GNG2101

Design Project Progress Update

GROUP #14

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Table 2. Glossary

Term	Acronym	Definition

1 Introduction

In this document, we will first develop a business plan to identify a suitable business model for the transformation of our prototype into a product. Our focus includes the development of a business model canvas, an analysis of potential social and economic impacts, and the identification of five critical X factors essential for product development.
The second objective involves an examination of the problem definition and concept development processes. The goal is to formulate a well-structured plan ensuring the timely completion of multiple prototypes, aligning with the ultimate showcase on Design Day. The final objective in this document is to delve into the specifics of the design. These specifics include the bill of materials, the detailed design for two separate prototypes, a time estimate of how long these prototypes will take to complete, resources available for the creation of these prototypes, and the critical assumptions of the designs in the context of mass production. These objectives resonate together to initialize the prototyping and testing process of the design.

2 Business Model Canvas and DFX

Business model and sustainability report

1.

Identify and describe your value proposition that would be well suited to commercializing your team's product. Discuss the reasons for your choice.

Value Proposition: Makes ice skating accessible and comfortable for older youth, adults and elders experiencing foot fatigue and needing supportive and adjustable skates.

Reason: We decided to not only market these skates to people who use orthotics but more generally to anyone who can't usually use regular skates due to any other medical conditions. By doing so, these skates provide value through accessibility since it opens the opportunity for people who can't usually participate in ice skating, to be able to with these skates.

2.

Fill in a triple bottom line business model canvas by answering the how, what, who and how much of your chosen business model.

Table 3: Triple Bottom Line Business Model Canvas for Bob Skates

Customer Segment	Individuals focusing on older youth, adults and seniors who use orthotics and are unable to use regular skates. Possibly also people looking for double-bladed ankle support when ice skating.
Customer Relationships	Self-Service Relationship: customer can buy these bob skates off the website or try them on in-store on their own. These skates are designed to be adjustable both width and lengthwise, so they don't need to be customized for them specifically.
Channels	Website, sports stores and department stores.

Value Propositions	Makes ice skating accessible and comfortable for older youth, adults and elders experiencing foot fatigue and needing supportive and adjustable skates.
Key Partners	Sports stores, department stores, manufacturers
Key Resources	Manufacturers, advertising, designers, customer service representatives
Key Activities	Customer feedback and skate improvements, manufacturing, marketing, selling, and distributing
Revenue Streams	Sales revenue from direct purchase of skates, additional accessories, maintenance kits and warranty options.
Cost Structure	Manufacturing, advertising, distribution, employee salaries, loan interest etc.

3.

Describe the core assumptions that you have made in developing your business model canvas and comment on its feasibility. Important: These core assumptions should be based on the business model you have chosen and not on your prototype (e.g. what type of clients do you assume your product will attract?).

Table 4: Business Model Canvas Assumption Feasibility Assessment

	Feasibility
Customer Segment	**Feasible.** When benchmarking we found that double-bladed bob-skates larger than size 13 kids are not offered anywhere in the market and meeting with our client we learned that there is a market out there seeking a product like ours.
Customer Relationships	**Feasible.** Since our skates are adjustable, they can work with almost any size length and width size. Since we are also hoping to sell these in store, people can try them on for themselves as well.

Channels	**Feasible.** Having a website specific to our product will act as a central hub for any information customers are looking for and will make it easy for them to purchase as well. However, it's also important we sell them in sports and department stores to make our product more accessible and to expand our outreach. This is also feasible since these stores are known for selling skates and most customers will check there first for what they are looking for.
Value Propositions	**Feasible.** Since our product is aimed at a niche community that does not have any options like this available in the market today.
Key Partners	**Feasible.** Having a partnership with a manufacturer is important to produce and ensure the quality of our product. Furthermore, forming partnerships with retailers, such as sports stores, is important for strengthening our market presence and will help with the success of our product.
Key Resources	**Feasible.** Having manufacturers, advertising, distribution channels and customer service representatives are all crucial to the success of any product-based business. Good management of these resources will decide the success of our business.
Key Activities	**Feasible.** Since our product is aimed towards such a niche market, the feedback we receive from our customers is one of the most important things to consider in our product. Also manufacturing, marketing and distribution are important as stated before.
Revenue Streams	**Feasible.** If we focus on the marketing and distribution of our product, it is feasible that we receive profits from direct sales and product add-ons such as accessories.
Cost Structure	**Feasible.** This is a basic cost structure for a business and has proven to be successful in the past.

4.

Provide a sustainability report that reflects on at least two of your product's major social, environmental, and economic impacts, both positive and negative. Perform a simple analysis of these impacts and use this analysis to help you fill in the triple bottom line of your business model canvas.

Sustainability Report:

One of the major social impacts our product will have will be empowering and creating accesiblity for individuals who must use orthotics or any other sort of foot support. This product will empower these individuals by enabling them to participate in activities with regard to ice-skating that they otherwise would not be able to participate in. A way to measure this empowerment could look like us asking individuals of the amount of pride they feel while wearing and using these skates.

One of the major economic impacts our product will have will be the jobs that it creates. Not only will we all have to participate in the development of this product, but we might also have business partners. For example, we may have to partner with a manufacturing company to use their equipment. We could also partner with retailers to help advertise our product in their stores if need be. We can measure the number of jobs created by simply keeping track of all the individuals we have working for us.

However, a negative impact affecting both the social and economic aspects of our business model could be the affordability of our product. We need to price our products in a way that we can pay for all the expenses needed to produce and market but also make a decent revenue stream from them. This could mean pricing our products higher which limits how accessible this product is for our customers. This can also ultimately affect how much profit we make from the product if less people are buying it.

Design for X

1. Based on your research and what you have heard from your client, list the 5 most important factors in your design. Justify the choice of each of those factors.

1. Manufacturing – The product must be manufacturable with existing machining processes. The manufacturing process should be efficient, cost-effective, and environmentally friendly. Materials should be readily available.
2. Accessibility – The product should aim to allow those with disabilities to partake in the actions of able-bodied people without experiencing discomfort. The design should be suitable and accessible for children aged 7 and above.
3. Functionality – The product should function as intended. The bob skates should provide smooth and stable gliding for young users. Safety features, such as adjustable straps and reliable braking mechanisms, should be incorporated.
4. Adjustability – The product should be adjustable to accommodate people of different shoe sizes. The skates should be adjustable to a range of 6 inches, so its adjustable to accommodate various foot sizes.
5. Durability – The product should be durable enough to last for an appropriate amount of time.

7 Problem Definition, Concept Development, and Project Plan

Problem definition

1.List and prioritize client needs/problems and define all relevant known and unknown information.

Table 5: Client Needs/Problems

Problem	Interpreted Need	Type

Client's daughter cannot fit into traditional skates due to her orthotics.	There is a need for an alternative approach to traditional skates.	Functional
The client's daughter is unable to balance on single bladed skates because of her disability.	The skates need to provide extra support for maintaining balance.	Functional
Client's daughter was dragging her feet with the previous pair.	The skates need to be lightweight.	Non-Functional
The client's daughter will need to replace her skates as her foot size grows.	The skates need to be adjustable.	Functional
The previous bob skates that the client's daughter used were only adjustable to a certain length which no longer meets her foot size	There is a need for larger size skates.	Non-Functional

Other Relevant Information

Client has shown interest in the product having the same design as the bob skates that his daughter previously used.

Implied need based on the nature of the product

- Durability
- Weight capacity
- Appearance/Aesthetics
- Affordability

Table 6: Needs Prioritization

Interpreted Need	Priority	Justification
There is a need for an alternative approach to traditional skates.	High	High priority because our client is unable to use regular skates because of their orthotics.
The skates need to provide extra support for maintaining balance.	High	High priority because if the skates were not supportive, our client would be completely unable to use them.
There is a need for the skates to be lightweight.	Medium	Medium priority because our client mentioned that they would prefer the skates to be a bit lighter than the previous ones, but that they were still usable.
There is a need for the skates to be adjustable.	Medium	Medium priority because it would be convenient for the skates to grow as the client grows but would still be functional if they were not.
There is a need for larger size skates.	High	High priority because our client's biggest problem is that larger sized bob skates are not available to buy – this is the whole point of our design.
There is a need for the skates to be durable.	Medium	Medium priority because our client did not mention this as a problem, but it is necessary for safe use.

