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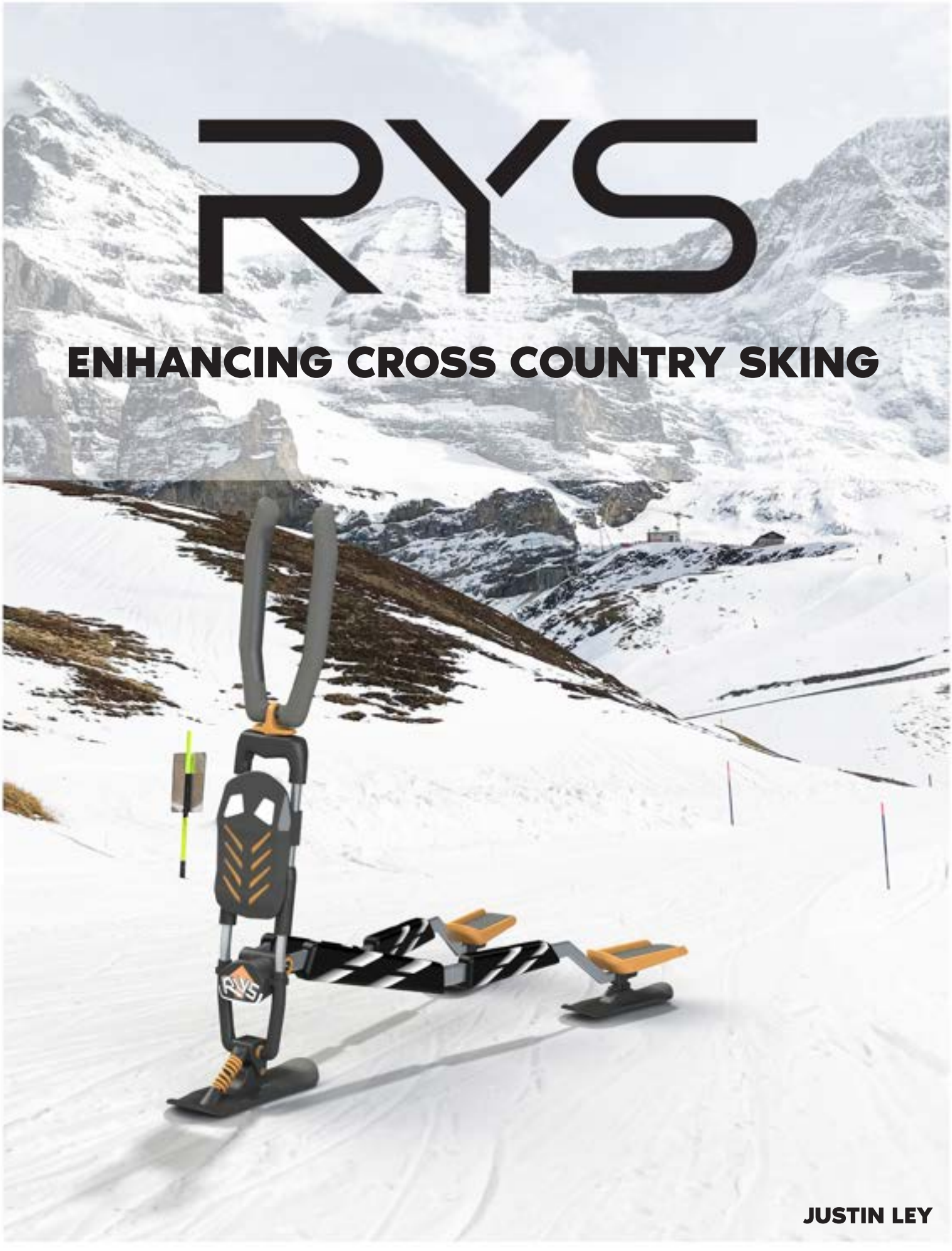
## ENHANCING CROSS COUNTRY SKING



JUSTIN LEY

# Enhancing cross-country skiing

by **Justin Ley**

Submitted in partial fulfillment of the requirements for the degree of

**Bachelor of Industrial Design**

Faculty of Applied Sciences & Technology
Humber Institute of Technology and Advanced Learning

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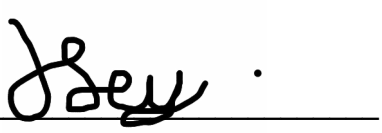
Student Signature : 

Student Name : Justin Ley

# Abstract

As the popularity of alpine sports increases, the need for more fun options grows while not restricting movement or safety. The safety concerns that are present need to be mitigated. This is especially a problem when considering the terrain park, which has large jumps and features such as rails, boxes and more. "injury rates in snowboarders have fluctuated over time but currently remain higher than in skiers. Wrist, shoulder, and ankle injuries are more common among snowboarders, while knee ligament injuries are more common among skiers. Injured snowboarders were significantly younger, less experienced, and more likely to be female than injured skiers or snowboard control participants." (Kim, S. 2012) Currently, there are only two methods that are popular (skiing and snowboarding), with a third method (snow blading) which recently gained popularity. These methods lack difference and have a lot of room for improvement due to the nature of the sport and the number of people that enjoy the winter months. Providing an option that can create a safer environment while allowing for a more intuitive learning experience would make alpine sports much more accessible for young riders, while also providing a fun learning curve for intermediate riders. This thesis will focus on a method for enabling young riders and the challenges that come with performing alpine activities, analyzing the difficulties that are currently being faced by new riders. Using surveys and interviews and firsthand observation will allow for a comprehensive understanding of where improvements can be made and finding where innovation can be achieved. Evaluation will be done using ergonomic studies and user testing to fully understand the hardships and how to mitigate them. Creating a solution to this problem will enable more people to invest time into the sport while providing a new fun way for experienced riders to enjoy alpine activities.

# Acknowledgements

Thanks to the professors that helped greatly along the way, and thanks to my advisor for helping to inform my decisions through a persessional lens, and to the others that helped throughout this difficult creative process.

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CHAPTER 1

# Introduction

Figure 1 - How to dress for cross-country skiing - Retrieved from https://www.salomon.com/sites/default/files/content_hub/teaser_import/landscape__16601.jpg

### *1.1 Problem Definition*

In Canada, winter sports are prevalent, being an essential part of Canadian culture, with people of all ages gathering to locate ski hills as much as possible every year. Despite how popular these winter activities are, there have not been any significant innovations for many years. The Problem definition is “how may we improve safety and enjoyment for Alpine sports enthusiasts?” When looking into how we can develop the current methods of alpine sports, we need to understand why the current methods of skiing and snowboarding are so popular and understand where the faults lie, as well as why new methods that come out have not become very popular. The primary considerations that need to be solved include safety while riding for both the rider and others, speed and direction, visibility of surroundings, portability, accessibility, and ease of learning. These primary considerations play a prominent role in how well its users will receive the activity.

Understanding the frame of this problem means comparing the current user’s needs and where these needs are; simply developing a new solution will not drive the market. Instead, looking into where these problems are not solved makes for an opportunity to create innovation. The big problem when conducting user research is that many riders do not enjoy cross-country skiing. This lake of enjoyment is since it is difficult to maintain speed on flat trails. Creating a system that encourages riding on these flat terrains would provide an exciting new direction to the current market of skiing. Another problem that has arisen throughout user research is the worry that comes from parents of young riders due to the inherent danger that comes with taking part in these winter activities. Improving safety toward riders would create a new market towards new and young riders looking to learn these activities.

The preliminary needs statements that were developed for this thesis are:

- Users need to be able to travel long distances fast while being safe.
- User needs to have the ability to control speed and direction while riding.
- The user needs to have a safe method for traversing the hill while using minimal energy.
- User needs to have a portable device that can be easily travelled with.

### *1.2 Rationale & Significance*

Currently, there are only two popular methods (skiing and snowboarding), with a third method (snow blading) which recently gained popularity. These methods lack difference leaving much room for improvement due to the nature of the sport and the amount people that enjoy the winter months. There is a need for the development of new activities, and because when going to a ski hill, there are two main types of riders, it shows that the market lacks depth. New concepts have come out recently, proving a need for an alternative method of traversing a mountain that can provide a more fun experience. The number of opportunities we have with new developments in technology and finding an overlap of what needs to be solved and what technology can be adapted for these activities.

Some of the questions that this thesis topic will look to answer and tools used throughout research and design include,

| Questions addressed: | Research tools utilized: |
|---|---|
| **How may we make cross country skiing more fun?** | Survey & 1-1 interview |
| How could you make downhill skiing more enjoyable? | **Literature reviews** |
| **How may we enhance safety and enjoyment for Alpine sports enthusiasts?** | User research |
| How may we improve riders' enjoyment for beginner to intermediate riders? | **User observation** |
| | Video research |

***Table 1 - Research methods.***

Answering these questions will help to enable a different viewpoint into the topic as well as develop questions aimed towards a specific demographic / age range.

### *1.3 Background / History / Social Context*

Winter sports are a large part of the culture in Canada and around the world, considering the large population of people who enjoy going out during the winter and taking advantage of these activities. People that choose to take part in these winter activities do so often and tend to invest quite a lot of money into taking part in these activities. These sports can be pretty expensive, which tends to hinder new people from trying them. The rider will have to rent equipment or buy their own; this can range in price quite drastically but average around 600 dollars to get started. As a result of this high cost, many interested people will not even attempt

it; this high cost of entry is an essential factor when gaining interest from new riders. Developing a way to lower this cost while providing an exciting experience is important.

CHAPTER 2

# RESEARCH

Figure 2 - Cross-country and Backcountry Skiing - Retrieved from https://www.lakeplacid.com/do/outdoors/winterspring/x-countrytelemark

### *2.1 User Research*

This thesis aims to help inspire appeal to young winter sports enthusiasts; Canada has a large demographic of people who enjoy and take part in either skiing (including cross country) or snowboarding. Developing a new form of these sports would allow for a wave of new and exciting riders. Bringing new riders to this sport would help improve the riding experience and benefit the community. A large population of these snowsport riders was between 12-17, making up about 15% of riders while the highest being 45-54 with 21% (Canadian Ski Council, 2015); understanding the typical rider gives insight into some of the areas of concern that they might have. These concerns include Ease of control, safety towards the rider, speed control, safety towards others, portability, and accessibility. These needs show insight into what the demographic is looking for when considering riding. When comparing this data to cross-country skiing, the numbers are much different, with the lowest number of riders being 18-24 and 12-17. Bringing excitement to this market would help bring the steadily decreasing number of yearly riders back upwards.

### *2.1.1 User Profile – Persona*

**Persona: Beginner rider**
**Gender:** Male
**Age:** 14
**Employment Status:** Unemployed, lives at home with family that loves going to their winter home at "Blue Mountain", wants to find a new sport that is easy to start and fun.
**Hobbies:** Scootering at skatepark, hanging out with friends, doing tricks.
**Description:** Loves to go to the ski hill and watch his brother and his friends go on the terrain park but is nervous to try himself, looking to learn a winter sport.

- **Primary user is young riders.**
- **Young Riders looking to get in the terrain park.**
- **People wanting to learn a new sport.**

***Table 2 - User persona.***

A beginner rider persona is used, a fictitious person who helps show the demographic this thesis aims to motivate. Developing this persona helps to distinguish their specific wants and needs and utilize some of the primary motivators that would promote them to participate in snowsports.

#### *2.1.1.1 Primary User*

Primary users are young beginner riders looking for a safe and fun method of cross-country skiing. Young skateboard/scooter riders, Young skiers and snowboarders, young cross country skiers.

#### *2.1.1.2 Secondary User*

Secondary users are intermediate riders who would want to have more fun while cross-country skiing that could potentially be used for downhill riding. Cross country skiers, Intermediate riders, Scooter riders.

#### *2.1.1.3 Tertiary User*

Tertiary users are older experienced ski/snowboarders looking for safer alternatives without redistricting on enjoyment. Terrain park riders, Adult riders.

### *2.1.2 Current User Practice*

Current winter sports enthusiasts do either skiing or snowboarding, with some exceptions; the options for riding have been minimal. There is only one option of skiing when it comes to cross-country skiing because the rider needs to gain momentum while riding if there is a flat spot or you lose speed. This idea of self-propulsion is fundamental and is why you do not see any snowboarders on trails unless they are downhill. Understanding that this sport of cross-country skiing does not have any diversity in options for the riders poses an excellent opportunity for innovation. Through user practices, finding that summer sports, including skateboarding, biking, rollerblading, and scootering, all have the same aspect of getting speed from the body's movement. Seeing where to take from those activities and implement them into a winterized form would help provide a new and fun experience.

### *2.1.3 User Observation – Activity Mapping*

Walking through the activity of cross-country skiing helps learn what essential parts of this process include. The majority is before getting to the location, whether or not the rider has their gear, and how they are storing the equipment if they have their own. For the sake of this example, we will assume the user does not own their gear.

Getting to cross country ski hill:

- First, the rider will enter the lodge to get the rental gear and get dressed to ride and store their stuff either in the lockers or car.
- Once the rider has gear they bring it with them and go to the trail.
- Rider straps into their ski and grabs their ski poles.
- Riders use the ski poles as well as pushing off with their legs to gain speed (this is a difficult way of gaining speed and can cause stress on the legs).
- While the rider is on the trail they are looking around enjoying the environment and conversation with other riders.
- When the ride is finished they return to the lodge to return their gear and get changed.
- Then the rider goes back to their car to finish the journey.

Going into the “User experience mapping" helps to tell the story of a rider that goes on a ski hill and the different riding options that they may encounter.

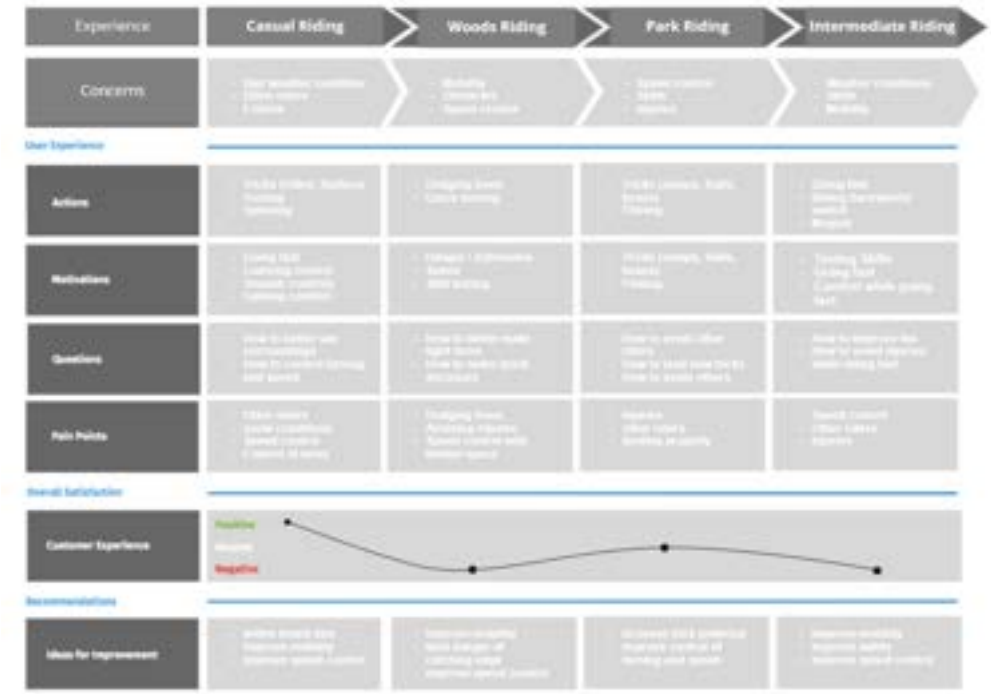



***Table 3 - User experience mapping.***

The four main riding experiences that are covered are Casual Riding (downhill smaller hills), Woods Riding (the Glades), Park Riding (terrain park), and Intermediate Riding (downhill larger hills). Using these main riding experiences and comparing the sports of snowboarding and skiing by looking at what provides the rider with the best experience. This user experience map uses a mix of experience and user observation to conclude what riders find more enjoyable compared to where they usually ride.

### *2.1.4 User Observation – Human Factors of Existing Products*

Looking into how current scooter products are designed tells a lot about what group they are designed for; many scooters have adjustable dimensions to accommodate different users. However, the overall form is designed to suit a younger demographic. The adjustability is also made to accommodate an older demographic; raising the handlebars for both a young and older rider would be more comfortable while controlling movement. The Razor scooter specifies the minimum rider age as +5 and a maximum weight of 143 lbs; this gives insight into what is needed to increase the riding age and where improvements will need to be made to accommodate this difference.

The ergonomics considerations associated with scooters also include angling the handlebar slightly inwards to limit the need for the rider to reach far while making turns and riding; this is done with consideration to the handlebar, not hitting the rider. People usually would ride a scooter for travel purposes, but there are many instances where the rider would take the scooter to a skatepark to do tricks. The ability to do tricks while riding is a big plus to the enjoyment of the riding experience.

### *2.1.5 User Observation – Safety and Health of Existing Products*

Improving the safety aspect of riding a scooter means that the design of the scooter needs to incorporate a braking system that would allow the rider to control the speed at which they are travelling without having to adjust the direction of travel. Elements that improve safety on current electric scooter products include:

- Lights
- Turn indicators
- Throttle
- Tire traction
- Brakes

Otherwise, they provide a list of ways the rider can stay safe like suggesting the rider wears a helmet and proper protective gear (Alexander, 2021). From this safety measure insight is that having control while riding with such things like speed and traction; another importance is the rider themself and other riders seeing what you are planning.

### *2.2 Product Research*

This thesis focuses on improving the enjoyment of cross-country skiing for young riders. To do so it would need to be a completely different thing that is currently on the market. The aim is not to make another ski or snowboard, but to bring in a new demographic to the culture of winter sports which could adapt to the different styles of riding; starting with cross-country skiing. Four products that are currently on the market that is cross-country skiing related are:

| Image | Product Name | Product Reference |
|---|---|---|
|  | Cross Country Ski<br><br>X-Tour Venture AR Ski + Tour Step-In Binding, Size 176 \| Rossignol | Figure 3 - X-tour venture ski- Retrieved from<br><br>https://www.google.com/shopping/product/5970542282788264103?q=cross+country+skis&prds=epd:15912665236625765370,eto:15912665236625765370_0,prmr:1&sa=X&ved=0ahUKEwisp8_7h9r0AhVPkokEHUC0CRoQ9pwGCAY |
|  | Snow Shoes<br><br>Men's Winter Walker Snowshoe Blue \| L.L.Bean | Figure 4 - Men's Winter Walker Snowshoe - Retrieved from<br><br>https://www.google.com/shopping/product/16433005597570297283?q=snow+shoes&prds=epd:4920258641096945234,eto:4920258641096945234_0,prmr:1&sa=X&ved=0ahUKEwiFo_jWiNr0AhXGk4kEHV_ODPUQ9pwGCAU |

| | | |
|---|---|---|
|  | Snowfeet<br><br>Snowfeet \| Mini Ski Skates | Figure 5 - Snowfeet \| Mini Ski Skates - Retrieved from<br><br>https://www.snowfeetstore.com/products/snowfeet1?variant=39497042952307&utm_source=google&utm_medium=cpc&utm_campaign=Google+Shopping&currency=USD&gclid=CjwKCAiAksyNBhAPEiwAlDBeLFB1T-FdU7v6zUbcb54A1fbo_tNRvJM6bBjFz4qKCgXP8rV0vDuhbRoCe8UQAvD_BwE |
|  | Snow racer<br><br>PHAT Snow Racer, Snow Bike Sled, Snow Sled for Kids, Durable Metal Snow Slider - Three Grooved Rugged Skis, Maximum Weight 165 lbs | Figure 6 - Snowfeet \| PHAT Snow Racer - Retrieved from<br><br>https://www.bestbuy.ca/en-ca/product/phat-snow-racer-snow-bike-sled-snow-sled-for-kids-durable-metal-snow-slider-three-grooved-rugged-skis-maximum-weight-165-lbs/14204917?cmp=seo-14204917&cmp=knc-s-71700000081845877&gclid=CjwKCAiAksyNBhAPEiwAlDBeLIsqwti7iV5fryVEJ9X0YtfzyhdCj1_JwuJAjpThX7ZEESFd3NBdHRoCIaIQAvD_BwE&gclsrc=aw.ds |

***Table 4 - Current benchmarking product.***

### *2.2.1 Benefits and Features of Existing Products*

The features of these products are compared to what aspects could potentially relate to the chosen direction and how to implement these ideas into a new form of cross-country skiing. The main comparison with all of these products is that you are facing forwards while riding and using your body to generate speed, except for the “PHAT Snow Racer,” which uses gravity. The main benefits change depending on the product. Cross-country skis are usually made with a

long ski blade to help the rider carry the momentum generated for a longer time. In contrast, Snow Feet, designed for downhill skiing but can be used for cross country skiing, is made with the shortest blades possible to give the user much more control while making turns.

Some more benefits from these products are lightweight, easy to store, adjustability, brakes, and easy to control; there are not many different options for cross-country skiing, so development for this topic is essential.

### *2.2.2 Benchmarking – Functionality of Existing Products*

After analyzing the current product benchmarking and their functionality, there are two main ways to go cross-country skiing, skis, and walking with snowshoes. These methods, while being practical, are not easy tasks and take up much energy to not travel very fast; with skiing, the rider has to push themself with their poles while pushing off with their feet. With “Snow Feet” the rider is ultimately pushing with their feet and constantly skating to maintain the speed. Snowshoes are very different where their only function is to flatten down the snow to make stepping forwards easier.

Bringing a new method that could use the body’s motion to generate speed with a steering wheel/handlebar to control direction would create a more functional experience while not being as strenuous as an activity.

| | | | | |
|---|---|---|---|---|
|  |  |  |  |  |
| 1 | 2 | 3 | 4 | 5 |
| Burton Family Tree Hometown Hero X Camber Splitboard | YES OPTIMISTIC Snowboard | Snowfeet \| Mini Ski Skates | Völkl Katana V-Werks Skis 2022 | Stöckli Stormrider 102 Skis 2022 |
| - Lightweight<br>- Versatile<br>- durability<br>- reliability<br>- strength<br>- twin flex | -Faster<br>- light<br>- responsive<br>- strong edge hold<br>- explosive release<br>- enhanced turning<br>- 9/10 flex | -Light<br>- small<br>- easy stopping<br>- One size fits all<br>-easy to control | - Good performance<br>- sturdy<br>-Edge control<br>- lightweight<br>- strong<br>- stability<br>- reliable<br>- easy to use<br>- maximum speed<br>-wider | -Widest<br>- versatile<br>-excellent edge hold<br>- stability<br>- speed<br>- durability<br>- easy ride<br>- |

***Table 5 - Benchmarking of current products.***

On the practical side, “Snow Feet” is very accessible with a one-size-fits-all design and a very portable size. Which makes them the most flexible out of the products analyzed; there is room for improvement in maximizing speed generation.

### *2.2.3 Benchmarking – Aesthetics and Semantic Profile of Existing Products*

The benchmarking research of current products related to cross-country skiing and scootering assist in providing a baseline for what the design and style are of products that are popular on the market. When comparing the scooter, they usually have an ergonomically designed handlebar with a narrow frame and comfortable food pads. The skis have much more detail in design due to their very compact nature, but overall, they are flat boards strapped onto

the rider. The scooter's look (decal) changes depending on the branding, but the overall form does not change very much between products.

