LIFT UP
THE COMFORT OF SNOWBOARDERS.

Aleksandra Wojcik
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Aleksandra Wojcik
Diploma Spring 2018

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Lift up - the comfort of snowboarders.

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Most of the ski resorts were developed (as the name suggests) for skiers, in time that predated snowboarding. Since the late 90s we have seen evolution of every aspect of this sport except riding a lift which is where snowboarders spent about 30% of their time (Lokshin, David, 2012). The design and ergonomics of ski lifts leave the other users a lot to be desired.

My aim is to create a product that meets snowboarders needs and significantly improves their experience of using a ski lift.
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INTRODUCTION
This diploma focused on the use of the chairlift, the T-bar, the platter and the magic carpet. These (and the rope tow) are the only lift types that snowboarders use while having the snowboard on, and are the most popular lift types in Norway. I did also look into the use of lifts during warmer seasons and their industrial evolution over the years in order to gain a broader image of the context.
Photo: The chairlift used for transportation of mountain bikes, Source: Pinkbike

Photo: The first ski chair lift built in Sun Valley, Idaho in 1936, Source: Modern Gentleman
Source: Annika Mang
Snowboarding Transworld
The Dark Room
TARGET GROUP

I’ve started my project with the main target group defined as snowboarders, however it’s not as specified as it sounds. That is because snowboarders appear in many shapes and with varying level of experience: from toddlers to grown ups, and from new beginners to professionals.

Photo: Torah Bright - professional snowboarder, Source: NSW Institute
In addition, there are other users of lifts that I have to take into consideration, including good old skiers and alpinists with disabilities. I plan to observe and/or talk to representatives of all those groups in order to gain a deeper understanding. From that backdrop, according to the findings, I’ve planned to narrow the target group down or design a universal product.

> Photo by Matthew Kane, Source: Unsplash
v Source: dualski.com
Motivation

Snowboarding is still on the rise (Barclay, 2015) and the snowboarding industry expects to see an uptick as the next generation of snowboarders — children of the early riders — take up the sport (New York Post, 2015). After my first and only season of skiing I turned 15, started snowboarding and do it recreationally ever since. During that time I did experience myself and saw others struggling with same difficulties when it comes to using a lift. Those problems are obvious for all of the boarders I know, yet nobody actually talks about it and nothing changes.

This gave me motivation for my diploma to finally make that change.
## METHODS

### INSIGHT

<table>
<thead>
<tr>
<th>What</th>
<th>Why</th>
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<tr>
<td><strong>Snowboard</strong> myself and focus on the use of different types of lifts.</td>
<td>To dive into the topic and gain understanding from the first person’s and the primary user’s point of view.</td>
</tr>
<tr>
<td><strong>Observe and film</strong> snowboarders and other users of lifts (without informing them).</td>
<td>To expand the understanding and get as real picture as possible.</td>
</tr>
<tr>
<td><strong>Do interviews</strong> with the whole range of users, i.a. young, average and professional.</td>
<td>To talk to people and find out things I won’t be able to observe, like their thoughts and feelings.</td>
</tr>
<tr>
<td><strong>Obtain cooperation with a ski resort</strong> in Oslo and/or a company that works with ski lifts.</td>
<td>To gain easier and closer communication with people that work with lifts and snowboarders on daily basis.</td>
</tr>
<tr>
<td><strong>Spend a day with a lift-assistant.</strong></td>
<td>To gain the experience from ”the other side” (the secondary user’s point of view).</td>
</tr>
<tr>
<td><strong>Read about the history of snowboarding and ski lifts, and current products.</strong></td>
<td>To understand the evolution of ski lifts on the background of the evolution of relevant winter sports.</td>
</tr>
<tr>
<td><strong>Get acquainted with the use of lifts during warmer seasons and their industrial evolution over the years.</strong></td>
<td>To gain a broader image of the context.</td>
</tr>
<tr>
<td><strong>Research on different methods of transporting people upwards.</strong></td>
<td>To get inspiration and probably some more radical ideas.</td>
</tr>
<tr>
<td><strong>Get to know the laws and regulations applied to ski lifts.</strong></td>
<td>To be able to design a feasible and genuine product.</td>
</tr>
<tr>
<td><strong>Question</strong> where does the problem actually come from.</td>
<td>To avoid being led into the trap and to make sure to understand every aspect of the use of a lift.</td>
</tr>
<tr>
<td><strong>Make a document summarizing</strong> the research phase.</td>
<td>To formulate a groundwork for the whole project.</td>
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## CONCEPT DEVELOPMENT

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<tr>
<td>Choose which <strong>user group</strong> and/or <strong>type of lift</strong> I’ll be developing a product for.</td>
<td>To narrow down the target group and the context and make some more detailed guidelines.</td>
</tr>
<tr>
<td>Design at least 3 different solution, in form of <strong>sketches</strong>, <strong>mock-ups</strong> and <strong>models</strong>, and confront them with users.</td>
<td>To find the right direction for further product development. To give users a choice and get feedback from them. To communicate ideas as clearly as possible without focusing on details but function.</td>
</tr>
<tr>
<td>Through <strong>developing and testing</strong> of prototypes choose one of the concepts.</td>
<td>To narrow down the context and choose a concept with the most potential to “succeed” and meet my goal.</td>
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## PRODUCT DEVELOPMENT