There is a need for the skates to have a sufficiently high weight capacity.	Medium	Medium priority because our client did not mention this as a problem, but it is essential for safe use.
There is a need for the skates to have an appealing appearance.	Low	Low priority because our client did not mention this as a problem, and it does not contribute to functionality.
There is a need for the skates to be affordable.	Low	Low priority because our client did not mention this as a problem, and it does not contribute to functionality.

2.

Create a problem statement (what is the problem, who has the problem, and what form can the solution be).

Problem Statement

The client's daughter needs skates large enough for her current foot size that are lightweight, provide additional support, are adjustable, and are built to withstand the challenges of winter play.

3.

Provide a list of need inspired metrics with appropriate units, and conduct benchmarking on similar solutions (can satisfy some or all needs). Provide descriptions and pictures when possible.

Table 7: Metrics

Need	Metric	Units
There is a need for larger size skates	Size	inches
There is a need for the skates to be durable.	Durability	Years
There is a need for the skates to be lightweight.	Total weight	lbs.
There is a need for the skates to be affordable	Cost	$CAD
There is a need for the skates to have a sufficiently high weight capacity.	Weight capacity	lbs.
There is a need for the skates to be adjustable.	Adjustability	inches
There is a need for support for maintaining balance.	Balance Support	Yes/No

Table 8: Benchmarking

Picture of product	 **Figure 1: Amazon Youth Bob-Skates**	 **Figure 2: Amazon DUWIN Ice-skates**	 **Figure 3: Amazon SKATEEZ**
Product link on Amazon	Link	Link	Link
Size	19.51 x 9.09 x 8.1 cm	25.91 x 1.48 x 38.99 cm	n/a
Weight	526g	1.63kg	209g
Cost	30.99CAD	66.99CAD	39.99CAD
Adjustability	7.5 inches	8.5 inches	NA
Balance support	Yes	No	Yes

Benchmarking results:

Considering client needs, the bob skates are the best option. Despite the size of the bob skate design, we can adjust them to be larger. The reason as to why the Skateez are not the optimal design is because they would require ice skates which our client does not have because of the difficulties of her orthotics fitting. As such, the strap on design of bob skates is optimal as the client does not need to wear traditional skates.

4.Develop a set of target specifications (both ideal and marginally acceptable values). Provide reasons for your choices.

Table 9: Target Specifications

Metric	Units	Ideal specification	Acceptable specification
Size	inch	7.5inches	>6 inches
Durability	Years	5 years	>2 years
Total Weight	kg	0.4 kg	<0.5 kg
Cost	CAD	<$75	<$100
Weight capacity	kg	80kg	50kg
Adjustability	inches	6 inches	5 inches
Balance Support	Yes/No	Yes	Yes

Table 10: Explanation Table

Metric	Units	Ideal specification	Acceptable specification
Size	inches	8 inches in length when not extended. A typical size 13 shoe for children is around 8 inches in length. To accommodate for growth over time however, it is important that the skates are adjustable past our client's daughter's current shoe size.	Having this product be greater than 6 inches will still ensure that the product is usable by the client's daughter considering the product will be adjustable.
Durability	Years	The Product should be able to last for at least 5 years. This time frame was given because of how we estimated how long the skates would be used for.	Having the product last more than 2 years at the very least can be an acceptable standard seeing as this product will be unique and its life cycle may be unexpected.
Total Weight	kg	The weight of the product should not exceed 0.4kg so that the clients daughter is able to move easily in the bob skates.	If the product is less than 0.5 Kg, then the client's daughter should still be able to lift her feet off the ground while skating.
Cost	CAD	The Product cost should not be greater than the budget for the design project this term. We are being given $75 for the project this term.	If need be, our team will utilize resources of our own to develop this product. However, we do not plan on spending more than $25 dollars over our product budget.

Weight capacity	kg	The youth bob skates should have a weight capacity that ensures durability and safety for a range of users. This capacity should be well above the average weight of the target age group.	The weight capacity should at least meet industry standards for safety and should accommodate the intended user without compromising the overall stability and performance of the skates.
Adjustability	inches	The aim is to be able to extend the skate 6 inches past its base value, so a fully extended skate would be 14 inches in length.	Extending the skate by at least 4 inches past its base value, making it 12 inches in length when fully extended.

Concept development

1.Based on your problem statement, develop final prototype concepts for each sub-system, as well as the entire assembled system required to solve the problem.

Table 11: Sub-system - Blades

Image	Description

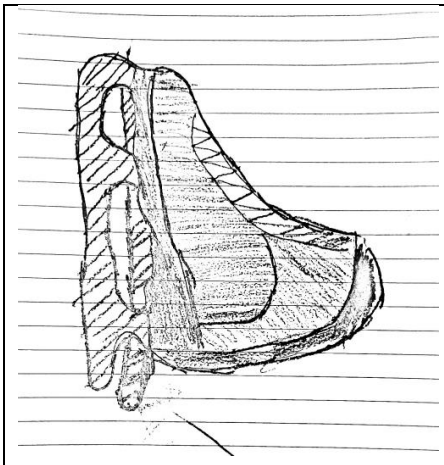
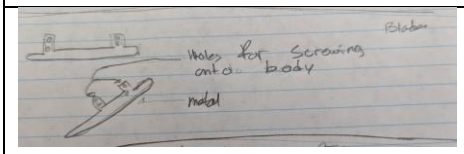
 **Figure 4: Sketch of Blade Sub-System Idea 1**	Concept of double blades: Featuring two blades in the design will ensure that the user has plenty of support for their ankles.
 **Figure 5: Sketch of Blade Sub-System Idea 2**	Concept for bob skate blades. The design is meant to be easily replaceable should the blades become damaged and for easy storage. It would be attached to the bob skate's base by screws that would hold the skate onto the base.

Table 12: Sub-system - Body

Image	Description

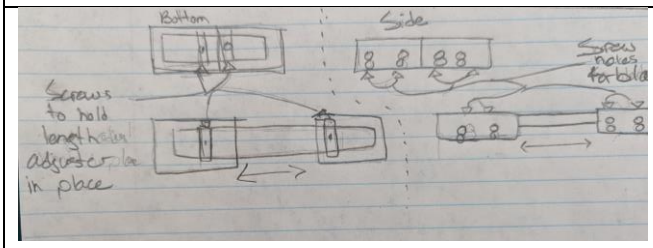
 **Figure 6: Sketch of Body Sub-System Idea 1**	Concept to make putting the skates on easier: A shoe whose top opens with a zipper to allow more room for the feet of the user.
 **Figure 7: Sketch of Body Sub-System Idea 2**	Concept for base of bob skate, it is similar to pre-existing designs the only difference being that it would be made for a bigger foot.

