# Needs, Problem Statement, Benchmarking, Metrics and Target Specs

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## 1. Statements and Observations

1. Liam's disability is caused by a third replication of the ninth chromosome. He has hyperflexibility in his hips and hypotonia which causes extremely loose muscles and joints due to weak signals from the brain through motor neurons. His condition causes no abnormalities while walking but when he runs, his arms and ankles kick out in order to keep balanced.
1. The prototypes that David currently has are too heavy and his wife can't bring Liam skating on her own because she can't lift the prototype into the back of her car.
2. David is knowledgeable about different types of skating aids and specifications needed for skating aids for children and people with disabilities. David has learned from physiotherapists at Ottawa Children's Treatment Centre (OCTC) the importance of having a keel to keep children from crossing ankles while skating and having rounded handles to hold onto.
3. We saw how emotional David gets when he is able to provide for his son. He was tearing up when telling the story of Liam's first bike ride on his own once he got a bike that worked for him.
4. David is 67 years old (although he doesn't look it). He gets arthritis in the mornings and a problem bending his knee. Although he'll do anything in his ability to help his son to reach his goals and to skate, he can't do that if he's injured. In the past he has help up Liam while he's skated but it is difficult for him to hold up Liam if he falls without injuring himself.
5. David showed us a video of Liam using his first prototype. It functioned with all of Liam's friends pushing it (which was unexpected to David as he thought he would be pushing Liam along the whole time) while they cheered him on! Liam has extremely supportive family and friends!
6. It's dangerous for both the kid and the parent/attendant going from the shack where you put on your skates to the rink.
7. Liam has other friends with disabilities that want to skate as well but can't always rely on their parents to help them skate for various reasons. Although the prototypes were initially built for Liam, they are adjustable for when he grows and when other kids want to use the product.
8. While David was putting the first prototype together, members of our team had to hold up the sides so that they didn't fall in on him. The second prototype was able to keep the sides up during setup but they added a lot of unnecessary weight.
9. David explained that Liam and many other kids with disabilities are fearful. Liam, for example, is doesn't like to cry because his condition causes the movement of crying to turn into coughs and them vomiting and he is afraid of being embarrassed. David wants his son and others to feel fearless while learning to skate.

10. To Liam, the hot chocolate cup holder is the most important aspect of the skating aid. He wants to skate down the canal with a spot to keep his hot chocolate.
11. Liam often gets tired after 10-15 minutes of skating and wants to take a break while David wants to continue skating. On the first prototype, David could adjust the aid to have a seat, but then Liam would be sitting in a different direction of the runners and would sit sideways to the path of motion which wasn't ideal.
12. Many aids for people with disabilities are extremely expensive. David wants a product that is effective but affordable for families.

**2. Needs and Priorities**

1. The skating aid is able to catch the user if they fall with the use of an adjustable chair, reducing the risk of concussion and injury to the user or to their attendant.
2. The skating aid is lightweight (10-15lbs) and transportable. It is able to fit in the back of their car and David's wife is able to lift the aid by herself.
3. Aspects to make the aid usable for children with disabilities are included such as rounded handles and a keel to keep users from crossing their ankles.
4. The skating aid looks cool and has a cup holder for drinking hot chocolate while skating down the Canal. (Although these aspects are the most important to Liam, safety is our main concern)
5. The skating aid is functionable for Liam and is adjustable so that others may use it to skate as well.
6. Spherical orbs are used on the bottom of the skating aid so that once Liam gets tired and the seat is adjusted, the aid can follow any path of motion with the rider facing that path.
7. Sides of the skating aid are able to stay upright without fear of falling in on users during setup with the use of lightweight friction tabs.
8. Children are able to sit on the skating aid to tie up their skates reducing the danger of injury of both user and attendant of the skating aid by eliminating the trip from the shack to the rink on skates.

**3. Problem Statement**

Liam has always wanted to skate down the Rideau Canal and his dad has yet to come up with a sufficient solution, so therefore our groups task is to design and build a support that allows Liam to Skate down the Canal with his dad without risk of injury to either of them.

In terms of a solution, David has got a head start with a of couple prototypes that he has tested on the ice with his son and also other kids who also have similar disabilities as Liam. The prototypes worked to a certain degree and allowed Liam to skate with the help of his friends propelling him from behind. Seeing David's prototypes in person, and also videos of them in use was very helpful and helped us imagine some specs and designs we wanted to approach in our design. (Attached at the bottom of this document are some pictures of David's prototypes

[Figure 1-3]) David explained to us that although his design was able to help his son skate, it had a number of faults that needed to be fixed in future designs.

