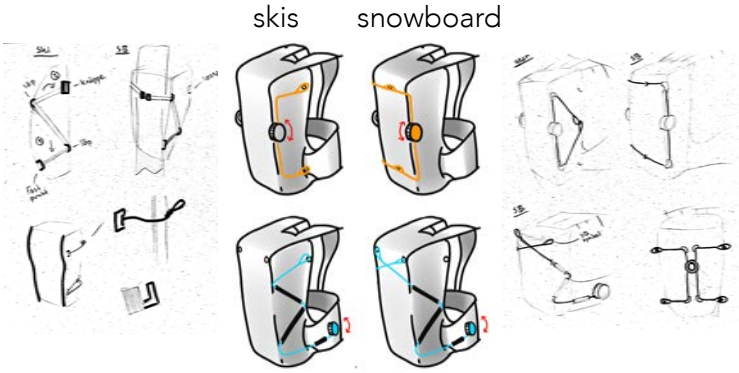


Figure 72. BOA system.

Figure 73. Unstable concept.

Concept 2 - Minimal

The idea behind the second ski carrying concept was to create a system free from attachment points which would lead to the fastest attachment system possible. The idea was simple, therefore a quick prototype could be constructed to evaluate if this solution was suitable for further development. The testing of the concept showed that the design, including such few amount of attachment points, resulted in a unstable carrying experience. By only include one attachment on top of the backpack, both skis and snowboards where moving out of position, forcing the user out of balance, see the red arrows in figure 73.

Concept 3 - Fold out / stable system

The last concept was developed mainly as an answer to the part of the problem identification phase showing that skiers rarely uses the exterior equipment carrying system, but still wants the opportunity to perform this activity. The concept included a pocket, containing a hidden strap construction for ski carrying activities. Figure 74 shows how this solution was prototyped and successfully tested to ensure the heavy load demand. The orange parts of figure 75 illustrates alternative attachment points for how this system could be attached to the backpack. Figure 76 illustrates a step by step instruction of how the pocket is opened, strap system fold out and finally the ski attached. This third concept was assumed to fulfill the users wants and needs as well as the design guidelines and therefore chosen for further development. The main advantages with the concept was as followed:

- the system is hidden away when not in use
- there is no disturbing straps
- it is easy to achieve a tight fit in a few amount of steps.

Figure 74. Prototype.

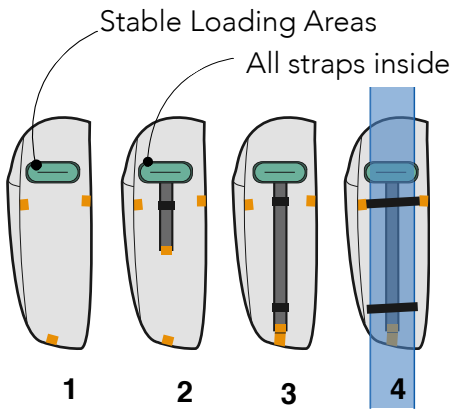


Figure 76. Step by step attachment.

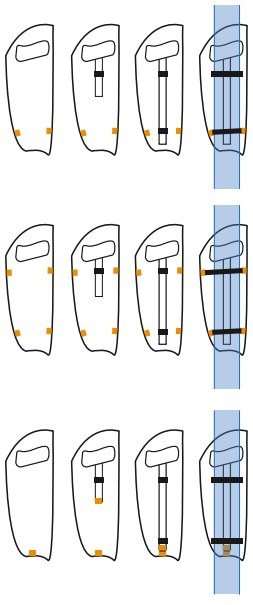


Figure 75. Hidden strap system development.

3.3 Second phase summary

The result of the developing partial solutions phase consisted of 5 developed backpack parts, see figure 77. The suspension system included the USWE *X-look*, two attachment points and one tightening action. The backplate had an integrated back protector which was designed to create awareness through shape and transparency. The pack geometry was developed with inspiration from the USWE design language together with the guidelines regarding the geometry and ended up in a slim profile and *3-patch* design. The compartment sectioning consisted of five main compartments with room for items which was in need of different level of access, tolerance and size. Finally the exterior carrying solution did consist of a hidden system which could be folded out during a hiking experience.

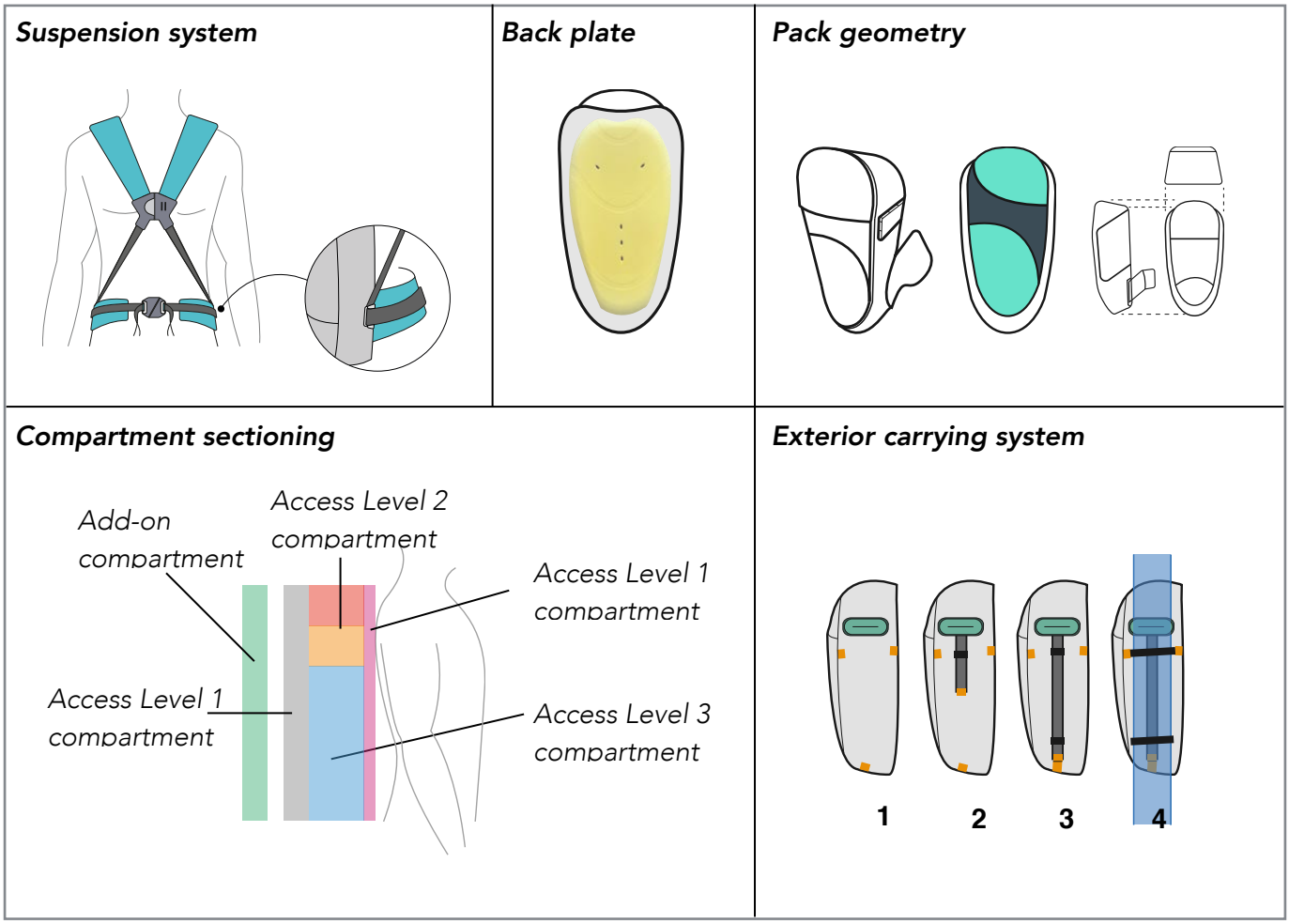


Figure 77. Final partial solutions.