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<tr>
<td>Use the MoSCoW (<strong>Must-Should-Could</strong>) method</td>
<td>To develop a list of requirements ranged by the level of priority.</td>
</tr>
<tr>
<td>Test some further developed prototypes.</td>
<td>To find out which one would work in a real situation and what adjustments it still needs.</td>
</tr>
<tr>
<td>Contact a <strong>ski lift designer, engineer or technician</strong>.</td>
<td>To get technical informations about the product. To get help with finding the right technical specifications of my product.</td>
</tr>
<tr>
<td>Work with digital and physical <strong>3D modeling</strong>.</td>
<td>To create an accurate representation of my concept and to not be limited by the program and my CAD-skills.</td>
</tr>
<tr>
<td><strong>Design</strong> a product that reflects the process and the workload I could have done in the time available.</td>
<td>To complete the project, meet my goal and make a change.</td>
</tr>
<tr>
<td>Make a <strong>prototype</strong> in (most possibly) 1:1 scale.</td>
<td>To create a credible representation of the product and (hopefully, to some degree) give the audience possibility to test the solution.</td>
</tr>
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> Photo by Lucas Neasi, Source: Unsplash
CONTRIBUTION

Better experience of using the chair/surface lift for snowboarders.

Elimination of any injuries of snowboarders and equipment damage related to the design of ski lifts.

Be a part of the change of ski resorts into “snow resorts” (for snowboarders and all other users).
RESEARCH
BRIEF HISTORY OF LIFTS

1616  ITALY

Mechanical ropeway

The first recorded mechanical ropeway was by Venetian Fausto Veranzio who designed a bicable passenger ropeway in 1616 (Wikipedia, Chairlift).

1644  POLAND

Mechanical ropeway on several supports

The world’s first cable car on multiple supports was built by Adam Wybe in Gdańsk, Poland in 1644. It was moved by the horses and used to move soil over the river to build defences (Wikivisually, Ropeway conveyor).
The first surface lift was built in 1908 by German Robert Winterhalder in Schollach/Eisenbach, Hochschwarzwald (Wikipedia, Surface lift).

A steam-powered toboggan tow, 950 feet (290 m) in length, was built in Truckee, California, in 1910 (Wikipedia, Surface lift).

The first Rope tow is claimed to have been built in Canada in the late 1920s (Skiheisen 1999).
1934  SWITZERLAND

J-bar surface lift

The first surface lift was built in Davos in Switzerland in 1934 with J-bar (Litt heishistorie, Skiheisen 1999).

1935  USA

Poma-lift

Poma-Lift created and patented in 1935 by Jean Pomagalski, the ski lift system consists of a rope loop running over a series of wheels. Hanging from the rope overhead are vertical poles or cables attached to a plastic button or platter (Wikipedia).

1936  SWITZERLAND

T-bar surface lift

In 1936 was that j-bar lift (Davos, Switzerland) rebuilt to T-bar and was in operation in whole 37 yeras. Than it’s impressive to think that the first surface lift was built in Norway, Tryvanns- kleiva in 1937 (Litt heishistorie, Skiheisen 1999).
Chairlift

The first chairlift was built in USA as early as in 1936. In Europe there should have been a couple of chairlifts built in Czechoslovakia in the late 1930s (Litt heishistorie, Skiheisen 1999).

Magic carpet lift

The first ever Magic Carpet lift was launched in 1990 in Denver, Colorado by a company called Rocky Mountain Conveyor & Equipment (RMCE) (Dunbar and Boardman, 2016).
Ski lift market

Nowadays, the market is dominated by big ski lift producers like Doppelmayr, Leitner and LST. They offer very similar products from categories of ropeway, surface lift and rail way.

Their innovation is directed towards new applications like urban transport, technical/mechanical solutions like detachable chairlift, and small adjustments for better efficiency or durability.
During the research phase I came across many interesting ways of going uphill over the years and some of them really stood out, like the unique bus lift built in 1951. The first row of pictures presents the most interesting ones.
All ski lifts are mainly operated in winter time, but many of them are full of life during the warm season. Chairlifts are used for transporting hikers to mountaintops or bikers for exciting rides. Preparation of chairs requires lots of work from the lift’s staff.

Some surface lifts are also used for thirsty for adrenaline bikers. They are pretty challenging to use while keeping the balance on the way up. ProTow is a new product that adapts surface lifts to transport bikes. It lets ski resorts offer extreme sports year round and provides bike parks with an uplift solution, differentiating it from anything on the market (iF - world design guide, 2016).
In order to dig in the history of ski lifts and winter sports I’ve visited a place with a great archive - The National Library of Norway. There I’ve got hold of many useful reading materials and ordered full collection of the norwegian newspaper “Skiheisen” (eng. ski lift) and the journal “Skiing Heritage”.

Source: Lydrommet
The origins of snowboarding are poorly documented. When the first person rode a single plank through the snow is unknown, but anecdotes of miners in Austria riding a long wooden board with a rope or handlebar for balance - the device called a ruariser knappenrosser - date back to the 16th century, and there are tales of a knappenross race taking place in the 1800s. There are also claims that U.S. soldiers stood sideways on barrel staves and slid downhill during World War I.

Western snowboard historians were apparently unaware of any community that was actively riding snowboard-like devices when snowboarding’s modern era began in the 1960’s. Then, in January 2008 snowboarders Jeremy Jones and Stefan Gimpl journeyed to Turkey’s Kackar Mountains and were introduced to people in a remote village who ride sideways on a flat, rectangular, toboggan-like device called lazboard. According to legend, the practice began some 400 years ago for fun and it made travelling in deep snow easier. Based on current research, this community has been actively riding snowboard-like devices for a continuous period longer than any other population (Skiing Heritage, March 2009).
60s  USA

Getting alive

Burton on an advanced Backhill, complete with water ski binding.

Source: (Sick) a cultural history of snowboarding, Susanna Howe

80s

Boom!

