Project Deliverable B: Needs, Problem Statement, Metrics, Benchmarking and Target Specifications

Professor: Rubina Lakhani

Submitted by: Section A02, Group 04
Yendra Yogarajan - 300239233
Gurjot Grewal - 300263760
Brian Bulitka - 300248903
Matej Mincev - 300056451
Kevin Zhang - 300104907

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1.0 Introduction

At this stage of the design process, it is important to carefully listen to the client's needs so that their problems can be fully comprehended. Our first client interview, which took place this past week, was a success in that we were able to actively recognize their feelings, behaviours and thoughts towards the issue at hand. This will firstly help us define a list of interpreted customer needs that are to be met; we can then prioritize them from the most significant to the least. Next, our team will develop a problem statement that highlights what the problem is and who has it, while also envisioning a potential solution that can be implemented. Furthermore, a measurable set of metrics based on the clients' needs will then be defined. Using these metrics the team will conduct benchmarking of current solutions present in the market. Using the metric and benchmarking knowledge, we will create a list of target specifications that our group will aim to meet, either ideally or marginally. Finally, we will reflect on the process and establish any missing information that we may need to obtain in the future.

2.0 Client Statements

The first step in the process is to determine a list of statements and observations that were obtained during the interview with the client. Empathizing with the client is the crucial step here, as our team aims to understand the problem from their perspective.

#	Client Statements
1	It would be a pretty cool experience to try out something new
2	I just want to have fun riding the bike
3	The device would give us another way to get around instead of taking OC Para Transpo
4	We don't have a vehicle to get around
5	We would like to bike on the road and by the river
6	We might possibly be doing some types of daily tasks in the bike
7	We are open to any new ideas that you can propose
8	We would like to have lights and a bell for aesthetics, and a bright orange flag for safety
9	We would like to be able to bike on a possibly hilly terrain near our house

10	The device needs to be attached to the wheelchair
11	We want the device to be red
12	The device needs to be sturdy and secure
13	Any modifications to the wheelchair or the bike are not allowed
14	We want to be in the front, so we can help direct the staff on where to go and can see directly ahead of us
15	We don't want the assembly process to be complex, a duration of around 5 minutes is fine

Table 1: Client Statements based on the Interview

3.0 Customer Needs

Next, we will put together a list of translated customer needs based on the statements presented above. The importance of each need will also be emphasized in this part of the deliverable, as some needs are more crucial than others. We will use a ranking scale from 1 to 5, where 5 is the most important while 1 is the least.

#	Needs	Importance
1	The device allows the rider to be moved in a safe manner	5
2	The device and users are visible at night time	5
3	The device is able to help move the wheelchair in slightly bumpy or hilly terrain	3
4	The device is assembled quickly and simply	3
5	The device has the wheelchair user sitting at the front	4
6	The device does not require permanent modifications	5
7	The device is aesthetically pleasing	2
8	The cost of the device does not surpass the maximum budget allocated for this project	3
9	The device is able to support the user's weight	3
10	The device is compact in size	2

11	The device is lightweight	2
12	The bike and device assembly can be an alternate means of transportation to the wheelchair	1

Table 2: Translated Customer Needs based on the Client Statements

Although a lot of valuable and insightful information was gained during the interview with the client, there do remain some unknown details which would need to be figured out. The type of bike the customer intends to use, as well as the overall size of it, are important to understand as this may help with a mathematical analysis when designing the prototype, for example. We would also need to comprehend what the available storage is for the device, and also whether the client has any specific maintenance requirements for it. Furthermore, obtaining the exact wheelchair dimensions is also a helpful piece of information, since this would have an impact on the manner in which we design, build and test our prototype. As we move forward, we may encounter other unknown information that is relevant to the project, and we will be sure to reach out to the customer to acquire these details.

4.0 Problem Statement

This will now lead us to define the problem statement at hand. This statement will accurately describe who has the problem and, more specifically, what the problem is. This is crucial to understand at this point in the design process, as it will help us to envision an eventual final solution to this design issue.