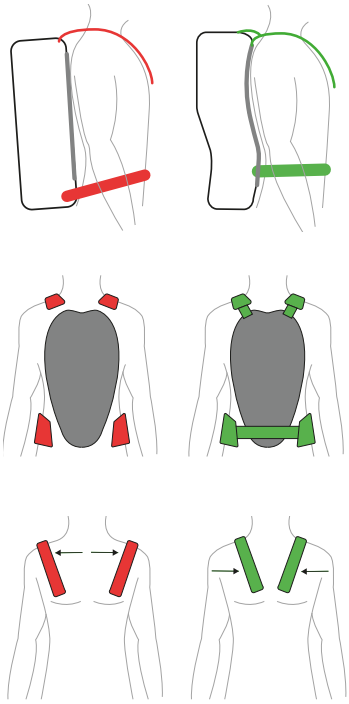
Combining partial solutions

4

In previous phase where each part was developed separately, the focus of attention concerned the functionality of each part. However, as this phase focused on combining these different parts, the focus of attention was switched to mainly address the fit. The focus regarding fit required a lot of testing and prototyping and in this phase the main prototyping technique was rapid paper prototyping (Wikberg Nilsson et al., 2015). This phase was further divided into two parts, covering all backpack parts. First part addressed the suspension system, backplate and back protector combined. The second part addressed the pack geometry combined with the carrying system for interior and exterior equipment.

4.1 Combining suspension system and protector backplate

The wanted outcome from the first composition was to develop a system in which the back protector would be integrated in the backplate and further be working with, and be equally important as the suspension system. By looking at how this joint was constructed in a commonly used solution today, it was found that this connection did not exist. The red parts in figure 78 shows a commonly used construction in which the back protector and suspension system lacks in regards to interaction between the two parts. The green parts in figure 78 illustrates three guidelines which was developed to improve on the interaction between the protector-backplate and suspension system and was assumed to further improve on the fitting experience .



This design will:
- improve the contact between the back protector and the users spine.

This design will:
- tighten the back protector at the same time as the waist strap is tightened.

This design will:
- keep the chest strap in place without sliding off the users shoulders.

Figure 78. Interaction guidelines.

In order to achieve this goal the backplate, suspension system and back protector was joined, see figure 79. The strap was developed to travel from the chest, down behind the back protector, out on the hip belt and out to the hip belt attachment point, meaning that one single strap would be running all the way from the shoulder strap down to the waist strap. This design would facilitate for only one tightening movement for all three parts.

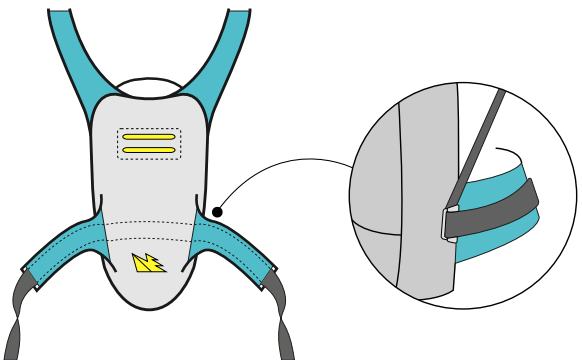


Figure 79. Joining the suspension system with the protector and backplate.

4.1.2 Paper prototyping

To test and evaluate the one step tightening solution, paper prototypes were constructed. The paper prototypes provided the designer with a fast, simple and cheap way to evaluate the fit and size of different designs solutions, but was used this late in the project since earlier phases had focused more on shape and less on fit. As the interaction between the suspension system and the back protector was assumed to be one of the most important interactions in the making of this backpack, the chosen protector, was always in the center of attention while constructing the prototypes, see figure 80. To further improve on the suspension system fit, the first step was to construct several prototypes using the same design but slightly different dimensions, see figure 81. To further make small changes on these prototypes, the author was acting as test person, see figure 82.

Figure 80. Protector determines shape.

Figure 81. Finding the right dimensions.

Figure 82. Testing paper prototypes.

Figure 83. Final shape.

The shape which provided the best fit is shown in figure 83 and to further improve on the design of this solution it was once again brought to the ideation board. It was important to find the right appearance suitable for the context and company. Figure 84 illustrates the ideation, including design suggestions regarding combined shoulder strap and hip belt. including the highlighted final shape.

Figure 84. Combined hip belt and shoulder strap designs and final design.

To test the fit and function of the final suspension system design in a more realistic context with weigh included, the next step was to construct a functional prototype. This process started of as illustrated in figure 85, where the final paper prototype was used as a pattern, but will be further presented in the result chapter of this paper.

Figure 85. Building functional prototype.

4.2 Combining interior & exterior carrying system with pack geometry

The second composition developed during this phase concerned the carrying system for interior and exterior equipment and the geometry of the pack. Figure 86 illustrates the process of how the main compartments were joined with the geometry of the pack as a first step of the joint and how the exterior carrying system was applied during a second step. The result of this composition activity will be presented based on the main compartment sections.

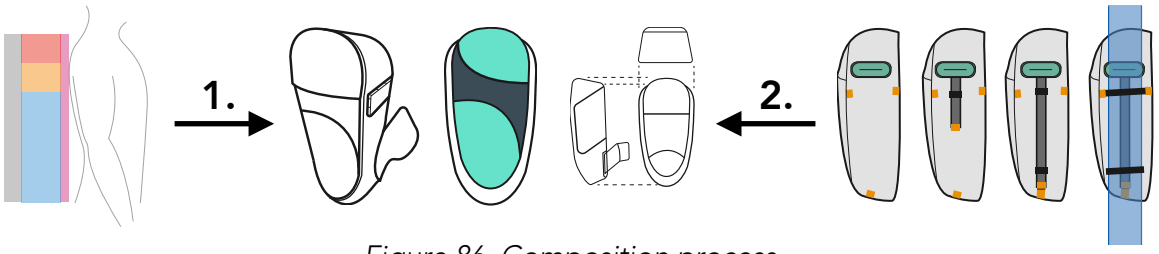


Figure 86. Composition process.