Figure 7 - PXID Scooter

Much of the design detailing is focused on the intersection between the handle and the frame and the connection between the wheels and the frame. The housing of the scooter is sometimes rounded and organic of a form but can also be sleek and chiselled; this is all dependent on the company selling them and the user demographic. Children’s scooters tend to have much more colour where adults scooted and are limited in bold colours (generally using black) and have a modern look to them

### *2.2.4 Benchmarking – Materials and Manufacturing of Existing Products*

Figure 8 - Swing Scooter

Manufacturing and material benchmarking are going to be looking at scooters to understand how they are manufactured and what materials they use.

| Material | Benefits | Reference |
|---|---|---|
| Stainless steel frame | Provides a lightweight portable frame that generates speed quickly. cheap material to manufacture and is widely available. | https://www.alibaba.com/product-detail/3-wheels-foldable-adult-speeder-kick_1130289908.html |

| | | |
|---|---|---|
| 200mm, Polyurethane(PU) Wheels | Cheap manufacturing cost, and very accessible material. | https://www.alibaba.com/product-detail/3-wheels-foldable-adult-speeder-kick_1130289908.html |
| Rubber handlebar grips | Cheap manufacturing cost, malleable surface for ergonomic consideration. | https://www.aosom.ca/item/homcom-tri-scooter-children-3-wheels-foldable-speeder-slider-winged-push-motion-black~B4-0053.html?utm_source=google&utm_medium=cpc&utm_campaign=google_shopping&gclid=CjwKCAiAksyNBhAPEiwAlDBeLIaGalL7DcXNwCv1cK8Phm7sdRxsEaEc7rurT-RkyoOvk2bHGZExGxoCcYoQAvD_BwE |

***Table 6 - Materials and manufacturing.***

Overall the cost to manufacture this scooter is low being sold for $99.99 Canadian, this scooter makes for a great alternative for any young rider who is looking for a scooter that has excellent mobility and a fun riding experience.

### *2.2.5 Benchmarking – Sustainability of Existing Products*

Looking into both current and new materials commonly used during the production of skis and skiing equipment. Significant changes in this sport have not been made for a long time regarding the overall activity. However, many improvements have been made towards the materials used, which can help improve speed, traction, and mobility. One significant advancement was manufacturing the skis with multiple layers having a hardwood core sandwiched between lightweight aluminum and coated in plastic. This new method of manufacturing skis developed by Howard Head helped improve the popularity of skiing significantly and revolutionized the sport. "Head Standard Ski enabled skiers to maintain more

control as they went down the slopes, the common practice of carving was now possible, and the ski lasted years longer than its predecessors." (Laudone et al., 2015); after this development in skiing, new materials were incorporated to improve the riding experience further. Some skis replace the wood core by using carbon fiber, kevlar, fiberglass, titanium, and even foam to try and improve the sport. However, the advantages these materials provide help with different aspects of skiing. Focus on cross-country skiing means ensuring that the rider has a lightweight and sturdy ski usable in specific conditions.

### *2.3 Summary of Chapter 2*

It utilizes a variety of products to compare and contrast what is popular within these demographics and what considerations are implemented when it comes to safety and semantics. A critical insight from the benchmarking research was the ergonomic considerations made when designing a scooter, especially for a younger riding demographic, specific things such as the height of handlebars, the width of handlebars, and the width of handlebar placement to make an enjoyable experience for riders between 12 and 15. An essential factor discovered from the research is what is most popular for winter riding; products for alpine sports include snowboarding and skiing. Recent innovations towards these sports, such as “snow feet” which are skis with a tiny blade that can be attached to any shoes, make for a great and cheap alternative to skiing. There have been little to no innovations made for the sport of cross-country skiing. The appeal towards cross-country skiing is on the decline, and implementing a new product into this sport would help to bring more excitement.

CHAPTER 3

# ANALYSIS

Figure 9 - Cross-Country Skiing in Ontario - Retrieved from https://www.sandylaneresort.com/wp-content/uploads/2019/11/Cross-Country-Skiing-in-Ontario.jpg

### *3.1 Analysis – Needs*

Analyzing the needs for users both directed towards downhill skiing and cross-country skiing and the summer sport of scootering allows for a comparison between the seemingly different activities. Scootering is so popular among younger extreme sports enthusiasts because of how easy it is to get started. The activity of scootering makes for the perfect introduction to extreme sports and is very portable and accessible to riders of all demographics.

Cross-country skiing provides very few options for alternative riding methods and has one primary method of riding; with only one method, the demographic for this activity is very small. With no riding alternatives, if someone is not pleased with this activity and does not find enjoyment from it, then they are much less likely to do it again. The needs for cross-country skiing and scootering are very similar but have distinct differences. For example, there is the opportunity to do tricks while riding with scootering, whereas in cross-country skiing, there is no opportunity for this. Providing this as an option for riders may help to improve the element of fun and entice riders to come back to the sport.

Downhill skiing has a very different set of needs related to the control that the rider needs to maintain while riding. Primarily because the rider travels much faster while riding downhill and has less time to react to things that come up, this experience is related to cross-country and scootering because control is just as important. Making sure the rider is comfortably in control during the activity would help mitigate potential dangers such as injuries.

### *3.1.1 Needs/Benefits Not Met by Current Products*

One of the needs that are not currently being met by current products directed towards scootering is the opportunity to ride on different terrain. The main downfall of scootering is that the riding experience is limited to riding on smooth pavement and limits the rider from riding in wet, snowy, uneven, or grassy conditions. This limitation makes scootering only accessible for casual summer riding or a skate park. Cross-country skiing has a main limitation of only having one type of riding experience, which limits the target demographic to people who enjoy skiing. Cross-country has an issue of not being accessible for people who do not enjoy skiing and making the activity only accessible to people who either own their equipment or can rent the equipment from the facility. Towards downhill riding, there are two main types of riding: skiing and snowboarding, which are expensive when starting and do not have many opportunities for other riding methods. The primary need that is consistent with these three different riding types is that the rider needs to have control while riding, and the rider needs to have access to quickly get started in the sport without having to invest too much money when starting.

### *3.1.2 Latent Needs*

When looking at the needs of the rider for cross-country skiing they are broken down into 3 different categories being: immediate needs, Latent needs and wants and wishes, immediate needs being most important, latent being after the fact and wants and wishes is not necessary but would improve riders satisfaction during the experience.


Figure 10 - Needs analysis

The main needs that the rider wants to be met with a new product are safety, individuality (customizations), ease of control, and speed control. Having these needs met would make the rider happy with trying a new sport.

### *3.1.3 Categorization of Needs*

When categorizing the needs of the rider one has to break down the activity into different categories that are important to the rider. The categories chosen to be analyzed are Speed and mobility control, Safety, Portability and learning curve.


Figure 11 - Categorization of needs

Some of the most important needs discovered were that the rider needs to be able to see surroundings, the rider needs to easily be able to gain speed as well as slow down on command, the rider needs to have a portable device that can be transported when needed, and that the rider needs that ability to learn quickly. These considerations provide insight into what the rider is looking for in a new activity and when these needs can be met.

### *3.2 Analysis – Usability*

Through analisis of the usability of current product The main experiences that should be examined are downhill skiing, cross country skiing, snowboarding, snow blading, sledding ad skating. These are the main activities that are done in the winter time and equate to what the majority of enter sport enthusiasts enjoy, these activities leave an opportunity for innovation via leaving the market of scootering un met. Thorough examination of the journey of the user and an analysis of the experience will allow for further exploration into posible innovation.

### *3.2.1 Journey Mapping*

Journey mapping towards scooter riding and what they see, do and feel during the activity, important factors to understand before the journey mapping is that the persona targeted for the journey is a 14-year-old boy who loves scootering during the summer and wants to get into a winter sport and frequently goes cross-country skiing with his family.

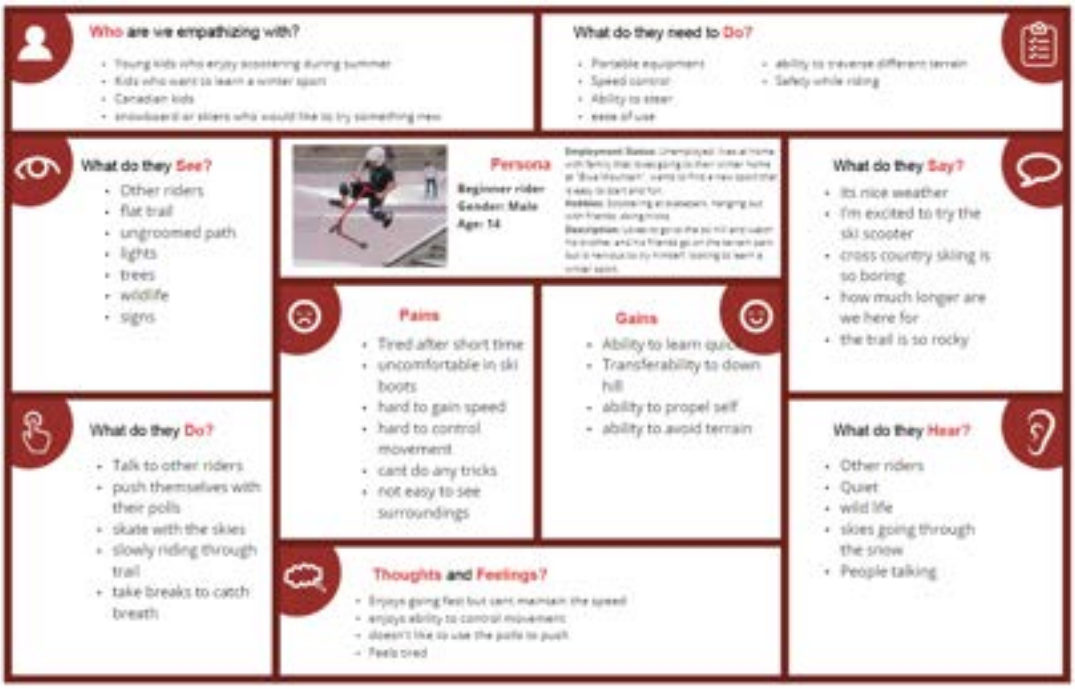



***Table 7 - Journey mapping.***

Some important takeaways from the journey mapping are that the pains from cross-country skiing are that it's tiring after long rides, hard to maintain speed while riding on flat terrain and that they cannot do any tricks while riding. Some gains are that he was able to learn the activity very quickly and that he can transfer the skills to downhill riding easily making for enjoyment in the future. Looking at some of these pains is where important innovations can be

made and bringing a new activity to the sport of cross-country skiing has the opportunity to make this more enjoyable for younger riders.

### 3.2.2 User Experience

When analyzing the experience users have during winter sports considerations were made towards the different activities that are commonly chosen for these activities. Comparing skiing and snowboarding come with positives in some aspects while having negatives towards others. Skiers found that riding downhill is more enjoyable on a snowboard while riding in the terrain park, both sports are very fun and accessible to different people.


| User Goals | Ability to travel fast | Ability to control speed and direction | Opportunity to do tricks | Ease of use | Control on all terrains |
|---|---|---|---|---|---|
| **Problems/Challenges** | • Flat terrain<br>• Long distances<br>• easy to gain speed | • Easy directional controls<br>• Easy of speed generation<br>• ease of slowing down | • Ability to do jumps<br>• Ability to control spins<br>• Safety while doing tricks<br>• Fastening scooter to rider | • Quick learning experience<br>• Simple instructions<br>• Relate instructions to common experience | • Speed control on all terrains<br>• Edge control on ice<br>• Limiting friction of snowy terrain |
| **Ideas/Takeaways** | • widen board size<br>• improve mobility<br>• improve speed control | • improve mobility<br>• limit danger of catching edge<br>• improve speed control | • Increase trick potential<br>• improve control of turning and speed | • Improve mobility<br>• Improve safety<br>• Improve speed control | • Ability to avoid obstacles<br>• Speed control on all terrains<br>• Directional control on all terrains |

***Table 8 - User experience mapping.***

Some insights from the user experience mapping are that improving the ability to see the rider's surroundings would improve all aspects of the riding experience and being able to quickly adjust

directions and speed is an important part of the riding experience. Having a method for indicating what the rider is down to other riders would greatly improve the ride quality towards all activities and implementing safety precautions for the rider themself would help to improve enjoyment due to limiting the worry towards other riders.

## *3.3 Analysis – Human Factors*

### Introduction

Understanding the designed solution's human factors helps determine the main connection points between the user and how the user interacts with them. The main connection points with the user are the hands, hips, feet, and eyes. This solution interacts with the hands via the handlebar, which the rider uses to control the direction that they are travelling, allowing them to make adjustments as needed while riding. The rider utilizes the feet by being the part of the scooter they stand on to connect the rider to the product. The hips generate momentum and adjust the direction travelled; having the hips as the primary method for generating speed takes the pressure off the ankles and creates a less strenuous movement for the rider. These interaction points with the rider are essential because the target use case for the designed solution is a cross-country ski trail that is usually flat and not perfectly groomed. Generating speed on flat terrain will be the driving factor of why people will choose this product over others.

### Literature Review

Using Henry Dreyfuss's measure of man and women as the reference allows for considerations towards the scooter's design to allow for the intended demographic of young

riders to be comfortable while on the concept. The scooter will include an adjustable handlebar and footpad placement for a customizable riding experience perfect for anybody. The solution is designed for young riders aged between 12-15; the measurements are for kids 12 years old, both male and female. This product would be ridden by anybody, similar to riding a scooter in summer.

**Methodology**

The testing of the solution uses a current scooter product with three wheels and uses the rider's movement to generate speed without pushing with their feet. This allows the rider not to have to dismount from the scooter to gain momentum and allows the rider to control both the direction they are travelling and their understanding of their surroundings. Using this research to understand that providing the rider with this improved awareness and control makes the riding experience safer.

**Objectives**

The main goal of this solution is to develop a safer and more enjoyable riding experience for cross-country skiers in the targeted user group and create the opportunity to change the current view of the sport of cross-country skiing. Adding adjustability towards the scooter enables the target user demographic to be expanded and makes for an accessible experience for all percentiles.

### *3.3.1 Product Schematic – Configuration Diagram*

For the configuration diagram, the products chosen for evaluation are a GT Racer and a Yvolution Y Fliker A3 Air Foldable Scooter, these products have many defined features and benefits that are similar even though the use cases for these products are completely different.

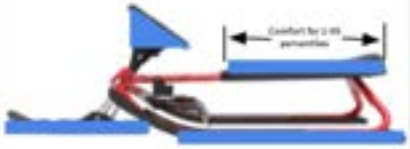
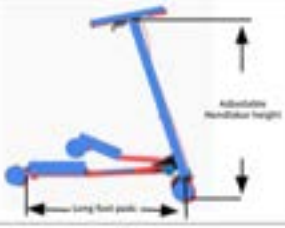
| **Configuration 1**<br>GT Racer | **Configuration 2**<br>Yvolution Y Fliker A3 Air Foldable Scooter | **Definition / Exploration** |
|---|---|---|
|  |  | **List of components:**<br>• Handle bar / steering wheel<br>• Foot pad<br>• Braking system<br>• Wheels / skis<br>• Frame<br>**Location these components affect:**<br>• Steering / directional controls<br>• Speed controls<br>• Portability<br>• Ergonomics |
|  |  | **Configuration diagram: Touchpoint evaluation**<br>• Handlebars<br>• Foot pad<br>• Seat<br>• Brakes<br>• wheels |
|  |  | **Ergonomic diagram:**<br>• Adjustable handlebar height<br>• Adjustable foot pads<br>• Adjustable Seat position<br>**Percentile evaluation**<br>• Designing product to comfortable for 12 year old youth<br>• Adjustable to allow for rider to grow with product |

***Table 9 - Product configuration diagram.***

The main interactions with the user include:

- Adjustable and collapsible frame
- Handlebar
- Free spinning blades (for gaining momentum)
- Braking system

- Ski pad
- Foot mount
- Securing line (to fasten to the rider)

These are essential parts of these products that provide either safety or other benefits to the user, the adjustability of these products opens the target demographic of riders to a larger set of people and enables all percentiles to have a comfortable riding experience. There are also safety precautions in each of the products such as the securing line to fasten the rider to the equipment to not lose control of the product.

### *3.3.2 Ergonomic – 1:1 Human Scale Study*

This thesis is designed for young riders aged 12-15. This product would be ridden by anybody, similar to riding a scooter in summer. The scooter includes an adjustable handlebar and footpad placement for a customizable riding experience. For the 1:1 mock-up, the frame of the Ski Scooter is a Sway Scooter to get a feel for the size and adjustability that comes standard. The Ski Scooter is a concept that aims to improve the enjoyment of cross-country skiing in all types of conditions.

The current design uses wheels but would replace them with skis for the front and skates for the back to show the intended scale. Maintaining control of the speed and direction of the scooter is done by using the handlebar and swivel motion of the rider. Additions to the concept include a screen for the rider to see what speed they are travelling at and elevation and distance travelled while riding.

### 3.4 Aesthetics & Semantic Profile

Scooters are a recognizable form in which the user instantly knows how they are meant to ride them, this instinctual form is made to help the rider with instructions without the need for any direction. ensuring the user knows how to use the product will help to make the learning curve of the product much simpler. The aesthetics have to help the user to understand all of the functionality of the product whether it be the foldability of the scooter for storing purposes or the adjustability of the handlebar. Even the method at which you ride the product has to be easily understood and easy to use. Since very early on in skiing culture the design has stayed consistent with minor innovations being made to both the form and semantics of the product. “ The earliest records of people gliding on snow date as far back as possibly 10,000 years ago in Altai, China, where cave drawings showed ancient hunters using something resembling skis.” (Michelson, 2018) which shows that the current activity of skiing has been used since as early as 8,000 BC. the next major advancement was made around 1926 “skier Rudolf Lettner developed the first ski with metal edges after a slide-for-life incident nearly killed him. It took him a decade to figure out how to attach the metal edges to wooden skis. “Metal edges held better on hard snow and ice, and they made skis stiffer and less likely to break, says Lowell Skoog” (Michelson, 2018), this metal edge design is still used in today’s ski design and plays a major part in enabling control for the rider. In 1965 the first version of snowboarding was developed by Sherman Poppen which he called “Snurfing”. With other innovations mainly regarding material changes and the creation of what is known as twin-tipped skis developments in the sport have not come for a long time. Bringing a new and improved product that implements a similar riding experience and aesthetic as scootering will bring more excitement to the industry. Another main development in skiing is to limit the strain on the legs of the rider “To improve the transmission of

the propulsive force of the legs, bindings have been developed to allow more effective control of the skis. Metal bindings were introduced during the first half of the 1900s and a thinner clasp developed in the 1970s. The upper surface of the binding and the boot sole have been shaped to prevent the heel from moving laterally, a necessary constraint for leg pushes when skating." (Pellegrini et al., 2018), skiing is a strenuous sport and further minimizes the strain on the rider's legs would make it much safer.

Some inspiration in semantics that has influenced the design of this product is from scooters and sleds like the GT Racer which are designed for different situations but both efficient within their desired use cases.

Figure 12 - Yves Behar design - retrieved from: https://www.dexigner.com/news/33886

Figure 13 - Unicorn Scooters - retrieved from: https://abduzeedo.com/node/85235

Figure 14 - The Infento Big Snow Kits - retrieved from: https://www.trendhunter.com/trends/sled-design


Figure 15 - Yvolution Y Fliker Lift Kids Scooter - retrieved from:

https://www.amazon.ca/Yvolution-Fliker-Lift-Scooter-Size/dp/B018SKT5N6

Figure 16 - RIDEDASH DISPLAY UNITS - retrieved from: https://www.giant-bicycles.com/global/ridedash

Designs that implement interesting adjustability are influential in showing the potential arrangement of parts and different opportunities for how parts of the product interact with each other. The purpose of exploring the aesthetics of current products helps to understand what has been successful in other products and what is appealing to its customers.

### 3.5 *Sustainability – Safety, Health and Environment*

The rider's health is considerably related to the safety that the ski scooter provides, making sure that the use of the ski scooter will not put the rider in any danger; the danger of this thesis project comes from losing balance when riding and falling off of the scooter. Ensuring that this is an unlikely situation, as well as preventing any other accidents from happening, will be the primary method for keeping the rider safe. This thesis project looks into improving cross-country skiing for younger riders means that the ski scooter needs to be adjustable to make for the perfect connection to any rider. The scooter has a securing line that clips onto the riders to help them not to lose the scooter while riding on a more steep hill. Losing the scooter while riding may create a danger to other riders, and maintaining this connection to the rider minimizes this as a potential situation.

### *3.6 Innovation Opportunity*

There is a big opportunity for innovation in the field of cross-country skiing and alpine skiing, this is mainly due to the fact that there have been very few updates in either of these sports. Bringing new forms of riding on snowy terrain makes for the perfect areas for a thesis project in which innovation and developing new technology are needed. Scootering is a great alternative to skateboarding and rollerblading for summer and opens up the question of how it

can be developed for winter riding. The materials used in skiing and snowboarding can easily be adapted to scooter riding and with the extensive amount of research that has already been conducted towards friction and material properties the scooter can utilize the best materials for the design.

### *3.6.1 Needs Analysis Diagram*

When analyzing the needs of this thesis is important and doing so using a diagram that covers a variety of different categories of potential needs,

| Product: Scooter | | |
|---|---|---|
| Needs | Benefits and underlying needs | Level of importance |
| Basic needs - Basic needs | | |
| Food, water, shelter | | |
| Pleasure, gratification | Satisfaction from going fast and doing tricks. | High |

***Table 10 - Needs analysis diagram - Basic Needs.***

| Product: Scooter | | | | |
|---|---|---|---|---|
| Needs | Benefits and underlying needs | Level of importance | | |
| Basic needs - Security | | | | |
| Safety | Safety for riders of all levels. | | Moderate | |
| State, Group, Individual | New riders | Slight | | |
| Securing resources | Pricing, durability, reliability | | Moderate | |
| Control over environment | Ability to see surroundings | | | High |
| Long Term Security/Stability of Group | Product lasting a long time for all use cases | | | High |

***Table 11 - Needs analysis diagram - Basic Needs - Security.***

| Product: Scooter | | | | |
|---|---|---|---|---|
| Needs | Benefits and underlying needs | Level of importance | | |
| Basic needs - Social belonging | | | | |
| Fear of Abandonment | Rider feels safe | | Moderate | |
| Fear of the enemy | Ability to easily see surroundings | | | High |
| Behavior cues for social interaction of group | Social status from having cool scooter | | Moderate | |
| Social Expectation | Ability to customize scooter with colours and stickers | | | High |

***Table 12 - Needs analysis diagram - Basic Needs - Social Belonging.***

| Product: Scooter | | | | |
|---|---|---|---|---|
| Needs | Benefits and underlying needs | Level of importance | | |
| Basic needs - Esteem | | | | |
| Social Status | Comparison to other sport in coolness | | Moderate | |
| Social recognition | People judging/applauding sport | Slight | | |

*Table 13 - Needs analysis diagram - Basic Needs - Esteem.*

| Product: Scooter | | | | |
|---|---|---|---|---|
| Needs | Benefits and underlying needs | Level of importance | | |
| Basic needs - Self-actualization | | | | |
| Intrinsic pleasure | Ability for anybody to step on and quickly be able to ride. | | | High |
| Creative endeavour | Allows for ability to do tricks, ability to travel fast. | | | High |
| Emotional | Ability to change parts of the scooted for individuality | | Moderate | |

*Table 14 - Needs analysis diagram - Basic Needs - Self-actualization.*

Breaking the needs of the user up into sections of their basic needs encourages a deeper level of understanding to be developed before trying to solve for anything in particular. Categorizing the sections by their level of importance ensures that proper attention is placed on specific concerns such as Intrinsic pleasure and control over the environment which both have a high level of importance. Attention is paid towards sections that have both moderate and slight levels of importance but are not considered as high of a priority. designing a product that can solve as many needs as possible is ideal and to do so an evaluation of all the needs must be made.