Source: (Sick) a cultural history of snowboarding, Susanna Howe

90s

POP and dominating

Source: Skiheisen, 90s

2018

Peace and harmony

Photo: Aleksandra Wojcik
Snowboarding has burst into our lives and become a vessel of meaning for kids, marketers, media and advertisers around the world. Getting snowboarding accepted at ski resorts was the single most important contribution to its growth in the 80s. ((Sick) a cultural history of snowboarding, Susanna Howe). At that time it has reached a growth turning point. 70 percent of all visitors of the ski resorts in Oslo were snowboarders. The majority of norwegian resorts were investing millions in new ski lifts and snowparks (Skiheisen, 90s).
Vassjellet satser på snowboard

Det er i toppen av å ta ideen for et snowboard-område med 140 meter høyde på Rv. Det er nå en av de mest spennende ideene i området. (Foto: -)

Rauland satser på brett

Rauland Skisenter AS har i vinter investert i en ny traktemaskin med pipedrag. Det vil til utstrække for å la det hele slike slik at brentskjermer får sikre nedsening. Desse tilbudet skulle værevis å la av, i lag med halptjeppe i Rauland Skisenter Vest også.

SNOWBOARD ER POP

SNOWBOARD er blitt et populært sporsel. Neste år sletgar eller rant opp med satser av brett. (Foto: i Newsdesk)

Stor snowboardsatsing

Gelo Tushoe skal investere nær 20 millioner kroner i å åpne teknologisk. (Foto: i Newsdesk)

Skisentre satser på snowboard

Skisentre i Rv. skal også bygge et slikt område med pipedrag. (Foto: -)

Snowboarden skaper kø


Snowboard - et problem eller et nytt marked for norske alpinanlegg

Det er ingen tvil om at det er en liten natur- 

tolksjon på gang som de fleste ikke er heit klar over omfanget av. I Sverige gikk andelen snowboardere sist sesong opp fra 5.3% til 9.2% ifølgje norske alpinanlegg. I Amerika var den samme andelen 11.2% i 1990. 

Kongsvik: 

Av diskusjonen på konferansen fremgikk det at snowboardere av mange opplærte som et problem. Noen eksempler: Dei måtte å være på, klær og språk virker fremmed og ufordel-

tig. Dei sniker i heiskoen, bruker ikke fangem, 

Kongsvik: 

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tig. Dei sniker i heiskoen, bruker ikke fangem,
Other concerns

While going through the reading material at the library I’ve found articles about the whole range of different concerns - from constant development of the snowboarding equipment, to smoking of weed on slopes but nothing, not even one coment about the ski lifts.

Many ski resorts in Norway were at that time betting on snowboarding, were spending millions on snow parks and same old chairlifts as before snowboarding, and no one in a single article discussed the use of ski lifts by a whole different user group that would require big changes in ergonomics.
Safety

Use of helmet

New equipment

Snowboard

Snowboard rental

Beahaviour, language, weed

Snowparks and slopes

Style and competition

Safety

Use of helmet

New equipment

Snowboard

Snowboard rental

Behaviour, language, weed

Snowparks and slopes

Style and competition
The t-bar is a cruel joke on snowboarders perpetrated by the skiing industry.
The first opinions of snowboarders about ski lifts I’ve found in recent magazines and internet forums. When this topic is first broached it’s obviously not about describing great experiences but giving instructions to beginners, advices on how to avoid pain, and sharing humiliating and funny memories.

The article “Kjærlighet til en t-krok” (eng. Love to a t-bar) was written to celebrate it’s 50th anniversary in 2017. Its author, Anders Wyller describes with passion and respect, the incredibly difficult for snowboarders first contact with the t-bar lift and the feeling of pride after mastering it.
When riding pomas/tbar I often get pain on the inside of my thigh on my lead leg near the knee. I'm ok for an hour or two. After that I was lying on the floor cooling my leg with snow after each lift.

/MaD_BaRoN_HahA/

Thigh burn? I get that on the longer Pomas after a while. I have no solution.

/jonnybaaheid/

On the subject of button lifts does anyone find that they get bruises on the inside of their front leg after a while of using the lift?

/warrmr/

May also be a front binding issue, with the Poma pulling your knee joint in a direction it simply doesn't want to bend.

/dunx/

I’m having a problem with the pain I get in my inner thigh. If it's one T-bar a day it’s not bad at all. But if 90% of lifts are T-bars and I’m riding a whole week in the same resort, the pain in the evening is tremendous.
The inner thigh problem

Among all the discussed topics the inner thigh problem appeared most often. After long and/or steep rides with surface lifts many snowboarders experience pain, burn or discomfort in that area. They also comment on the twisting of the knee joint that takes place on surface and chairlifts.

That results in having shorter days on slopes, choosing shorter lifts or resorts that offer chairlifts, or even switching sport to skiing.
Kapittel 10. Felles krav til taubaner

§ 10-2. Generelle tekniske krav
Taubaner skal til enhver tid være innrettet slik at de kjørende kan ferdes og stige på og av uten fare.

Traseen skal være ryddet, tilstrekkelig bred og tilgjengelig.

Kapittel 12. Tilleggskrav til stolheiser som er godkjent etter reglene som gjaldt før 3. mai 2004

§ 12-1. Utforming av kjøretøy
Stoler, kabiner eller andre kjøretøy skal være utformet på en slik måte at passasjerene kan transporteres sikkert, at de ved normal oppførsel ikke kan falle ut og slik at på- og avstigning kan foregå sikkert. Stoler og kabiner skal ha en utforming som legger til rette for redning av passasjerer.