4.2.1 Compartment level 1

As explained during previous phases, the most common reason for bringing a backpack to the ski resort is to able the carrying of avalanche gear. Therefore the important level 1 compartment was developed to carry all of the non sensitive items including a shovel and a probe within the fastest access level, see figure 87. To improve on the accessibility, except placement far out on the backpack, the compartment needed to contain an user friendly opening mechanism, accessible wearing gloves or not. As this part was developed, it was realized that the compartment needed to be glove friendly not only on the outside of the compartment, but also on the inside. A problem not solved by any competitors. This was key, since the problem identification part clearly indicated on that a lot of backpack interaction was performed while wearing gloves. Figure 88 illustrates how the compartment was joined with the geometry of the pack and furthermore how the glove friendly shovel shaft and probe holder was integrated to the compartment.

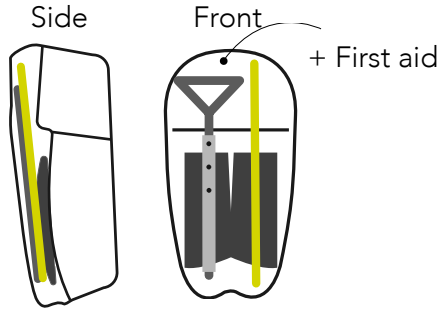


Figure 87. Placement, avalanche gear.

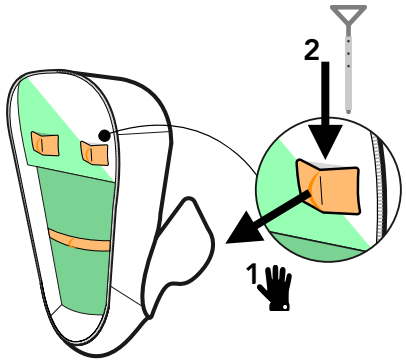


Figure 88. Joined design and glove friendly inside.

4.2.2 Compartment level 2

Presented in the compartment breakdown paragraph in previous phase, a lot of items were in need of fast access. Therefore, compared to common used top placed compartments, this one was designed to fit a larger amount of the users most frequently used items and further be top-loaded to guarantee fast access in all situations, see figure 89. Further reason for the placement was to improve on the weight distribution, avoiding all items from ending up in the bottom of the backpack, like in figure 90.

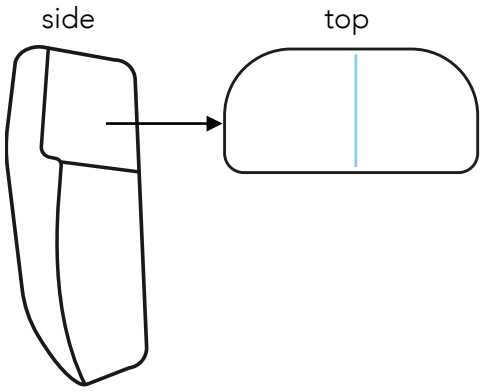


Figure 89. Top loaded, fast access compartment.

Figure 90. Uneven wight distribution.

As it was found that different users did load their backpacks with a lot of different items, this compartment was developed to be customizable. The movable walls within the compartment allows for alternative item placements, see figure 91. Furthermore, figure 92 illustrates how the compartment was joined with the geometry of the pack and also how the opening will provide the user with a nice item overview.

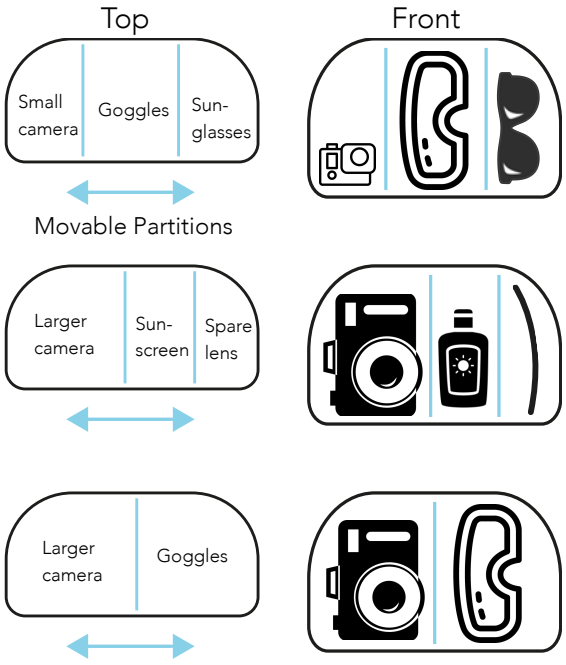


Figure 91. Customize and organize.

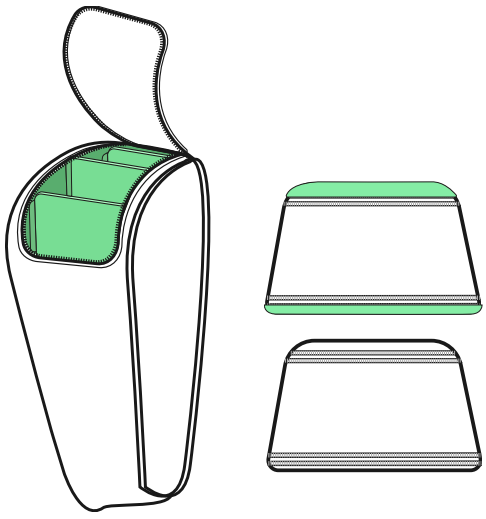


Figure 92. Compartment joined with pack geometry and Item overview.

4.2.3 Compartment level 3

This compartment contained mainly low access level items and was developed to keep spare clothes dry and warm.Therefore it was placed close to the users back, surrounded by the other compartments, see figure 93. Presented in previous phase, the compartment opening position was most efficient when opened from the backplate of the backpack. This was found to be the case both when evaluating the backpack performance and while analyzing the user insights and therefore implemented to the compartment, see figure 94.

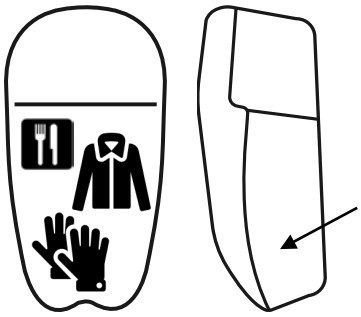


Figure 93. CoffeeBreak compartment.

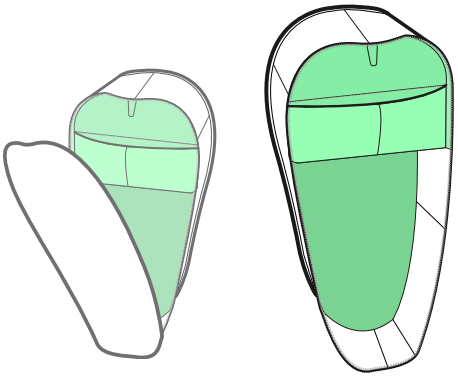


Figure 94. Compartment joined with pack geometry and opening from back plate.

