GNG2101

Design Project Progress Update

FLOWTECH INDUSTRIES AND A03-CFL3

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Table 1, Acronyms

Acronym	Definition
DFX	Design for X
LCA	Life Cycle Assessment

Table 2, Glossary

Term	Acronym	Definition

1 Introduction

This paper describes our project, which involved creating a flow limiter for the Nosey cup with the goal of improving drinking for people who have trouble swallowing and specifically meeting the demands of the client. This document's goal is to give a comprehensive overview of our work, including insights into the development process and results, from problem identification to the final design.

The goal of our project is to design a device that can be integrated into the current Nosey cup and efficiently regulate liquid flow to meet the unique requirements of the customer. The client's preferences and requirements must be taken into consideration while designing in order to strike a balance between usefulness and user comfort. The project's fundamental presumptions include moving from a prototype to full production and choosing materials that are long-lasting, clean-up-easy, and visually pleasing to the client.

This report's format is intended to help you navigate the many phases of our project. Starting with the problem definition, we address the issues related to the client's needs and the existing Nosey cup. The concept development part that follows goes over the design concepts we thought of and how they solve the difficulties we found. A Gantt chart displaying task timelines and responsibilities is used to explain our approach to project management in the project plan section.

We give the Bill of Materials (BOM) and the comprehensive design in the following parts. This comprises our design specifications, technical drawings, design elements, and an exhaustive inventory of the materials needed for manufacturing. Any changes made during the design phase will be reflected in an updated Gantt chart.

The conclusions section, which highlights both the project's triumphs and challenges, concludes by summarizing the lessons learned. We also address any unresolved problems or their consequences for future work, making suggestions for future research or possible enhancements.

We offer thorough analysis and explanations for every project component throughout the report. By combining these components, we hope to produce a final product that not only satisfies the needs of the customer but also upholds strict quality and usability guidelines.

2 Sustainability Report and DFX

2.1 Sustainability report

Table 3, Sustainability Report

Triple Bottom Line	Positive Impact	Negative Impact
Economic	● Cheaper for consumers. They can pay a 1-time fee for a reusable cup+lid which they can bring in the future and get a discount for bringing their reusable cup.	● High initial costs. Getting the manufacturing operation started can be costly at the beginning compared to using single use cups and lids.
	● Caters to the growing market of eco-friendly solutions. Customers in general are leaning towards eco-friendly solutions. More people are willing to buy a reusable cup than get a single use cup every time they buy a drink.	● Lots of existing competition. Most companies already have their own reusable cups they sell to their loyal customers. It may be difficult to break into the market.
	● Creates more jobs. People are needed to design, refine, manufacture, and distribute this product globally, which can help create jobs, especially in low-income areas.	● Supply chain disruptions. Production may be dependent on existing global supply chains. These chains can suffer disruptions out of the companies control which can impact the manufacturing of the product.
Environmental	● Reusable nature The ability to utilize the cup and lid reliably indefinitely given proper care removes the user's need to purchase duplicates. Without a need for many additional cup and filter sets, the environmental effects are lessened considerably.	● Manufacturing Footprint The production process to produce the lids may generate damaging waste/emissions depending on the materials and methods employed.
	● Limits waste Due to the increased control over the flow of liquids, there is an	● Non-biodegradable The product could be non-biodegradable depending on the