### *3.6.2 Desirability, Feasibility & Viability*

The materials that are popularly used in skiing and snowboarding for the board have gone through development over time “From originally being made of wood since the 1970s XC skis are constructed of polyethylene plastic, fiberglass, and carbon fiber. Olympic skiers have

30–50 pairs (< 25% of which are used in most races) (H-C Holmberg, personal communication, 30 March, 2018), each designed for specific snow temperatures and conditions (Breitschädel, 2012). Sintered thermoplastics have become the standard base material, allowing new processes and treatments that have lowered the friction coefficient substantially" (Pellegrini et al., 2018). These innovations have greatly improved the riding experience on all varieties of terrain. The material selection needs to consider current products used for alpine sports to make for an optimized riding experience.

The desirability of a new form of cross-country skiing is present and the lack of development in this activity shows that there is a need for a new product. Developing a new form of riding will help to strengthen the popularity of this sport and help to drive more people to repeatedly ride due to improved enjoyment.

### *3.7 Summary of Chapter 3 – Defining Design Brief*

The design brief helps to provide a focused direction towards what is being solved and directs the research towards the key points that are most important to detail. For this thesis topic, the design brief aims to create a solution that enhances the experience of cross-country skiing for young riders. This design brief covers ten different areas in which there is a need for innovation and development, this is also the case for some of these categories being developed from other products currently on the market. This brief aids in the development of concepts and how the concepts can be developed into new products, as well as influencing the user experience for the rider. Since a lot of the needs were developed from the experience of scooter riding, current skiing and snowboarding practices mean that some of the considerations need to be developed towards riding on snow.

| | |
|---|---|
| **Designer For The User** | Improves enjoyment for cross country skiing. |
| **Adjustability** | Folds for easy portability and customizable parts. |
| **Integration** | Improves the culture of winters sports by bringing a new demographic of riders to sport while being easy to learn. |
| **Accessibility** | Only the scooter is needed to be able to ride, no extra purchases. |
| **User Ergonomics** | Utilizes the user's hip movement to generate speed. |
| **Versatility** | The ability for riders of all ages to learn quickly. |
| **Sustainability** | Doesn't require and power and uses recycled aluminum. |
| **Maintenance** | Ski Blade is removable for sharpening needs. |
| **Affordability** | Removes need to buy specified equipment to ride (ie. boots and bindings). |
| **Integration Of New Technology** | Utilizes bodies motion to generate speed with intuitive controls. |

***Table 15 - Design Brief.***

# CHAPTER 4 DESIGN DEVELOPMENT

Figure 17 - Winter night - retrieved from: https://upload.wikimedia.org/wikipedia/commons/b/b0/Winter_forest_silver.jpg

## 4.1 Initial Idea Generation

### 4.1.1 Aesthetics Approach & Semantic Profile

Initial design process included looking into different products and understanding some relationships between parts and bringing them to this thesis project.

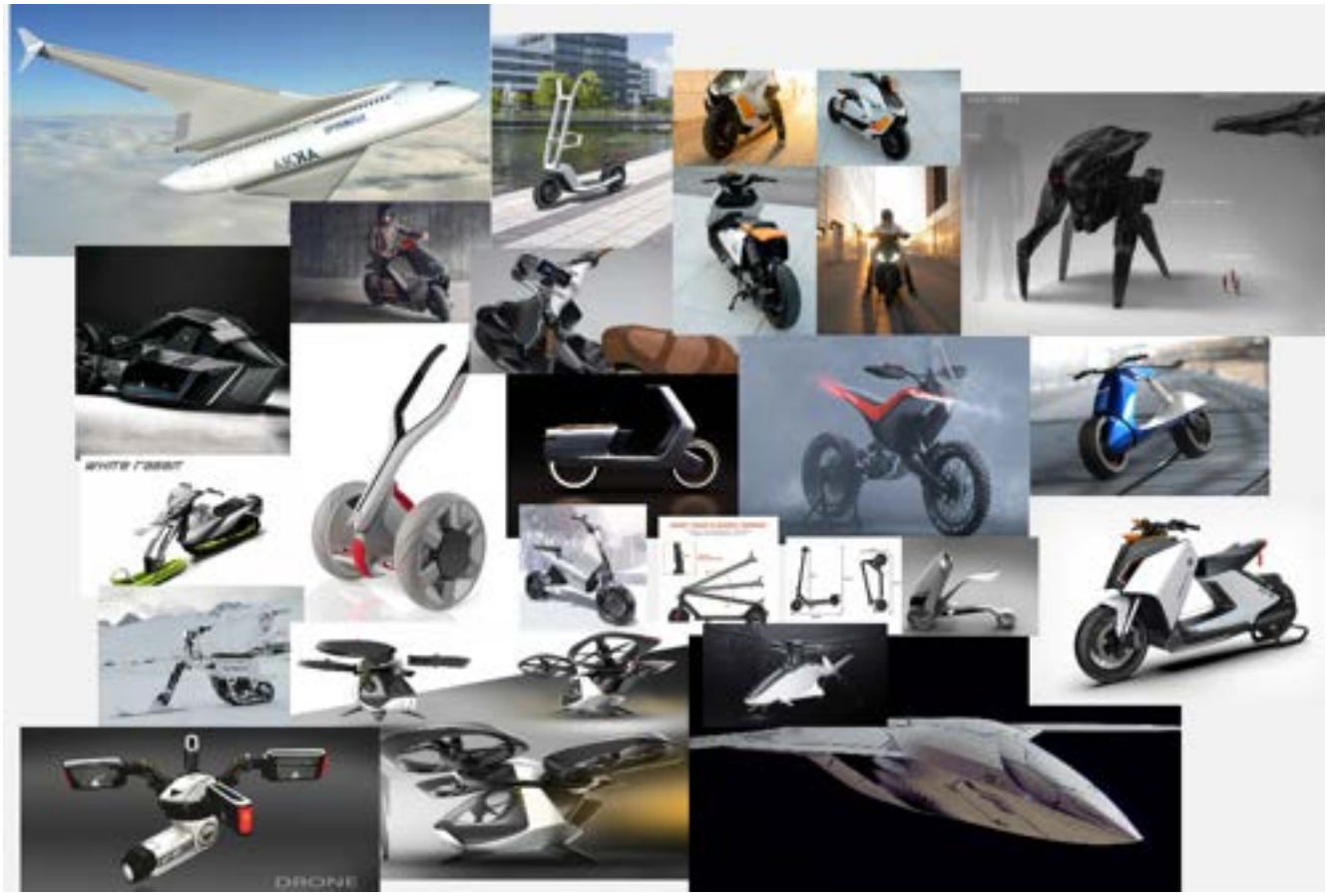



Figure 18 - Inspiration from miro - retrieved from: https://miro.com/app/board/o9J_IxcCorU=/

Looking into things that inspired creativity allows me to understand the market and what people enjoy and want to spend their money on.

### 4.1.2 Mind Mapping

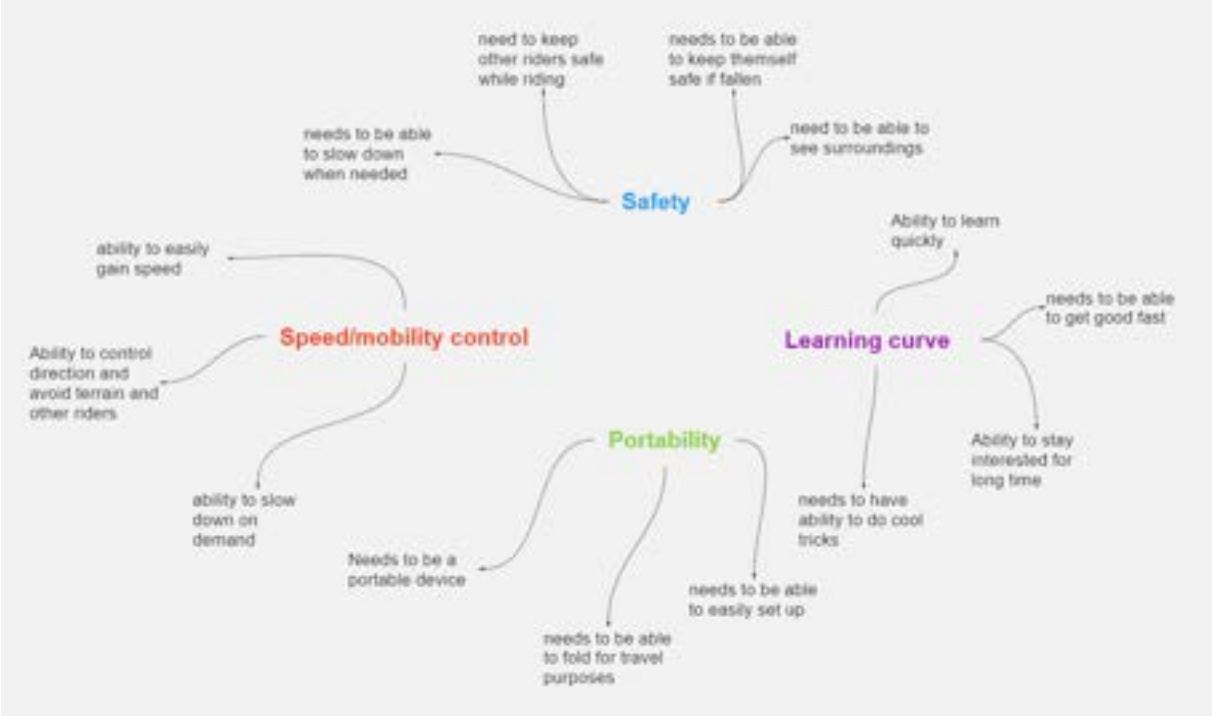



***Table 16 - Design Values.***

Using mindmapping to find a clear area to which need the most focus and or innovation. Once the need is discovered then the problem can start to be solved. This is a good starting point for finding innovation in different areas of life.

### 4.1.3 Ideation Sketches

Development of concepts is done to define an aesthetic of the design of the product which would improve the appeal towards cross country skiing as a sport.

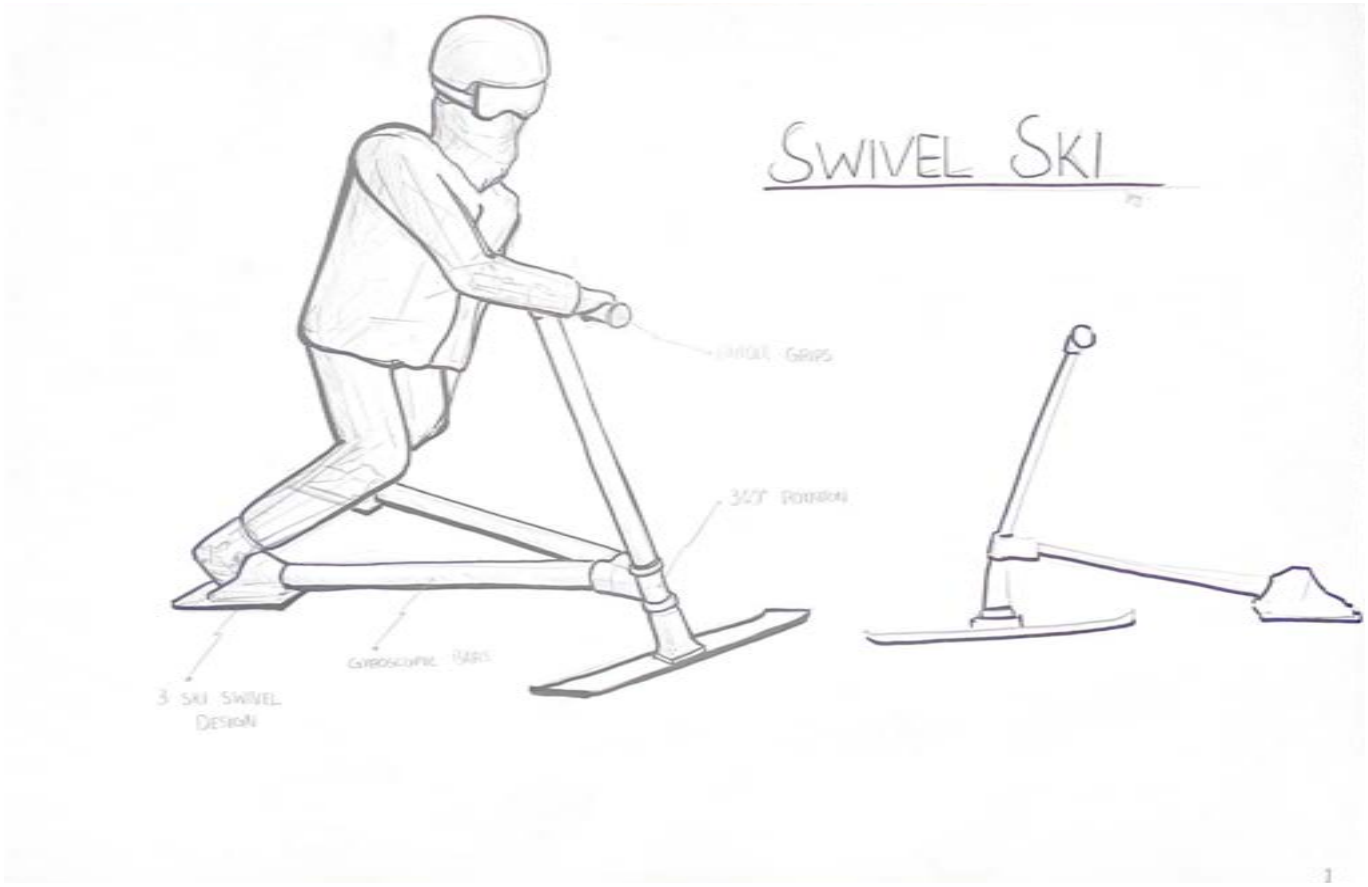



Figure 19 - Ideation sketch 1

Needs that this design aimed to solve were:

- Down hill / Terrain park
- Groomed hill
- Good for tricks
- Uses momentum to gain speed
- Easy to steer

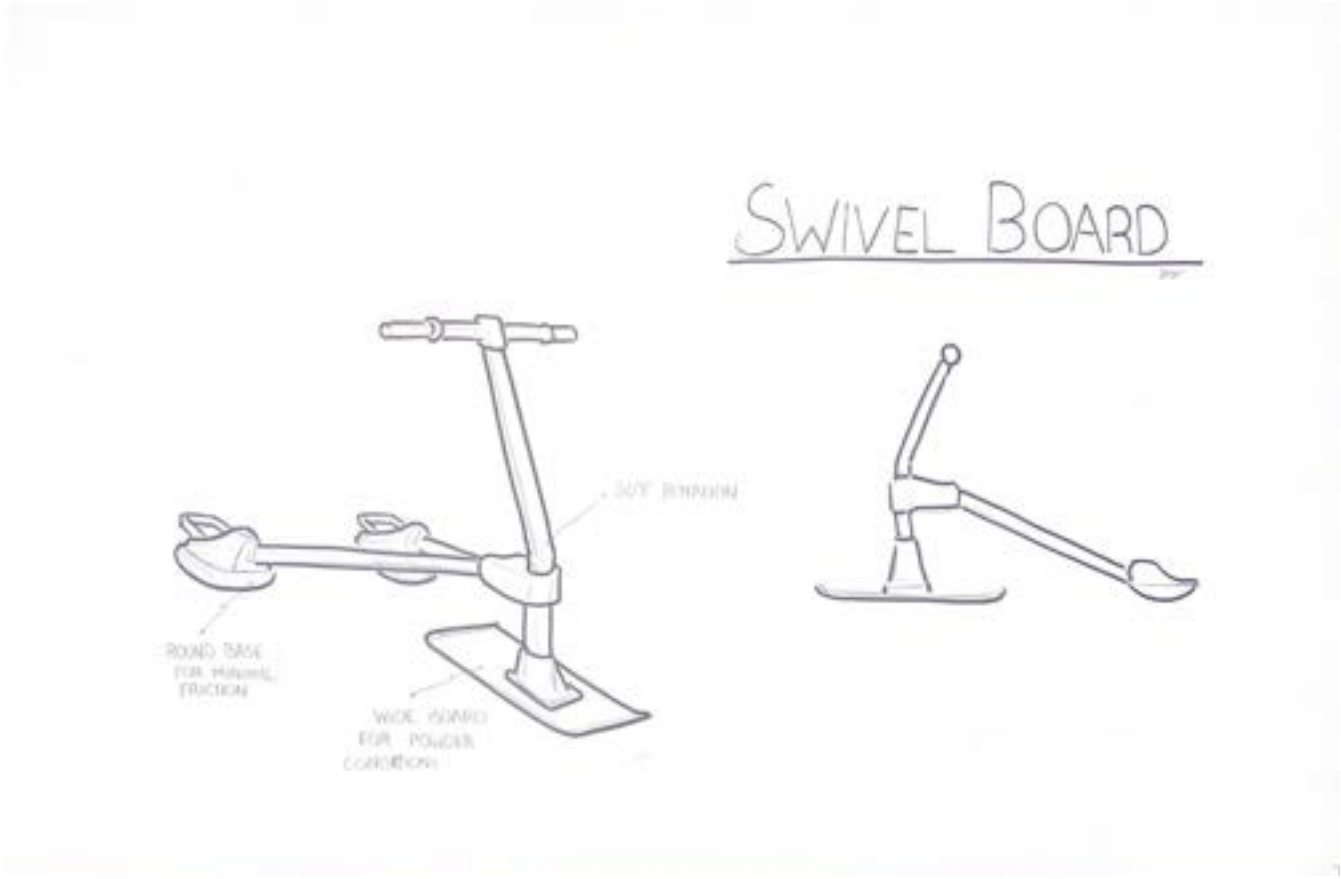



Figure 20 - Ideation sketch 2

Needs that this design aimed to solve were:

- Down hill / Terrain park
- Powder / ungroomed hill
- Good for tricks
- Uses momentum to gain speed
- Easy to steer

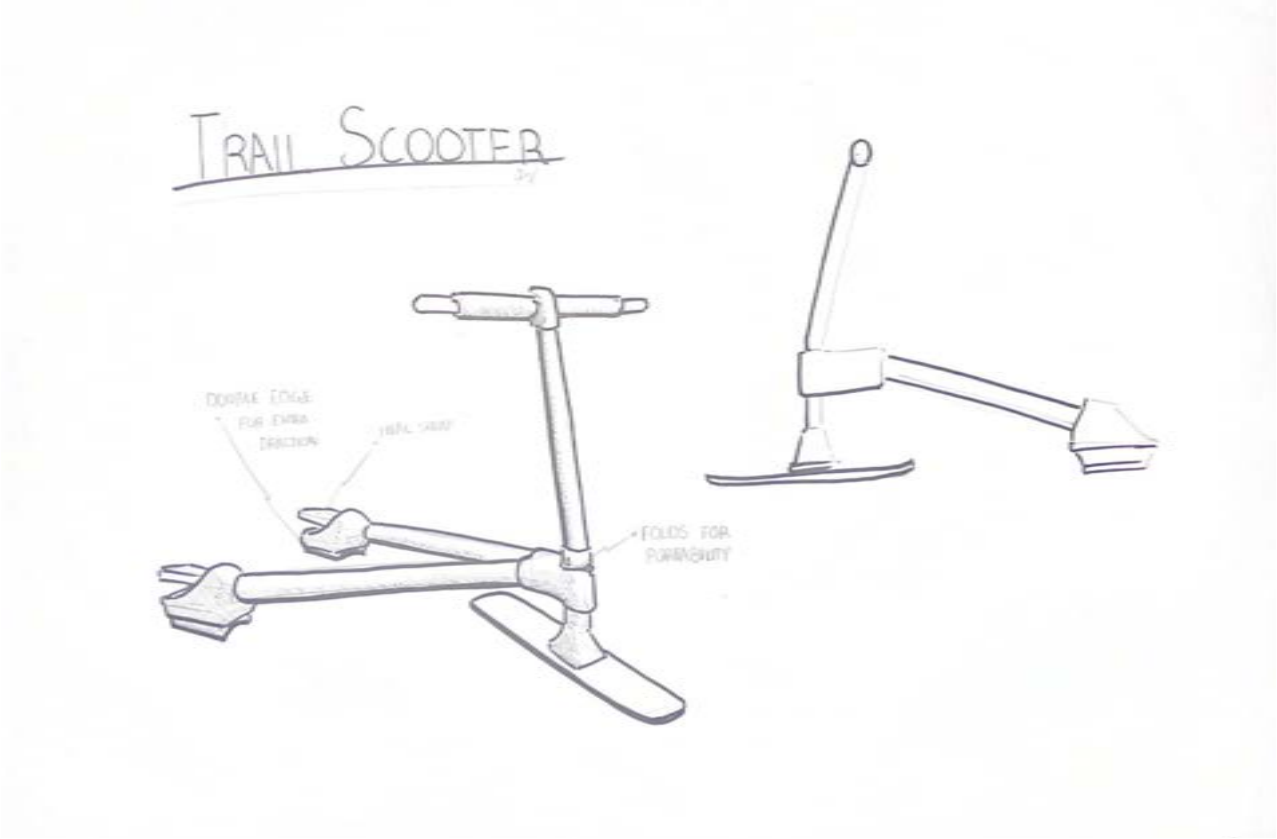



Figure 21 - Ideation sketch 3

Needs that this design aimed to solve were:

- Flat terrain / Cross country
- Groomed / ungroomed hill
- Good for flat trails
- Uses momentum to gain speed
- Easy to steer

The initial design phase was aimed towards developing the scooter market into the winter sports market and thinking of different avenues that this was a potential option. Either go

with the downhill option, long-distance option or a more terrain park trinks option. the direction that Felt the most useful was the long-distance or cross-country option.

### 4.2 Concepts Exploration

Knowing the direction that was most inspiring three directions were moved forward with finding distinct different use case that pushed the product further in function and enjoyment.

#### 4.2.1 Concept One

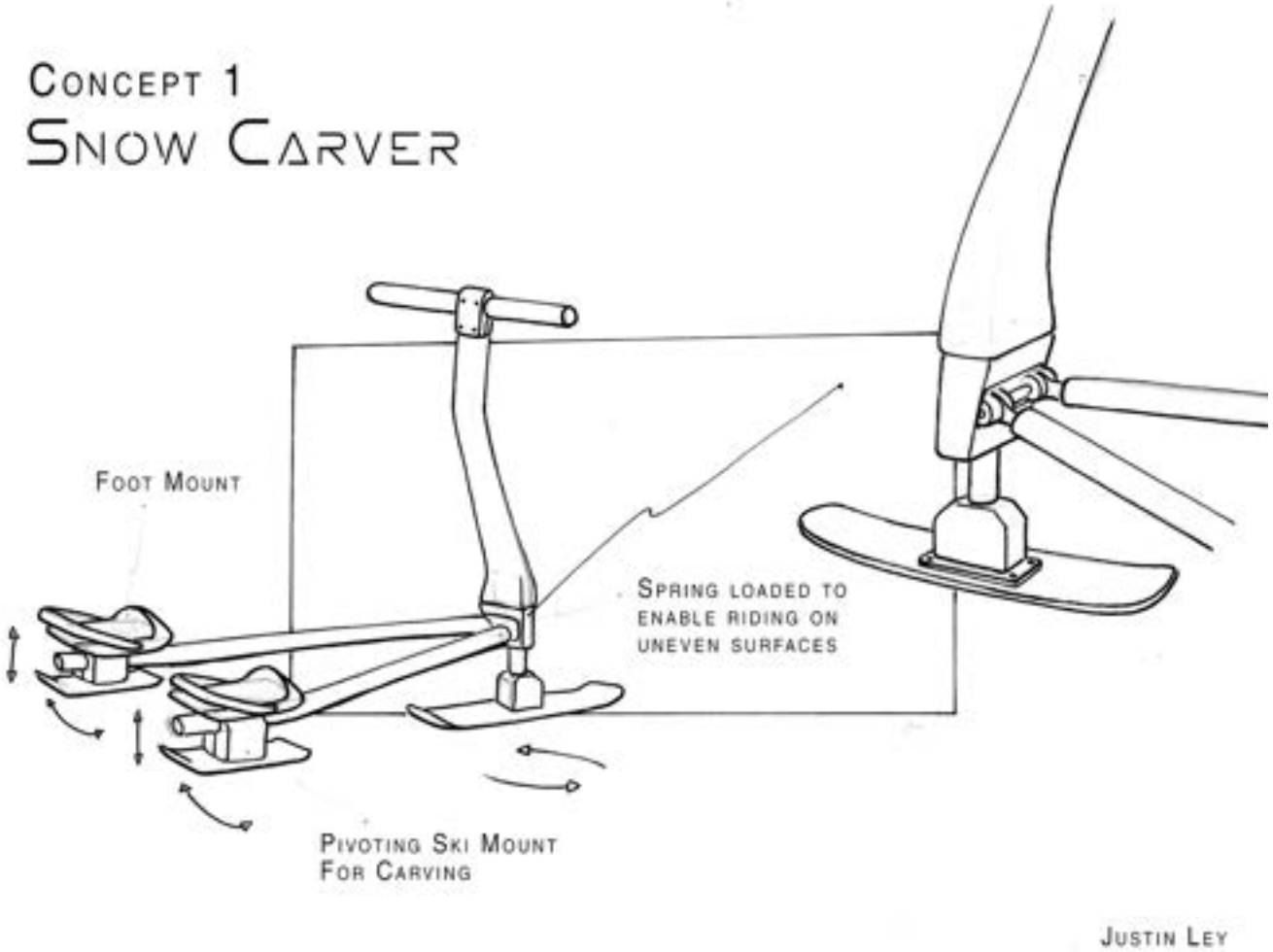



Figure 22 - Concept refinements 1

Concept one was designed with the idea of finding the perfect mechanism for ease of control while riding on all different terrains, this makes the enjoyable to ride on weather the terrain is groomed or not.