4.2.4 Compartment level 4 and ski carrying system

The implementation of the level 4 compartment involved the 3-patch design presented in previous phase. Therefore, this part involved another ideation activity and several 3-patch designs was evaluated, see figure 95. The idea was to integrate the pocket so that it would be a part of the pack geometry, including a fold out, lightweight bag. The highlighted illustration in figure 95 shows the design which was assumed to successfully contribute to the USWE design language and pocket functionality. When opening the pocket the idea was to create the bag-like compartment in such way so that it would interfere with the pack design as little as possible. Therefore the compartment was constructed in a transparent material, see figure 96.

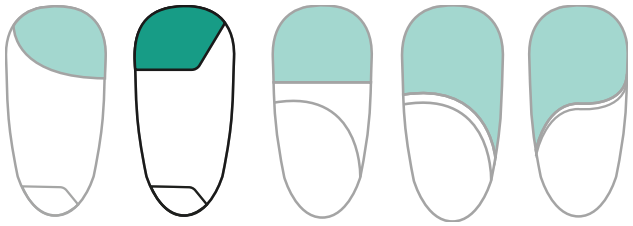


Figure 95. Pocket design ideas.

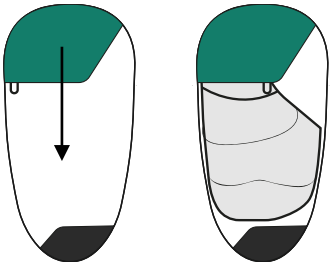


Figure 96. Transparent compartment.

To continue on the flat and strapless design, the fold-out ski carrying system, presented in previous phase, was design to contribute to the simplicity of the pack geometry. To further establish a uniform design, the carrying system was just as the fold out compartment, constructed as a pocket and will be presented in the result part of this paper.

4.3 Third phase summary

The *combining partial solutions* phase resulted in two main backpack systems, containing all of the backpack parts developed during the phase. The suspension system consisted of the chest strap, hip belt and backplate combined and had been developed to cooperate as one united part in order to fit the user and context, see *system 1* in figure 97. Regarding the second system, the compartment sectioning and carrying external solution had been developed to fit the pack geometry, see *system 2* in figure 97. Both systems was after this stage, prepared to be composed into a final concept.

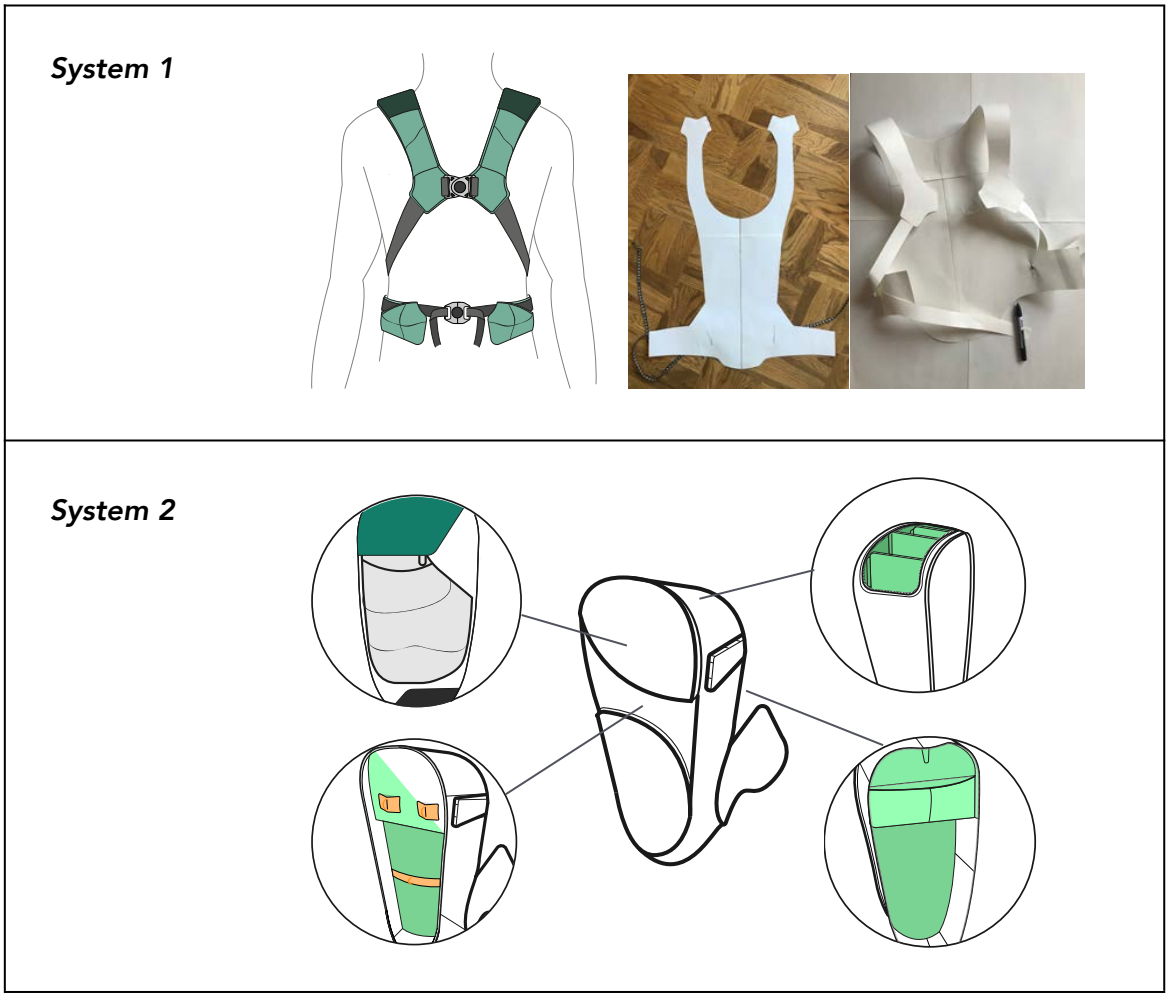


Figure 97. Phase result including two systems.

Result

5

As the result from previous phases was based on backpack users and their journey at a ski resort, the result will be presented based on this journey. The result will focus on how the final backpack design will simplify this journey for the user and improve on the overall user experience.

5.1 UPAC - The reliable, user friendly backpack which ALWAYS fits.

UPAC emerged from the mission of creating a user friendly backpack, made for days on the mountain. The name is trying to inspire the users to bring their skiing and snowboarding to the next level as they are interacting with the backpack. UPAC is designed to be reliable in all situations, and in an effortless way, provide the user with a tight fit every time, becoming one with the user without disturbing the skiing activity. UPAC is user friendly during all steps of the user journey, including activities around the actual skiing and it will guide the user towards a enjoyable experience. Regarding the structure of UPAC, it is designed to include and merge all parts to one uniform design. The final result consists of the two following systems, including all UPAC parts and an overview can be seen in figure 98.