Our problem statement is as follows: “There is a growing desire for wheelchair users to be able to enjoy a common leisure activity such as riding a bike. There is a need for an attachment-based device that connects a typical bike to a wheelchair, without making any permanent modifications.”

5.0 Metrics

Metrics, a set of design criteria based on quantifiable units of measure, will now be determined so that they can be used to benchmark with competitive products and establish target specifications. In this section, we will also link the above needs to each metric, while determining whether each metric is functional or non-functional. A key attribute that the group uses here is critical thinking, as we are showing that we can analyze, process and synthesize information.

#	Link to Need #	Metric	Importance	Functional or Non-Functional	Units
1	8	Cost	3	Non-Functional	$ (CAD)
2	11	Attachment Weight	3	Functional	kg
3	9	Maximum User Weight	3	Functional	kg
4	10	Footprint Size	2	Functional	cm^3
5	1, 2	Maximum Safe Speed	5	Functional	km/h
6	4	Assembly Time	3	Functional	mins
7	7	Aesthetics	2	Non-Functional	Subjective
8	1	Material Tensile Strength	4	Functional	MPa
9	2	Visibility (distance)	5	Functional	m

Table 3: List of Metrics based on Customer Needs

6.0 Benchmarking

The next stage is to research competitive products and to compare our design criteria to these other existing designs in today's market. These solutions can be products that satisfy some or even all of the customer needs presented previously. We will benchmark on metrics based on six different competitive products, while also including images and brief descriptions of these solutions on the market.

#	Name	Image of product	Website	#	Name	Image of product	Website
1	**Burley Flatbed Cargo Trailer**		Product 1	5	**Flex-Nexus 8 - Wheelchair Cargo Bike - 2021**		Product 5
2	**The Duet Wheelchair Bicycle Tandem**		Product 2	6	**Roam Twinbike Plus UK**		Product 6
3	**Trail-Gator Trailgator Bicycle Tow Bar**		Product 3	7	**OPair Wheelchair bike**		Product 7
4	**VeloPlus Wheelchair Bike**		Product 4 and Product 4	-	-	-	-

Table 4: Competitive Products Legend

Metric	Need	Metric	Importance	Units	Product 1	Product 2	Product 3	Product 4	Product 5	Product 6	Product 7
1	8	Cost	3	$ (CAD)	380	5345	115	7210	8250	5525	5875
2	11	Attachment Weight	3	kg	6.6	39.4	3.2	64	N/A	45	58
3	9	Maximum User Weight	3	kg	45	125	32	200	120	N/A	120
4	10	Footprint Size	2	cm^3	270 354	N/A	6261	1 447 160	2 341 350	1 966 500	731 880
5	1, 2	Maximum Safe Speed	5	km/h	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6	4	Assembly Time	3	mins	5	3	7	2	2	5	4
7	7	Aesthetics	2	Subj	7	5	7	9	9	5	7
8	1	Material Tensile Strength	4	MPa	400	655	655	400	655	400	400
9	2	Visibility (distance)	5	m	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 5: Benchmarking based on Competitive Products

Note: Metrics listed with “N/A” were those metrics which were unable to be found in the product descriptions.

7.0 Target Specifications

After benchmarking based on six existing, similar products, target specifications will be created based on that analysis. The ideal value is based on our main target that we would like to approach as close as we possibly can, and the marginal value is the specification that is mandatory for our design to attain.

Metric #	Metric	Units	Marginal Value	Ideal Value	Reasons
1	Cost	$ (CAD)	200	150	This is based on the budget limit in the project description that was provided to us, as well as benchmarking current products on the market.
2	Attachment Weight	kg	6	4	This is based on benchmarking the current products on the market.
3	Maximum User Weight	kg	50	90	This is based on the average weight of an adult.
4	Footprint Size	m^3	1	0.5	This is based on the client's request to have a compact device.
5	Maximum Safe Speed	km/h	10	15	20 km/h is around an average to slow cycling speed. We picked these values by taking into account two people being cycled around by one person.
6	Assembly Time	mins	15	5	We took into account the client's experience with tools and general assembly.
7	Aesthetics	Subjective	6 out of 10	9 out of 10	This is subjective, as it is based on the opinions of the client and the design team.