### 4.2.2 Concept Two

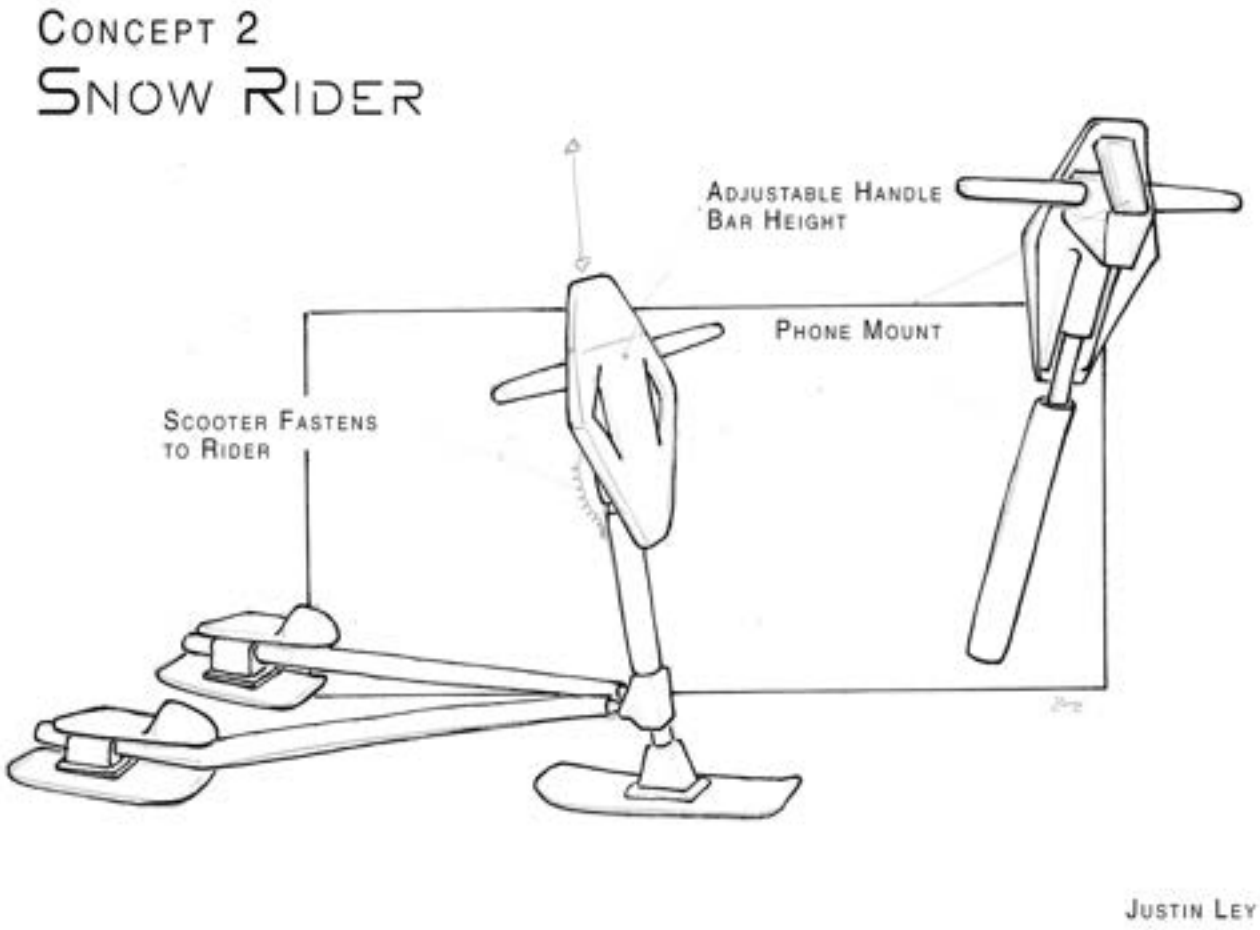



Figure 23 - Concept refinements 2

Concept two makes the attemp to involve the users phone mount in a sturdy and safe way to involve the adaptation of phone apps that could tell the user key information about where they are as well as provide the user with directions to different trails.

### 4.2.3 Concept Three

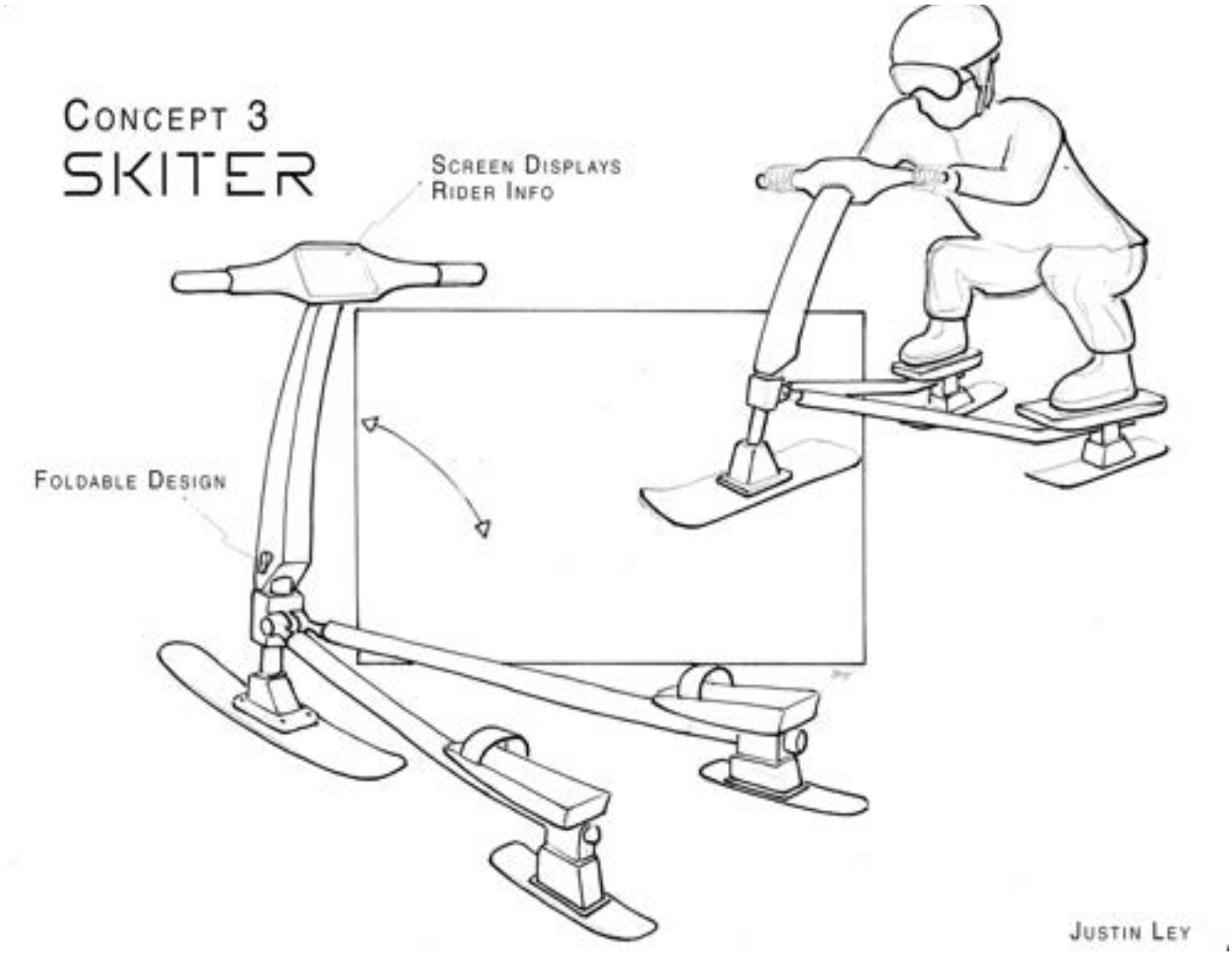



Figure 24 - Concept refinements 3

Concept three attempts to incorporate portability into the function which helps to make the product more accessible for all users. Portability seems to be a big problem with most winter sports options and finding a method by which the ski scooter could be made portable adds to its functionality.

### 4.3 Concept Strategy

The stratagy for the chosen concept was to bring the most effective solutions from all previous concepts to one concert and find a solution that best solved for the discovered problem and user needs.

#### 4.3.1 Concept Direction & Product Schematic One

Figure 25 - Ergonomic evaluation

Figure 1 shows a person standing on the scooter and holding the handlebars while looking at the display. This design explores all three touchpoints while acting as the representation of ergonomics. The 3d mock-up in use is a representation of the final thesis project.

Figure 2 shows the dimensions for modelled mock-up and is a good starting point for a reference towards the sizing of the final model. The height overall of the scooter is 42 centimetres, the handlebars are 21 centimetres apart, and the distance between the footpads and the frame is 31centimeters. (Claire, 2006)

## 4.4 Concept Refinement & Validation

### 4.4.1 Detail Development

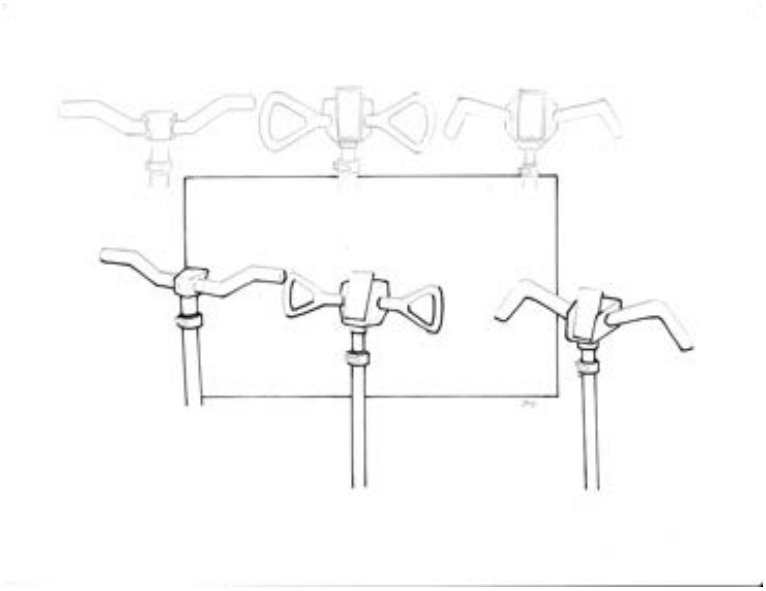


Figure 26 - Detail development

Developing the details of the design included how the user would interact with the product staring with the most basic levels. Finding a proportionate handle bar style that allowed for the most comfortable grip, while having manuverability on how it is held to accommodate for different percentiles.

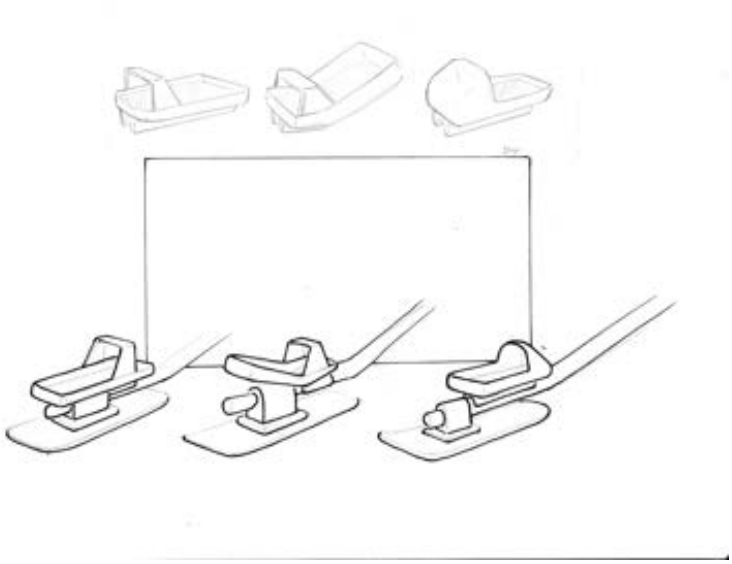


Figure 27 - Detail development 2

The Foot mount is also an important part of the concept because insuring the use has the appropriate stability to provide a safe riding experience. Deciding on how to fasten the foot to the scooter involved looking into how much movement the foot needs to create the riding motion.

### 4.4.2 Refined Product Schematic & Key Ergonomic

| Part Name | Part Color |
|---|---|
| Frame | Red |
| Foot mounts | Orange |
| Leg guard | Green |
| Handle bar | Teal |
| Phone shield | Blue |
| Skis | Grey |
| Phone mount | Purple |

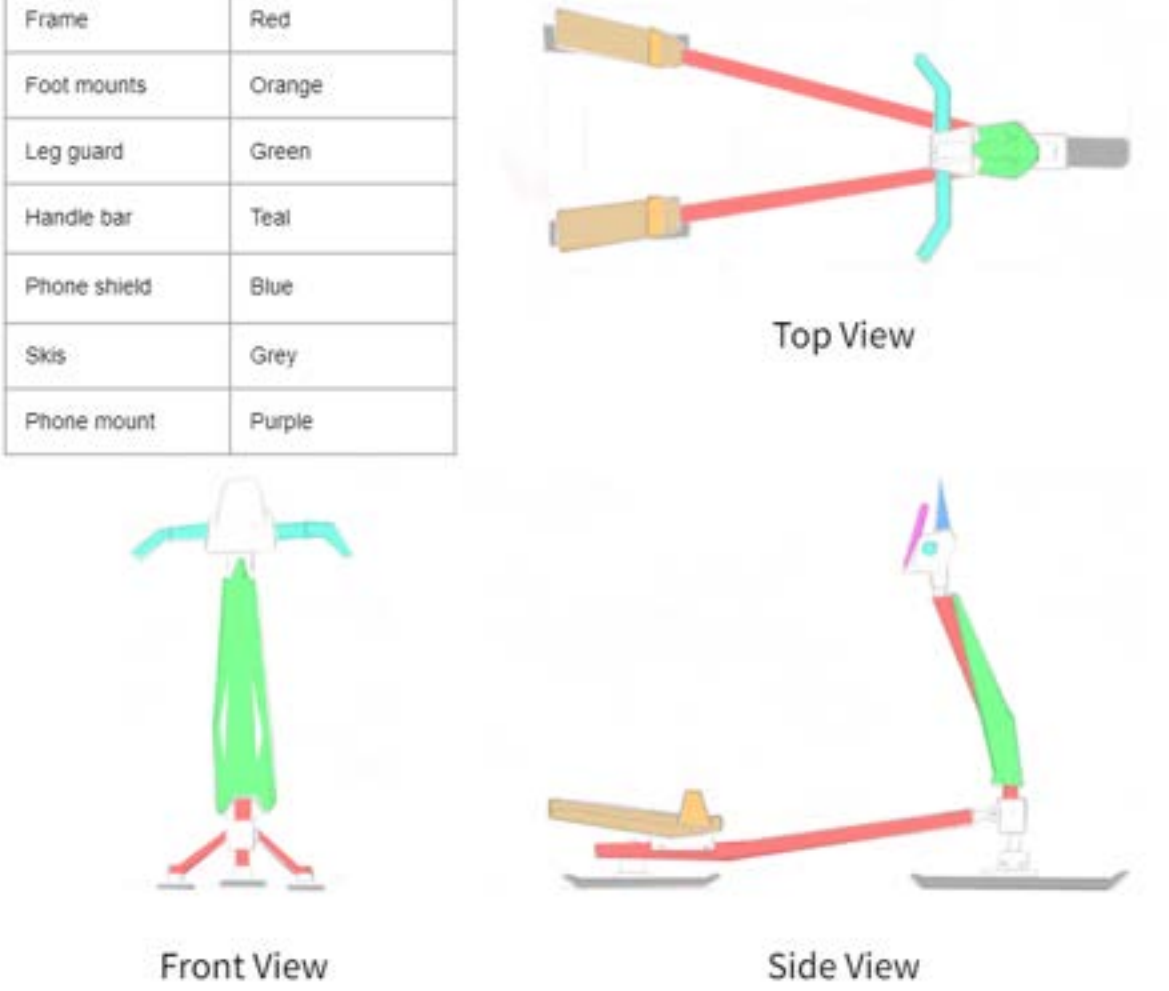



Figure 28 - Refined Product Schematic

The exercise of looking at the product and what is being interacted with as well as what is necessary for the concept to function helps to better understand what can be designed and played with. the most important part of the product which allows for it to be used is the frame

and the skis, otherwise, the rest of the components can be altered and updated to better suit the concept's overall aesthetic.

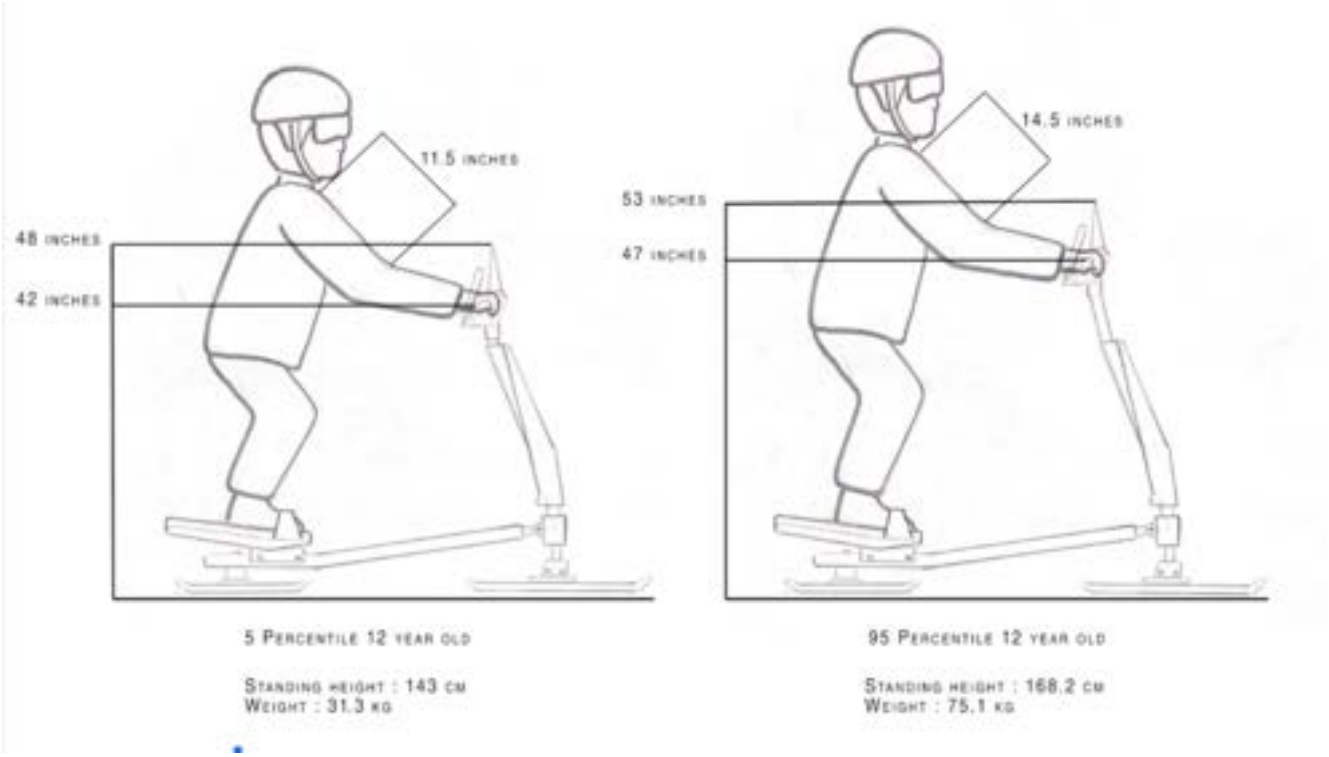



Figure 29 - Refined Product Ergonomic Evaluation

Understanding the appropriate sizing compared to using user demographic helps to create a rough size for what the product will be. this is extremely helpful for the fabrication of the prototypes and allows for further manipulation of the concepts features.

### 4.5 Concept Realization

Looking into different forms that the product can take helps to flesh out a direction for what the concept will be. Developing different potential bodies allows the design to speak to

what its purpose is, the concept that stands out the most will then be further innovated and adapted to improve its form and functions allowing the concept to come to life.