1. U-fit suspension system
- including suspension system, backplate, protector and pockets

2. U-place compartment breakdown
- the shape of UPAC, including compartments for interior and exterior equipment

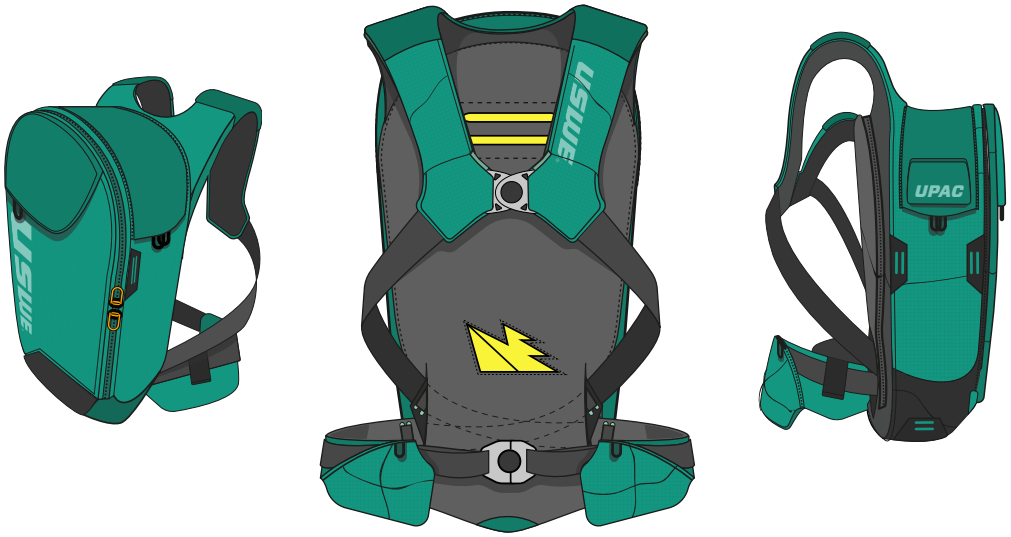


Figure 98. UPAC overview.

5.2 Placing items in backpack

U-place compartment breakdown

With three main compartments instead of one or two, the compartment breakdown allows for a simple loading process made with precision every time. The U-place compartment sectioning will make the loading step of the user journey more efficient and not as time consuming, which furthermore is the first important step for a successful experience on the mountain, preventing frustrating interaction activities between user and backpack. The three compartments is designed to carry different items depending on size, level of access and level of tolerance. They consists of a Safe-Guard compartment, a Customizable compartment and a Coffee-Break compartment, see figure 99. These different compartments will be further on explained throughout the result.

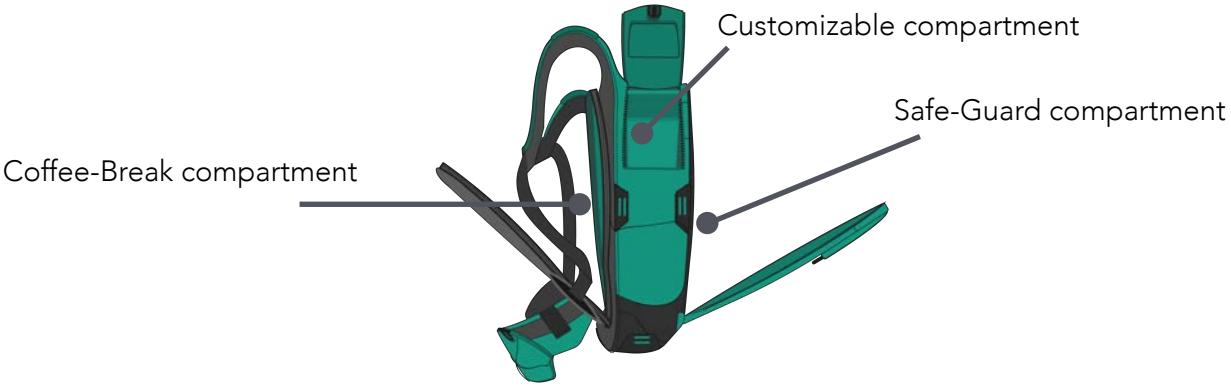


Figure 99. Placing items in three main compartments

5.3 Walking to the chair lift

U-fit suspension system

To facilitate ski-on-shoulder carrying activities, and also to prevent the skis from sliding of the shoulder as well as providing with extra cushioning, the shoulder straps are equipped with durable non-slip patches, see figure 100. UPAC is not only there to help the user with the long distance hiking activities, but also during shorter distances. With a simple solution, never before solved by a backpack, the user will experience less struggle when walking to the skiing or off-piste area.

Figure 100. Short distance ski carrying system.

Figure 101. Suspension system pockets.

5.4 Going in the chair lift

U-fit suspension system

The *few step design* of the U-fit suspension system will ease the action of removing and putting on the backpack when going in the chair lift. However, if the user still decides to keep the backpack on, UPAC will reduce the risk of getting stuck due to loose straps. This is made possible since the entire back and sides of the backpack is strapless. Furthermore, the suspension system pockets were designed to be accessible even if the backpack is kept on while entering the chair lift, see orange marks in figure 101. To simplify the opening activity, the opening of the shoulder strap pocket is placed on the inside of the strap, which further allows for an ergonomic arm movement. Furthermore, due to ergonomic aspects, the hip belt pocket is equipped with a slightly angled opening, just as a pocket on a regular jacket, see picture in figure 101.

5.5 Skiing

U-fit suspension system

To simplify the action of removing and attaching the backpack the U-fit suspension system is equipped with two attachment points but only one tightening movement. Since a great backpack fit is key to improve on the users riding skills, the UPAC suspension system makes it easy for the user to achieve a tight to body fit in every skiing situation through this few step design, see figure 102. It will prevent the user from start skiing without tighten the backpack and so on adventure the overall skiing experience. The one movement does tense no less than three parts of the backpack, including chest strap, waist strap and protector backplate and is called the *perfect fit technology.* Number 3 in figure 102 illustrates how the strap system involves all suspension system and backplate parts in the single tightening movement.