Table 13: Sub-System - Straps

Image	Description

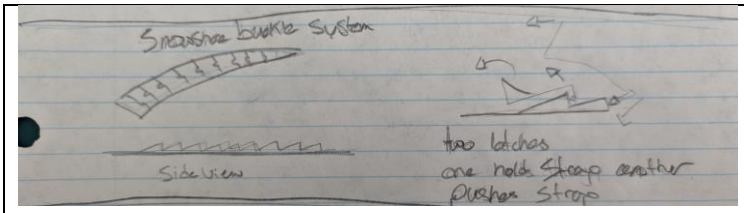
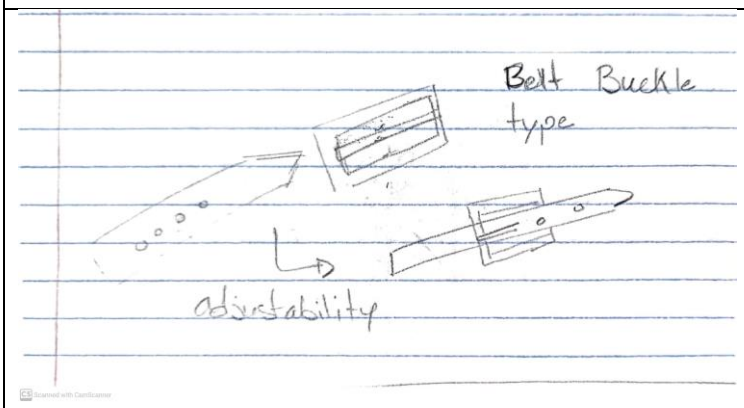
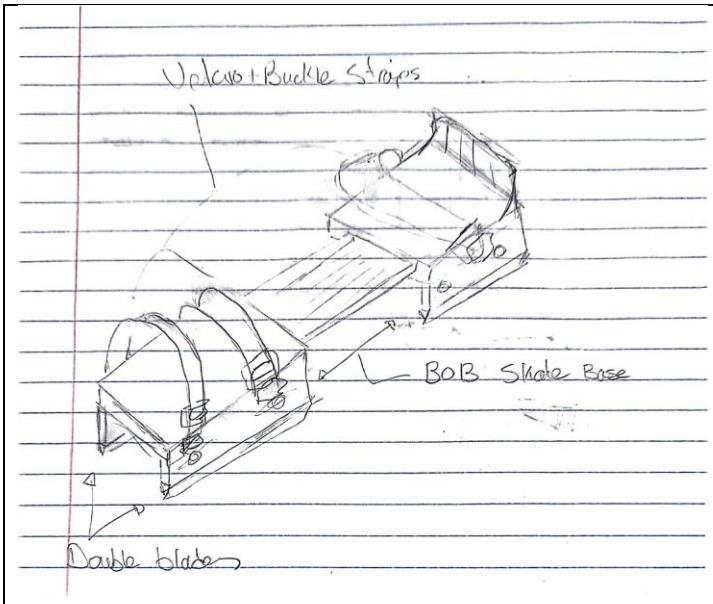
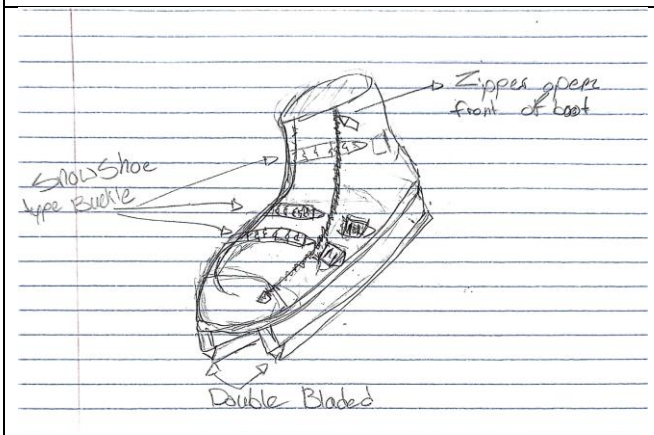
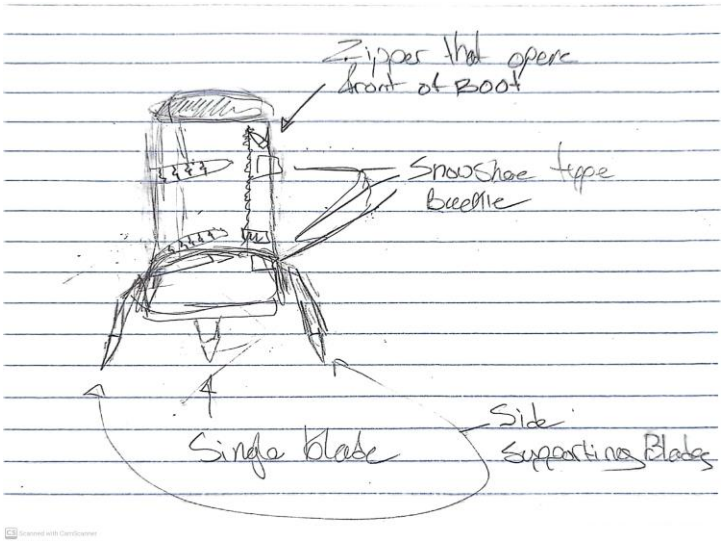
 **Figure 8: Sketch of Strap Sub-System Idea 1**	Concept for buckle type system to hold foot in place on bob skates. Inspired by the straps some snowshoes use to secure foot
 **Figure 9: Sketch of Strap Sub-System Idea 2**	Belt buckle type strap for the skates that would allow tightening of a foot into the skates. The strap would be made from a tough fabric that has holes along the centre and the buckle and pin would be metal.
 **Figure 10: Sketch of Strap Sub-System Idea 3**	The strap is made of a synthetic fabric with velcro on one side. The strap can be run through a plastic buckle and attached to the other side of the strap using the velcro.

Table 14: Entire Assembled System

Image	Description

 **Figure 11: Sketch of Assembly Idea 1**	The assembled system in this drawing is made of three parts which are the Bob skates base, The double blades, and straps using velcro and belt buckles. The Bob skate base and the Straps are highly adjustable and the double blades provide stability to the wearer of the skates
 **Figure 12: Sketch of Assembly Idea 2**	This assembled system depicts a boot using the straps seen on snowshoes as well as the zipper seen on "Billy shoes" so that the front of the shoe can move forward making it easier to put on. The bottom of the Boots has two skate blades for providing support to the wearer.
Boot body, single blade with skateez and zipper with snowshoe buckle.	The depicted assembled system has a boot with a zipper in the style of "Billy shoes" as well as adjustable snowshoe type buckles. The boot has

f  **Figure 13: Sketch of Assembly Idea 3**	a single blade under it and has two plastic supporting blades on its sides to provide stability to the wearer.

2.Analyze and evaluate all concepts against the target specifications you defined. Use simple calculations and/or simulations to make decisions. Justify the process and methods used for analysis and evaluation.

Concepts:

C1: Bob skate base, double blade, velcro with buckle straps

C2: Boot body, double blades, zipper with snowshoe buckle

C3: Boot body, single blade with supports and zipper with snowshoe buckle

Ranking scale: 1- Low

2- Moderate

3- High

Table 15: Decision Matrix

	Lightweight	**Durability**	**Affordability**	**Adjustability**	**Weight Capacity**	**Size**	**Total Points Rank x Weight)**
Criteria Weight Factor	0.15	0.15	0.10	0.225	0.15	0.225	
C1	3	2	3	3	2	3	2.775
C2	1	3	2	1	3	3	2.1
C3	1	2	2	1	2	3	1.85

Justifications:

As a team, we decided that the best way to evaluate our concepts was by comparing them in a decision matrix. We evaluated each concept against the target specifications that were defined earlier. Each concept was then scored out of 3 for each criterion and the total scores were compared. Since some criteria are more important to the client than others, we gave each a respective weight. Rank weights were determined by considering our ranking from the needs prioritization - if a need was determined to be highly important, the associated criteria would have a larger weight factor (closer to 1). Adjustability and size were given a heigh criteria weight factor of 0.225 for their high importance, weight capacity, assembly weight and durability were given a 0.15 for their moderate importance and affordability was given a 0.1 for its low importance. Note that all weight factors added together equal 1.

Concept 1: Offers moderate durability and weight capacity due to its sturdy construction and double blade design. It has a lower cost, making it more accessible to a wider range of users. The adjustability with velcro straps and buckle, along with its lengthening base, further contributes to its overall point total.

Concept 2: Highest durability and weight capacity with its boot body design and double blades. It has a moderate cost and provides some adjustability with the straps. It will have a larger weight capacity than Concept 1 because of the entire boot. Additionally, the accessibility is like Concept 1, with the zipper and snowshoe buckle allowing for easy putting on and taking off.

Concept 3: Moderate durability and weight capacity due to the single blade design and use of plastic supports. It would have a moderate cost and can only be adjusted with the straps. Additionally, it may have a moderate weight capacity. The accessibility may also be compromised due to the single blade design.

3.Choose one or a few promising solutions you wish to develop further based on your evaluation.

Based on the evaluation above, we will continue to develop Concept 1: Bob skate base, double blade, velcro with buckle straps. This is the assembly concept that was awarded the highest weighted point total in our analysis.