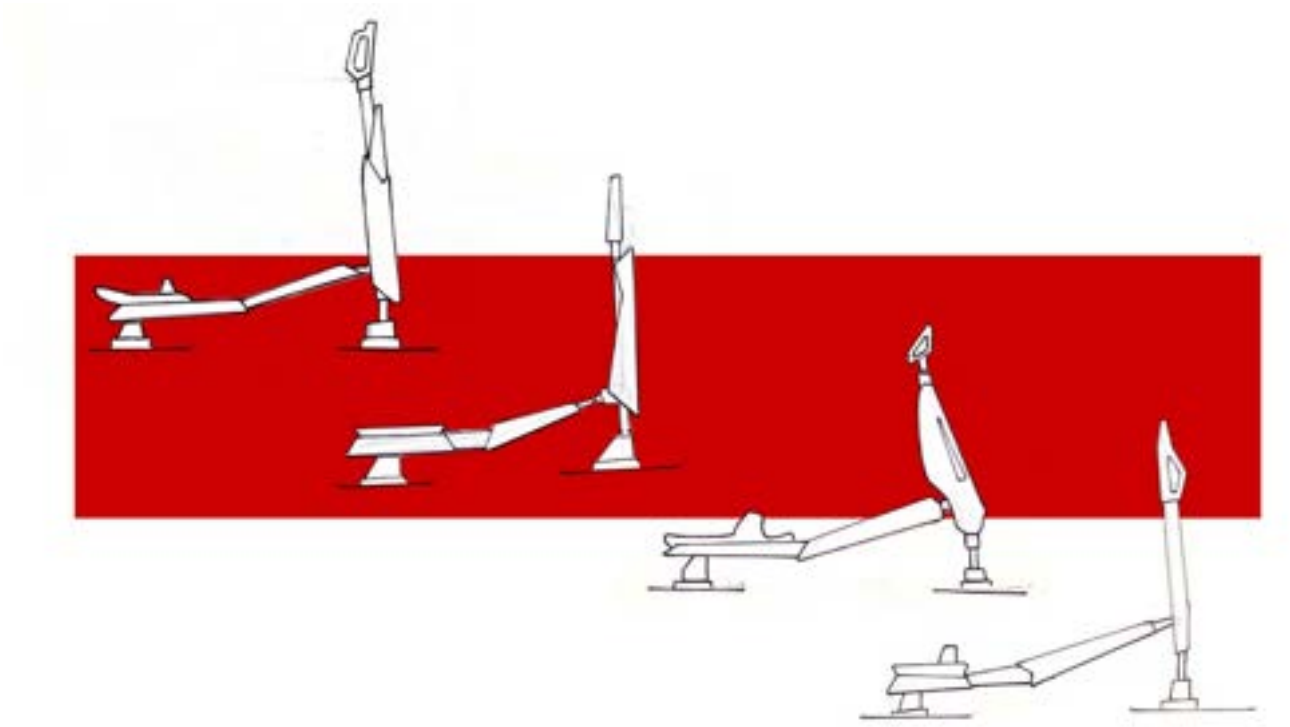


Figure 30 - Concept Realization

### 4.5.1 Design Finalization

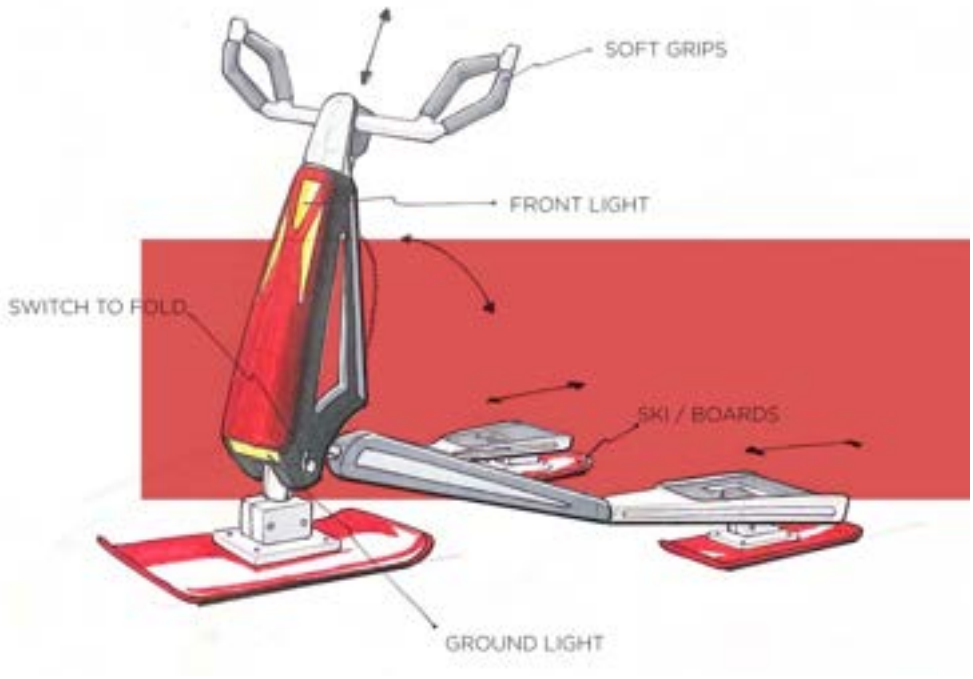



Figure 31 - Design Finalization

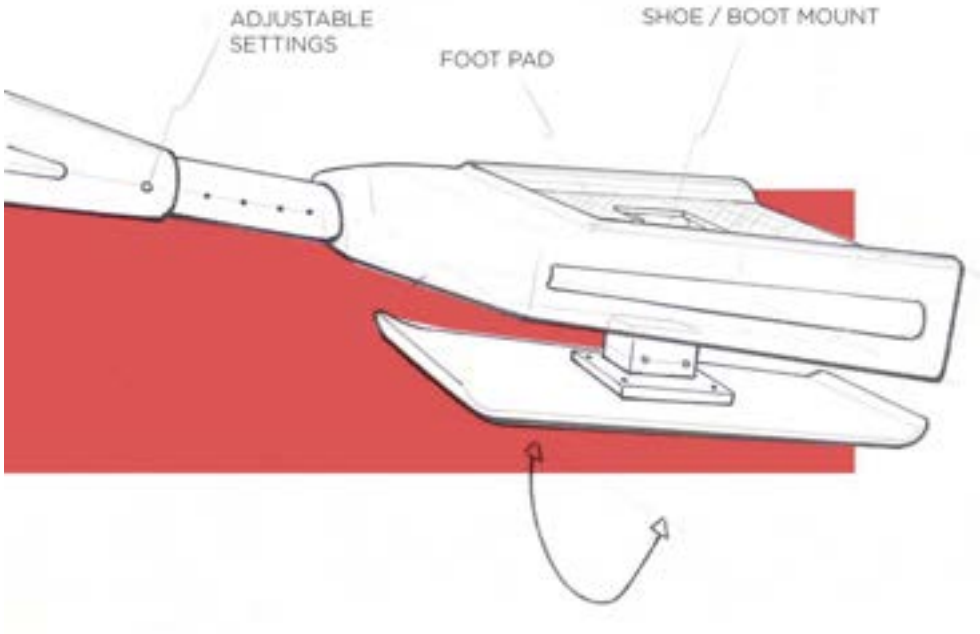



Figure 32 - Design Detailing

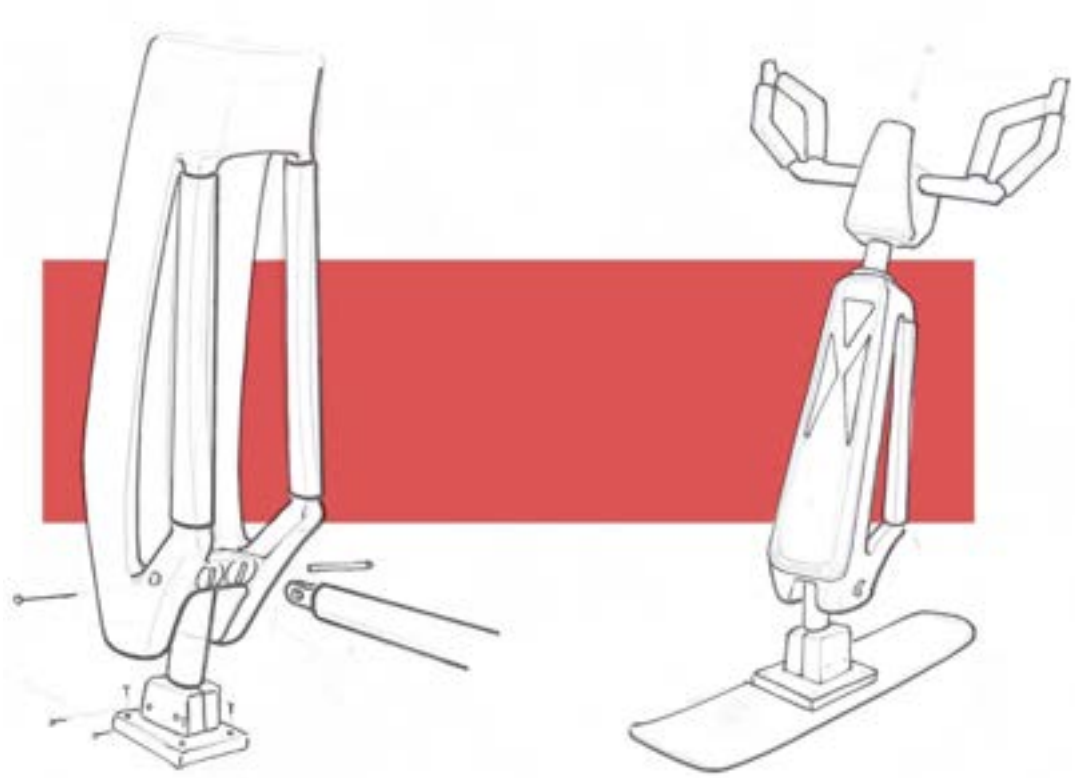


Figure 33 - Design Detailing 2

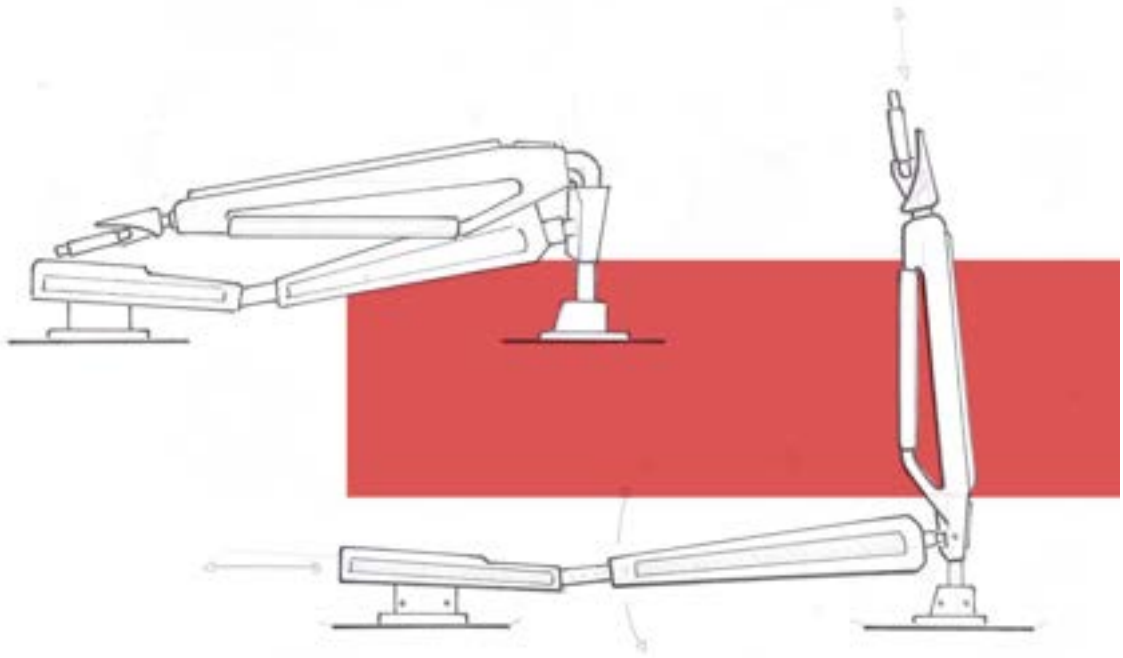


Figure 34 - Design Detailing 3

The finalized concept still included some things that needed fine-tuning but finalized the form of the initial concept and showed what was chosen to be incorporated into the usability. The portability and functionality make for an ideal product that could be great as an addition to the winter sports genre. Incorporating lights to improve visibility and an adjustable foot pad allows for the user to have control of what perfectly fits their riding experience.

### 4.5.2 Physical Study Models

The physical study model helped to inform the design process in the scaling of the different parts of the product. The things that needed to be adjusted were redesigned and or reevaluated to better suit the needs of the user. this part of the step helped to further the design to be more usable in the finalization of the thesis model.

Figure 35 - Design Finalization

Figure 36 - Study Model Image 1&2

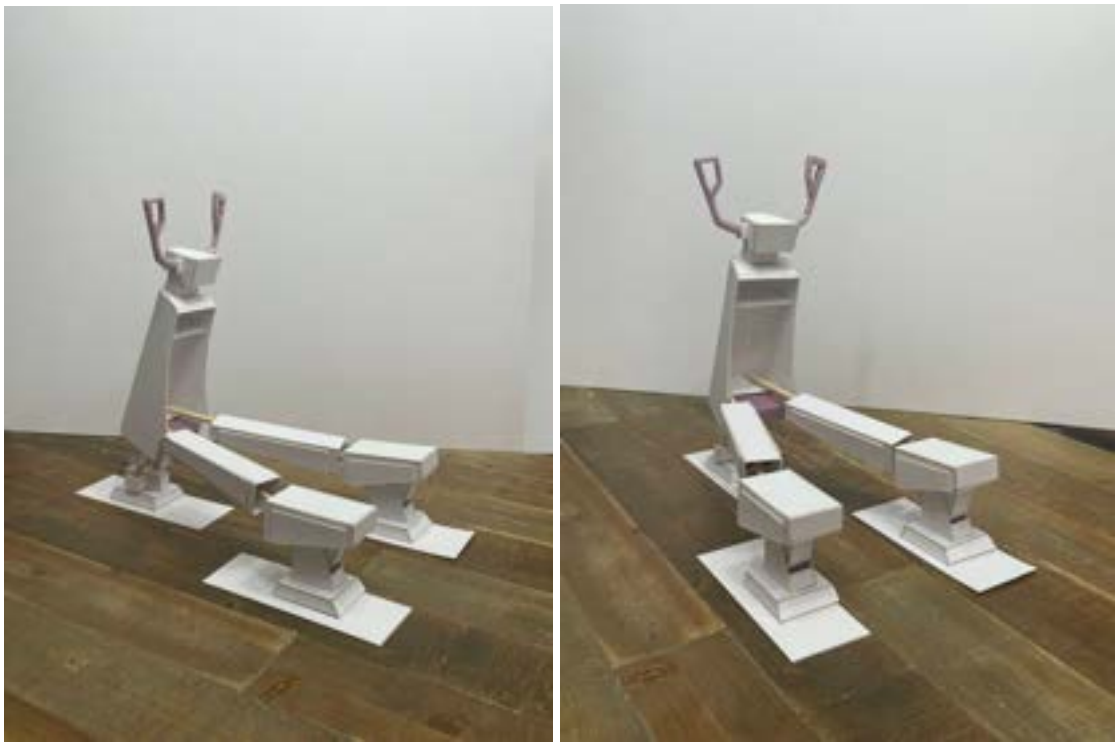


Figure 37 - Study Model Image 3&4

### 4.6 Design Resolution

Finalized design includes an amalgamation of the features from previous design iterations and brings them to one finalized concept, these features include an adjustable handlebar height and footpads length, front and floor lights, front ski suspension. These features all help to improve ridablilty while making for a fun and enjoyable experience for all levels of riders.

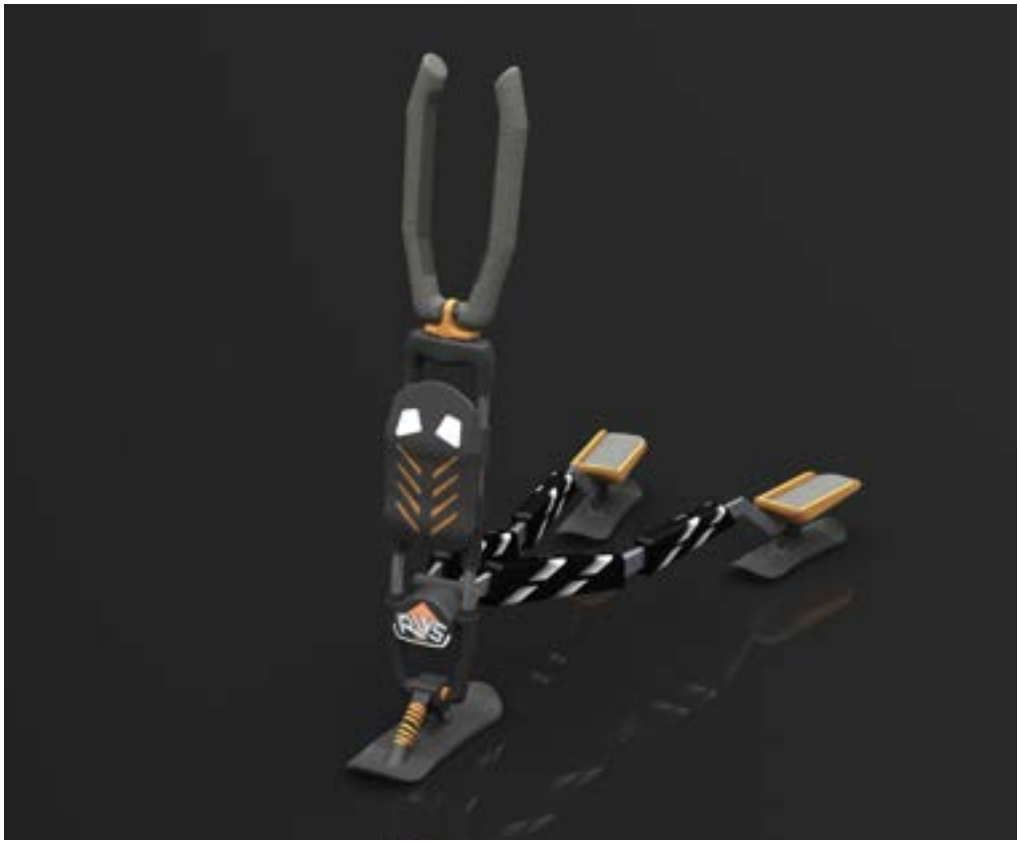


Figure 38 - Final Rendering

### 4.7 CAD Development

Included below are some close up renders of the cad model as well as some of the key feature details which show how the product would be used by the rider.

Figure 39 - Final Rendering (Rear Leg)

Figure 40 - Final Rendering (Front Leg)

Figure 41 - Final Rendering (Rear Foot Pad)

Figure 42 - Final Rendering (Front Frame)

## 4.8 Physical Model Fabrication

Figure 43 - Model making process

Figure 44 - Model making process

Figure 45 - Model making process

CHAPTER 5

# Final Design

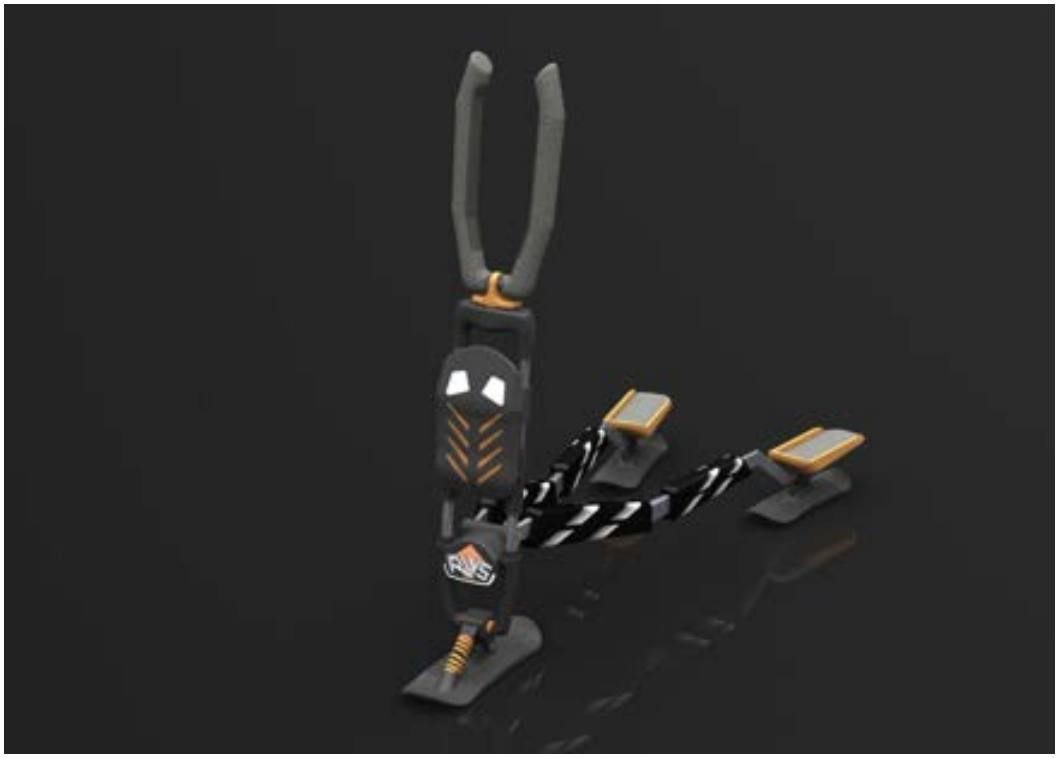


Figure 46- Final Rendering

## 5.1 Summary

The final design of the RYS ski scooter takes inpiration from a multiture of different products that are on the market and uttilizes the parts that would serve in a functional way to the design and use of this product. The overall colour theme for RYS is black, chrome, and orange, keeping the overall color of RYS black helps to align to a wider audience of users while having a bright orange as a accent colour to help make the key features stand out. making sure that the features that are going to be used most often are easy to see improves the overall experience of getting started in the journey.

## 5.2 Design Criteria met

### Four Essential Pillars for Design Excellence

The four essential pillars encompass human-centric design approach and the understanding of full-bodied, three dimensional physical interaction of user, product and environment. The projects generate innovative solutions using research-driven, evidence-based designs which focus on the user experience.

### Enhancement of Human Lifestyle

There is a need for the development of new activities, when going to a ski trail, there are two main types of riders either snowboarding or skiing, this shows the market's lack of depth. Developing a new method that changes the way riding is done while encouraging fun for its users is needed.

**Human-Interaction & User-Centric Design**

Developing the human- interaction & user-centric design means looking into understanding how someone will interact or use the product.

**Ergonomics & Human Factors Design**

Ergonomics and human factors look at the sizing of the user compared to the size of the product to provide an enjoyable and comfortable riding experience for all riders.

**Sustainability & Social Responsibility**

Utilizing sustainable materials and manufacturing processes to encourage a long-lasting product.

**5.3 Technical Drawings**

Going over the technical drawings which come from the solid-works cad model that has been made to the ¼ scale of the real product, this equates to around 13” tall and 15” long. the ski legs expand about a 0.5” and the handlebars extend to be 1” taller if needed to help accommodate for different size users.