§ 13-4. Medbringere
Medbringere skal ikke ha deler som kan hekte seg fast i klær, ryggsekker o.l., og skal for øvrig være av en slik utførelse at de kjørende lett kan frigjøre seg fra dem. Dersom det benyttes tall-erkenmedbringere skal det ikke være hull eller utsparringar i disse. Videre skal medbringerne være slikt utformet at det ved vekslende oppstramming
The Norwegian Railway Authority is responsible for laws concerning ski lifts. The general technical demand (§ 10-2) says that ski lifts shall always be arranged so that the users can travel and get on and off without danger. The route must be cleared, sufficiently wide and accessible.

Laws about chair and surface lifts forbid the most obvious security issues like falling off the lift during normal use, and parts that can get hooked on clothes, backpacks etc.
The time to move from the library out to the field has come. I've done my studies mostly in Oslo at Tryvann, but also in Hemsedal, Kirkerud and Zakopane in order to try different types of lifts and to extend the research outside Norway.

I’ve been the user myself, observed and interviewed all kinds of users and ski resort’s staff. The lift operations manager from Tryvann, Gustav Haugli and the CEO of Skiheisservice, Stein Arvid Strand were very helpful. I’ve learned a lot about lifts from the technical and users’ point of view.
The first type of lifts I've taken a closer look at was the chairlift. It's a type of aerial lift, which consists of a continuously circulating steel cable loop strung between two end terminals and usually over intermediate towers, carrying a series of chairs. They are the primary onhill transport at most ski areas (in such cases referred to as ‘skilifts’), but are also found at amusement parks, various tourist attractions, and increasingly in urban transport (wikipedia). There are around 75 of them in Norway (alpinanleggene.no).

There are two main types of chairlift that differ in the way of fastening to the steel cable: fixed-grip and detachable. Fixed-grip chairlift at Tryvann goes between 1,6 and 1,8 m/s in order to enable people to get on and off safely. The detachable one is much more expensive but goes between 3,6 and 3,6 m/s because it slows down during embarking and disembarking. Even if the two types have the same ammount of seats the last one has much greater capacity and thus, bring more profit to the resort and comfort to users.

> Photo: Aleksandra Wojcik
SNOWBOARDERS

Photo: Aleksandra Wojcik

SKIERS

Photo: Aleksandra Wojcik
There are some important observations that I’ve made:

**Skiers** are the most *organized* users, have natural position and it’s easy to see that this lift was designed for them.

**Toddlers** don’t reach to the support, move around and seem to have bigger chance of falling off.

**Snowskaters** have to keep their skates on the lap or hook it on the safety-bar.

**Snowboarders** seem to struggle with finding the right position and place for the snowboard. Some choose not to rest the board at all, some place it on the rear foot or on the support by unnaturally twisting the knee joint. It’s easier when two snowbaorders sitting beside each other have the board attached to the same foot.
There were some, unfortunately unsuccessful, attempts to solve these problems. Rotating snowboard binding allows to rest the board just like a ski but create some problems while disembarking. The dual snowboard is probably very comfortable on the lift but gives a completely different experience while sliding downhill.
On the picture to the left you can see the most common support. It’s used by two passengers and is attached to the bar that goes between them. Because of the danger of children falling off ski lift produces designed a new solution- it’s shown on the picture in the middle. This one has much smaller support and the bar it’s attached to goes between the passenger’s thighs.

This new design raises a whole range of new problems. The support is uncomfortable for skiers, almost impossible to use by snowboarders and not planned for sit-ski users. The sit-ski has only one ski in the middle and thus, can’t be rested on the support that’s also in the middle. Tryvann solved that by removing one compartment from every sixteenth chair so that the sit-ski user can take two seats in the middle.
A magic carpet is a conveyor belt installed at the level of the snow. Some include a canopy or tunnel. Passengers slide onto the belt at the base of the hill and stand with skis or snowboard facing forward. The moving belt pulls the passengers uphill. At the top, the belt pushes the passengers onto the snow and they slide away.

Magic carpets are limited to shallow grades due to their dependence on friction between the carpet and the bottom of the ski or board. Their slow speed, limited distance, and capacity confines them to beginner and novice areas (wikipedia).
UBETJENT SKIBÅND

STÅ, IKKE LIGG ELLER SITT PÅ BÅNDET

NØDSTORP
Frame captures from video “Magic carpet” by Aleksandra Wojcik
I’ve documented my observations with a short video (see digital delivery: magic carpet.mp4). It clearly shows how slow this type of lifts is. Some people manage to cross over the lift or choose to walk uphill insted, and don’t seem to be moving slower.

They are also installed directly on the ground and for models without heating, like the one on the video, heavy snow fall can be quite of a inconvenience. Magic carpet generally have no guards and raising level of snow can cause stopping of the lift or make disembarking challenging.
There are about 490 surface lifts in Norway (alpinanleggene.no). A surface lift is a means of cable transport that transports skiers and snowboarders, in which riders remain on the ground as they are pulled uphill. Today, surface lifts are most often found on beginner slopes and small ski areas. They are often utilized at glacier skiing resorts because their supports can be anchored in glacier ice due to the lower forces.

Surface lifts have many **disadvantages** compared to aerial lifts: they require more passenger skill, the surface must be continuous, they impede skiable terrain, are slow in speed, and of limited capacity.

Surface lifts have two **advantages** over aerial lifts: they can be exited before the lift reaches the top, and they can often continue operating in wind conditions that are too strong for a chairlift.

There are two main types of this lift: the platter and t-bar. **The platter lift** consists of equally spaced vertical poles or cables attached to a plastic button or platter that is placed between the skiers legs and pulls the skier uphill. Snowboarders place the platter usually behind the top of their front leg.

