GNG2101

Project Deliverable B

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Abstract

In this deliverable, our team has used the data extracted from our client in the form of client statements, to better understand how to develop our product. This was done through translating the aforementioned statements into client needs, then prioritizing them. Through this, we found that our client stressed the importance of a fun and enjoyable experience while riding the bike but did not care too much about the product functionality and mechanisms, as well as longevity. After this, our team defined our problem and analyzed the market through benchmarking, to create an internal standard for form and function of our product, as well as gain an understanding of metrics' range. Furthermore, this helped us develop a list of metrics and target specifications. These concentrated mostly on dimensioning and force withstanding. As such, based on our interview, extrapolation, and research, in the end we reflected on our gaps in knowledge. This allowed us to reflect on our process and understand the next steps our team needs to take into creating our product.

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List of Acronyms

Acronym	Definition
Approx.	Approximately
cm	Centimeters
N	Newtons
LBS	pounds
s	Seconds
m	Meters
Km/h	Kilometers per hour
CAD	Canadian dollar

1 Introduction

Our team was tasked with interviewing the client to extract relevant information, to then be interpreted for the development of our product. The problem our client faces is the inability to use their existing wheelchair with a bike, and therefore they are prevented from having a biking experience. As such, in this day in age, where inclusivity is the standard – and not merely a luxury – it is important to understand the limitations of previous technologies – such as a bike – and to therefore engineer a solution suitable for everyone. In this report, our team will explore the issues conveyed by our client to then interpret need statements, define a problem statement, list metrics, create target specifications and research benchmarking.

2 Client Statements and Observations

Client Statements	Observations
The clients have had little to no experience with an inclusive bike.	
When asked about pros and cons of the inclusive bike, the client had given us the following information: Pros: • Very fun! Cons: • Uncomfortable • Not secured properly allowing for more movement than what they were comfortable with.	Excited expressions when recalling their experience to be fun. From the statements, it is safe to conclude that they want to remain in their chairs while on the bike for comfortability.
When asked about the experience they wished to have while riding, the clients stated: • They want to go fast	One client is nervous about speed but would like the option to go fast when they are more confident on the bike

• See where they are going, be at the front of the bike • Can go on bike paths, specifically by the canal • They want to feel secure and safe riding	
In context of knowing the user experience of the person who is biking, the clients had stated that they would like for the ride to be leisure and relaxing for them as well.	
The clients would like to use the bike as a form of transportation as well as for leisure riding.	
Home storage did not seem to be much of an issue; however, they did mention a van that may transport the bike to a path and therefore the bike should be portable.	
When asked about terrain, they had mentioned not being a fan of sidewalks as they are bumpy	Potential for adding in some shock absorption to prevent the bumpy feeling.
When asked about aesthetics, they said they would also like it to look cool so they can show it off to their friends	
A couple points that were mentioned often were a need for security and that they wanted to remain in their own personal wheelchair for comfort.	

Table 1 Client Statements and Observations

3 Customer Needs Statements

Customer Statements	Interpreted Needs	Priority
I want to have a fun experience	The bike gives excitement to users	3
I want to be comfortable	The user is not moving excessively in their seats, and experiences little vibration	4
Wheelchair is properly secured and safe	The connection from the bike to the wheelchair is strong	4
	There is adequate connection between the bike and wheelchair to ensure the safety and stability of the biker and wheelchair user	5
I want the inclusive bike to be fast	The inclusive bike enables fast biking speeds	3

I want to be at the front of the bike	Place the wheelchair in the front of the bike	4
I want to ride beside the river/bike path	Easy to attach/detach the devise	3
	Product will be able to withstand offtrack terrain such as: trails, biking paths, etc.	3
Not being used on sidewalks because they are bumpy	Product prevents “bumpy” feeling	4
Looks cool when I ride the bike and show it off to my friends	Product looks aesthetically pleasing	1
Van will be used to transport the bike/ will be stored in backyard shed	Product is portable, easy to store, and lightweight	2
Want to remain in their own wheelchair	The inclusive bike will not require the wheelchair user to leave their wheelchair	5
Use it to get place (as a mode of transportation)	Product will sustain long periods of usage and long distances	2
The biker should be at their leisure, do not want them doing additional work/intense exercise	Product enables leisurely experience for all participants	3
	Product eliminates difficulties of bike pushing an additional load (the wheelchair)	4
Some nervousness regarding speed, would like the ability to go fast but not always	Product can achieve variable speeds both fast and slow	2