**4. Benchmarking of similar products**

There have been other attempts to solve this problem, which have all failed to fully satisfy the needs of the customers looking for this product. Firstly, the design that was made in 1977, is a “Mobile skating aid for providing support to beginning skaters” [Figure 4]. A design very similar to this is still used today to help beginner skaters learn how to skate, however it does not provide sufficient enough support for kids with disabilities to use on the ice. Next came a design that was made in 1991 which composed of a series of telescoping posts that ran in vertical and horizontal directions, and held in place a seat in the middle of the device. [Figure 5] The problem with this design is that it was very difficult to get the patient into the middle of the device where the seat is located. After that came a design that was made in 2003 which used a frame that surrounded the subject and held them in place with a harness that supported them while skating. [Figure 6] An obvious disadvantage to this design is that it is very large and would be extremely difficult to transport to multiple locations. Lastly comes a design that was made in 2014, which we believe best illustrates something similar to what we plan on designing and building for Liam. This design comprises of 3/4 legs that hold in place a bar which supports a seat that the user can either sit on or stand over, with a telescoping handle bar at the front of the device providing something that the user can hold onto while skating. [Figure 7]

**Pictures of David's prototypes**

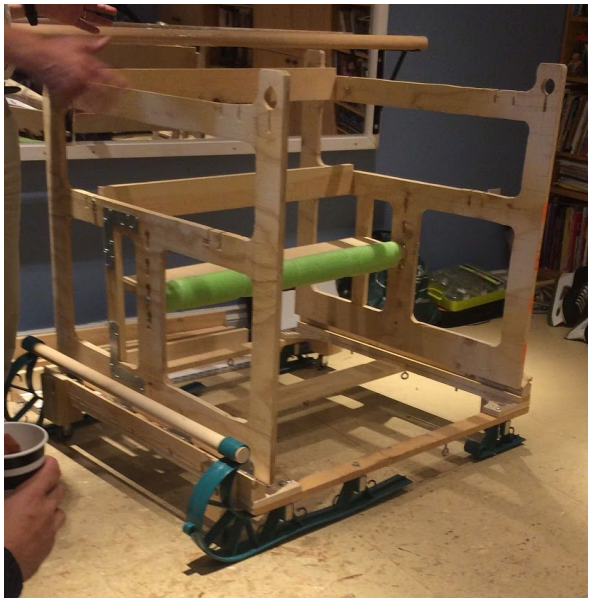

Figure 1 (David's first prototype)

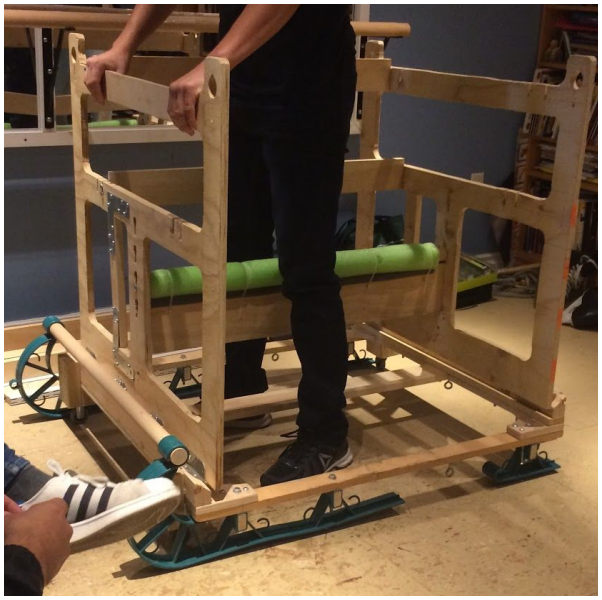

Figure 2 (David's first prototype)

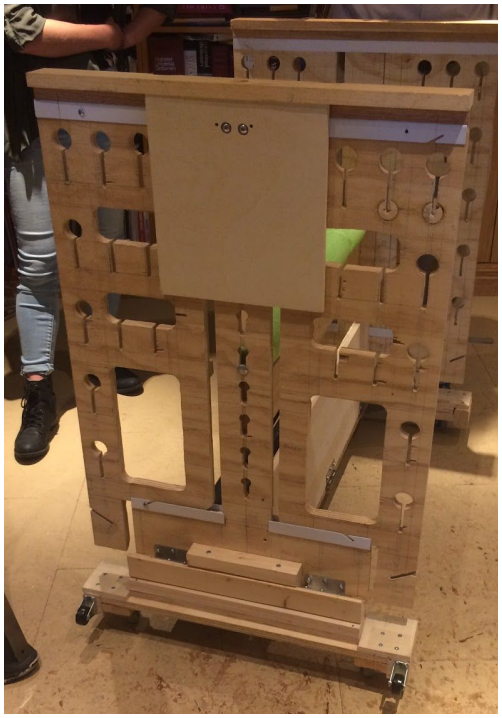

Figure 3 (David's second prototype)