8	Material Tensile Strength	MPa	300	400	This is based on the Ultimate Tensile Strength (UTS) of steel, which is a material that we could potentially use for the design of the device.
9	Visibility (distance)	m	15	20	This is based on the braking distance of a vehicle in a typical residential area.

Table 6: Target Specifications based on Ideal and Marginally Acceptable Values

8.0 Client Meet Reflection

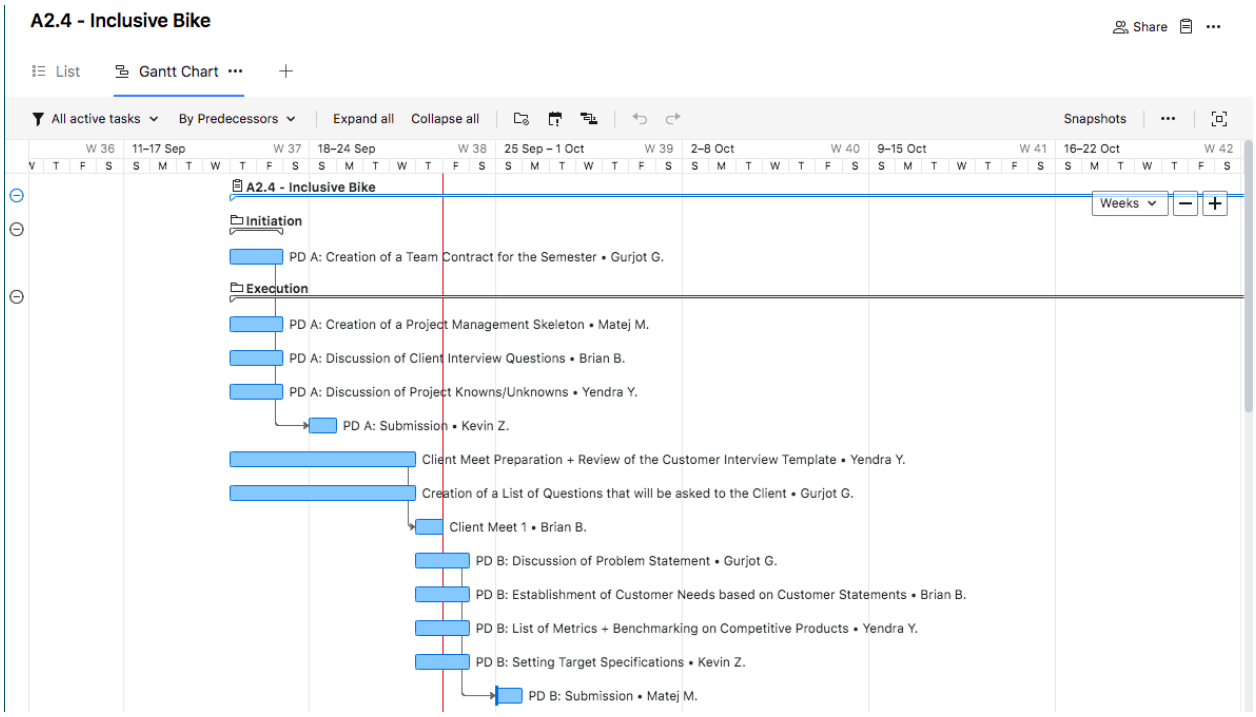
The client meeting has taught the group many new things. The opportunity to interview the customer has given the team a deeper understanding of the client's needs and has also helped us empathize with the customer. The main pieces of important information we have learned include the client's main goals and desires with regards to the functionality of the device, as well as its associated aesthetics. They want to experience the joy of biking while also having a secondary means of transportation if this is required.