	inherent reduction in potential waste. With lessened risks of spillage, a more efficient use of the liquid is achieved.	choice of material(s). After the product is used to its fullest, after being discarded it may not be able to be recycled and contribute to landfill issues.
	● Promotes recyclability If manufactured with recyclable materials, the product can be an opportunity to foster awareness regarding proper disposal and recycling at the end of its life.	● Inherent transportation emissions Once the product has been produced and packaged, there is an inherent need to ship it to the client. Expanding on this idea when producing on a higher scale, shipping to different locations and markets will have definite greenhouse emissions.
Social	● More awareness on resource conservation. By selling a reusable product, we are bringing attention to the growing issue of limited resources and how we can become a more sustainable society.	● User frustrations If the flow limiter does not work as expected or is not intuitive, it may cause some frustration which will lower the overall user experience.
	● Encourages community engagement. Creating different programs to encourage the use of reusable cups and lids will educate communities and force a change towards a eco-friendlier way of life.	● Perception regarding dependency Some users may feel that using such an assistive drinking tool signals a sense of dependency. This could hurt their self-esteem and is an important consideration for design.
	● Improves public image of the company. The company will be perceived as more socially responsible. This will help get more support in any sustainability efforts we are trying to make.	● Limited market availability If the product is not widely available or not marketed enough to those with accessibility concerns, it may be difficult for users to find which can lead to feelings of frustration and concern.

1. Life Cycle Assessment (LCA)

The first element of a Life Cycle Assessment is to define the scope/ boundary of the assessment. The boundary set out shall encompass the extraction of the raw material, transportation of the raw material to manufacturing facilities, the manufacturing process, the packaging of the product, and the disposal of the product after it reaches end-of-life. These items are generally measurable by the company manufacturing the product and are items that can benefit from refinement based on the feedback provided by a life cycle assessment. Excluded from the scope of the life cycle assessment is the handling of the product, the individual transportation of users associated with purchasing the product, and the environmental impact associated with transporting the goods to recycling or landfill facilities once it reaches end of life. Those items are largely not measurable to a reasonable extent and would otherwise be minimally impacted if at all by a life cycle assessment.

The next step is the Inventory analysis, which encompasses product interactions with the environment, raw resources and materials consumed, and any environmental emissions. The materials and manufacturing of the product will require mining oil and processing it into plastic to form the key components of the limiting flow cup. Additionally, the energy required to heat and mold the plastic components using an injection molding device will require electricity, which itself would likely come from nuclear or hydroelectric power generation if made in Ontario. The packaging of the material would have to be made of processed wood into cardboard for the boxes and paper void fill to avoid any damage to the product during shipping. Ideally recycled materials could be used in the packaging itself, but it is likely that some virgin wood will inevitably be a part of the packing material. The transportation of the product will require diesel or gas to power road-going transport trucks, diesel locomotives, or cargo freighters for international water shipping. Additionally, brake dust, rubber from tires, engine oil, and other by-products are worn and indirectly introduced into the environment as part of the shipping process. The usage of the product will involve washing and cleaning with soap and

water, but otherwise has a relatively minimal environmental impact. Finally, the product's end of life involves, ideally, recycling the plastic of the cup into new products but has the possibility of ending up in a landfill. If the product is not recycled properly, the end-of-life phase could end up being one of the most taxing phases in the product's life span.

The impact Assessment step of the LCA aims to note the results for all impact categories, after which the importance of each impact category is assessed by applying weighting factors. An appropriate way to interpret the environmental impact of the aforementioned categories is to look at the carbon emissions of each category. For every pound of PET plastic produced there is an emission of up to "three pounds of carbon dioxide" (Ritchie, 2023). This is distributed over the transportation of raw materials (29%), production of plastic monomer resins (30%), production of the plastic (8%), storage, packaging, and end of life in landfills (33%) (Marie-Luise Blue, 2019). There are several other variables that can help limit and reduce the carbon footprint of plastic use including recycling, using less plastic in component design, and using more energy efficient transportation methods.

Finally, interpreting the results of the LCA. Examining the impact assessment shows that the bulk of the environmental impact related to plastic use results from the raw materials, production of raw monomers, and end of life. Therefore, the group should consider designing for recycling and designing for durability. If the cup flow limiter can be used for a longer period, the emissions related to replacing the cup flow limiter in the future will be reduced. Additionally, when it comes time to dispose of the cup flow limiter, ensuring that it can be recycled and does not enter a landfill can help reduce overall emissions by 30-70% (Marie-Luise Blue, 2019).