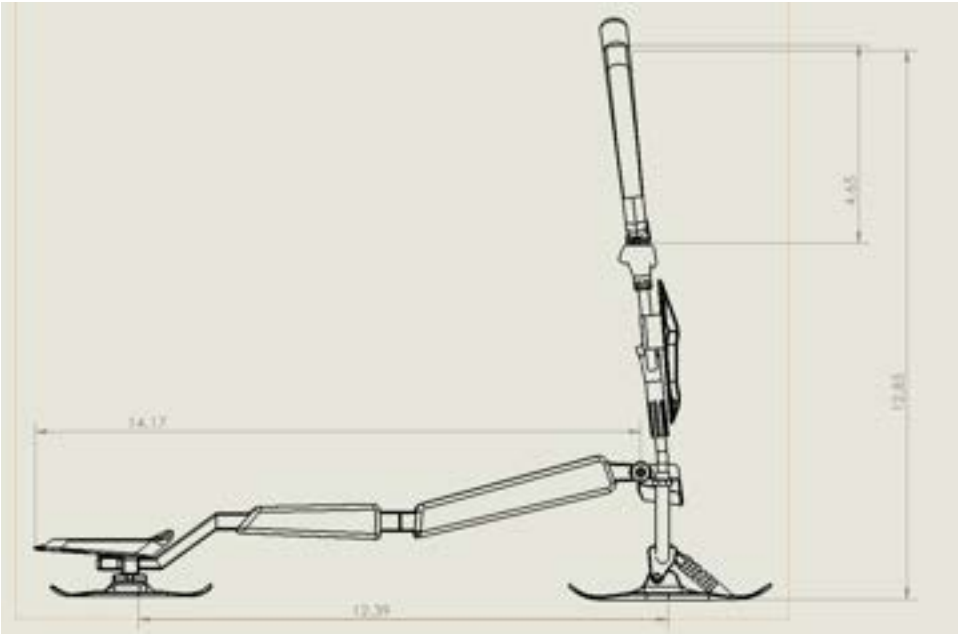


Figure 47- Technical Drawing (Side view)

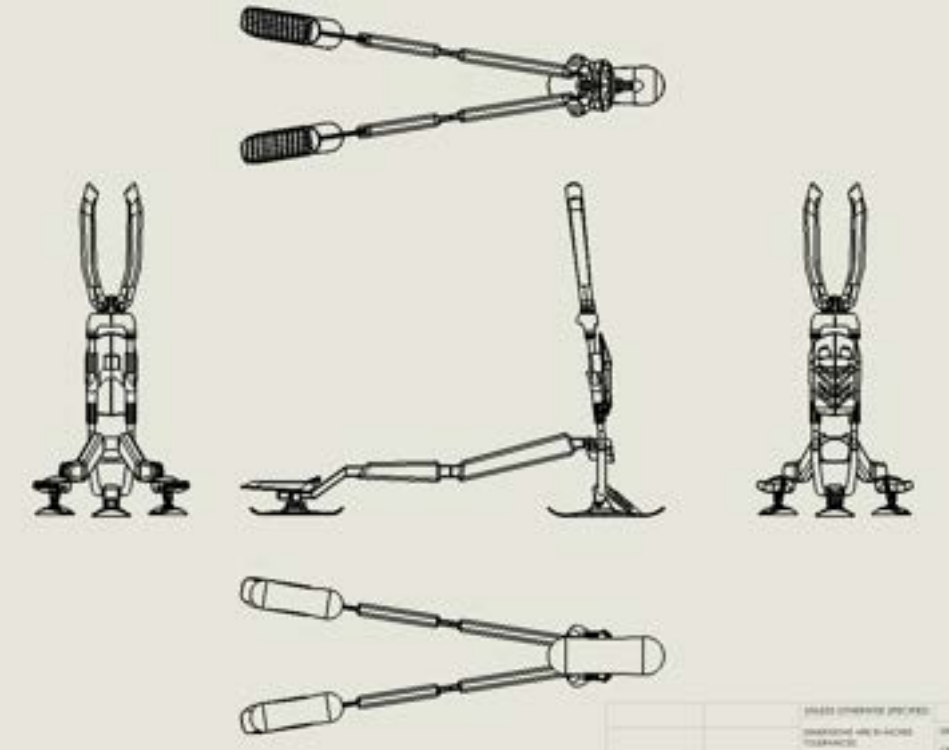


Figure 48 - Technical Drawing (isometric views)

Looking at the isometric views allow for an understanding of how the parts interact with eachother as well as helps to give a different perspective for the dimensions of the product.

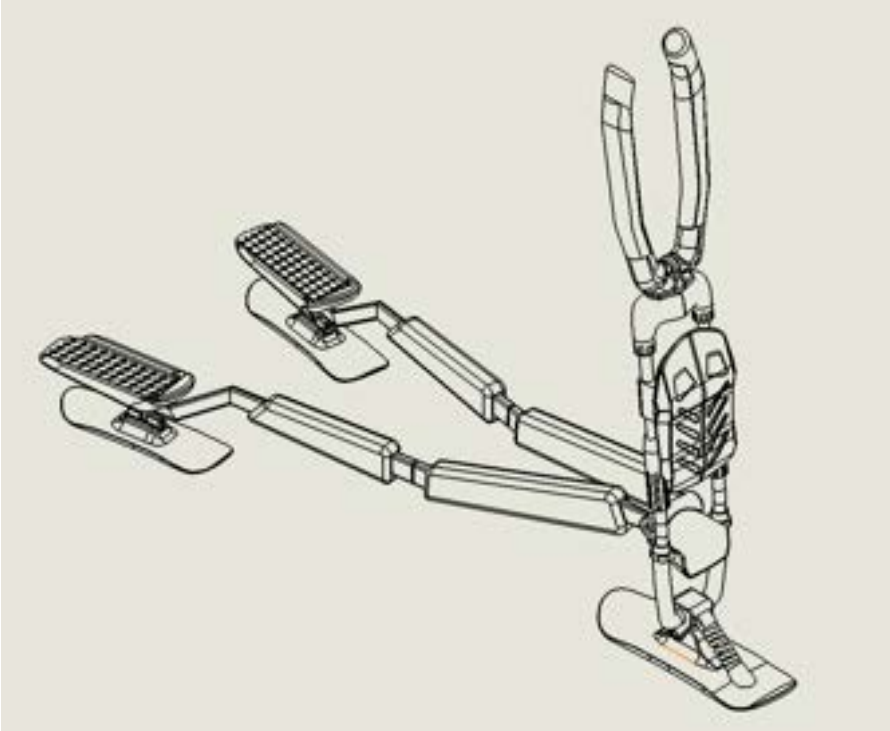


Figure 49 - Technical Drawing (three quarter view)

### 5.4 Bill of Materials

The manufacturing of this thesis project will mainly involve aluminum extrusion and casting for the scooter frame. At the same time, the skis themself will be a more complex manufacturing process with them incorporating multiple layers, including the core, p-tex bottom coat, and steel edge. The footpads are made of a hard injection-molded polycarbonate that creates a solid base for the rider when traveling on flat and groomed terrain, enabling them to have a comfortable experience. The footpads will have a silicone over mold to provide a grippy

connection to the rider and the scooter while allowing for easy control of the scooter when making turns and or micro-adjustments.

| Part | Material | Manufacturing process |
|---|---|---|
| Frame x10 | Aluminum | Extrution |
| Ski x3 | polyethylene plastic | Injection molding |
| Foot pad x2 | Rubber | Injection molding |
| Foot mount x2 | polycarbonate | Injection molding |
| Connector pieces x8 | Steel | Cast and Painted |
| Spring | Steel | Extruded |
| Handle x2 | polycarbonate & rubber | injection molded and over molded |
| Front mount | polycarbonate | Injection molded |
| Head lights x3 | Led | n/a |
| Fasteners x12 | Steel | Machined |

***Table 17 - Bill of Materials.***

CHAPTER 6

# Conclusion

Figure 49 - How to dress for cross-country skiing - Retrieved from https://hips.hearstapps.com/hmg-prod.s3.amazonaws.com/images/best-winter-carnivals-2022-1639582196.jpg?crop=1.00xw:0.752xh;0,0.123xh&resize=1200:*

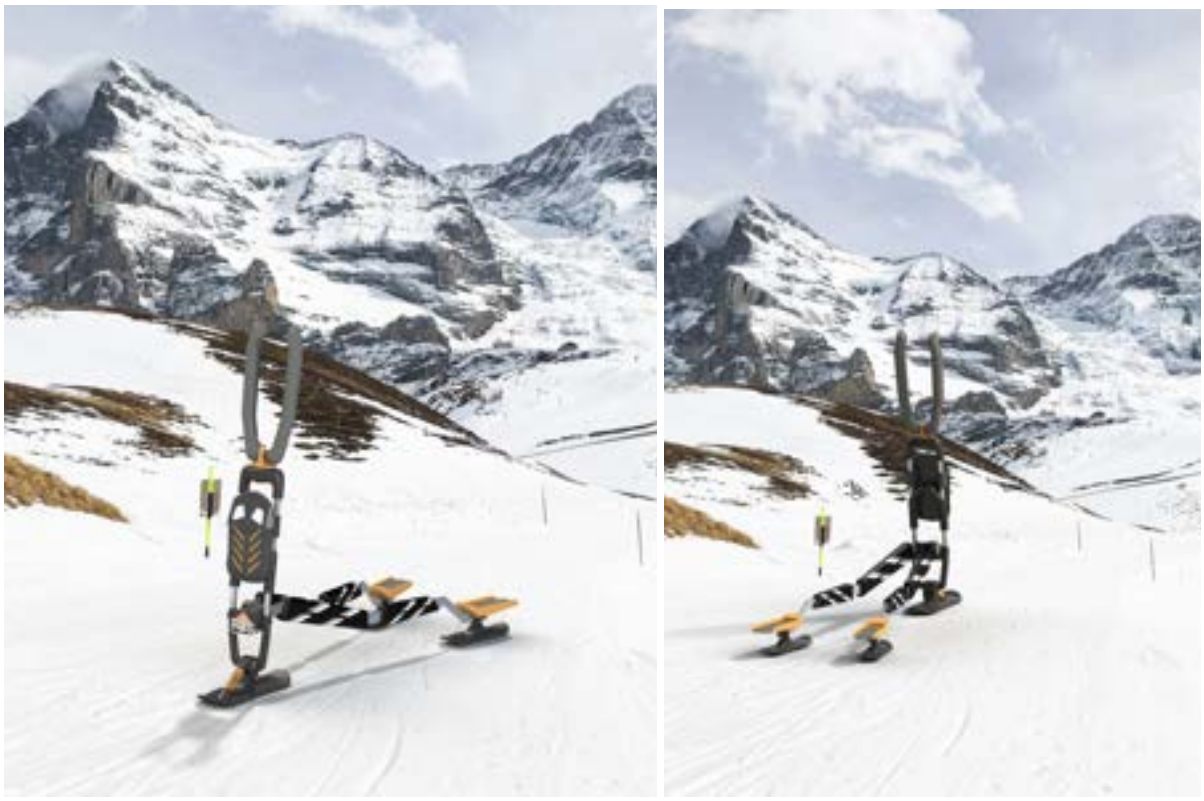


Figure 50 - In situ renders

The current state of winter sports in Canada is stagnent, even though they are an important part of the winter culture, with people of all ages gathering to find ski hills as often as possible each year. Despite their popularity, these winter activities have lacked significant innovation for several years. The problem is defined as "how can we improve Alpine sports enthusiasts' safety and enjoyment?" When considering how to improve current alpine sports methods, we must first understand why current methods of skiing and snowboarding are so popular, as well as where the flaws are and why new methods that have emerged have not

become very popular. Finding a solution that can be brought to the market and breed new imaginative ideas into the budding winter sports culture.

RYS is the perfect option for this and I am excited to present this concept to the world. RYS is a Long distance ski scooter which provides its user with a easy and fun riding experience that is not like any other activity that is found at the trail. Solving the problem of not having a easy beginner sport for young kids being introduced to the winter sport culture, RYS is the ideal solution.

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# Appendix A – Discovery

## Benchmarking- Benefits and Features

### Burton Family Tree Hometown Hero X Camber Splitboard

#### Description

Have split, will travel. Set your course for points unexplored on this ultra-lightweight and versatile split.

There are backcountry bowls and secret tree stashes calling your name. Light is right in the backcountry, and the Burton Family Tree Hometown Hero X Splitboard is our lightest split model. Its lightweight build and Methlon base lighten your load to explore further, while our Split Channel mount is the most reliable system in the splitboard game. The directional shape floats in powder and offers plenty of pop when you need it. Durable end-grain wood in high-impact zones increases durability without adding weight to every step of your tour.

ABOUT THE GRAPHIC: Once again, we worked with artist Ty Williams, this time on the graphics for the Family Tree lineup. Ty came by Burton HQ in Vermont and painted a sweet mural in our Craig's prototype facility, which our product teams pulled from to create this year's graphics. "I seem to work better in a big hurricane of ink and paint" – Ty Williams

All 2014 and newer Burton snowboards with The Channel mounting system (such as the one you are looking at here) are backed by a three-year warranty from the date of purchase.

#### Features

- **Bend**

  **Directional Camber Bend has camber under both feet for stability through deep-diving turns and variable conditions and a rockered nose that adds lift for increased float**
- **Shape**

  **Freeride Directional Shape features a setback camber and a sidecut that is centered on your stance to create a twin freestyle stance when riding flat base, while on edge it turns tight and quick with the float and prowess of a directional deck**
- **SHAPE**

  **12mm Taper provides a versatile ride that promotes free and easy turns, making this board perfect for riding in any condition**
- **Flex**

  **Twin Flex is perfectly symmetrical from tip to tail for a balanced ride that's equally versatile regular or switch**
- **Core**

  **Dragonfly 600G Splitboard Core features end-grain woods in impact zones for lighter weight that doesn't sacrifice strength**
- **Fiberglass**

  **Mystery Glass Fiberglass build is a complex carbon layup that helps manipulate flex while revolutionizing the strength-to-weight ratio**

  **1 - TOP HARDGLASS UDC + UDG +/- 45° PRE-CURED**

  **2 - CORE**

  **3 - BOTTOM GLASS UNIDIRECTIONAL CARBON & +/- 45°STITCHED**

  **4 - BASE**


## YES OPTIMISTIC Snowboard

### Description

Just like it says. Pellets or course powder is pressed until it forms a solid. There are several suppliers for our entire industry and they each have different codes for them, depending on the color and transparency. These codes can make it seem like you're getting many different kinds and grades of sintered but they're all pretty much the same as far as you and I will ever tell. True Sintered is harder and more expensive than extruded and it can be faster for those that ride aggressively fast. But to do that, it needs to be waxed and prepared for local conditions.

Evolving over the years, the PowerDrive core is always about maximizing the power and energy of any given shape. The Optimistic begins with the same light, snappy Poplar and Bamboo core featured on the Standard and Ghost. We then mill two custom programmed channels about 30mm in from the edge, running parallel to and matching the sidecut dimensions.

Inserted into these channels are pre-bent bamboo stringers wrapped in carbon. The end result is a highly responsive core that precisely matches and compliments the outline of each board. From intuitive turn initiation, solid edge hold and explosive release, the PowerDrive core is constantly active.

UnderBite edges re-distribute a rider's weight in such a way that it enhances turning ease and edge hold. Creating divots inward at the binding area reduces and disrupts the surface area of the edge that has contact with the snow while the board is turning. This increases the edge pressure by distributing your weight/energy in the areas where you need it - from the binding out, and through the center of the board where the carving arc is taking place. This segmentation of the sidecut into 3 key zones focuses your body weight onto areas that initiate, hold and release turns.

### Features

- **RIDERS Half of the Masters Banked Slalom Racers**
- **SHAPE Directional**
- **CORE Carbon PowerDrive 2.0**
- **GLASS Triax + Carbon**
- **BASE MATERIAL Sintered Spec**
- **FLEX 9/10**
- **OUTLINE UnderBite**
- **BASE PROFILE Camber**
- **UnderBite By redistributing rider weight and input, the UnderBite enhances turning ease and edge hold from every sidecut we apply it to.kg**

## Snowfeet | Mini Ski Skates

### Description

- A combination of skis and skates.
- One size fits all. We recommend Snowfeet for shoes of size: 6-13 US / 38-47 EU.
- Fits into any bag: extremely light and small.
- Highly durable fiberglass reinforced material. Metal ski edges enable easy stopping. Heel brake lets you slow down.
- Use them for downhill on the slopes and hiking trails, in snow parks, or just have fun on your local sledding hill or in your backyard.

### Features

- One size fits all
- Just attach Snowfeet to any winter shoes or snowboard boots with bindings.
- Take these snowskates to the backyard hill and enjoy bobsledding along with the kids.
- You could also try Snowfeet on Cross-country trails. It's like ice-skating on snow.
- Take these short mini skis on a hike and slide down the narrow hiking trails and forest paths like never before.

# Völkl Katana V-Werks Skis 2022

## Description

This ski has attained legendary status, and for good reason. Völkl began with the old school Katana, a heavy big mountain plank, and completely revamped the construction with the most advanced tech they had. The rest, as they say, is history. Since then, the Völkl Katana V-Werks Skis have been one of the most revolutionary, advanced, and just darn good big mountain skis out there. The V-Werks series is all about cutting weight wherever possible without sacrificing performance, and the Katana is the prime example of the success of the philosophy. Despite the wafer thin sidewalls at the tip at tail, the V-Werks Katana is as sturdy as they come. These things float through pow, drive with power, and still somehow clock in at a weight you wouldn't mind slapping a touring binding on.

## Features

**Rocker Type**

*Full Rocker* – The ski is bent at a constant curvature along its entire length.

**Shape**

*3D.Ridge Carbon* – Central Woodcore Ridge with superslim wings to significantly reduce weight and swing weight and keep the stability where necessary. Combined with Full Carbon Jacket for Stability.

*Moderate Taper* – Moderate setup of tapered tips for an allmountain oriented combination of precision on piste and easy handling off piste.

**Core**

*Multilayer Woodcore Light* – The combination of beech and poplar results in an extremely durable wood core composed of hard wood in the binding area and lighter wood surrounding it. Slotted to reduce weight.

**Laminates**

*ICE.OFF Topsheet* – Topsheet technology to reduce the weight of the ski when skiing and hiking. Will reduce the snow attachment to the ski at an average of 20% to 30%. The next step in effective weight reduction. ICE.OFF stands for the latest topsheet technology on our touring skis. The unique surface structure and material composition reduces icing as the snow simply slides off the topsheet. This leads to a drastic reduction of weight in use, on average up to 20% to 30%. In addition, mainly white graphics support the anti-icing effect. Lighter skis prevent fatigue, especially on long and steep uphill sections.

*Full Carbon Jacket* – Material layup for direct transmission and high reliability/stability at the lighest possible weight.

**Sidewalls**

*Center Sidewall* – Direct and strong power transmission with partial sidewalls in the center of the ski, combined with the superslim 3D.Ridge construction.

**Base**

*P-Tex 4500 Base* – A sintered, ultra-high molecular polyethylene base with an extremely high density. Besides a great wear resistance and perfect wax absorption, this base material is extremely fast and exclusively used on Volkl's top of the line and race models. The material has been upgraded with special additives to make it thermal and electro-conductive and proves its qualities with premium glide and maximum speed in races.

**Additional Features**

*SkinPin* – A skin fastening system that is magnificent in its simplicity: perfect fixation and easy to use; full functionality without unnecessary bells and whistles. The skin is attached by inserting its pin through a shaped hole in the shovel of the ski. The skin is then rotated 90° to lock it in place. Once rotated the skin fixation is 100% reliably secured. The system can be monitored by the skier from above at any time to provide visual peace of mind. The hole in the tip of the ski is also helpful for building a rescue toboggan in an emergency.

**Binding Compatibility**

*We recommend a brake width equal to or at most 15 mm wider than the ski waist width.*

# Stöckli Stormrider 102 Skis 2022

## Description

The Stöckli Stormrider 102 Skis are the widest offering in the formidable Stormrider line - no doubt the Swiss believe that if you can't handle a deep day on a 102mm-waisted ski you should stay in the chalet and order up some Rösti rather than messing up the untracked snow for others. In the western US, we prefer to think of this as a "mid fat" or versatile all-conditions ski, and the Stormrider 102 is one of the best. Traditional sandwich construction, full sidewalls, and an extra Titanal laminate hint at a powerful ski with excellent edgehold and tons of stability at speed, and the 102 delivers all that and more.

## Features

**Rocker Type**
**Tip Rocker – Better float in powder and less effort required to initiate turns**

**Tail Rocker – Decreases the amount of edge contact toward the tail, making the ski more playful**

**Big Powder Rocker (BPR) – Longer and more gradual tip and tail rocker than other skis in the Stormrider Series**

**Core**
**Paulownia and Poplar Light Core**

**Laminates**
**Titec Pro Technology – Double Titanal layers with graphics directly applied to the topsheet**

**Sidewalls**
**Full Polywall Sidewall – Great impact resistance and durability**

**Base**
**Racing Graphite Base**

**Edges**
**Solid Metal Edge Light – Same edge thickness as the standard edge, but with thinner insertion tabs**

**Additional Features**
**Made in Switzerland**

**Binding Compatibility**
**We recommend a brake width equal to or at most 15 mm wider than the ski waist width.**

| Features |  Burton Family Tree Hometown Hero X Camber Splitboard |  YES OPTIMISTIC Snowboard |  Snowfeet \| Mini Ski Skates |  Völkl Katana V-Werks Skis 2022 |  Stöckli Stormrider 102 Skis 2022 |
|---|---|---|---|---|---|
| Core | Dragonfly 600G Splitboard Core | Carbon PowerDrive 2.0 | N/A | Multilayer Woodcore Light | Paulownia and Poplar Light Core |
| Rocker | rockered nose | Base profile Camber | N/A | Full Rocker | Tip Rocker, Tail Rocker, Big Powder Rocker |
| Size | 151 | 151 | One size fits all | 173 | 173, 182, 191 |
| Shape | 12mm Taper | Directional | Short and narrow | Central Woodcore Ridge w/ superslim wings | 102 mm Waisted ski |
| Material | Fiberglass | Sintered Spec | Highly durable fiberglass | P-Tex 4500 Base – A sintered, ultra-high molecular polyethylene base | Racing Graphite Base |
| Flex | Twin Flex | 9/10 | N/A | 2/10 | Medium flex |
| Warranty | Yes (3 year) | N/A | N/A | N/A | 1 Year |

|  |  |  |  |  |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| Burton Family Tree Hometown Hero X Camber Splitboard | YES OPTIMISTIC Snowboard | Snowfeet \| Mini Ski Skates | Völkl Katana V-Werks Skis 2022 | Stöckli Stormrider 102 Skis 2022 |
| - Lightweight<br>- Versatile<br>- durability<br>- reliability<br>- strength<br>- twin flex | -Faster<br>- light<br>- responsive<br>- strong edge hold<br>- explosive release<br>- enhanced turning<br>- 9/10 flex | -Light<br>- small<br>- easy stopping<br>- One size fits all<br>-easy to control | - Good performance<br>- sturdy<br>-Edge control<br>- lightweight<br>- strong<br>- stability<br>- reliable<br>- easy to use<br>- maximum speed<br>-wider | -Widest<br>- versatile<br>-excellent edge hold<br>- stability<br>- speed<br>- durability<br>- easy ride<br>- |

**Takeaways:**

**What worked?**

- All products explained what materials were used properly.

- Shape was a very important when understanding control and speed of ride.

**What can be improved?**

- Flex is not clearly described.

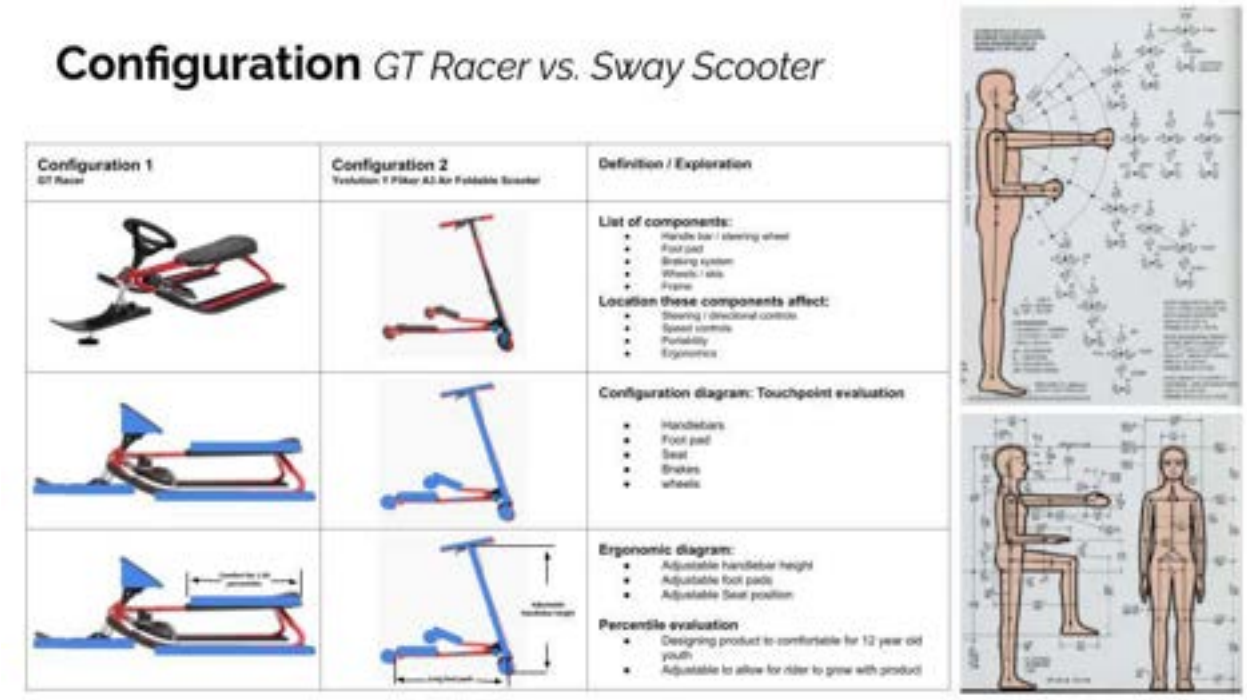
- only one product focused on safety when in emergency, and extra features.