**The t-bar lift** consists of a series of vertical recoiling cables, each attached to a T-shaped bar measuring about a meter in both dimensions. The horizontal bar is placed behind the skier’s buttocks or between the snowboarder’s legs, and pushes the passengers uphill while they slide across the ground (Wikipedia). The t-bar is ment for 2 passengers and can be slightly uncomforttable otherwise.
Frame captures from video “Poma lift” by Aleksandra Wojcik
My observations are summarized in a 2 min video (see digital delivery: poma lift.mp4) that represents the real use of a surface lift and related challenges.

To the left are three frame captures from that video. They show an adult snowboarder with the platter placed on his chest even on a nursery slope, a toddler-snowboarder that can’t yet take a poma lift alone and is being pulled uphill by her instructor, and a mother that struggles with placing the platter between her kid’s legs.

My general observation is that it’s clearly more challenging for snowboarders—especially beginners, and for the youngest ones to travel with a surface lift.
A customer that bought these new t-bars from Sweden is very dissatisfied. They are too weak and break easily.

Stein A. Strand
Skiheisservice

The new t-bar from Sweden

For the first time in over eighty years, the classic and reliable t-bar ski lift gets a face-lift. The swedish company Boardie developed a wider, more ergonomic t-bar seat to improve the ski lift experience for everyone. Unfortunately, my research shows that it still needs some adjustments for better durability.

Personally I think that Boardie is a great start but it’s not a revolution and there are still some problems with surface lifts that should be solved. The t-bar is ment for 2 passengers and can be slightly uncomfortable otherwise. Person riding it alone is usually sliding off. It’s quite big and thus not child-friendly. An adult riding it together with a kid ends up having it placed above knees and kid - on the back.
**PLATTER LIFT**

**Price**  
- normal 300 kr  
- comfort 850 kr

**Recommended length** 800 - 1000 m

**Speed**  
- 1.4 - 1.8 m/s  
- (Tryvann) 2.6 - 2.9 km/h

**Max angle** 31°

**Suitable for**  
- 1 person  
- 1 adult + 1 child (skiers)

**T-BAR LIFT**

**Price** 400 - 500 kr

**Recommended length** <1000 m (social aspect)

**Speed**  
- 1.4 - 1.8 m/s  
- (Tryvann) 2.6 - 2.9 km/h

**Max angle** 29°

**Suitable for**  
- 2 adults / 2 children (skiers)  
- 1 person
The best surface lift available.

Stein A. Strand from Skiheisservice about the comfort platter lift.

The comfort version of platter lift is the most popular one. Most of the snowboarders I’ve talked to preferred this one over a t-bar.

It can transport one person or an adult and a child. Even tho it mostly transports only one person, it has bigger capacity than the t-bar. Snowboarders and sit-ski users travel alone. Because of it’s size and weight it’s not the best solution for children. When used by two people it’s bigger change for falling dawn. It results in stopping of the lift while the platter lift can go continuously.

Some ski resorts replaces old t-bar lifts with platter.
Summary of observations and interviews

During this phase I talked, in person or via Facebook, to about 20 ski lift users from toddlers to elderly, from begginners to professionals, from athletes to disabled, doing different winter sports (notes from some interviews in appendix).

Out from that big amount of informations I chose those most important and most often repeated. At that stage I’ve decided to abandon further research on magic carpet and move forward with these two that seem to have bigger potential.

CHAIRLIFT

Quick and social

- You can take a rest between rides.
- You have time to eat chocolate and talk with friends.
- It’s nice to and enjoy the view
- The most comfortable type of lifts.

Uncomfortable

- Causes twisting of the ankle.
- There is no good solution on how to rest the board.
- When the lift is full it’s easier to just let the board hang.
MAGIC CARPET

Comfortable and easy

- Kids can use them without much or any help.
- Can be used with or without the equipment (skis, board).
- Beginners are sometimes afraid to use other lifts.

Super slow

- They stop often when it’s snowing.
- It’s super slow.
- Works only on nursery slopes.
- Some people stand and some prefer to walk.

SURFACE LIFT

Smaller que

- Provides access to a specific area like snowparks.
- Has usually smaller que than chairlifts.
- You can get off at any point.
- Those that go through a forest can give you a beautiful tour.

Difficult and painful

- Not comfortable at all.
- It’s difficult, requires concentration.
- Some hold it under the arm instead in order to avoid the pain.
- Works only on nursery slopes, otherwise it hurts the leg.
Many helpful people and organizations were involved in my research.

I've learned a lot from the company Skiheis Service, the newspaper Skiheisen, The Norwegian Railway Authority and National Ski Areas Association.

I've conducted research and interviews at Tryvann, Hemsedal and Kirkerud Ski Resort, and talked to people from Funkis - snowboard club for kids with disabilities.
WORKSHOP

In order to get more detailed insight on the whole experience of going uphill with a chair and surface lift, I held one workshop with skiers and one with snowboarders.

Together we have developed four maps showing passengers’ emotional journey ranging from +2 to -2, representing the most positive and negative feelings. Later we’ve defined the biggest problems and brainstormed some ideas on how they could be solved.
EMOTIONAL JOURNEY: CHAIRLIFT

This map shows the chairlift passengers’ emotional journey. The scale, ranging from +2 to -2 is shown to the left. The journey of snowboarders is in green and of skiers in purple. The text boxes in the bottom indicate different stages of the tour uphill (maps in full size delivered as separate prints).