2.2 Design for X

Based on our research and insights from the client, the following five factors are critical in the design of the flow limiter for the Nosey cup:

1. Ease of Use
2. Durability and Safety
3. Cleanability
4. Material Selection
5. Aesthetics and Usability

1. Ease of Use

The flow limiter's main objective is to guarantee that the user can safely and comfortably. Both the user and the parent or caregiver helping with the drinking must find it simple to use. This contains attributes that facilitate the flow limiter's installation and adjustment.

Table 4, Design Criteria for Ease of Use

Objectives/Needs:	Metrics:	Constraints:	Design Criteria:
Ensure the user can comfortably drink without choking or spillage. Facilitate easy handling by the caregiver.	User feedback on ease of use during testing. Time required for installation and adjustments.	The design should not complicate the current use of the Nosey cup. Must accommodate various user needs without excessive complexity.	Simple, intuitive design with clear instructions. Adjustable components that are easy to operate.

2. Durability and Safety

In order to stand up to frequent use and unintentional drops, the flow limiter needs to be robust. In order to avoid any risks that could endanger the user, safety is crucial. A choking hazard could be posed by small parts or sharp edges; thus the design should be safe but robust.

Table 5, Design Criteria for Durability and Safety

Objectives/Needs:	Metrics:	Constraints:	Design Criteria:
Provide a long-lasting product that maintains performance over time. Ensure safety during use to avoid any injuries or hazards.	Testing for impact resistance and longevity. Safety testing for potential choking hazards.	Must be robust enough to handle everyday use and potential drops. Material should be non-toxic and free from sharp edges.	Use of durable, drop-resistant materials. Safety features like rounded edges and secure fitting.

3. Cleanability

It should be simple to clean the flow limiter to preserve hygiene and stop the formation of bacteria. Users who have trouble swallowing should pay special attention to this because it immediately affects their health.

Table 6, Design Criteria for Cleanability

Objectives/Needs:	Metrics:	Constraints:	Design Criteria:
Ensure the product can be thoroughly cleaned, ideally in a dishwasher. Minimize the risk of bacterial growth and residue build-up.	Ease of cleaning as reported by users. Dishwasher compatibility and effectiveness.	The design must allow for easy disassembly and reassembly. Should be resistant to staining and odors.	Smooth, non-porous surfaces that are easy to wipe clean. Simple design without hard-to-reach crevices.

4. Material Selection

Making the correct material choices is essential to guaranteeing that the product is both comfortable and useful. The materials ought to be safe, long-lasting, and appropriate for the intended usage. To prevent clanging noises, they should also be in line with the client's taste for non-metal components.

Table 7, Design Criteria for Material Selection

Objectives/Needs:	Metrics:	Constraints:	Design Criteria:
Use materials that are durable and safe for regular contact with liquids. Avoid materials that could cause discomfort or have adverse reactions.	Material performance in terms of strength and safety. User comfort and satisfaction with the material used.	The material must be lightweight yet sturdy. Avoid metals or other materials that might be uncomfortable or unsafe.	Use of hard plastics that are durable and non-reactive. Materials that are easy to clean and maintain.

5. Aesthetics and Usability

The design needs to be eye-catching and blend in perfectly with the current Nosey cup. It should also be created with the client's tastes in mind, considering things like color and overall style, to make sure the customer is accepted and feels at ease using the product.

Table 8, Design Criteria for Aesthetics and Usability

Objectives/Needs:	Metrics:	Constraints:	Design Criteria:
Ensure the product is visually consistent with the existing cup and appealing to the user. Consider the user’s preferences for colors and designs.	User satisfaction with the aesthetic aspects of the design. Consistency of the design with existing products.	The product should not look markedly different from the existing Nosey cup. Must be available in preferred colors, such as purple and blue.	Match the visual style of the Nosey cup while incorporating functional elements. Use colors and designs that align with the client’s preferences and comfort.