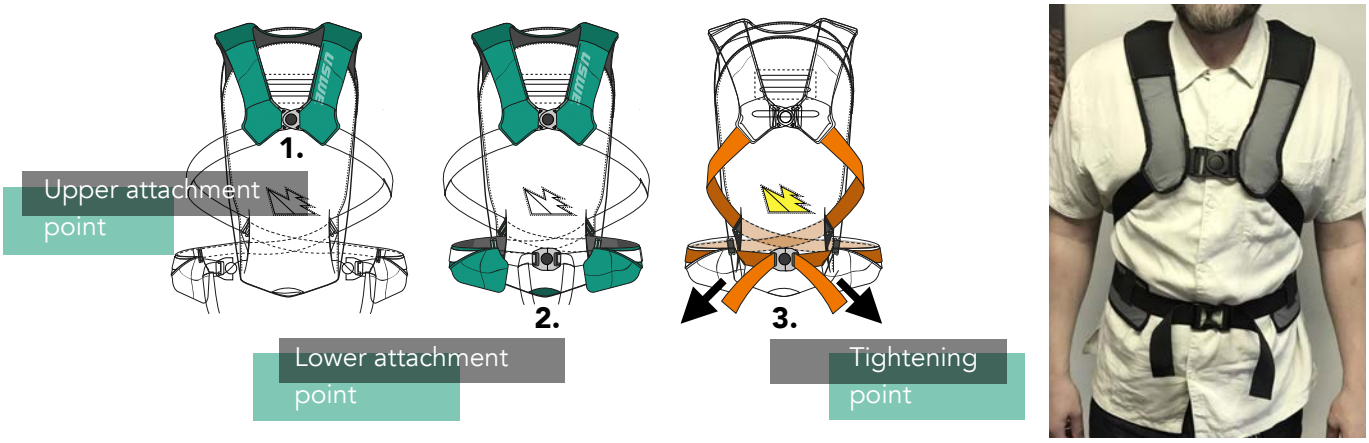


Figure 102. Few step design results in a perfect fit.

As known, all people are different regarding body size. Therefore, the U-fit suspension system is adjustable to fit different torso lengths. Figure 103 illustrates how the hip belt size is changed from small to medium by moving the waist strap and the chest strap attachment points, down on the inside of the protector backplate.

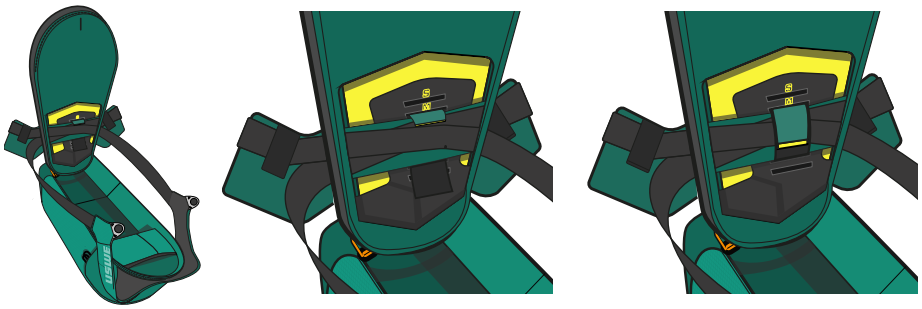


Figure 103. Simple size adjustment.

U-place compartment breakdown

The shape of UPAC is developed to prevent disturbance during the skiing and snowboarding activity. The user is allowed for full freedom of movement, referring to arms, shoulders and head. The shape furthermore contributes to an even wight load which also improves on the body balance. The level 2 compartment presented in previous phase is called the Organization Compartment and is designed to allow for fast access during the actually skiing activity and the user is provided with a good overview of his/her most used items, see figure 104. In this case, as

the user is having a camera placed in this compartment, the movable walls contributes to a tight camera fit which furthermore will protect it from moving around while skiing, see far right illustration in figure 104. The walls are constructed with a cushioning material and covered with a soft material, which will be gentle towards sensitive gear such as goggles and cameras.

Figure 104. Organization Compartment.

5.6 Hiking

U-place compartment breakdown

The *less-strap design* could be implemented thanks to the carrying exterior equipment solution which is integrated in to the geometry of the pack itself. A system, not interfering with the skiing activity and ready once the user is up for a hiking experience. Furthermore, this solution allows for ski attachment in 3 simple steps, illustrated in figure 105. This reduces the time needed for attaching equipment as well as allowing for the stealth mode design.

Figure 105. Fold-Out ski carrying system.

The level 3 compartment is called Coffee-Break Compartment and is accessible through the backplate of the backpack, see figure 106. This position keeps the items inside of this compartment dry and warm during cold conditions. Figure 106 furthermore shows how the top of the compartment contains a number of small pockets in which the user can place important items such as keys and wallet. When hiking distances further than one hour, the user often carries items which is in need of more space. Therefore the Fold-Out Compartment is designed to make room for some extra large gear, further allowing UPAC to be used during a variety of skiing situations, preventing the need of multiple backpacks for different situations. Figure 107 shows how this compartment is expanding out of a small pocket. The fold out compartment can also be used as a helmet or jacket holder.

Figure 106. Coffee-Break Compartment.

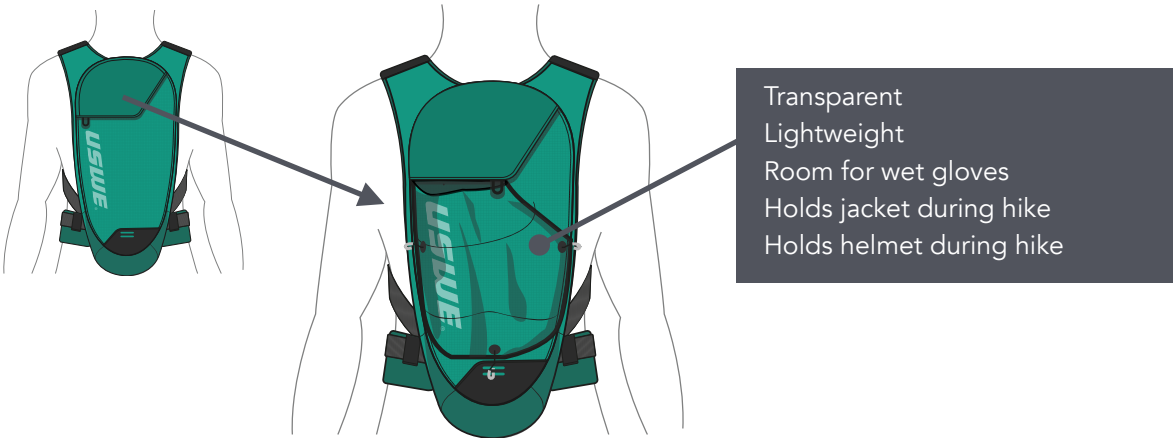


Figure 107. Fold-Out Compartment.

U-fit suspension system

Except a close spine contact, the protector backplate is transparent towards the user by showing parts of the protector through the transparent logo on the backplate, see figure 108. This part of the design will provide the user with more confidence and awareness of that UPAC contains as much back protector as backpack. The backplate design is also part of the hiking activity included in the user journey. It provides the user with a back handle which will simplify the action of putting on the backpack after attaching ski or snowboard equipment on the backpack. It got a integrated, flat design to prevent the handle from interfering with the close to spine fit, see figure 108.

Figure 108. Transparent backplate & backplate handle.

5.7 Critical situations on the mountain

U-place compartment breakdown

the openings of the different compartments are placed in such way so that they are accessible at the right time and situation. The level 1 compartment, also called the Safety Compartment, is equipped with a glove friendly design both inside and outside of the backpack. As shown in the far right illustration in figure 109, the handles on the outside is constructed with a oversized, easy to grip design, containing a bright color which will obtain the users attention and provide guidance in a stressed out situation. The design will show the user what to interact with in order to successfully solve a situation. This design also goes for the inside handles, shown in the far left illustration in figure 109. The inside holders are made to flex, allowing for the probe and shovel shaft to stay in place while riding but simply be removable when facing a critical situation.