4.

Develop a global design concept which is either an integration or modification of the promising concepts chosen in the previous step, or a brand-new concept created from these ideas. Justify your approach.

Our global concept will comprise largely of our chosen assembly concept - concept 1, along with some modification to the strap sub-assembly that will be used. Instead of using three straps, only two will be used, one on each side of the base and they will both be the velcro type straps because of their light weight and affordability. Additionally, since the bob skate design was chosen, we can now work on developing an improved adjusting mechanism specifically for the system. We can also devise a manner to connect the blade to the base.

Although we have decided to move forward with the bob skate base, there is still a lot of design work that needs to be completed pertaining to material, manufacturing, the adjustability mechanism and the blade connection.

Possible materials for the base include:

-Plastic (ABS, PLA for prototyping, ASA, Polycarbonate)

-Wood

-Sheet metal

-Carbon fiber or another composite

-Resin

Manufacturing Options:

-3D printing (FDM)

-Resin printing (SLA)

-Metal working

-Wood working

Current adjustability mechanism design:

The bob skate base is composed of two separate pieces, one with an extension that overlaps below the other piece. The extension consists of a slot which is in line with a counterbored hole in the other part. A screw can be placed through and fastened with a wingnut on the bottom. The screw can be loosened, and the two parts can be adjusted as necessary. This design will be improved on.

Blade Connection:

This will depend largely on the material used for the base. At the moment, we are considering many different options such as some sort of fastener such as screws or rivets, an adhesive like epoxy glue or even brazing/welding.

5.Visually represent (sketch, diagram, CAD model, etc.) your global concept.

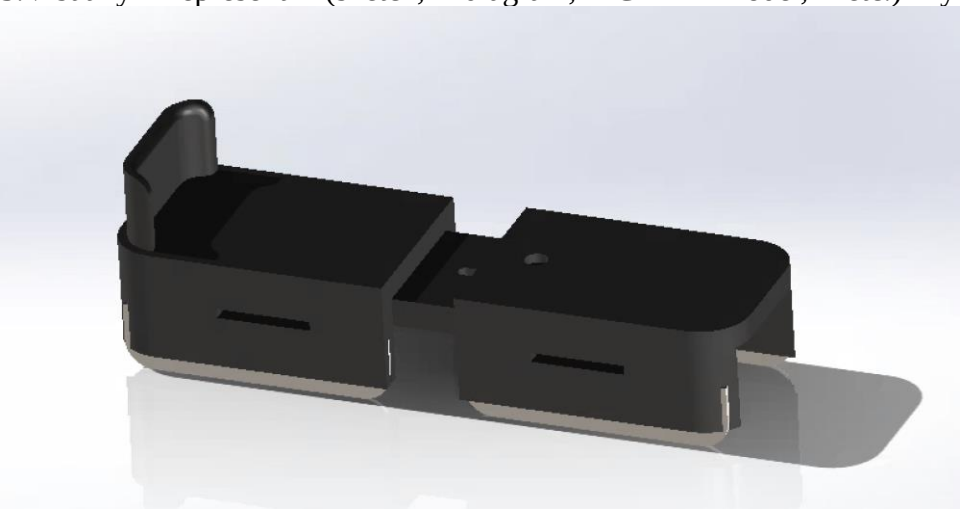


Figure 14: CAD Model of Design 1

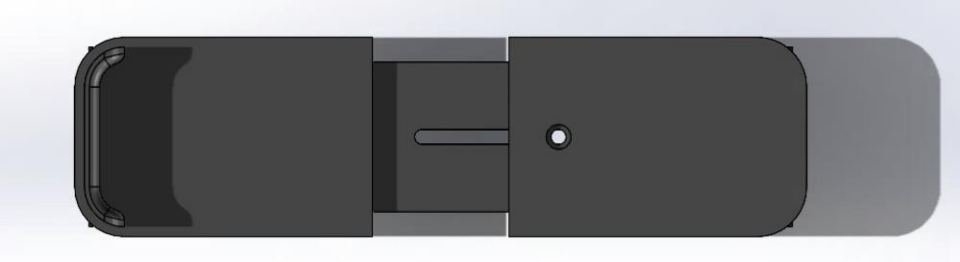


Figure 15: CAD Model of Design (Top View)

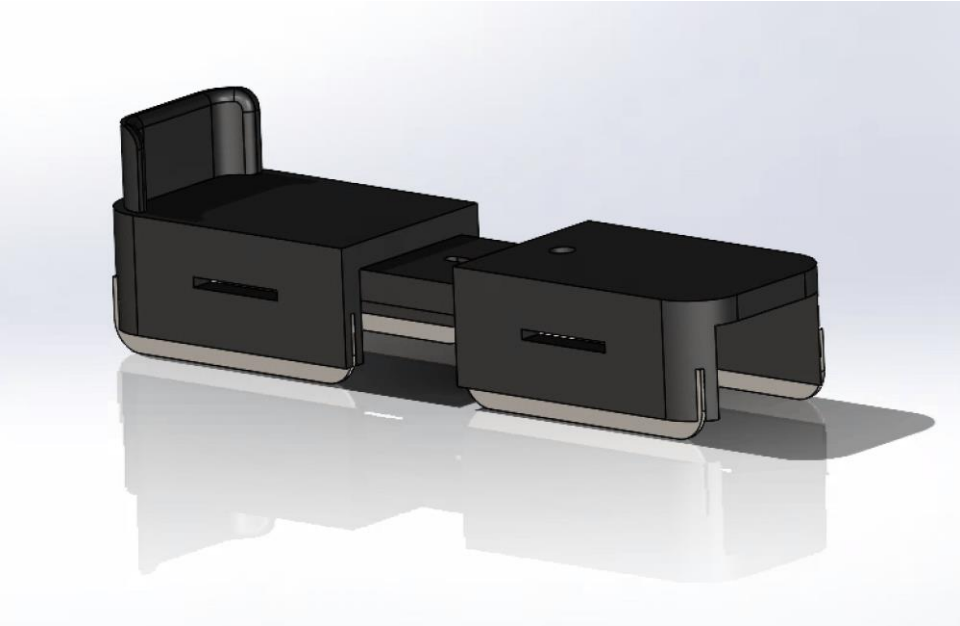


Figure 16: CAD Model Isometric View

6.Provide a few lines explaining your concept's relationship to the target specifications, as well as its benefits and drawbacks.

Our concept is optimal for achieving the target specifications. Depending on the material, this concept should be within our weight range since it is only a base, and the user will still wear footwear on it. Also depending on the material and manufacturing method, this design will meet our needs regarding durability and weight capacity. This concept is designed to offer an outstanding adjustability of more than 6 inches and have a size of 7.5 inches. Lastly, this design can be relatively affordable, but it really depends on the manufacturing and material.

The benefits of our concept are its larger size, sufficient durability and weight capacity, high adjustability, low weight, great balance support and affordable cost.

Its drawbacks are that the design may not be aesthetically pleasing, and the design will require rigorous prototyping and testing to determine the material and manufacturing method.