3 Problem Definition, Concept Development, and Project Plan

3.1 Problem definition

2. Needs Identification

The client's primary concern is addressing the difficulty their child has when consuming liquids. The main needs can be listed as follows:

- **Liquid Flow Limitation**: The device must limit the liquid flow to prevent choking or overwhelming the child.
- **Ease of Use**: The product should be easy for the parents to hold and administer liquid without difficulty.
- **Compatibility**: The design should be compatible with a standard cup or a Nosey cup, making it convenient for the client to use anywhere.
- **Hygiene and Durability**: The product must be dishwasher-friendly and durable enough to handle frequent use and accidental drops.
- **Aesthetic and Design Preferences**: The design should resemble standard cups and align with the client's preferences for color and non-sippy cup-like appearances.

3. Problem Statement

The client, who has a daughter with physical disability, finds it difficult to use traditional cups to feed her fluids in a safe and controlled manner. The child has trouble eating and swallowing, and consuming too much liquid at once can result in choking. A solution that preserves the appearance

and usability of a standard drinking cup while restricting liquid flow and guaranteeing simple handling is needed. In addition to being ideally compatible with both Nosey and regular cups, the product needs to be robust and simple to clean.

4. Metrics

Table 9, Metrics Description Table

Metrics	Units	Description
Liquid Flow Rate	Milliliters per second (ml/sec)	Ensures controlled dispensing of liquids.
Weight	Grams (g)	It should be lightweight enough for parents to hold easily.
Volume	Milliliters (ml)	This refers to the total volume of liquid the product can hold.
Durability	Number of drops (m)	The product can withstand before breaking or suffering damage.
Handle Diameter	Millimeters (mm)	Determine the force the handle can endure before breaking.
Dimensions	Centimeters (cm)	This could include the height, width, and diameter of the product.
Price	CAD ($)	Determining the economic viability and competitiveness of a product.

5. Benchmarking

Table 10, Benchmarking Table

	Nosey Cup	Reflo Smart Cup	Wedge Cup
Liquid flow rate	NA	Variable Flow Rate	Fully adjustable flow rate
Weight	120 g	9.07 g (According to Amazon Link)	340.2 g
Volume	240 mL (Nosey Cups, 2024)	170.48 mL	118 mL
Durability	Polypropylene plastic (Caregiver Products, 2024)	Unbreakable High –Impact Plastic	Polypropylene plastic
Handle diameter	NA	NA	NA
Dimensions (cm)	Height: 11.43 Diameter: 7.62 (Caregiver Products, 2024)	Height: 14.99 Diameter: 7.11	Height: 12.19 Diameter: 7.62
Price (CAD)	$4.75 (Nosey Cups, 2024)	$6.73 (2 pack, price per one)	$53.90 ($40 USD)

(Caregiver Products, 2024), (Reflo, 2024), (AliMed, 2024)

Figure 1, Nosey Cup, Reflo Smart Cup, Wedge Cup,

6. Target Specifications

Table 11, Target Specifications

Metrics	Units	Marginal Value	Ideal Value
Liquid Flow Rate	Milliliters per second (ml/sec)	2 drops pre second	1 drop per second
Weight	Grams (g)	100-200g	<100g
Volume	Milliliters (ml)	50-150mL	100mL
Durability	Number of drops (m)	Minimal scratches	No damage after 10 drops
Handle Diameter	Millimeter (mm)	7-12mm	10mm
Dimensions	Centimeters (cm)	Height: 8-15cm Diameter: 7-9cm	Height: 12cm Diameter: 7.5cm
Price	CAD ($)	<$20	$10

7. Concept development

8. Prototype Concepts

Concept 1:

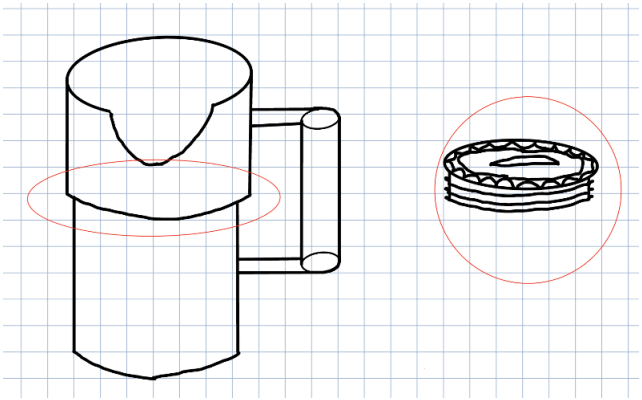


Figure 2, Concept 1, Travel Mug Style Concept

(With a screw-on top mid way and a side handle, this travel mug-style cup has tiny holes to restrict the flow of fluids. The notch at the top provides a controlled and comfortable drinking experience, emulating the shape of a Nosey cup.)

Table 12, Analysis for Travel Mug Concept

Metrics	Units	Ideal Value	Concept Value
Liquid Flow Rate	Milliliters per second (ml/sec)	1 drop per second	1 drop per second
Weight	Grams (g)	<100g	120g
Volume	Milliliters (ml)	100mL	250 Max

Durability	Number of drops (m)	No damage after 10 drops	No damage after 10 drops
Handle Diameter	Millimeter (mm)	10mm	20mm
Dimensions	Centimeters (cm)	Height: 12cm Diameter: 7.5cm	Height: 12cm Diameter: 8.0cm
Price	CAD ($)	$10	$10

User needs, safety, and practicality are given top priority in the design metrics of the flow-limiting cup. For users who have trouble swallowing, the liquid flow rate is regulated to one drop per second to ensure exact control and reduce the risk of choking. For ease of use, the desired weight is kept under 100g, yet the concept's sturdy materials cause it to slightly exceed this. Flexibility is offered with a 250 ml capacity while keeping the optimal flow control. The cup must be durable; it must be able to sustain several drops without breaking. Better grip is ensured by the handle's somewhat wider diameter than optimal. The $10 price point guarantees accessibility without compromising quality, and the dimensions are designed to be discreetly similar to a normal travel mug. These measurements provide a balance for the user's comfort, affordability, and functionality.

Concept 2:

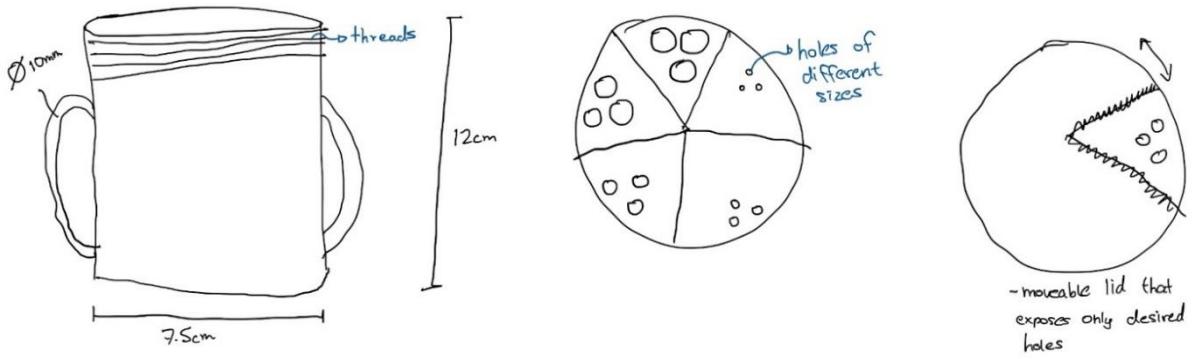


Figure 3, Threaded cup concept with different sized holes

Cup is meant to look like a generic cup with threads at the top to twist the lid into. There are 2 handles on the cup to help the client grab the cup with more ease. The lid will have 5 sections of 3 holes. Each triad of holes will be of different diameters to increase or decrease flow rate. To prevent spillage from undesired openings, there is a rotating cap at the top that covers any other holes. This means that only 3 holes at a time will be open.