Figure 109. Safety Compartment.

5.8 UPAC final words

UPAC will be reliable during every skiing and snowboarding situation and in an effortless way provide the user with a tight fit every time, allowing UPAC to become one with the user without disturbing the skiing activity, but instead enhance the experience. UPAC will take care of all the activities around the actual skiing and snowboarding, allowing the user to put all focus on the most important skiing aspects; progress and having fun.

Discussion

6

User tests in tricky context and environment
To early on observe and talk to the intended target group was found to be a key factor during the problem identification phase. It provided the project with knowledge and user insight regarding the sport of skiing and backpack usage. To further conduct these user tests at the intended context is suggested to be highly important while designing sport equipment. Not only during the problem identification phase, but also during the development and finalization phases. Since everyone in the intended context is a potential user, it will reduce the effort of trying to find the right users. By further on mapping these different users and their journeys, less focus and time needed to be spent on trying to create realistic personas of the intended target group. The qualitative data collected during this *context user tests*, was assumed to be of such reliability and relevance so that it could be used for most of the decision taking during the ideation and concept development phases.

To conduct the user tests at the intended context was beneficial, but it sometimes meant implementation difficulties. When conducting the interviews, the design of the actual test was found to be critical since the set of questions never seemed to be compressed enough. This was assumed to be due to the great weather conditions, which did result in skiers who were in a hurry of getting down the mountain. It was also found that one test person could spend ten minutes evaluating questions, meanwhile another one was seriously stressed out after a few seconds. Therefore, when conducting a test in a tricky context it is important to prepare for changes and allow for questions and structure to be manipulated during the test in such way so that it will fit the moment of situation and test person. The observations provided the project with useful quantitative data. However, it would have been advantageously to implement a set of questions to each observation and so on receive complementary qualitative data regarding the user and backpack interaction.

Just as during the problem identification phase, it would have been beneficial to visit the intended context also during the ideation and concept development phases. To access the potential users as an idea was developed, would have made these phases just as efficient as the first phase. Once again, this is suggested to be the case when designing sports equipment which is closely interacting with the user during several different situations while the activity is performed.

Design for all
A freeride backpack will address a wide range of people and is commonly used by people of different ages, genders and body measurements. While designing UPAC, the solution of creating multiple sizes of the same backpack was out of the question and it was early on stated that the suspension system needed some sort of adjustability. However, since the focus on the fit was stated as the most important factor by USWE and since it was hard to add the adjustability requirement to all of the early ideas, the adjustability factor was put aside during the early stages of the project. This made the *combining partial solutions* phase tricky and a lot of time was needed in order to further develop the partial solutions in such way so that they would fit the wide range of intended users. If the adjustability had been prioritized earlier on and if an early idea would have been evaluated against the adjustability factor and not only the fit factor, several steps between the different phases could have been avoided. This could furthermore have resulted in more time assigned to the finalization of the combined concepts and not on further partial solution development.

Products containing many parts
To develop a product that consists of many parts which all interacts closely with the end user did result in a wide range of ideas and a large-scale development process, containing a lot of different methods and activities. One single part had to fit and interact with other parts in a certain way in order to fulfill the fitting and user criteria. During the project it appeared that one solution which was fully functioning during one situation could fail during another. When combining two ideas into one single design, it often resulted in a new ideation session with focus of combining these two parts. Therefore, it would have been beneficial to include some design activities which could have focused on combining several early solutions instead of only joining the final partial solutions towards the end of the project.

Product development containing fabric material
The importance of adapting prototyping and idea generating techniques to fit the intended product material, was something that the USWE crew could show through many of their previous projects. Since fabric is a moving material, less common product development methods, such as paper prototyping was used. The way that paper prototyping can determine the functionality and fit of a solution, would never have been possible only by using sketching as a tool. To further construct the prototypes in the intended fabric material would be way too expensive due to high material costs. Paper prototyping was mentioned by the USWE crew in the following way; *If the paper prototype fits, the final fabric one will do as well*. Therefore, a lot of the traditional time-consuming prototyping (in which the prototype is built to determine the function of the product) could successfully be moved further ahed in the development process.

The most efficient way of facing a fabric ideation activity, was found to be the combination between sketching and prototyping and to perform these techniques during the same ideation session. The sketching was used for fast ideation and the paper prototyping for fast evaluation. Together with the data collected during the problem identification phase, the prototyping was used as the main evaluation tool.

UPAC and sustainability
UPAC is designed to fit different people and body sizes. In this way, the manufacturing process will be much more efficient than if UPAC would have been designed in several different sizes. The *Add-on compartment* will further allow for the backpack to be used during different situations which can require various amount of loaded items. Since durability was one of the main requirements stated by the users, UPAC will be constructed with durable materials throughout the entire design. The material choices together with the adjustability and *Add-on compartment* will create a long product lifetime as it can be shared between ages, genders and body sizes in different skiing and snowboarding situations.

During the actual usage stage of the backpack, UPAC will encourage people to go outside and explore. UPAC is designed to provide an effortless experience which will allow for the user to put more focus on the surrounding than on the product itself. By doing so, it will create awareness and learn people about the power of the nature and the mountains. Hopefully, UPAC can simplify the skiing activity also for people who is not as experienced, to feel more confident in the slopes or powder.

During the absolute end life of UPAC, USWE could offer a awarding return system which could provide some sort of benefit to the one who returns a UPAC. In this way USWE would have control

over the recyclability and at the same time keep the customer happy. This system could for example include a discount on a new USWE backpack when returning a old one. The old backpacks received by USWE could either be fixed and reused, disassembled and used as material for constructing prototypes, or recycled in the best way possible. This would not only benefit the environment, but also strengthen USWE as a sustainable brand.

Recommendations for further development

To allow for UPAC to develop even further, several development activities should be made, including:

- Material research to find the wanted material qualities for each part of UPAC with focus on durability and sustainability.

- Test the final UPAC prototype in the intended context to determine how the different parts of UPAC needs to be developed even further before starting to construct the final design samples. In these tests, several users should be included and the usability should be analyzed.

- Pattern designs to make UPAC ready for manufacturing.

- Testing and prototyping of the ski carrying system and evaluate the material wear over time.

Conclusion

7

This part will sum up and present the final concept UPAC based on the project questions.

Are the freeride backpacks found on the market today, designed to optimize the skier and snowboarder´s day on the mountain?
The problem identification phase provided the project with insight regarding how currently designed freeride backpacks interferes with the critical steps of the skiers user journey, which furthermore is the main reason for a less joyful experience at the ski resort or in the off-piste. The main task that a freeride backpack has today, is to provide the user with a good fit and a lot of performance but less regarding the usability and user experience.

Therefore, the task of UPAC is to further improve on the fitting and performance aspects, but also utilize the chance to simplify for all of the user journey steps included in the skiing and snowboarding experience. UPAC will make it easy for the user to operate and understand skiing and snowboarding activities such as loading, hiking, going in the chair lift, skiing and managing critical situations.