Table 2 Client Needs Statements

Based on our analysis of the customer interview, we have translated the customer’s statements into customer needs. However, it has showcased some of the gaps in our knowledge in terms of relevant required information. Listed here are some future customer questions we must ask, or information we need to further research:

- Wheelchair metrics: weight, height, measurements of specific components (handles, frame, etc.)
- Model and make of the wheelchair
- Will the person in the wheelchair be using their brakes while biking is happening?
- What manufacturing methods do we have available to us?

- How much force does the connection have to withstand?
- What material should we use?

Additionally, there are some foreshadowed problems we may run into, which are listed:

- If the wheelchair is placed at the front, braking will be difficult and potentially dangerous with the possibility of the bike ramming into the wheelchair (since the wheelchair is heavier)
- Steering is difficult if the wheelchair is at the front since the bike and the wheelchair have different turning radiuses
- The connecting mechanisms must withstand significant load and force, and there is danger with the connection breaking during moments of higher force (braking, acceleration, turbulence, etc.)
- The actual surface connection between the bike and the product must have lots of friction to allow for rotation in unison (same with the product and the wheelchair connection); if it is frictionless, it will not allow for steering. Therefore, specific care must be taken into designing the material and type of connector used.

4 Problem Statement

We must design an attachment to secure a bike and wheelchair together, to allow the user of the wheelchair and biker to experience biking leisurely and safely.

5 Metrics

Metrics	Units	Functional/ Non-functional/ Constraint
Portable Size	Dimension (m)	Functional
Low cost	CAD ($)	Constraint
Strong connection between bike and wheelchair	Force (N)	Functional
Transmits the force from bike efficiently	Force (N)	Functional
Light weight	Weight (Kg)	Functional
Product will sustain long periods of usage, and long distances	Time (s)	Non-functional
Product looks aesthetically pleasing	Survey (1~5)	Non-functional
Product can achieve variable speeds, including slow and fast	Speed (m/s)	Functional
Easy to store	Time to store (s)	Non-functional

Table 3 Metrics

6 Benchmarking

6.1 Fun2Go Side-by-side Bike

Figure 1 Side-by-side

This bike is made for two bikers, where the individuals get to sit side by side, eye to eye, and enjoy biking together. It is not originally made for someone who uses a wheelchair, but it could be easily modified to have this feature.

6.1.1 Key Metrics

Metric	Value
Price	€ 4.968
Dimensions	200cm x 113cm x 113cm
Max speed	20 km/h

Table 4 Side-by-side Metrics

6.1.2 Pros and Cons

Pros:

- User can ride side by side
- Only one person needs to pedal to drive the bike forward
- Can carry up to 120kg per person
- Optional electrical engine to give power assistance
- A unified steering bar (easy steering)

Cons:

- Expensive
- Inaccessible to wheelchair users as it currently is
- Appears difficult to store/ not portable
- Heavy

To conclude, this bike could provide good reference in terms of structural support of a wheelchair to a bike. However, the idea of having it side to side might not be very convenient for the customer.

6.2 Inclusive Bike from a Recycled Bike

Figure 2 Recycled Bike

Figure 2 about is an image taken from a YouTube video where a person has created an inclusive bike from parts of a bicycle and has then attached it to a wheelchair with a bar at the bottom to help with steering and security.

6.2.1 Key Metrics

Metric	Value
Cost	Approx. $180

Table 5 Recycled Bike Metrics

6.2.2 Pros and Cons

Pros:

- Affordable
- Wheelchair does not need to be altered

Cons:

- Hard to disassemble
- Dimensions are not known, hard to use as a size guide
- Would need to make changes to the bicycle
- Hard to store
- Unsure how design would work with a motorized chair

Overall, the concept is going in the right direction, but the execution would have to be changed to fit the needs of our client.