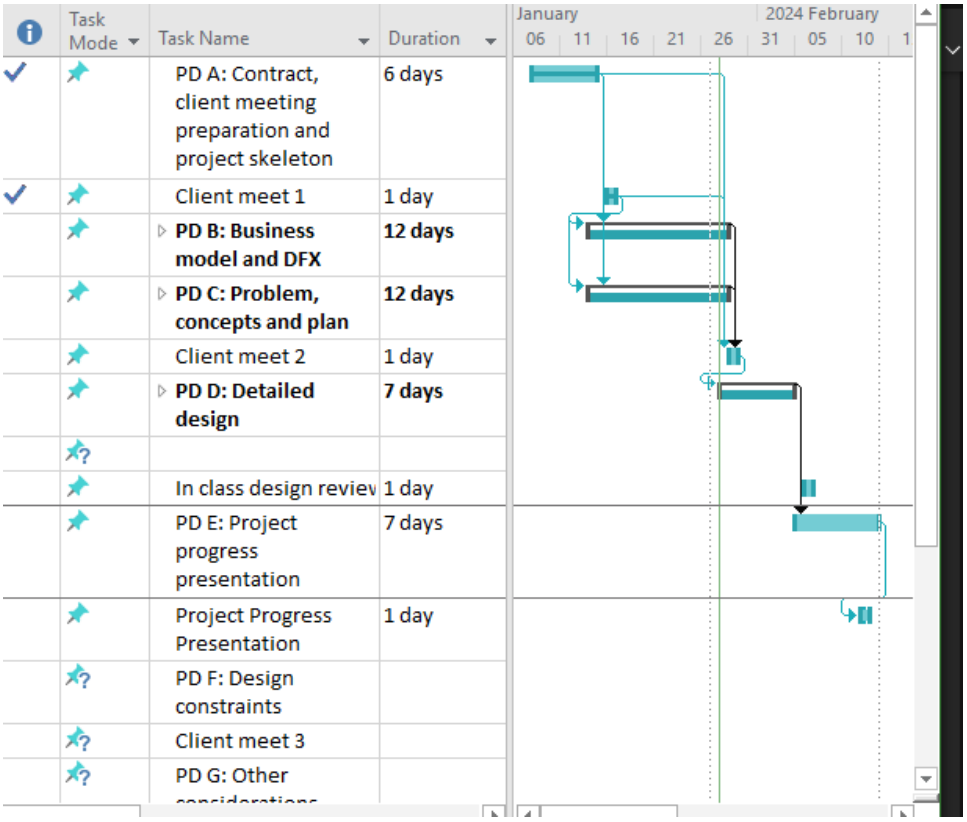


Figure 17: Updated Project Plan

8 Detailed Design and BOM

Client Meet 1 Feedback:

- Our current concept (3) is the ideal design.

- The client highlighted that adjustability and weight should be a higher priority unlike before where we had these metrics as "medium" priority.

- The client is worried about sheet metal being too heavy of a material.

- The client's daughter's favourite colour is purple and her favourite character is Clifford the Big Red Dog. We are hoping to incorporate these into our final design.

List of Skills and Resources:

- Solidworks will be used to make the model which we will 3D print.

- The Brunsfield center can be utilized to work with sheet metal.
- Makerspace can be used for 3D printing the base of the skates using the basic printer for our first prototype.
- We can use Metal Pros to get a sheet metal quote.
- We can purchase sheet metal from the Brunsfield center.
- Makerrepo can be used for submitting a 3D print request for a specialty filament.
- We can purchase fasteners and epoxy from local hardware stores.

- **Trainings:**

    - Basic Training from gng1103.
    - Basic Mill and Lathe training.
    - Laser Cutting training

- For any skills that our team lacks we will ask the people at the relevant place (metal related for Brunsfield and 3D printing for makerspace) for help if the task we are attempting is not feasible for us to complete because of lack of training and experience.

Design Implementation Time Assessment:

- Half of the group will be working on 3D printing material testing and the other half will be working on the sheet metal prototype.

- 3D printing prototype takes ~ 4 hours to print (estimate provided from lab manager). Assembly of subassemblies will add an additional 2 hours or more depending on complications (tolerancing, design flaws, etc).
    - The printing aspect of this can happen without us being present for the entire duration. We may need to be present for 1-2 hours.
    - Extra time will be needed for iterating the design with several materials.

- Sheet metal prototype ~ 2-3 hours to build (estimate given from Brunsfiled worker).
- A large part of the time assessment for this prototype relies on availability of the metal shop and staff for help and direction
- Our team has conflicting schedules, so we only have about 2 hours on Tuesday and Friday where everyone can meet.
- Since we broke up into 2 teams to complete the 2 prototypes, we have more flexibility setting times to work together.
- Realistically, each member of the team has about 4 hours a week to work on the design.

Critical Product Assumptions:

- 3D printing would be too expensive and time consuming to make 10,000 bob skates, so this would need to be injection molded.

- We have 90-degree angle bends in our model, this would not be feasible to make in the industry since this geometry can’t be injection molded.
- Our sheet metal prototype might be feasible to mass produce considering the way that we have designed it.