**Has this helped converge on a topic, or diverge?**

- Colour coding Features and benefits helps to make seeing similarities much easier.

- Organizing product information in tables allowed me to easily compare products.

**Configuration diagram - GT Racer vs Sway Scooter**



# Appendix B – Contextual Research (User)

## User Observation


### Major Takeaways from Preliminary User Observations by Video

- For thesis topic
  - This video helped to understand a method of categorizing the different categories of riding on the hill, as well as how to compare them to each other.
  - Gave me insight on some pain points that arise when riding in different areas of the hill.
  - Gave insight into methods of improving mobility while not riding.
- For in-person User Observation (next step in Design Research process)
  - Helps to provide questions for future user observations.
  - Creates many potential questions to ask riders during interviews and surveys.

# Objectives for this User Observation

- **User Needs** for alpine sports include addition of fun and incentive to ride for newer riders on medium and beginner hills. Providing ability to gain speed while on flat hills and long trips.

- **Research questions**

- How could you make cross country skiing more fun?
- How could you make downhill skiing more enjoyable?

- Objectives include understanding where improvements to these winter activities can be found, and figuring out what is important to maintain from current methods.

- Snowboarding, Skiing, Scootering, Skateboarding, Sledding, Tubing, Snowmobiling, etc.

- **Target users** include: Winter Sport enthusiasts, Current riders looking for new activities, Young riders.

- **The user environment** for activity is Winter weather conditions, Ski hills, cross country trails, powdery Mountains.

# Method

**Who** - For my user observation i was able to observe a video of a snowboarding and skiing comparison in order to find a focus for my future research in these activities. This video explained the positives and negatives of each sport. (16-22 year old winter sport enthusiasts, male or female, interest in finding fun activities for the winter)

**What** - Type of observation chosen was Option 2 - Video Observation with an expert.

Ski or Snowboard, which one is better?
(https://www.youtube.com/watch?v=I9zWqPSonAo&t=4s) 7:02

**Where** - Virtual meeting to observe video with my advisor.

**When** - October 31st

**How** - No recorded was conducted but key takeaways were observed and noted.

# Results from Observations

## My takeaways

- Portability while not riding
- Mobility while riding (ability to "skate" with skis)
- Trick abilities/options
- Safety (common injury comparison)
- Weight of equipment
- Difference in easy of riding in different conditions

## Advisors Takeaways

- Time between rides
- Safety (while in terrain park)
- Importance of awareness while riding (visibility)
- Safety towards other riders during accidents
- Mobility
- Comfort of riding

## Mapping of tasks (Journey Map)

Journey mapping for experience riding on a hill, and being at a ski resort.

Pains come from worries of getting hurt, and what they go through while riding.

Some of the main gaind come from riding with new people and progressing in skill.

This journey map relates to persona's experience while riding.

## User Experience Map

User experience of a rider while completing different styles of riding

Motivations for riding, questions while riding, pain points of each style.

Areas for improvement mainly include improving safety and mobility while riding.


# Summary of Major Points

Major points for observation include:

- Improving mobility while both riding and not riding (while on flat spots, or around the hill while wearing equipment.)
- Improving visibility of others while riding
- Ability to learn quickly
- Speed control
- Weight of equipment

# Appendix C – Field Research (Product)

**Analysis**

**Empathy Map**
Pains / Gains/ Feelings

Journey / Experience Map
Ideas / Take-aways

Comparison of Existing Solutions

Affinity Diagram

Prioritization Grid

Root Cause Analysis
5 Why's Analysis
Cause & Effect Analysis

Categorization of Needs

**Focus**
*Pains / Gains*
*What might make this:*
- *easier*
- *more productive*
- *more enjoyable*

## Persona

**Persona: Beginner rider**
**Gender:** Male
**Age:** 14
**Employment Status:** Unemployed, lives at home with family that loves going to their winter home at "Blue Mountain", wants to find a new sport that is easy to start and fun.
**Hobbies:** Scootering at skatepark, hanging out with friends, doing tricks.
**Description:** Loves to go to the ski hill and watch his brother and his friends go on the terrain park but is nervous to try himself, looking to learn a winter sport.

- **Primary user is young riders.**
- **Young Riders looking to get in the terrain park.**
- **People wanting to learn a new sport.**

**Pains:**

- dangerous, chance to get injured
- expensive sport
- hard to learn
- spend a lot of time not riding
- has to put on and take off bindings often

**Gains:**

- chance to meet new people
- fun time
- progressively getting better
- reason to enjoy winter

**Analysis**

Empathy Map
Pains / Gains/ Feelings

Journey / Experience Map
Ideas / Take-aways

Comparison of Existing Solutions

**Affinity Map of Insights**

Prioritization Grid

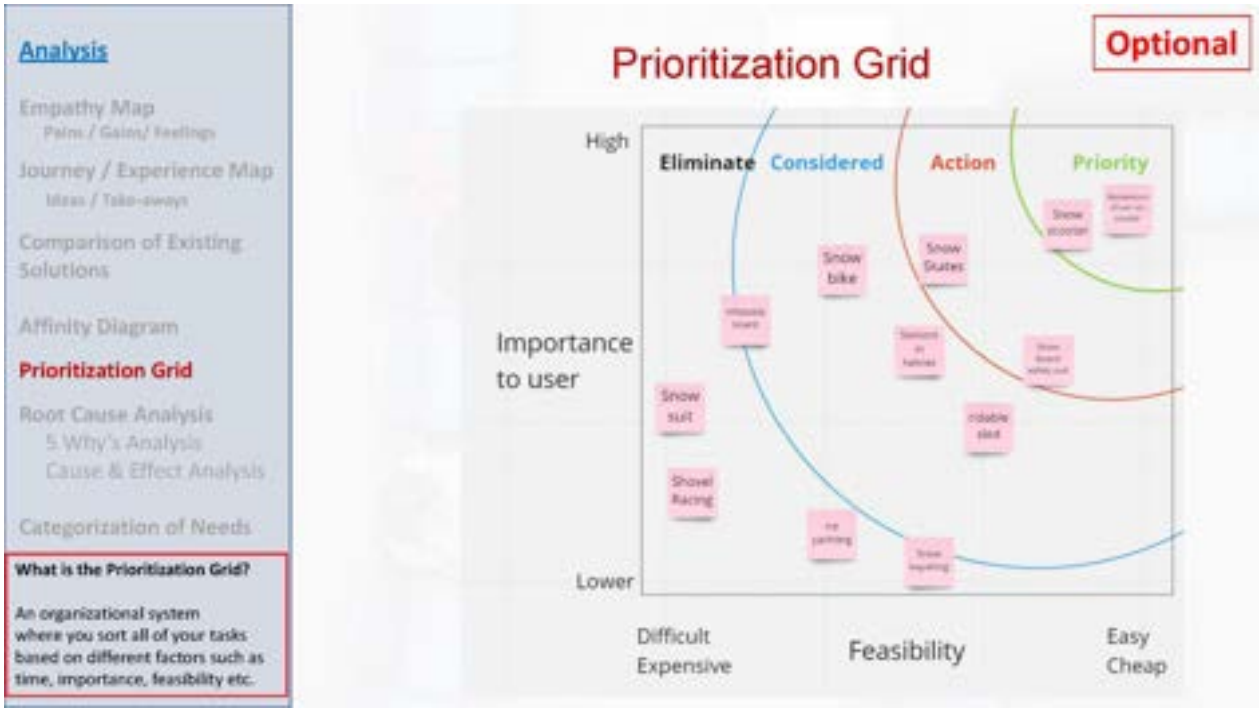
Root Cause Analysis
5 Why's Analysis
Cause & Effect Analysis
Categorization of Needs

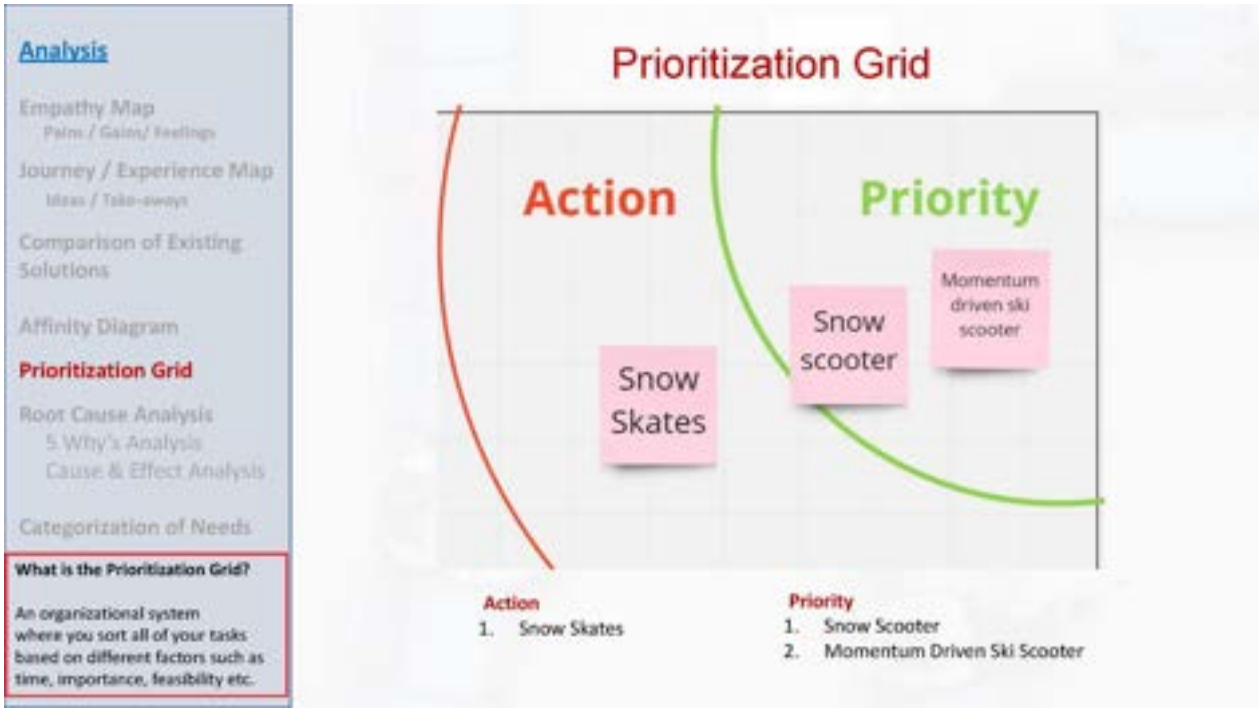
**Steps**
1. Brainstorm ideas on sticky notes (yellow)
   - *include insights from MAPS*
2. Cluster according to type, category or other similarity.
3. Name the cluster (orange)

## AFFINITY MAP of INSIGHT


# Appendix D – Results Analysis (Product)

**Analysis of needs:**



Analysis

Empathy Map
Pains / Gains/ Feelings

Journey / Experience Map
Ideas / Take-aways

Comparison of Existing Solutions

Affinity Diagram

Prioritization Grid

**Root Cause Analysis**
5 Why's Analysis
Cause & Effect Analysis

Categorization of Needs

# Root Cause Analysis

5 Why's Analysis

Problem 2: Cross country skiing is boring for young riders.


Analysis

Empathy Map
Pains / Gains/ Feelings

Journey / Experience Map
Ideas / Take-aways

Comparison of Existing Solutions

Affinity Diagram

Prioritization Grid

Root Cause Analysis
5 Why's Analysis
Cause & Effect Analysis

**Categorization of Needs**

# Categorization of Needs

**Cross country Skiing**

| *Immediate Needs* | *Latent Needs* | *Wants/Wishes* |
|---|---|---|
| • Ease of control | • Ease of learning | • Ability to bring onto all terrains |
| • Safety | • Ability to see surrounding | • Ability to do cool tricks |
| • Individuality | • Safety to other riders | • Ability to travel fast |
| • Speed control | • Fun | • Ability to avoid terrain easily |
| • Low amount of energy used | | |
| • Convenience | | |

# Needs Statement

Rider needs to be able to travel long distances fast while being safe.

Rider needs to be able to maintain a consistent speed without using to much energy.

Rider needs to have the ability to control speed and direction while riding.

Rider needs to have a safe method for traversing the hill while using minimal energy.

Rider needs to have a portable device the can be easily travelled with.



# Insight Statements

*(From Cross country skiing)*

1. Additional anxiety generated while riding due to
   - not maintaining a fast enough speed
   - not knowing how to ride

2. Controlling speed and direction can be difficult when starting out
   - Ease of control is important when learning new activity
   - ability to maintain and control speed of riding while on flat terrain.

Problem Statement

Needs Statement
Benefits and Features
Needs Statement Structure

Insights Statements

**Problem Statement**
Opportunity
General Solution

# Problem Statement

**Problem Statement**
Current methods of riding have been around for a long time and have become stale and boring especially for cross country.

**Opportunity**
Developing a new method for traversing the hill or trails will create a new demographic of riders.

**General Solution**
Momentum driven scooter that can be ridden on snow will provide a improved experience to riders.

Analysis

**Empathy Map**
**Pains / Gains/ Feelings**
Journey / Experience Map
Ideas / Take-aways
Comparison of Existing Solutions
Affinity Diagram
Prioritization Grid
Root Cause Analysis
5 Why's Analysis
Cause & Effect Analysis
Categorization of Needs

**Focus**
*Pains / Gains*
*What might make this:*
- *easier*
- *more productive*
- *more enjoyable*

## Empathy Map

## Analysis

Empathy Map
Pains / Gains/ Feelings

**Journey / Experience Map**
**Ideas / Take-aways**

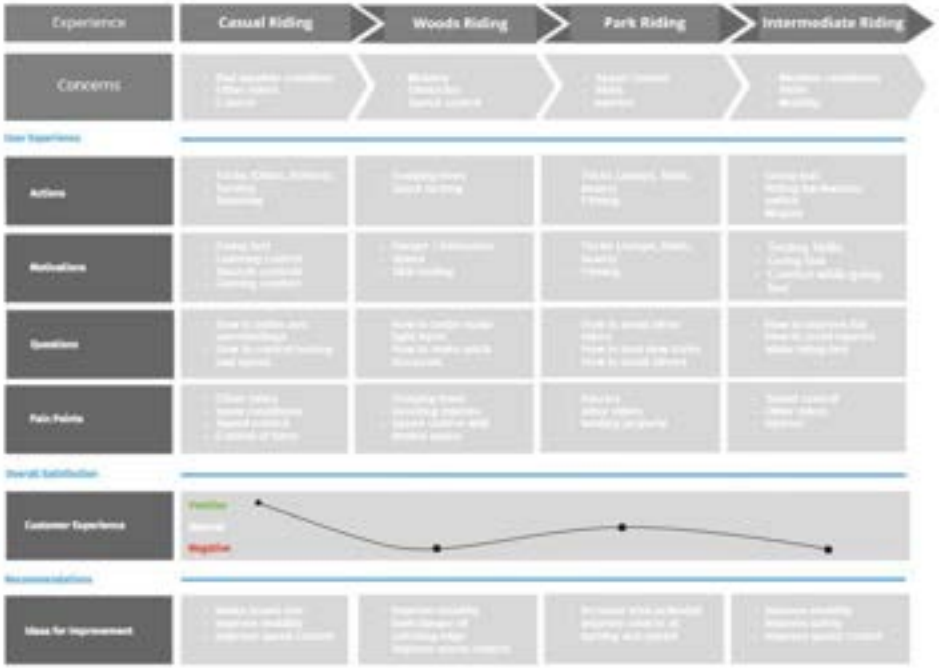
Comparison of Existing Solutions

Affinity Diagram

Prioritization Grid

Root Cause Analysis
5 Why's Analysis
Cause & Effect Analysis

Categorization of Needs



**Analysis**

Empathy Map
Pains / Gains/ Feelings

**Journey / Experience Map**
Ideas / Take-aways

Comparison of Existing Solutions

Affinity Diagram

Prioritization Grid

Root Cause Analysis
5 Why's Analysis
Cause & Effect Analysis

Categorization of Needs

**Focus**
Ideas / Take-aways


| User Goals | Ability to travel fast | Ability to control speed and direction | Opportunity to do tricks | Ease of use | Control on all terrains |
|---|---|---|---|---|---|
| Problems/Challenges | • Flat terrain<br>• Long distances<br>• easy to gain speed | • Easy directional controls<br>• Easy of speed generation<br>• ease of slowing down | • Ability to do jumps<br>• Ability to control spins<br>• Safety while doing tricks<br>• Fastening scooter to rider | • Quick learning experience<br>• Simple instructions<br>• Reliable instructions to common experience | • Speed control on all terrains<br>• Edge control on ice<br>• Limiting friction of snowy terrain |
| Ideas/Takeaways | • widen board size<br>• improve mobility<br>• improve speed control | • improve mobility<br>• limit danger of catching edge<br>• improve speed control | • increase trick potential<br>• improve control of turning and speed | • improve mobility<br>• improve safety<br>• improve speed control | • Ability to avoid obstacles<br>• Speed control on all terrains<br>• Directional control on all terrains |

**Analysis**

Empathy Map
Pains / Gains/ Feelings

Journey / Experience Map
Ideas / Take-aways

**Comparison of Existing Solutions**

Affinity Map of Insights

Root Cause Analysis
5 Why's Analysis
Cause & Effect Analysis

Prioritization Grid

# Comparison of Existing Solutions

Product Benefit:

Portability is a need for the scooter and having a easier method for transporting a scooter would make the product more useable.

Product A

- Ethic Erawan Pro Scooter
- https://www.skatepro.ca/en/218-16851.htm
- $239.95

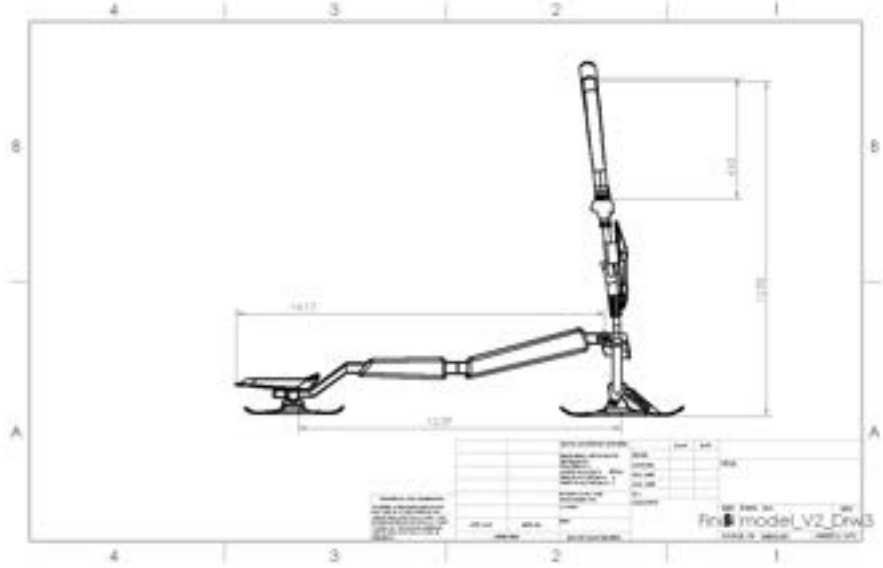
Product B

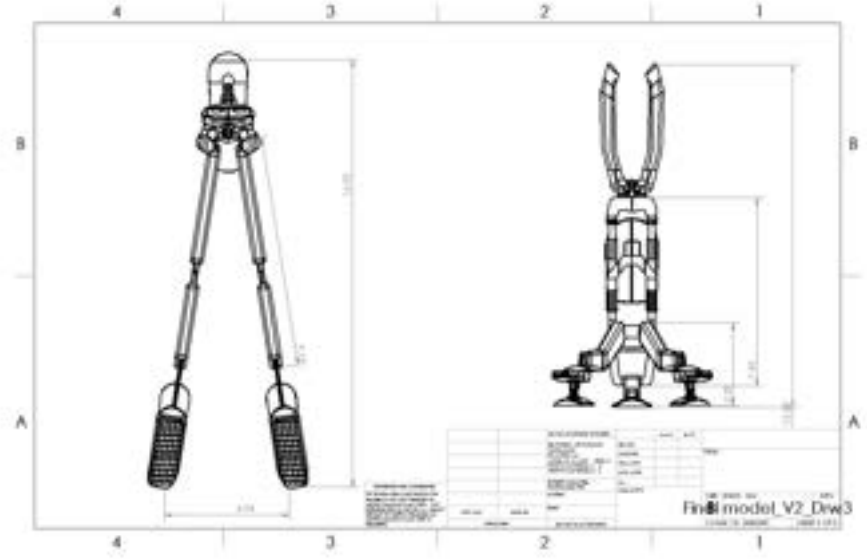
- Razor Beast V6 Sport Scooter
- https://www.sportchek.ca/categories/shop-by-sport/inline-skates-skateboards/product/razor-beast-v6-sport-scooter-color-333417006_01-333417006.html#333417006%5Bcolor%5D=333417006_01
- $129.99

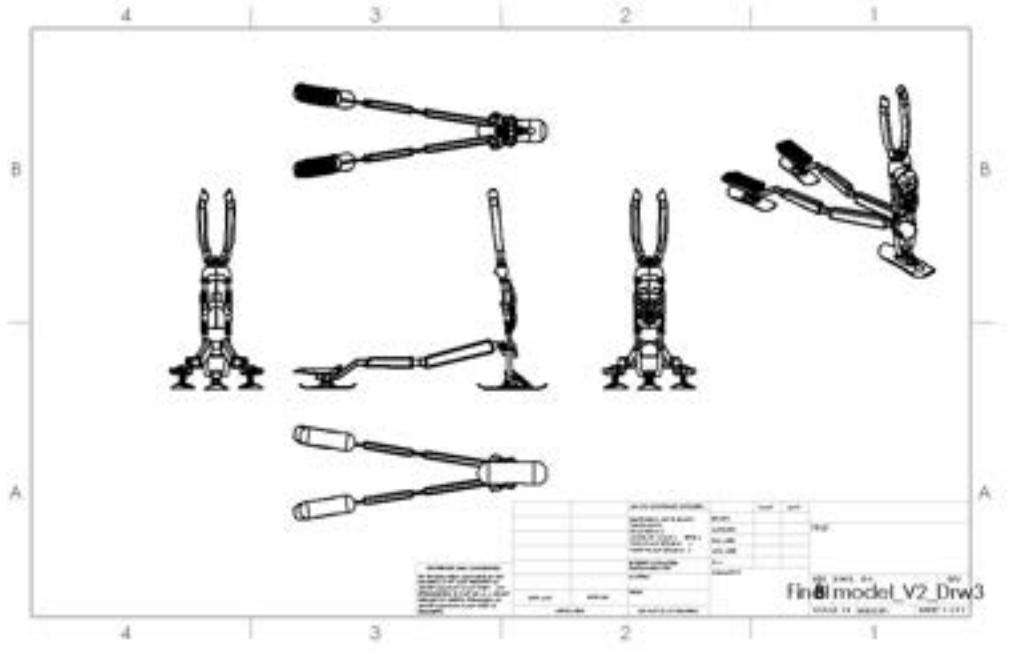
# Appendix E – CAD Development

# Appendix F – Physical model Photographs

# Appendix G – Technical drawings






4
3
2
1
B
A
Final model_V2_Drw3

# Appendix H – Bill Of Materials

| Part | Material | Manufacturing process |
|---|---|---|
| Frame x10 | Aluminum | Extrution |
| Ski x3 | polyethylene plastic | Injection molding |
| Foot pad x2 | Rubber | Injection molding |
| Foot mount x2 | polycarbonate | Injection molding |
| Connector pieces x8 | Steel | Cast and Painted |
| Spring | Steel | Extruded |
| Handle x2 | polycarbonate & rubber | injection molded and over molded |
| Front mount | polycarbonate | Injection molded |
| Head lights x3 | Led | n/a |
| Fasteners x12 | Steel | Machined |

# Appendix I – Sustainability Info



***Overview***

When looking into sustainability for this thesis project, a deeper understanding of materials and manufacturing processes must be used to compare what can be done to make the most ecologically sound product. The manufacturing of the product frame would mainly be either aluminum extrusion or casting; Aluminum is a sustainable material with the ability to be reused and recycled multiple times with no degradation of properties. This, along with its lightweight and high strength-to-weight ratio, makes it an excellent option for this thesis (AEC, 2016). The overall usability of the scooter takes no energy other than that created by the user. There are lights on the product to improve visibility for the user during night rides, and these are LED lights powered by a rechargeable battery embedded into the frame of the scooter. Aluminum casting is also very sustainable because it can be endlessly recycled, "Dies can also be fully recast, and even in direct recasting scenarios, minimal processing is required" (Catlett, 2017), illustrating the benefits of using this process and the reusability it has. The skis of the scooter will be a multi-layered board with a hardwood core, "titanal aluminum" layer for structural support, a base made with steel edges, and a P-tex base to make for a smooth ride over snowy or icy conditions. The manufacturing of the scooter's frame will primarily consist of recycled aluminum to ensure that the environmental footprint is as low as possible.