The first highlight shows that the biggest problem for snowboarders is resting of the board that also causes discomfort for the skiers. Despite this both groups are happy to be going up.
The second highlight shows that after reaching the top the experience of these two groups are opposite. Boarders are happy to be done with the lift and quickly find a place to bind the rear foot often standing in the way for others.
EMOTIONAL JOURNEY: SURFACE LIFT

This map visualizes emotional journey of surface lift passengers. The first highlight shows that already in the beginning of the tour snowboarders experience negative feelings while it’s completely neutral for skiers. In the beginning it’s challenging to hold the balance on a surface lift. The next highlight shows that it’s a quite negative experience when either you or someone else falls down. That can cause either humiliation and stress or stopping of the lift.
The last highlight shows that these two groups have opposite experiences, similar to those from chairlift. It can be slightly more difficult for boarders to release the lift and keep the balance.
In order to structure and summarize all insights I’ve created a map that kickstarted the ideation process. With that I’ve managed to collect 11 concepts on that wall. They ranged from a radical self-driving robot and a couch surface lift, to a differently shaped platter.

In the chapter Concept development I present four ideas that I chose to work further with.
POTENTIAL FOR IMPROVEMENTS: CHAIRLIFT

Support

which provides equal comfort to all passengers.
Safety bar

which provides safety and place for equipment like gloves, ski poles and snowskate.
POTENTIAL FOR IMPROVEMENTS: SURFACE LIFT

Ergonomics and balance

for easier start and comfortable tours uphill
CONCEPT DEVELOPMENT
CONCEPTS
CHAIRLIFT: COMFORTABLE SUPPORT

The support on a chairlift gives snowboarders most unpleasant experiences. I sketched out and tested with simple mock-ups new possible solutions.

Ideally, it was supposed to enable keeping the snowboard almost across even with all passengers wearing snowboard, and also suit children and sit-ski users.
PLATTER LIFT: ERGONOMIC SOLUTION

The biggest disadvantage of the existing platter lift is its poor ergonomy. Bigger surface of the seat would actually make a big difference for all passengers. I’ve sketched out and tested with scale mock-ups many shapes, proportions and alternative ways of use.
DOUBLE PLATTER

The ergonomic solution evolved into a concept of double platter lift. The idea actually came from Stein A. Strand that suggested designing a lift for two people, like a t-bar, but in form of a platter lift. From sketches I’ve moved to simple mock-ups of different mechanical solutions.
SLEDGE LIFT

This concept was born from combining the comfort of a chairlift, advantages of a surface lift and an idea from a snowskater that suggested having fun on the way to the top. Before sketching I had to choose context and target group, and take many measurements of the biggest and smallest users. First simple tests proved that it might be a possible solution.
EVALUATION

I took a strategic decision to discard the first concept. Mainly because chairlifts are already very comfortable and that it would be very difficult and expensive to conduct tests and to build and exhibit a full scale model.

After the presentation of remaining concepts to my supervisor Stein Rokseth and product designer (sledding enthusiast) Geir Øxseth, we’ve decided to develop further both concepts.
After the next round of sketching and testing mechanics in full scale, the concept of double platter lift was the next one to be discarded.

By facing it with my supervisors and the technical consultant from Skiheis Service it turned out to be too complicated, expensive and probably unfeasible.

I went back to the concept of an ergonomic platter because of its simplicity it would actually be a realistic solution and a satisfying project. Furthermore in my opinion, the simpler and more production-ready designs are expected, the more challenging project is.

Photo: Aleksandra Wojcik
Evaluation with detailed mapping

In order to decide between the sledge lift and ergonomic platter I’ve created two maps for each. One shows the potential user journey with the new lift, and the other one the journey of the lift itself (see separate prints: user jouney_platter lift, user jouney_sledge lift, lift jouney_platter lift, lift jouney_sledge lift).

The maps concerning the sledge lift show the amount of potential problems and challenges that are a part of the whole system, and that couldn’t be solved separately. This concept got killed because it wouldn’t be possible to develop a realistic and convincing design in one semester.
MUST-SHOULD-COULD

In order to move forward with the conceptualization I needed to create a list of criteria that the new design needs to meet. For that I used the MoSCoW method and divided it into four categories: design, ergonomics, production, and implementation.

**DESIGN**

<table>
<thead>
<tr>
<th>Must</th>
<th>Should</th>
<th>Could</th>
</tr>
</thead>
<tbody>
<tr>
<td>be comfortable for adult snowboarders and skiers</td>
<td>be child-friendly</td>
<td>allow transporting of two adults</td>
</tr>
<tr>
<td></td>
<td>be comfortable for snowskaters</td>
<td></td>
</tr>
<tr>
<td></td>
<td>suit sit-ski users and alpinists with disabilities</td>
<td></td>
</tr>
<tr>
<td></td>
<td>allow transporting of an adult with a child</td>
<td></td>
</tr>
</tbody>
</table>
### ERGONOMY

<table>
<thead>
<tr>
<th>Must</th>
<th>Should</th>
<th>Could</th>
</tr>
</thead>
<tbody>
<tr>
<td>have shape that allows placing it on the front thigh for snowboarders</td>
<td>have a placement indicating form</td>
<td>allow various placements</td>
</tr>
<tr>
<td>have shape that allows placing it on the buttocks or between legs for skiers</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### PRODUCTION

<table>
<thead>
<tr>
<th>Must</th>
<th>Should</th>
<th>Could</th>
</tr>
</thead>
<tbody>
<tr>
<td>be produced in materials that are suitable for various weather and continuous use</td>
<td>be produced in environmentally friendly or neutral materials</td>
<td>be produced with carbon negative processes</td>
</tr>
</tbody>
</table>