Detailed design – Prototype A

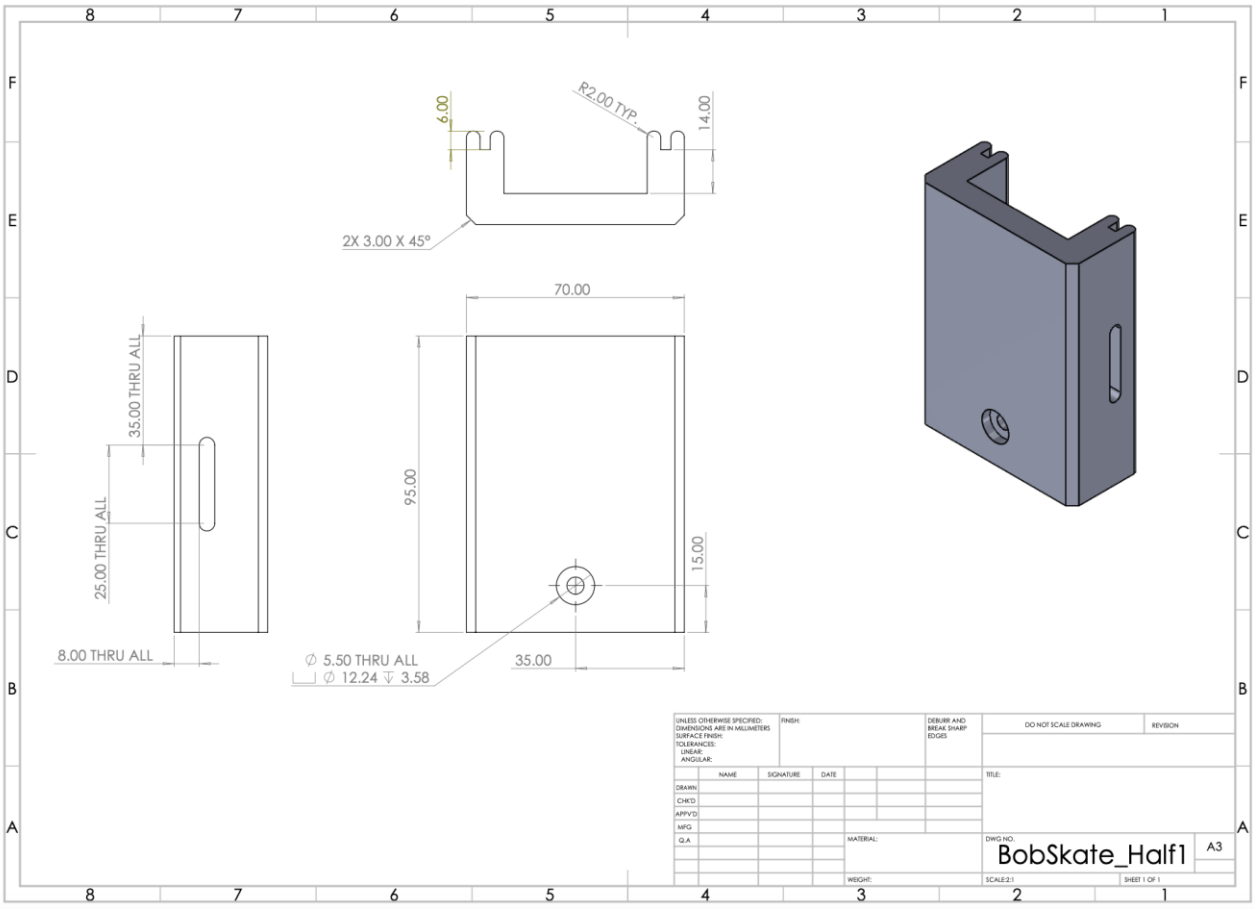


Figure 18: 3D Printed Skate Half 1 Drawing

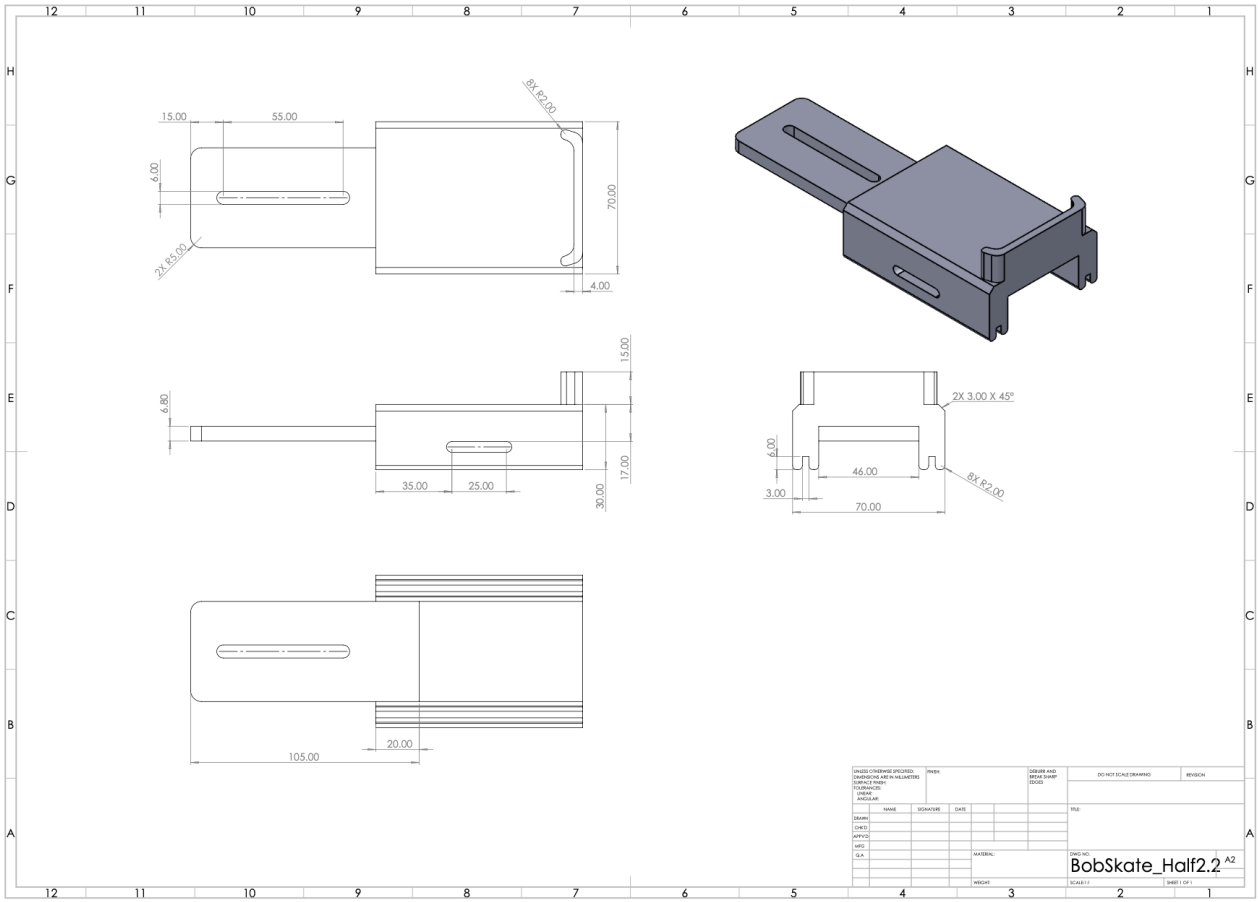


Figure 19: 3D Printed Skate Half 2 Drawing

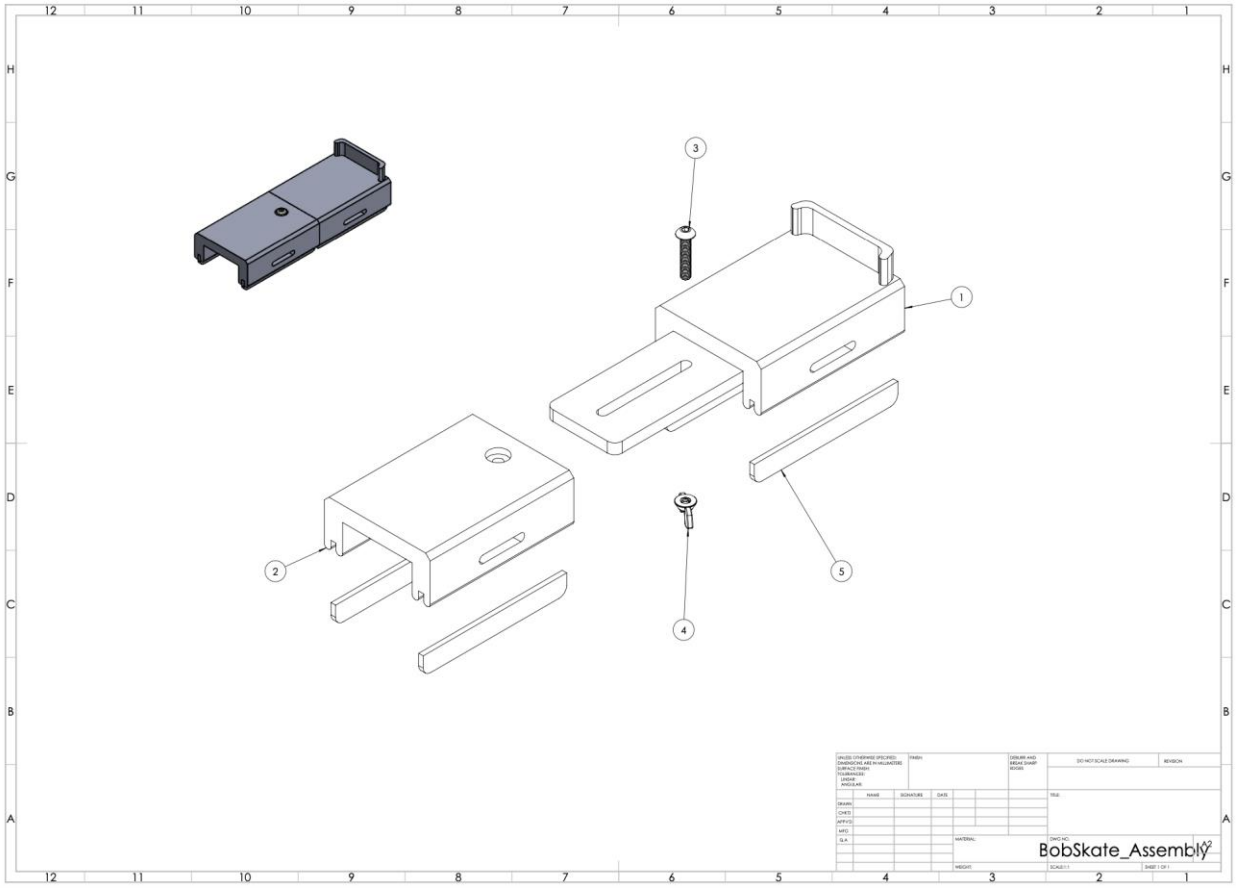


Figure 20: 3D Printed Skate Assembly Drawing

The final assembly of the 3D Printed Prototype Model includes these features:

1. 1x Back half of the bob-skate
2. 1x Front half of the bob-skate
3. 1x 10-24 x 1” Round Head Screw
4. 1x 10-24 Wing Nut
5. 4x Stainless Steel Blades

This model will also include Velcro straps which will be threaded through the slots on the sides of the bob-skates.