***Literature Review***

In order to help understand the topic of cross-country skiing, researching how skis are made and manufactured helps to provide knowledge on how to make a product that improves the current methods of cross-country skiing while creating a different method of travel. Skis are

made with many different materials and utilize multiple layers of materials to make for the most sturdy and lightweight riding experience; the perfect type of material depends on the riding that the ski will be used for. The design of this thesis project the goal of the ski is to be lightweight and sturdy that can be easily controlled while riding on generally flat and groomed terrain. For the ski scooter, making sure the optimal materials are used will help provide towards the overall goal of this thesis. Comparing and contrasting popular materials used help find the ideal makeup for the construction of the ski. (2018).

# *1 Materials & Manufacturing*

## *1.1 Materials*

Looking into both current and new materials commonly used during the production of skis and skiing equipment. Significant changes in this sport have not been made for a long time regarding the overall activity. However, many improvements have been made towards the materials used, which can help improve speed, traction, and mobility. One significant advancement was manufacturing the skis with multiple layers having a hardwood core sandwiched between lightweight aluminum and coated in plastic. This new method of manufacturing skis developed by Howard Head helped improve the popularity of skiing significantly and revolutionized the sport. "Head Standard Ski enabled skiers to maintain more control as they went down the slopes, the common practice of carving was now possible, and the ski lasted years longer than its predecessors." (Laudone et al., 2015); after this development in skiing, new materials were incorporated to improve the riding experience further. Some skis replace the wood core by using carbon fiber, kevlar, fiberglass, titanium, and even foam to try

and improve the sport. However, the advantages these materials provide help with different aspects of skiing. Focus on cross-country skiing means ensuring that the rider has a lightweight and sturdy ski usable in specific conditions.

### *1.2 Manufacturing*

The manufacturing of this thesis project will mainly involve aluminum extrusion and casting for the scooter frame. At the same time, the skis themself will be a more complex manufacturing process with them incorporating multiple layers, including the core, p-tex bottom coat, and steel edge. The footpads are made of a hard injection-molded polycarbonate that creates a solid base for the rider when traveling on flat and groomed terrain, enabling them to have a comfortable experience. The footpads will have a silicone over mold to provide a grippy connection to the rider and the scooter while allowing for easy control of the scooter when making turns and or micro-adjustments.

## *2 Sustainability*

### *2.1 Benchmark Sustainable Initiatives*

Innovation towards sustainability, specifically cross-country skiing, is mainly directed toward manufacturing processes since cross-country skiing does not rely on external forces to create movement or generate speed. Much of the efforts in improving sustainability for cross-country skiing include using more sustainable materials in manufacturing and improving the recyclability of the product when its life is over. The base of the skis uses a material called p-tex, a layer of polyethylene plastic that can either be sintered or extruded, which offers

different riding experiences. Sintered p-tex allows for a more durable and faster riding experience but makes it more challenging to repair. At the same time, extruded bases are less durable and slower but offer a more straightforward repair process. This p-tex material allows the ski to be easily repaired by shaving a thin layer of the base coat to uncover a smooth ride removing any nicks or dents in the base. (2018). The ski's core can also affect sustainability depending on what material is used. Using carbon or titanium raises the cost while improving weight and strength but dramatically increases the cost; foam, aluminum, or wood are lower-cost solutions but influence the riding experience.

### *2.2 Health / Safety*

The rider's health is considerably related to the safety that the ski scooter provides, making sure that the use of the ski scooter will not put the rider in any danger; the danger of this thesis project comes from losing balance when riding and falling off of the scooter. Ensuring that this is an unlikely situation, as well as preventing any other accidents from happening, will be the primary method for keeping the rider safe. This thesis project looks into improving cross-country skiing for younger riders means that the ski scooter needs to be adjustable to make for the perfect connection to any rider. The scooter has a securing line that clips onto the riders to help them not to lose the scooter while riding on a more steep hill. Losing the scooter while riding may create a danger to other riders, and maintaining this connection to the rider minimizes this as a potential situation.

### *3 Sustainability Statement for Final Design*

These findings help create a deeper understanding of the main concerns when designing a product for winter sports. Sustainability in manufacturing and material allows for a product that has a small environmental footprint while also helping to lower development costs, during research into sustainability, a deeper understanding of what materials are best to use for the materials of the skis to create the most enjoyable riding experience for any rider.

## Conclusion

In conclusion, the design of this thesis project focuses on manufacturing and material specifications to make for a sustainable product that also meets the demands that come with the development of a winterized sport. Ski scootering is not a current method of downhill winter sports. Designing the product to improve the amount of fun means making the materials lightweight and durable while ensuring a fast and enjoyable riding experience for all ages. Limiting the number of injuries in winter sports is another crucial part of selling this product. Ensuring a safe riding experience will encourage parents to buy this product for their kids without worrying that they may hurt themselves or others.

# References

- Aluminum Extruders Council. (AEC, 2016). *How does the aluminum extrusion industry impact the ... - AEC*. How Does The Aluminum Extrusion Industry Impact The Environment? Retrieved February 8, 2022, from https://www.aec.org/page/aluminum-extrusion-sustainability
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# Appendix J – Approval Forms

**IDSN 4002/4502**
SENIOR LEVEL THESIS ONE AND TWO

Humber ITAL / Faculty of Applied Sciences & Technology
Bachelor of Industrial Design / FALL 2021
Catherine Chiang / Sandro Zaccolo

**THESIS TOPIC APPROVAL:**

| | |
|---|---|
| **Student Name:** | Justin Ley |
| **Topic / Problem Definition** | How may we enhance safety and enjoyment for Alpine sports enthusiasts? |

**TOPIC DESCRIPTIVE SUMMARY (Preliminary Abstract)**

As the popularity of Alpine sports increases, the need for more fun options grows while not restricting movement or safety. The safety concerns that are present need to be mitigated. This is especially a problem when considering the terrain park, which has large jumps and features such as rails, boxes and more. "Injury rates in snowboarders have fluctuated over time but currently remain higher than in skiers. Wrist, shoulder, and ankle injuries are more common among snowboarders, while knee ligament injuries are more common in skiers. Injured snowboarders were significantly younger, less experienced, and more likely to be female than injured skiers or snowboard control participants." (Kim, S. 2012) Currently, there are only two methods that are popular (skiing and snowboarding), with a third method (snow blading) which recently gained popularity. These methods lack difference and have a lot of room for improvement due to the nature of the sport and the amount people that enjoy the winter months. Providing an option that can create a safer environment while allowing for a more intuitive learning experience would make alpine sports much more accessible for young riders, while also providing a fun learning curve for intermediate riders. This thesis will focus on a method for enabling young riders and the challenges that come with performing alpine activities, analyzing the difficulties that are currently being faced by new riders. Using surveys and interviews and firsthand observation will allow for a comprehensive understanding of where improvements can be made and finding where innovation can be achieved. Evaluation will be done using ergonomic studies and user testing to fully understand the hardships and how to mitigate them. Creating a solution to this problem will enable more people to invest time into the sport while providing a new fun way for experienced riders to enjoy alpine activities.

Kim, S., Endres, N. K., Johnson, R. J., Ettlinger, C. F., & Shealy, J. E. (2012). Snowboarding Injuries: Trends Over Time and Comparisons With Alpine Skiing Injuries. The American Journal of Sports Medicine, 40(4), 770–776. https://doi.org/10.1177/0363546511433279

| | |
|---|---|
| **Student Signature(s):** | JSey |
| **Date:** | 05/10/2021 |

| | |
|---|---|
| **Instructor Signature(s):** | Catherine Chiang Sandro Zaccolo |
| **Date:** | 07 October 2021 |

CRITICAL MILESTONES: APPROVAL FOR CAD DEVELOPMENT & MODEL FABRICATION

| | |
|---|---|
| **Student Name:** | Justin Ley |
| **Topic / Thesis Title** | ENHANCING CROSS-COUNTRY SKIING |

## THESIS PROJECT – DESIGN APPROVAL FORM

| | | |
|---|---|---|
| **Design is reviewed and approved to proceed for the following:** | X | **CAD Design and Development Phase** |

**Comment:**

- Initial CAD started reasonably well as of week #7/February 22nd, continue with detailing and refinement.
- Refinement CAD progress well as of week #8/March 8th, still need to refine some detailing.

| | | |
|---|---|---|
| **Design is reviewed and approved to proceed for the following:** | X | **Model Fabrication Including Rapid Prototyping / 3D Printing and Model Building Phase** |

**Comment:**

- Once CAD is completed, can move forward to model fabrication from week #9 onward.

| | |
|---|---|
| **Instructor Signature(s):** | Catherine Chong  Sandro Zaccolo |
| **Date:** | 8th March, 2022 |

# Appendix K – Advisor Meetings

IDSN 4002 / 4502
SENIOR LEVEL THESIS ONE & THESIS TWO

HUMBER
Faculty of Applied Sciences & Technology
Bachelor of Industrial Design / FALL 2021 & WINTER 2022

## INFORMATION LETTER

**Research Study Topic:** How may we improve safety and enjoyment for Alpine sports enthusiasts?
**Investigator:** Justin Ley, 6476274997, justin_ley@outlook.com
**Sponsor:** Humber ITAL, Faculty of Applied Sciences & Technology (IDSN 4002 & IDSN 4502)

**Introduction**
My name is Justin Ley, I am an industrial design student at Humber ITAL, and I am inviting your participation in a research study on various problems that the goal of this research is to find out what problems exist on the market today and how the current solutions can be better figured out via a more full bodied experience as well as improved safety. The results will be contributed to my Senior Level Thesis project.

**Purpose of the Study**
This study is being conducted as an aid in designing a more fun and more accessible experience for winter sport enthusiasts, allowing for more options when it comes to safety and storage as well as improving the time it takes a new rider to learn. This study is primarily based on understanding ergonomics, human interaction design activities, and user experience aspects of the research area.

**Procedures**
If you volunteer to participate in this study, your activities in interacting with equipment will be observed and documented. Your activities will be documented by means of user observation and video camera while operating the equipment. You will also be asked questions pertaining to the equipment and how you use it.

**Confidentiality**
Every effort will be made to ensure confidentiality of any identifying information that is obtained during the study. In the case of being recorded visually, your face will be masked /blurred or hidden. The information and documentations (photographs) gathered are all subject to being used in the final presentation of the study.

**Participation and Withdrawal**
Your participation in this study is completely voluntary and you may interrupt or end the study and the session at any time without giving a reason or fear of being penalized.

If at any point during the session, you feel uncomfortable and wish to end your participation, please let the moderator know and they will end your participation immediately.

**Humber Research Ethics Board**
This research project /course has been approved by the Humber Research Ethics Board. If you have any questions about your rights as a research participant, please contact Dr. Lydia Boyko, REB Chair, 416-675-6622 ext. 79322, **Lydia.Boyko@humber.ca**

1

## INFORMATION LETTER

**Conditions of Participation**

- ✓ I understand that I am free to withdraw from the study at any time without any consequences.
- ✓ I understand that my participation in this study is confidential. (i.e. the researcher will know but will not disclose my identity)
- ✓ My identity will be masked.
- ✓ I understand that the data from this study may be published.

---

☑ **I have read the information presented above and I understand this agreement. I voluntarily agree to take part in this study.**

| Click or tap here to enter text. | | Click to enter a date |
|---|---|---|
| Daniel Wynn |  | October 13 2021 |
| Participant's Name | Participant's Signature | Date |

**Project Information**

Thank you very much for your time and help in making this study possible. If you have any queries or wish to know more about this Senior Level Thesis project, please contact me at the followings:

Phone: 647 627 4997

Email: justin_ley@outlook.com

My supervisors are:

Prof. Catherine Chong, **catherine.chong@humber.ca**

Prof. Sandro Zaccolo, **sandro.zaccolo@humber.ca**

## PARTICIPANT INFORMED CONSENT FORM

**Research Study Topic:** How may we improve safety and enjoyment for Alpine sports enthusiasts?
**Investigator:** Justin Ley, 6476274997, justin_ley@outlook.com
**Courses:** IDSN 4002 & IDSN 4502 Senior Level Thesis One & Two

I, » Daniel Wynn, have carefully read the Information Letter for the project How may we improve safety and enjoyment for Alpine sports enthusiasts?, led by Justin Ley. A member of the research team has explained the project to me and has answered all of my questions about it. I understand that if I have additional questions about the project, I can contact Justin Ley at any time during the project.

I understand that my participation is voluntary and give my consent freely in voice recording, photography and/or videotaping; with the proviso that my identity will be blurred in reports and publications.

**Consent for Publication: Add a (X) mark in one of the columns for each activity**

| ACTIVITY | | YES | NO |
|---|---|---|---|
| **Publication** | I give consent for publication in the Humber Library Digital Repository which is an open access portal available to the public | ✓ | ☐ |
| **Review** | I give consent for review by the Professor | ✓ | ☐ |

**Privacy**
All data gathered is stored anonymously and kept confidential. Only the principle investigator /researcher, Justin Ley and Prof. Catherine Chong or Prof. Sandro Zaccolo may access and analyze the data. All published data will be coded, so that visual data is not identifiable. Pseudonyms will be used to quote a participant (subject) and data would be aggregated.

I also understand that I may decline or withdraw from participation at any time, without negative consequences.

I understand that I can verify the ethical approval of this study, or raise any concerns I may have by contacting the Humber Research Ethics Board, Dr. Lydia Boyko, REB Chair, 416-675-6622 ext. 79322, **Lydia.Boyko@humber.ca** or Justin Ley, 6476274997, justin_ley@outlook.com.

**Verification of having read the Informed Consent Form:**

☑ I have read the Informed Consent Form.

My signature below verifies that I have read this document and give consent to the use of the data from questionnaires and interviews in research report, publications (if any) and presentations with the proviso that my identity will not be disclosed. I have received a copy of the Information Letter, and that I agree to participate in the research project as it has been described in the Information Letter.

| Click or tap here to enter text. | | Click to enter a date. |
|---|---|---|
| Daniel Wynn | DW | Oct 13 2021 |
| Participant's Name | Participant's Signature | Date |

# Transcription:

Daniel Wynn 0:00
My name is Daniel when I have worked and I've had my life involved within the industry for probably the last 1012 years and before that I was scared. Then all over North America at least to do it. And I think I have valuable input.

Justin Ley 0:24
Perfect, thank you very much, Daniel Wynn. So, I am inviting you to be a research participant. And I'm going to be explained briefly the nature of the exploratory phase. So basically I'm finding information about snowboarding and how to learn how the experiences to learn, and where the difficulties live within snowboarding. I'm going to be using this information as a research method to try and develop some ideas to maybe provide answers to some of these problems.

Again, the interview is voluntary, and you can stop it at any time.

Daniel Wynn 1:12
Sorry, one more time.

Justin Ley 1:13
This interview is voluntary, so you can stop it at any time if you want if you don't feel comfortable with answering, answering any questions, there is no penalty for withdraw.

Daniel Wynn 1:23
All right. Gotcha,

Justin Ley 1:24
You understand. Yeah, okay, indicate the participant, it can be anonymous, if you want, will be anonymous like I'm not going to be posting any of your information other than for the project, that my teacher has access but you're not going to be public. And if you do wish that I don't share the photo.

Are you recording this?

yeah, I'm recording this or I'm not recording it, but I'm getting a transcription.

Daniel Wynn 1:53
Do you want to just say I said yes to all the consent stuff?

Justin Ley 1:55

No, but I have to have you verbally saying yes.

Daniel Wynn 1:58
Okay, gotcha, okay, cool.

Yes Yes Yes.

Justin Ley 2:04
Perfect. Okay, so I'm going to ask you a question. So how long have you been snowboarding?

Daniel Wynn 2:11
I have been snowboarding for 12 years.

Justin Ley 2:13
Perfect. And in those 12 years. Where have you travelled to snowboard?

Daniel Wynn 2:21
I have been around a few places in Canada and America.

Justin Ley 2:27
Awesome, mainly in parks where other people are or are it mountain sometimes, or any other version, sometimes not in located areas,
you
Daniel Wynn 2:43
namely hills, most of the time, located Erica's usually in parks where other people are

Justin Ley 2:53
okay, so no experience with like mountain outback.

Daniel Wynn 2:57
Not a lot of experience with mountain and Outback. Okay, but definitely.

Justin Ley 3:03
Okay. In your experience, riding in these hills like parks where do you spend the majority of your time?

Daniel Wynn 3:14
In the Terrain Park.

Justin Ley 3:17
And what do you usually try to do in the train Park are you doing tricks are you doing jumps, what is the majority of what you do.

Daniel Wynn 3:26

The majority of it is doing some tricks on some rails and training just trying to get a little better than how I started.

Justin Ley 3:34
Awesome. Well, during this time. Do you see any difficulties or problems with your current method of snowboarding? Do you have reoccurring issues with the gear or other things like that?

Daniel Wynn 3:51
Yeah, I'd say like one of the biggest issues is motivation, since there's so much risk involved in every single push to get better because it's just a risky sport especially within the context we're talking about, I would say that the proper motivation either have to have people there at least watching you cheering you on your friends is always the best option for that, but competition brings out the best in everybody. And if you don't have that you at least have music.

Justin Ley 4:24
Yeah. So you find you mainly ride with other people, or do you go on,

yes.

I think we'll get better, I don't have the motivation, entirely to do it on my own for gear issues I too, not too much unless you've forgotten. Goggles or, people don't have screwdrivers on the Hill that always helps.

Well, so you're saying mainly it's fun it's something to motivate you to keep doing it is something you would be looking for.

Daniel Wynn 5:08
What's the in this case,

Unknown Speaker 5:10
I just have a concern.

Daniel Wynn 5:14
Yeah, like not having the motivation to do it, and I guess. Yeah, not having the motivation. Even the worst hill in the world becomes the best when there are a few people that like

Justin Ley 5:35
Good point. So, the friends, the community aspect is the main motivating factor for snowboarding and just Alpine sports in general.

Daniel Wynn 5:47
Yeah. I feel like friends and esteem. I guess that is like directly social anyways so

Justin Ley 5:58
So I'm gonna now ask you to kind of thing from an outside perspective being much more knowledgeable about the sport in itself. When you were learning to or someone who's learning to ski or snowboard, what would be the most difficult part?

Daniel Wynn 6:27
I would guess, in, in regular riding going comfortable on the board, and using your edges, because I guess you could always learn to link upturns, but I find the biggest struggle is what everybody does with a bunch of speed when they're in a flat zone and that's how you can tell how comfortable people are. Some people need to constantly go between their edges just to remind themselves that they're still there. Some people can just hang out on one of those I guess you can tell her the more expertly inclined. I guess just coding comfortably with those controls.

Justin Ley 7:15
Oh, so that's, that's the majority. Do you see that, if there was another method other than skiing and snowboarding or blading, whatever that one's called? Would you try out another method, if it promised a more fun experience?

Daniel Wynn 7:40
Me personally, probably not, especially if it cost me anything. A big part of why I love it so much is the culture, like winter skateboarding.

Justin Ley 7:51
Yeah, it's a good part, the community aspect, again, that friendship building in an environment

Daniel Wynn 8:02
with a little bit of culture and history this time.

Justin Ley 8:16
So another concern being accessibility and or cost, how would this impact, new riders.

Daniel Wynn 8:32
A lot of you are going to start when you're young. With that in mind, it's going to be, who can afford to do it, who is kind of like assumed to do it so it's just gonna end up being a lot of like, well off families especially in the small town, but if you're going to see anyone who's skiing in the cities it's going to be the same people, they go out of town, maybe have somewhere to stay over the weekend. Either way, they have a car that can get them an hour away, afford a $50 Louis ticket for the day. Each child has about 300 $400 of gear on.

Justin Ley 9:17
Yeah, you have to drive out there as well so it's a main issue

Daniel Wynn 9:22

then, you know, everybody. Everybody, most people will talk about it too and like most of your friends who do it are going to be richer, so it's just going to be already this culture.

Justin Ley 9:36
So a question about who is on the hill. Would you say a large majority of the riders that you see are younger people, or in their teens or older? If you were to average it.

Daniel Wynn 9:52
I mostly see teens and young adults and children, I guess between children to young adults on the hill.

Justin Ley 10:27
Like cost and getting there and like just being raised into experiencing it. It is kind of cultural.

Daniel Wynn 10:38
Yeah,

Justin Ley 10:39
that's beyond the point so I'm trying to solve for skiing and snowboarding and like the fact that those are the only two main ways of going about Alpine sports like popular at least.

Daniel Wynn 10:56
Oh,

Justin Ley 10:57
I'm trying to like bridge the gap.

Daniel Wynn 10:58
like a sport that uses the environment too. If you're looking for another offline sport after something along those lines. And then, when I think of something that gets you into the Alpine for sports reasons. I generally don't think cheap like what else is there. Yeah, flying. If you like to fly little planes and like being a pilot or

Justin Ley 11:24
even like speeding. That's another thing that's like, but

Daniel Wynn 11:28
that wouldn't be Alpine, that would be like in the village below the mountain.

Justin Ley 11:32
Yeah, I'm trying to like bridge the gap of not necessarily Alpine but also like you here, cross country skiing and then you're down the trail,

Liam does ice climbing, Yeah, like all those rock climbers, I would say a quarter of them turned into like ice climbers in the winter.

And then the majority of snowboarders and skiers. Well, I wouldn't say skiers and snowboarders turn into skateboarders during the summer.

Daniel Wynn 12:08
Yes. Yes indeed.

Justin Ley 12:13
Okay, thank you very much, Daniel Wynn, I appreciate you taking the time to be part of my interview.

Daniel Wynn 12:20
Thank you I appreciate the opportunity

Justin Ley 12:24
in the future, if I do have any more questions, would you consent to another interview.

Daniel Wynn 12:31
I would, I would consent.

Justin Ley 12:34
Thank you very much. Have a good day.

Daniel Wynn 12:37
And. You

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