How can a alpine skiing backpack be designed to simplify and improve on the skiers experience?
UPAC is developed from a skiers point of view, with design solutions developed from the users want and needs and consists of two parts which will simplify and improve on the overall skiing and snowboarding experience. The U-fit suspension system is designed to provide the user with a *close to spine* fit and the U-place compartment system is designed to improve on managing and loading items inside and outside of the backpack.

As the aim was to develop a freeride backpack which would help the user with tasks that other backpacks did not, all steps of the user journey was included in the development process. It was found that since the skier is facing a lot of different situations and activities during a freeride run, the backpack needs to simplify for these in order to contribute to the overall experience. Thus it can not only be optimized for the actual skiing activity. During the development process it was found that when designing for all these user journey activities, also the actual skiing would be affected in a beneficial way. An example would be that the UPAC *few-step-design* suspension system simplifies for the backpack removal while entering and stepping of the chair lift, at the same time as it improves on the fitting experience during the actual skiing, since the system will allow for a perfect fit through minimal effort.

If designed in the right way, the suspension system is the most important part to improve on the fitting experience and freedom of movement. By involving the back plate and back protector, UPAC will provide the user with a suspension system that focuses on the fit and movement, including both the front and back of the users torso. Thus, the UPAC suspension system solution will allow for the user to feel safe on the mountain and improve on their skiing or snowboarding skills.

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Appendices

Appendix I - User insights
Appendix II - Ideation based on the user journey

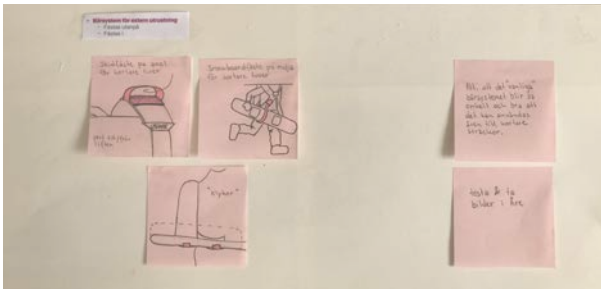
Appendix I

User insights regarding likes and dislikes with their freeride backpacks.

Likes:	Dislikes:
• Good arm and shoulder movement due to well fitting suspension system. • Great fit,"I don't feel the pack on my back". • Comfortable hip belt which puts the pack close to the back. • Nice size to fit all of my stuff. • Great freedom of movement. • The shoulder straps stays in place while riding. • Not to big to affect the skiing activity. • Easy to tighten the suspension system, even while wearing gloves. • Easy to compress. • Less amount of straps. • Slim shape. • Affordable price. • Integrated back protector. • Two nice large compartments instead of one. • Easy to organize stuff inside of the backpack. • Flat design which sits tight on the body. • Simple design with no unnecessary gadgets. • Robust feel. • Room for helmet during a hike.	• The protector does not sit tight to the back. • Hard to adjust while wearing gloves. • The design is weak. • Handle puts pressure on neck. • The width affects the freedom of movement. • Hard to adjust suspension system. • Too many steps to tighten the suspension system. • Hard to adjust suspension system while wearing gloves. • The design is not special enough. • Too wide. • The backplate is too stiff • Weak clasps • The centre of gravity is placed too far down on the backpack. • Complicated design. • Too many loose straps. • Bad compartment sectioning. • Hard to load in a good way. • The backpack affects the balance. • The backpack affects the arm movement. • There is no system for carrying skis or snowboard. • Bad openings to the different compartments. • Snowboard touches the ground while it is attached to the backpack. • Only one alternative to carry skis. • The form of the backpack is too deep and not slim enough. • The shoulder straps slides off the shoulders. • The bottom off the backpack is to wide. • Several different backpacks are needed for different situations. • Straps are flickering • Need more compartments

Appendix II

Full ideation process based on the user journey.



Focus

User journey step:
carry equipment to the slopes

Backpack part:
carrying system for external equipment

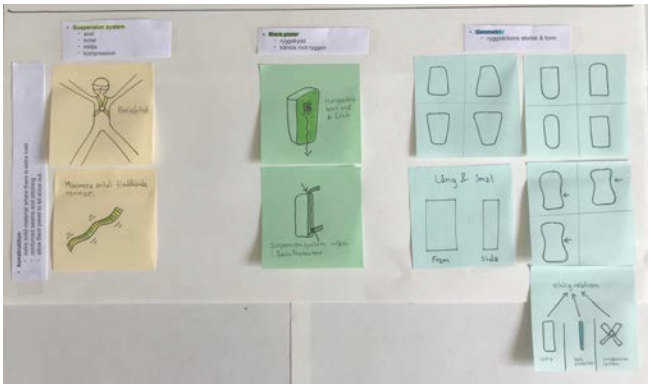
User wants & needs:
simplicity
carry equipment possibilities

Focus

User journey step:
Entering / going in / stepping of the chair lift

Backpack part:
Suspension system
geometry
carrying system for interior equipment

User want:
freedom of movement
simplicity
compartment breakdown

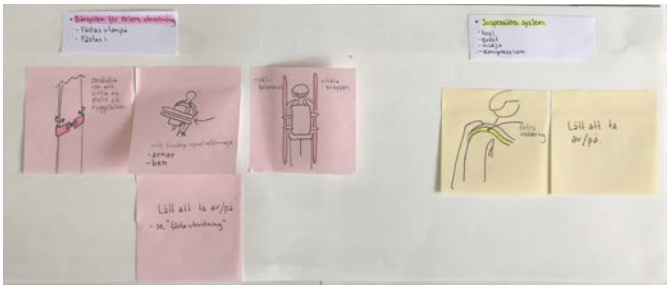


Focus

User journey step:
Skiing / snowboarding

Backpack part:
Suspension system
Back plate
Geometry

User wants & needs:
freedom of movement
fit
Robust
Back protector

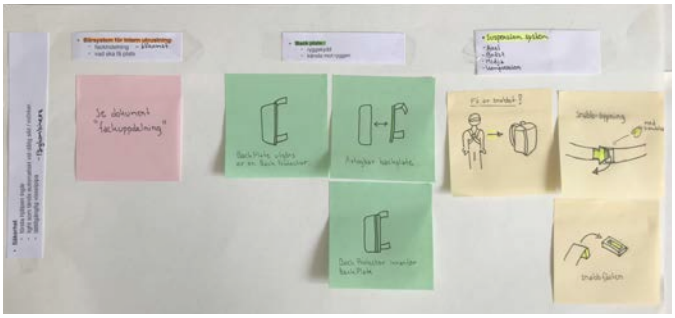


Focus

User journey step:
hiking with equipment

Backpack part:
carrying system for external equipment
Suspension system

User wants & needs:
freedom of movement
simplicity
Robust
carry equipment possibilities



Focus

User journey step:
critical situations on the mountain

Backpack part:
carrying system for interior equipment
Suspension system
Back plate

User want:
simplicity
compartment breakdown
Back protector