### IMPLEMENTATION

<table>
<thead>
<tr>
<th>Must</th>
<th>Should</th>
<th>Could</th>
</tr>
</thead>
<tbody>
<tr>
<td>follow SJT’s laws and regulations, thus be safe to use</td>
<td>cost approx same as the comfort platter lift (850,-)</td>
<td>be possible to produce in Norway</td>
</tr>
<tr>
<td>have similar weight to existing lifts (in order to be user-friendly and fit existing springs)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>fit in the existing system (to avoid huge investments into development and building of new installations)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOOK</td>
<td>FEATURE</td>
<td>ANGLE</td>
</tr>
<tr>
<td>------</td>
<td>---------</td>
<td>-------</td>
</tr>
<tr>
<td>Stiff + Text</td>
<td>Stiff that requires boiling</td>
<td>✓</td>
</tr>
<tr>
<td>Flexible</td>
<td>Flexible and low trim</td>
<td>✓</td>
</tr>
<tr>
<td>Soft + Anything So.</td>
<td>Soft and anything So.</td>
<td>✓</td>
</tr>
</tbody>
</table>
Next step was to develop further the chosen concept. I’ve categorized ideas after the seat’s placement, angle, feature and shape, and developed three versions of the new lift. Their common feature is that snowboarders instead of resting directly on the pole or the narrow t-bar, would rest on the comfortable seat itself.

The first one can be placed just like a platter lift and instead of a flexible joint the lift would have a form that allows adjusting to the angle of the hill.

The next version mixes together advantages of the platter and the t-bar lift. Skier could have the possibility to choose between placing the seat horizontally between their legs or vertically on their buttocks. Flexibility of the seat would allow adjusting to the angle of the hill.

The third one is a single version of the t-bar. The seat is much wider and adjusting the angle of the hill possible with a rotary mechanism.
For better understanding of these concepts I’ve made several small and full scale mock-ups with which I could easily test some of their qualities and proportions.

**Ergonomy studies**

The next step was very important for further development - ergonomy studies. I’ve used a wooden mock-up and a flex-tube to test many possible proportions and shapes of the pole on various users.
Safety

Safety is a very important aspect when it comes to ski lifts. Existing models can’t easily get hooked on something. The platter has a flexible joint and the shape of the pole makes it impossible for objects to reach the center.

The shape of the t-bar also has this restriction. When something is in the way, the t-bar can just swing to the side. The disadvantage of this one is the narrow seat that sometimes gets hooked on clothes.
When it comes to my concept, the shape of it requires to have the pull in the middle so a passenger won’t slide off it like in case of using a t-bar alone. That makes it a perfect hook.

In order to be a safe solution, the seat needs to be attached at a slight angle and the curved tip has to be flexible. That would change the track of the lift and allow the whole object to swing.
With ergonomy studies I’ve found three different shapes of the pole and could start to build first prototypes of my concepts in full scale and right materials.

It was important to make them durable and with functioning rotary mechanism to get as valuable feedback as possible. After few days prototypes were ready and waiting to be faced with demanding users.
Testing of those prototypes took place in many rounds with involvement of 10 users. Some of them were snowboarding and skiing for years and some have never seen a ski lift before.

Everything was arranged in school’s construction hall with prototypes attached to the crane. We used our own body weight, a longboard, rollerblades, wooden planks and shoes.

It turned out to be more fun than useful and testing needed rearrangement. Prototypes got attached to a pellet and remained static. That gave the volunteers possibility to spend some time with them, test different positions, placements and pressure.
Frame captures from video clips by Aleksandra Wojcik
Frame captures from video clips by Aleksandra Wojcik
With those tests I’ve gained lots of feedback and ideas. Many features were approved but some needed to get introduced. Skiers required a rotary mechanism in the pole, snowboarders - more comfort in the crotch area, taller/bigger users - slightly different proportions.
PRODUCT DEVELOPMENT
Important words for my design were: sporty, curves, sharp, modern, safety, industrial. Pictures of chair and sofa show the soft top and technical, strong bottom. The picture of the bench shows that those two can be merged in one.

Pictures of sport accessories show desired finish with matt black, chamfer fillet and lines indicating motion. The picture of the t-bar represents the technical aspect and existing product, and the one showing adidas shoe reminds of the required softnes.
The concept of an ergonomic solution needed a ergonomic seat. I’ve done many thumbnails of the top and the side of the seat. In order to look less like a suspender and more like a sporty bicycle seat it needed some sharp lines that indicated motion.
It was very hard to find the right shape of a complex 3d form with 2d drawings so I've quickly moved to full scale cardboard mock-ups and sculpting with styrofoam. I've got some help with testing from men that need some extra attention in the crotch area. What was comfortable for me - wasn't for them.
I was ready and finally got the chance to test my prototypes on the slope attached to the real lift. I’ve visited Vardåsen ski resort in Asker. The winter season was already over so only me and the staff could test it.

I was riding both snowboard and skis and tried many possible placements. We also observed how it behaves when released from different distances and from different tensions. I have to admit that it was more comfortable and easy to use than expected. The tension on my thigh while sliding uphill was much smaller that when testing it statically.
MATERIALS

Currently, t-bar and platter lifts consist of two main parts: an injection moulded with polypropylene seat and an aluminium pole. These materials are light, inexpensive and weatherproof. The same features are characterized by steel. Slightly thinner steel pole with smaller diameter would also have same weight. Steel has several, significant advantages over aluminium that I’ll present by describing both of these materials.

Aluminium

Aluminum is the most abundant metallic element in the earth’s crust, but is never found in nature in its elemental state. It occurs mainly as very stable oxides, hydroxides, and silicates. The first commercial aluminum was produced in 1854. Aluminum has many desirable physical properties. It is malleable and lightweight. Pure aluminum is relatively soft and weak, but it forms many strong alloys. Aluminum’s adherent surface oxide film makes it corrosion resistant (Ullmann’s Encyclopedia of Industrial Chemistry).