6.3 Vanraam Opair Wheelchair Bike

Figure 3 Opair Bike

The Opair is a wheelchair bike with which you can transport a wheelchair user. A seat for the wheelchair user/passenger is affixed to the front of the bike. From the back, the cyclist has an overview on the road and view of the passenger. The front part is easy to remove from the cycling component, which enables use as a wheelchair on location. The slightly angled front wheels provide increased driving comfort and stability. The depth adjustable seat of the OPair can be set to the passenger's measurements as well as the angle adjustable back rest and expandable side rests.

6.3.1 Key Metrics

Metric	Value
Price	$6766.64
Frame size	52 cm divisible
Colour	Blue grey matte

Table 6 Opair Bike Metrics

6.3.2 Pros and Cons

Pros:

- Adjustable seat
- Suitable for children and adults
- Fits through a normal door
- The front part is detachable and can be used as a wheelchair
- Comfortable and stable
- Optimal sitting position for driver
- Possibility for own orthotic seat
- Collapsible and adjustable footrest for passenger
- Pedal support is possible (smart e-bike)

Cons:

- The bike is made specifically for this wheelchair and cannot be used on different models
- Expensive

Overall, the design and features of this bike closely resemble the ideas for our design. We would just need to modify it to fit the wheelchairs of our clients and remove some of the more superficial features to lower the overall cost.

6.4 Curt 45155 2” Fusion Ball Mount with 2” Welded Ball

Figure 4 Ball Mount

This device is used as a connection between a trailer and a car.

6.4.1 Key Metrics

Metric	Value
Cost	$53.95

Material	Alloy steel
Colour	Grey

Table 7 Ball Mount Metrics

6.4.2 Pros and Cons

Pros:

- Easily attach and detach
- Low cost
- Small enough to store
- Stable connection
- Corrosion resistant

Cons:

- No option for design
- Wheelchair will be placed behind the bike

This product is the most commonly used design to carry things like camping cars and trailers behind cars. Stability and steering have already been verified. It is worth benchmarking if our final product would place the wheelchair behind the bike.

7 Target Specifications

Metric	Marginal Value	Ideal Value	Unit
Size	100-110 X 55-65 X 85-95	105 X 60 X 90	cm

Cost	150-300	150	CAD
Weight	15-20	15	LBS
Lifespan	30+	30+	Years
Speed	0-30	0-20	Km/h
Material	Aluminum Frame, rubber tires	Aluminum frame/ acrylic frame, rubber tires	N/A
Maximum Force	1000-1300	1300	N

Table 8 Target Specifications

8 Client Meet Reflection

The client meeting helped our team greatly in narrowing down target specifications and the needs of our clients. From the meet, we have discovered the level at which they wanted to participate in the actual movement of the bike which helped to eliminate some concepts from benchmarking and steer towards more specific ideas. We know that they would like to be at the front of the bicycle which helped to specify where to attach our design. This may come as a challenge when we are working on steering mechanics, yet it is best to know now so we can do benchmarking on steering objects in a pushing movement instead of pull. We also, found that they want to have a leisure ride for their staff as well who would be riding the bike, that would mean that our design would be more efficient if it was self-propelled. Some information from the clients remains unknown to our team. We discussed that the design of the inclusive bike should be aesthetically pleasing, it would be helpful to know later into the process if they have a favourite colour or design that could be incorporated in. It would also be helpful to know the model of their chairs so we can do research as a basis for force and size requirements of our design. Overall, the client meeting was successful, and our team is excited to continue to work with the clients to create a product that they will enjoy.

9 Conclusions and Recommendations for Future Work

In this report, we have interviewed our clients to find out their needs. It was a great opportunity meeting the actual clients face to face. In this interview, emphasizing was important. Our client has totally different identity than our team. This experience is meaningful for future work too. Then, we translated the client's statements into the actual technical needs and defined the problem statements as simple and abstract as possible. Based on the metrics defined in section 4, we specified the target. And made the list of other products for benchmarking. Also listed the pros and cons of those products. All team members have participated in our project and successfully done the deliverable B.

10 Bibliography

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APPENDICES

No additional information to be added to this document.