Table 13, Analysis for Threaded Cup Concept

Metrics	Units	Ideal Value	Concept Value
Liquid Flow Rate	Milliliters per second (ml/sec)	1 drop per second	1-10
Weight	Grams (g)	<100g	90
Volume	Milliliters (ml)	100mL	200
Durability	Number of drops (m)	No damage after 10 drops	No damage after 10 drops
Handle Diameter	Millimeter (mm)	10mm	10
Dimensions	Centimeters (cm)	Height: 12cm Diameter: 7.5cm	Height: 12 Diameter: 7.5
Price	CAD ($)	$10	$15

The flow rate was estimated by using the size of potential diameters. The smallest diameters would yield 1 drop per second while the biggest diameters would yield 10 drops per second. The weight was established by using the density of polypropylene plastic and an estimated volume of the cup. The volume of liquid that the cup can hold was decided based on benchmarking of current products. Other cups were around 200mL so for this cup to look as ‘normal’ as possible, the same volume capacity was chosen. Additionally, polypropylene plastic is very durable and capable of withstanding multiple drops without breaking. Moreover, the handle diameter was chosen based on client data. The client expressed a need for any handles to be very thin (about diameter of a crayon) to help his child grip the handle with minimal issues. Therefore,

a diameter of 10mm was chosen as that is thin enough that it is believed the client will be able to grip it. Height was based on benchmarking, with the attempt to assimilate this cup to other cups as much as possible.