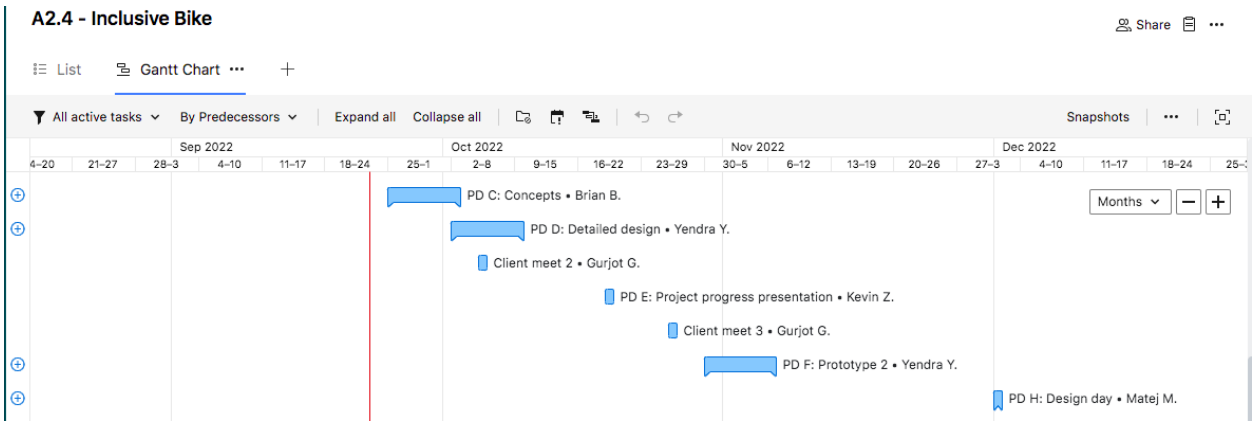
The meeting was very insightful, however some information still remains unknown. As mentioned previously, these include the type and size of bike that the client has, storage space for the device, specific maintenance requirements and exact wheelchair dimensions. We plan to clarify all of these unknowns during the next client meeting.