Over 95% of the alumina produced globally is through the Bayer process. Because of its demand for incredible amounts of energy most of the aluminium mill are located near a power plant. Production of this metal consumes 1% of the total energy produced in the world.
Bauxite tailings or Red mud is the waste product that is produced in the digestion of bauxite with sodium hydroxide. It has high calcium and sodium hydroxide content which makes a complex chemical composition. This makes it very toxic and a source of pollution that extinguishes life for decades or even centuries.

The scale of production makes the waste product an important one. For every tonne of alumina produced, approximately 1 to 1.5 tonnes of bauxite tailings. Annual production of alumina in 2015 was approximately 115 million tonnes resulting in the generation of about 150 million tonnes of bauxite tailings/residue (Wikipedia).

For more pictures see separate digital delivery: aluminium.mp4.
Steel

Steel is an alloy of iron and carbon containing less than 2% carbon and 1% manganese and small amounts of silicon, phosphorus, sulphur and oxygen. Since 200 BC, many cultures have produced steel in one form or another. A British inventor, Henry Bessemer, is generally credited with the invention of the first technique to mass produce steel in the mid 1850s.

Steel is the world’s most important engineering and construction material. World crude steel production reached 1,626.6 million tonnes (Mt) for the year 2016.

It’s is very friendly to the environment, completely recyclable, possesses great durability, and, compared to other materials, requires relatively low amounts of energy to produce. It can be recycled over and over again without loss of property and is the world’s most recycled material (The World Steel Association).

Stainless steel is a generic term for a family of corrosion resistant alloy steels containing 10.5% or more chromium. All stainless steels have a high resistance to corrosion. This resistance to attack is due to the naturally occurring chromium-rich oxide film formed on the surface of the steel. The film is rapidly self repairing in the presence of oxygen, and damage by abrasion, cutting or machining is quickly repaired (The Australian Stainless Steel Development Association).
That is why I would like to limit the production of aluminium only to necessary and replace it with other materials when possible.

By choosing steel for my product there is one technical solution that requires a change. The rotaty mechanism is attached to the pole by shrinking (see picture above), and that is most likely not possible with steel. The seat would still be injection moulded in plastic, but a more flexible and hopefully recycled one.
MECHANISM

As mentioned in feedback: skiers required a rotary mechanism in the pole. The existing poma lift has two rotary mechanisms embedded in the pole on both ends (see p. 121). I’ve decided to use them, and move one higher to obtain right rotation. I’ve produced both parts myself and modified one from a 360° rotation to 60°. They got attached with steel wires welded to the pole but the finale product would require help from an engineer to find the most efficient method.
The last step before making a finale prototype was to make a 3D drawing including all details. The whole product is about 1,1 m tall and 0,4 m wide. The seat, the rotary mechanism and the pole are connected with one screw underneath, between ribs - in place difficult for the passenger to access. Ribs ensure strength with light weight.

The shape of the seat prevents anything from getting attached. It’s curvy, sporty and ergonomic. I kept current colors of the t-bar and the platter - orange is the easiest color to notice on the snow or sky background. Black seat preserves associations to current lifts and and their aesthetics. Whole j-bar is attached to the rope with a standard part of Doppelmayr’s production.
PROTOTYPE BUILDING

CAD drawing of the seat was 3D printed with SLS, grinded, primed and painted. It was more work with making the pole with functioning rotary mechanisms. All parts were put together with welding and grinding. Next, primed and painted.

The prototype contains almost same parts as the finale product. Most important for this phase was good planning of all elements in advance and precision that would determine the quality of the end result.
Photo: Aleksandra Wojcik
CONCLUSION

The finale product fits in the exiting system, is comfortable and designed as planned. Big surface of the seat would give snowboarders what they need and deserve after all those years of being a part of ski resorts. The shape of the lift allows many possible placements for all users, and can even still be used on a bicycle during summer season.

This new j-bar is not a revolution but absolutely makes a significant difference for many people, and contributes to change of ski resorts into snow resorts and not least - to the good of the environment.
OUTRO

REFLECTIONS

This diploma project was quite challenging, required lots of work but gave fun and satisfaction in return. I hope that the next generation of snowboarders will experience an easier start and more comfortable tours uphill.

During this project I have learned a lot - from cooperating with professionals from different fields to fluency in 3D sketches in solidworks. With good planning and time pressure I've managed to use efficient methods of concept evaluation. In the end, I'm satisfied with the process and design proposal.
SPECIAL THANKS TO

my fiance, for all support he gave me during all five years at AHO.

my supervisors Stein Rokseth, Steinar Killi, Magne Ekerum, and not least Stein A. Strand from Skiheis Service, for help and guidance.

all friends and family, for their time and faith in me.
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APPENDIX

SJT - Utvalgte lover, forskrifter og veiledninger for taubaner og fornøyelsesinnretninger (2017) - regelverkshefte.pdf

Notes from interviews - interviews.pdf

4 maps of user and lift journeys - separate prints

1 of users emotional journey - separate print

Short films from field studies - poma lift.mp4, magic carpet.mp4

Short film from testing of prototypes - testing.mp4

Short film about aluminium - aluminium.mp4
I believe that design is a field that has responsibility to be a part of solving real problems and improve life quality for both people and our planet. Designers should absolutely dare to question and experiment.

Among my interests lie natural materials, japanese design, traveling, hand drawing and Sci-Fi. I’m a tea and nature lover who gets adrenaline kicks from snowboarding and climbing.