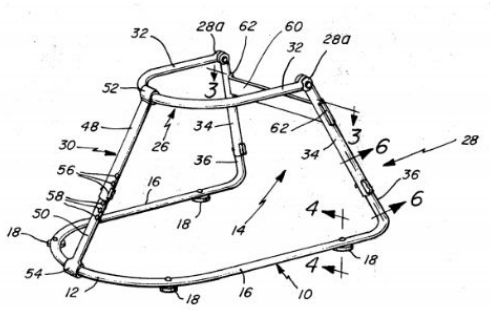


Figure 4

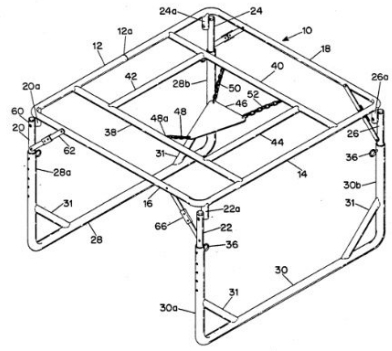


Figure 5

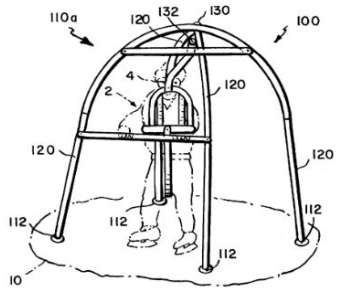


Figure 6

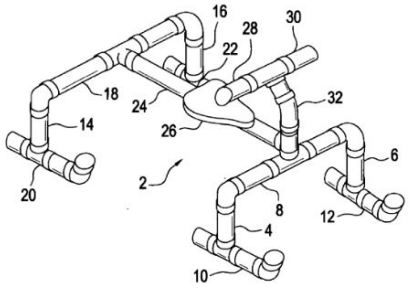


Figure 7

**5. A list of metrics with associated units. Identify which needs each metric address.**

| Metrics | Units | Needs Addressed |
|---|---|---|
| Weight | pounds | The client wants a light product so that it is easy to lift and pull around |
| Sturdiness | pounds | If the user falls the product needs to be able to support their weight |
| Size | cm | The product needs to be small so that it can fit into a small car |
| Time | seconds | The product and features should be able to be assembled quickly |

**6. A set of target specifications (both ideal and marginally acceptable values). Provide reasons for your choices.**

- The product needs to be light (within 15-20 pounds). The client wants a light product that can easily be lifted and placed in the car. He also wants the product to be easy to move around.
- The product needs to be sturdy to support at least 200 pounds. The client wants the product to help prevent the child from falling so the product has to be able to support his weight as well as the momentum the child has while falling.
- The product should be small (about 30cm x 30cm x 10cm) when folded. The client wants the product to be able to fit in a small car then it will have to fold up to a small perimeter.
- The product should take no more than 5 seconds to assemble each feature (adjust height of seat, set up the bench, etc). The client wants an adjustable seat and to be able to have a bench fold up and it would be very convenient if he could do theach of those very quickly.

| Specifications | Ideal | Marginally | Reasons |
|---|---|---|---|
| Light | Less than 15 pounds | Within 5 pounds | Easily to be lifted and placed in the car and to move around |
| Sturdiness | Holds 200 pounds | Within 25 pounds | Able to support his weight as well as the momentum the child has while falling |
| Small | 30cm x 30cm x 10cm | Within 10 cm per side | Able to fit in a small car |
| Easy Set Up | 20 seconds to unfold, 5 seconds per feature | Within 2 seconds per feature | Easy set up so anybody can do it without experience. Adjustable for the user |

**7. Reflection**

The client meeting with David was productive and his contribution to provided us with valuable information. He explained us in detail Liam's background story and the need for a device that can bring him support and allow him to skate down the Canal with someone else without risk of injury to either of them. The insight we gained from David has helped us to narrow our scope on the problem we are attempting to solve, as well as the impact that a product like this would have in the lives of kids with disabilities and their families. Furthermore, this product will help kids to feel more accepted and accomplish tasks that are normal for kids of their age in company of their loving ones, improving the level of safety for them.