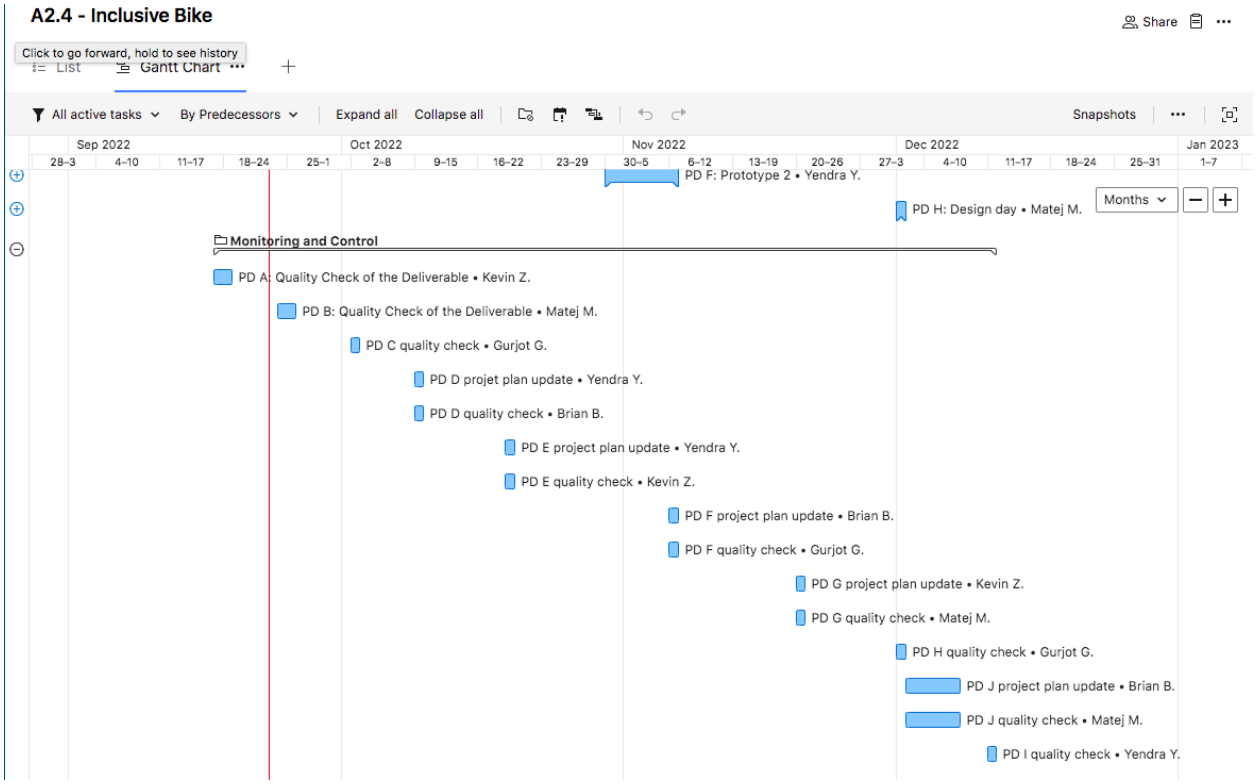
9.0 Conclusion

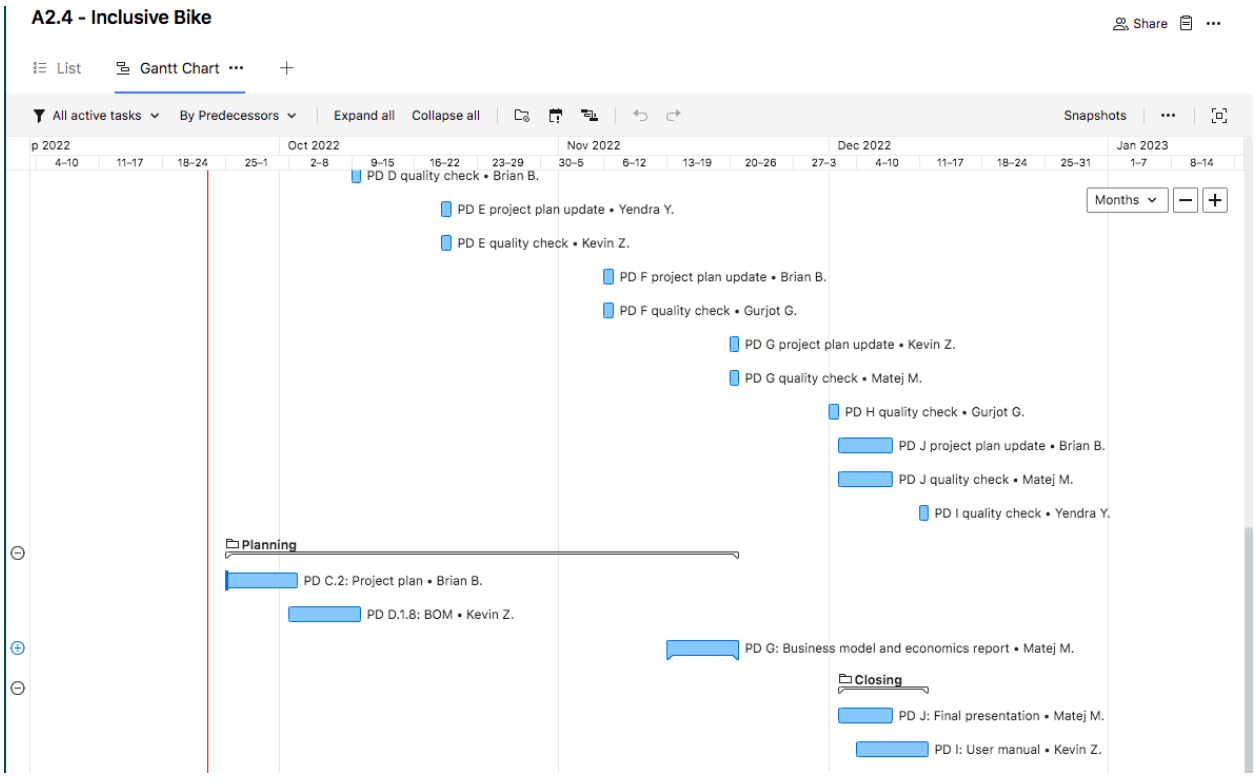
The client wants a wheelchair-bike attachment that can allow them to be biked around safely. After the client meeting, a lot of valuable information was brought to the attention of the team. With all this newly acquired knowledge, and learning about the current market options, the team is now ready to start initial conceptual designs, and to lay out a project plan to get the design task started. Once put into action, this idea can revolutionize the way wheelchair users get around in their day-to-day lives.