Detailed design – Prototype B

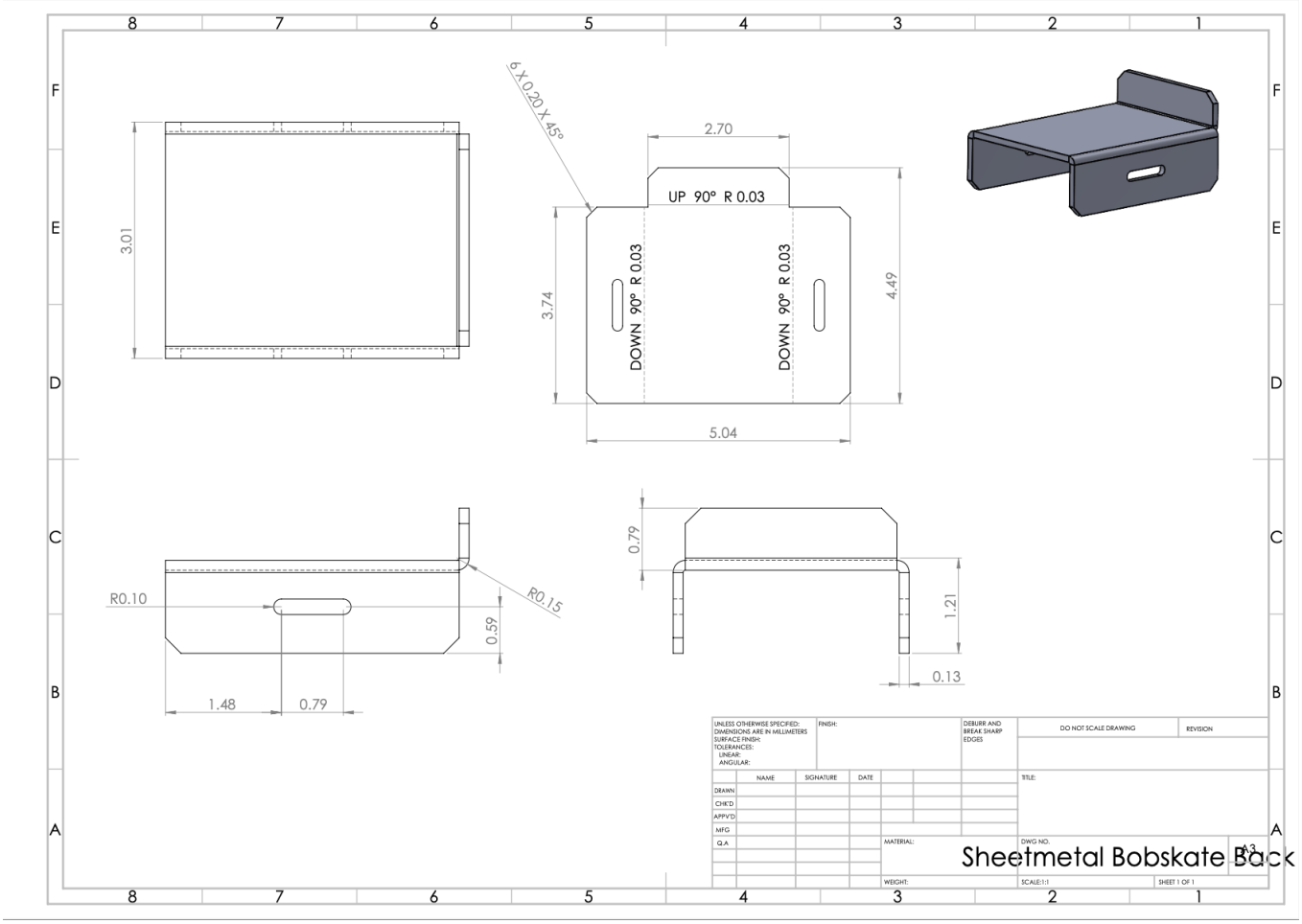


Figure 21: Sheet Metal Skate Back Drawing

Figure 22: Sheet Metal Skate Adjustment Plate Drawing

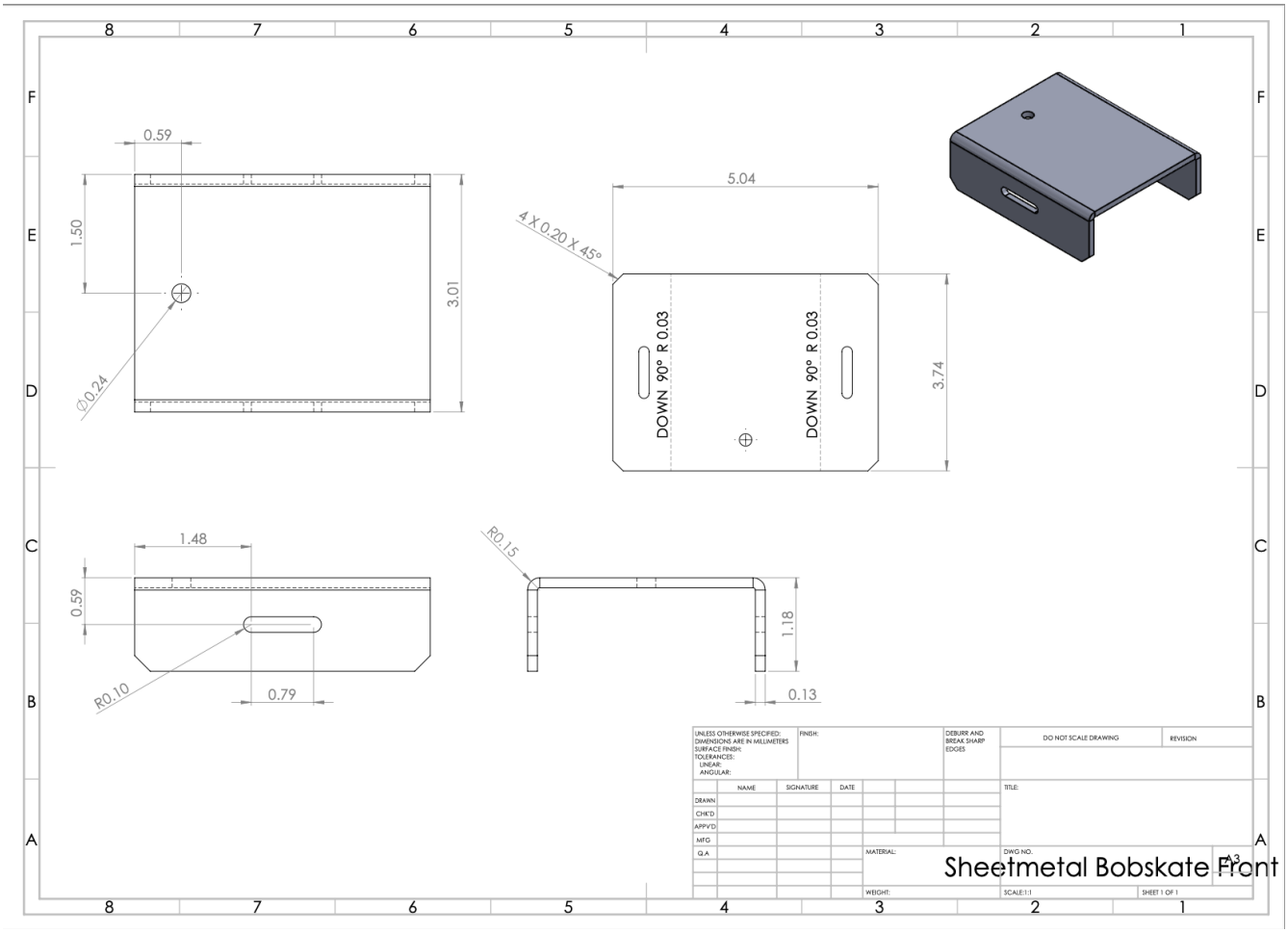


Figure 23: Sheet Metal Skate Front Drawing

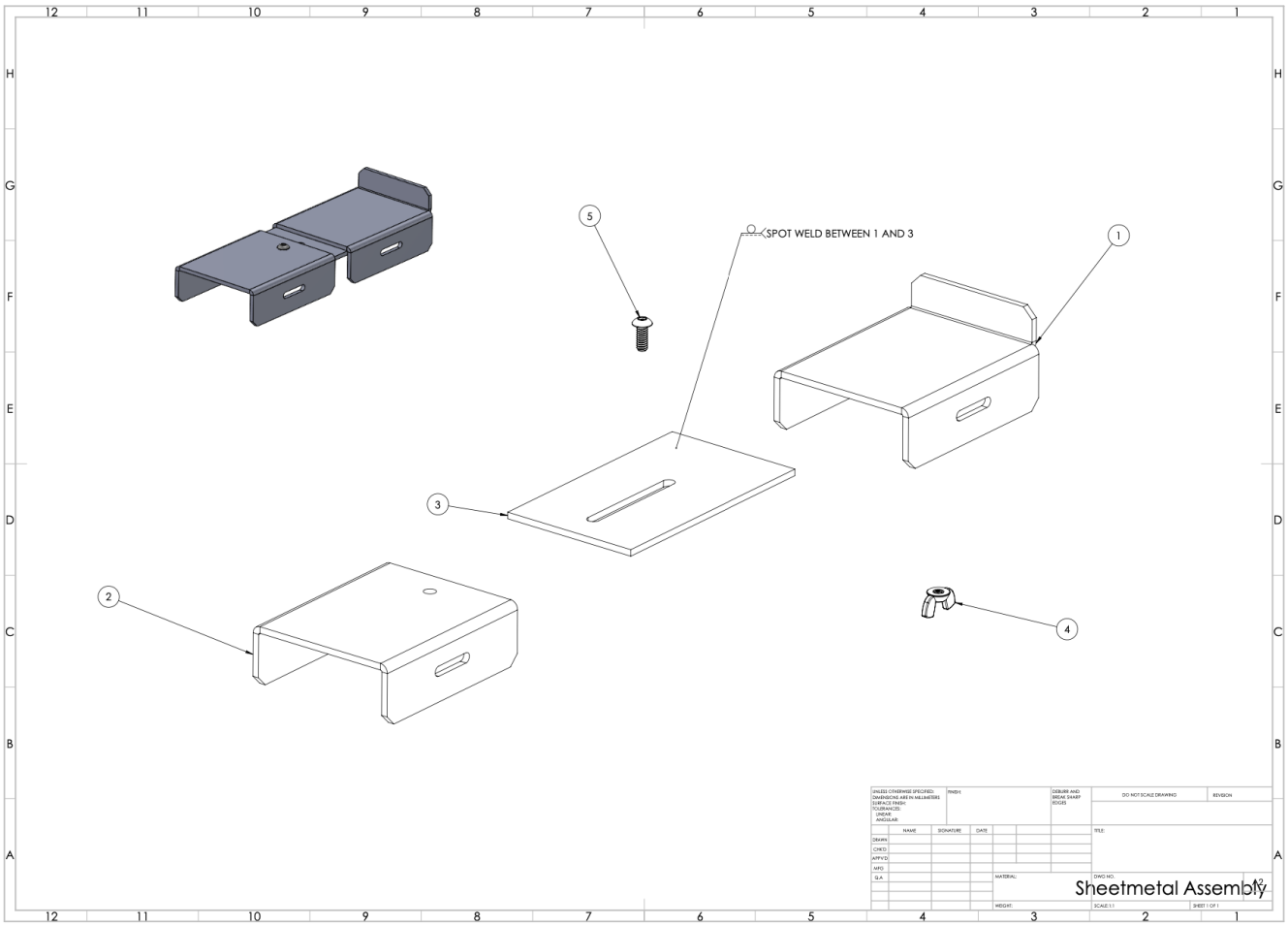


Figure 24: Sheet Metal Skate Assembly Drawing

The final assembly of the Sheet Metal Prototype Model includes these features:

1. 1x Back skate
2. 1x Front skate
3. 1x Adjustment Plate
4. 1 x 10-24 Wing Nut
5. 1x 10-24 x 1” Round Head Screw

This model will also include Velcro straps which will be threaded through the slots on the sides of the bob-skates.

BOM

Prototype A

Item name	Description	Units of measure	Quantity	Unit cost	Extended cost	Link
Gorilla Glue Epoxy	Amazon	Per Pack	1	$9.97	$9.97	dvcmdl=&hvlocint=&hvlocphy=9000668&hvtargid=pla-835452876955&mcid=b747e4e6e1903d11828d940d941e6c2e&th=1
PLA 3D Print	For now, we are trying the free PLA material, but depending on our prototype results, we may look into choosing a different one.	Per Gram	4	$0	$0.00	Makerspace
10-24 X 1" Button Head Screw	Already have	Per Piece	2	$0	$0	
10-24 Wing Nut	Already have	Per Piece	2		$0	
1/8" Steel Sheet	Brunsfield - We are going to try and get some for free.	Per Square Foot	1	$0	$0	https://www.uottawa.ca/faculty-engineering/spaces/brunsfield-centre
Velcro Straps	Already have from older skates	Per Pack	1	$0.00	$0	
Total product cost (without taxes or shipping)					$9.97	
Total product cost (including taxes and shipping)					$9.97	

Figure 22: Prototype A BOM

Prototype B

Item name	Description	Units of measure	Quantity	Unit cost	Extended cost	Link
1/8" 304 Stainless Steel Sheet Metal	Quote from Metal Pros - Bought from Brunsfield	Per Square Foot	1	$66.16	$66.16	https://www.uottawa.ca/faculty-engineering/spaces/brunsfield-centre
10-24 X 1" Button Head Screw	Already have	Per Piece	2	$0	$0	
10-24 Wing Nut	Already have	Per Piece	2	$0	$0	
Velcro Straps	Already have from older skates	Per Pack	1	$0.00	$0	
Total product cost (without taxes or shipping)					$66.16	
Total product cost (including taxes and shipping)					$66.16	

Figure 23: Prototype B BOM

Project plan update

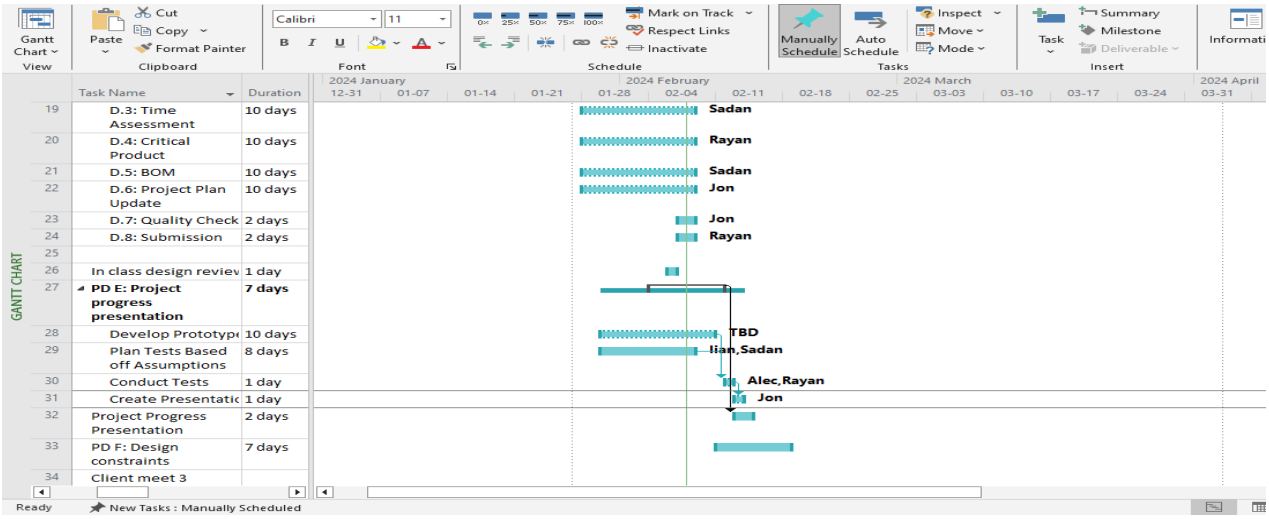


Figure 24: Updated Project Plan

9 Conclusion

In conclusion, this document delves into detail regarding our design in the context of how much it will cost, how each subsystem will work together, and how long it will take to create the two prototypes. The specifics regarding the detailed design were derived from the problem definition and of course, the concepts that were developed. This document also includes a suitable business model for the transformation of our design into a real-world functioning product. All these factors resonate together to initialize the testing phase of our design and ensure that the final prototype will be completed in a timely manner for Design Day.

10 Bibliography