10.0 Wrike Gantt Chart Screenshots






A2.4 - Inclusive Bike
Share
Click to go forward, hold to see history
List
Gantt Chart
All active tasks
By Predecessors
Expand all
Collapse all
Snapshots
Sep 2022
Oct 2022
Nov 2022
Dec 2022
Jan 2023
28–3
4–10
11–17
18–24
25–1
2–8
9–15
16–22
23–29
30–5
6–12
13–19
20–26
27–3
4–10
11–17
18–24
25–31
1–7
PD F: Prototype 2 • Yendra Y.
PD H: Design day • Matej M.
Months
Monitoring and Control
PD A: Quality Check of the Deliverable • Kevin Z.
PD B: Quality Check of the Deliverable • Matej M.
PD C quality check • Gurjot G.
PD D projet plan update • Yendra Y.
PD D quality check • Brian B.
PD E project plan update • Yendra Y.
PD E quality check • Kevin Z.
PD F project plan update • Brian B.
PD F quality check • Gurjot G.
PD G project plan update • Kevin Z.
PD G quality check • Matej M.
PD H quality check • Gurjot G.
PD J project plan update • Brian B.
PD J quality check • Matej M.
PD I quality check • Yendra Y.


A2.4 - Inclusive Bike
Share
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Gantt Chart
All active tasks
By Predecessors
Expand all
Collapse all
Snapshots
p 2022
Oct 2022
Nov 2022
Dec 2022
Jan 2023
4–10
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25–1
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6–12
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4–10
11–17
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8–14
PD D quality check • Brian B.
Months
PD E project plan update • Yendra Y.
PD E quality check • Kevin Z.
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PD G project plan update • Kevin Z.
PD G quality check • Matej M.
PD H quality check • Gurjot G.
PD J project plan update • Brian B.
PD J quality check • Matej M.
PD I quality check • Yendra Y.
Planning
PD C.2: Project plan • Brian B.
PD D.1.8: BOM • Kevin Z.
PD G: Business model and economics report • Matej M.
Closing
PD J: Final presentation • Matej M.
PD I: User manual • Kevin Z.

11.0 References

"Burley Flatbed Cargo Trailer | MEC." *Mountain Equipment Company*, www.mec.ca/en/product/5041-117/flatbed-cargo-trailer?colour=Black. Accessed 23 Sept. 2022.

"Duet Wheelchair Bicycle Tandem | ESpecial Needs." *Www.especialneeds.com*, www.especialneeds.com/shop/mobility/duet-wheelchair-bicycle-tandem.html. Accessed 23 Sept. 2022.

Inc, SmartEtailing. "VanRaam Velo plus (Wheelchair Transporter) - Moboevo." *Www.moboevo.com*, www.moboevo.com/product/vanraam-velo-plus-wheelchair-transporter-4143.htm. Accessed 23 Sept. 2022.

"Nihola Flex - the Cargo Bike for Wheelchair Users – Curbside Cycle." *Curbsidecycle.com*, curbsidecycle.com/products/flex-1. Accessed 23 Sept. 2022.

"OPair." *Van Raam*, 2017, www.vanraam.com/en-gb/our-bikes/wheelchair-bike/opair. Accessed 23 Sept. 2022.

"Side by Side Wheelchair Tandem Bike Twinbike plus Roam." *Www.ashfieldspecialneeds.co.uk*, www.ashfieldspecialneeds.co.uk/side-by-side-wheelchair-tandem-bike.html. Accessed 23 Sept. 2022.

"VeloPlus." *Van Raam*, 2022, www.vanraam.com/en-gb/our-bikes/wheelchair-bike/veloplus. Accessed 23 Sept. 2022.