Concept 3: Limited Flow Cup and Adapter

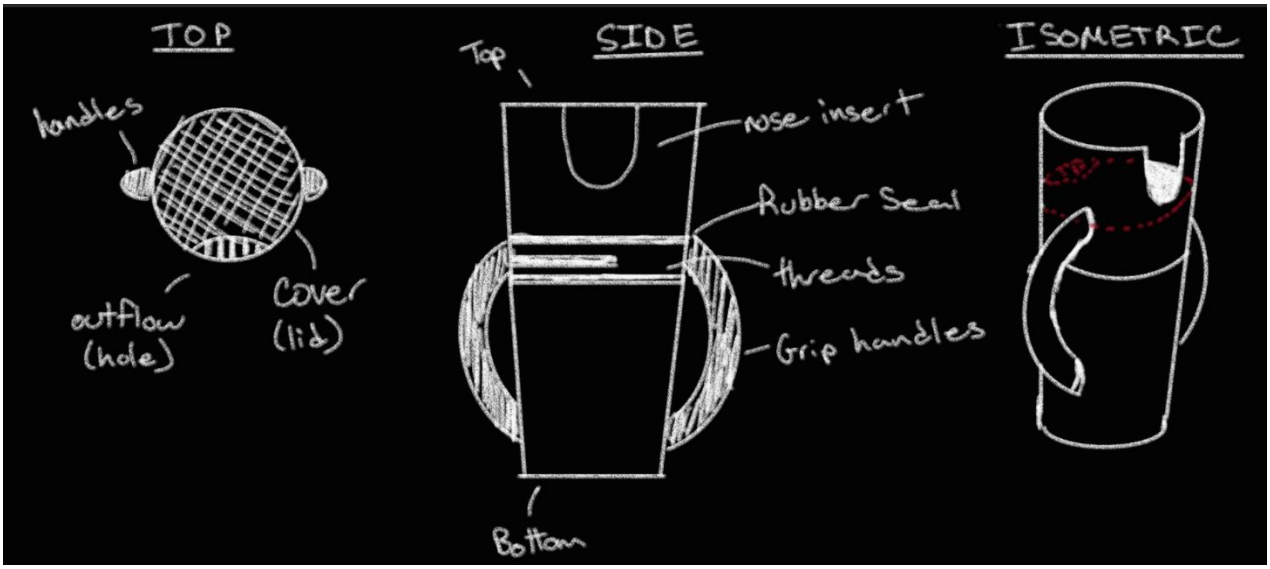


Figure 4, Thermos Style Concept

Lid is designed like a Thermos. This lid can be screwed on to the cup to fully close and to adjust the flow rate of the liquid coming through the lid. By changing how loose the lid is screwed on, you also change the amount of liquid seeping through the hole in the cup, allowing you to adjust the flow of the liquid by twisting the cup.

Table 14, Analysis for Thermos Style Concept

Metrics	Units	Ideal Value	Concept Value
Liquid Flow Rate	Milliliters per second (ml/sec)	1 drop per second	0 – 5 drops per second
Weight	Grams (g)	<100g	40 g
Volume	Milliliters (ml)	100mL	100mL
Durability	Number of drops (m)	No damage after 10 drops	No Damage after 10 drops
Handle Diameter	Millimeter (mm)	10mm	10mm
Dimensions	Centimeters (cm)	Height: 12cm Diameter: 7.5cm	Height: 12 cm Diameter: 7 –8 cm
Price	CAD ($)	$10	$8

This design works as a subsystem because of how it fulfils the minimum requirements for our product. The handles on the cup are designed for an easy grip for the client to not only attempt to drink by herself, but to allow the adult helping the client to have a better grip on the cup. This product uses similar concepts to the reflow Smart cup, using concepts from their limited flow design, the handles to the wedge cup, making sure that they do not exceed the maximum diameter, and the nosy cup, with its cut-out on the rim of the cup to accommodate the clients nose allowing it to be tipped even when the head is horizontal.

Concept 4: Existing Nosey cup attachment

(Left) Figure 5, Sketch of Nosey Cup with and without flow-limiting attachment

(Right) Figure 66, Top-Down Drawing of the Nosey Cup Attachment Concept

This concept seeks to utilize the client's existing Nosey cup with the addition of a flow-limiting lid. The lid is molded to fit around the half of the Nosey cup from which the user drinks, keeping the nose feature intact. The lid is slightly raised, and the fixed flow limiting opening exists here. Keeping the existing Nosey cup provides the established volume of 40 mL and mass of 120g. An additional estimated 10g is added to this running total for the mass of the lid. The lid is manufactured with an appropriate dishwasher safe and durable hard plastic.

Table 15, Analysis for Nosey Cup Attachment Concept

Metrics	Units	Ideal Value	Concept Value
Liquid Flow Rate	Milliliters per second (ml/sec)	1 drop per second	1- 5 drops per second
Weight	Grams (g)	<100g	130 g (120g from Nosey Cup + 10 g from cup)
Volume	Milliliters (ml)	100mL	240mL (From Nosey Cup)
Durability	Number of drops (m)	No damage after 10 drops	No damage after 11 drops

Handle Diameter	Millimeter (mm)	10mm	NA
Dimensions	Centimeters (cm)	Height: 12cm Diameter: 7.5cm	Height: 3 cm Diameter: 7.5 cm
Price	CAD ($)	$10	$5

The flow rate provided by the lid attachment for the Nosey Cup is imagined to be a fixed rate. However, the amount of liquid per second is still undefined as the opening size can be modified to meet the ideal flowing rate of around 1-5 drops per second. The total weight and volume are borrowed from the Nosey Cup with an estimated ten additional grams of mass. Due to the compactness of the design, the durability given an adequate material must be very damage resistant. The Nosey Cup also inspires the dimensions for the lid, so therefore they share the same diameter. With the raised nature of the lid an estimated 3 cm additional height is also proposed.

9. Chosen Concepts

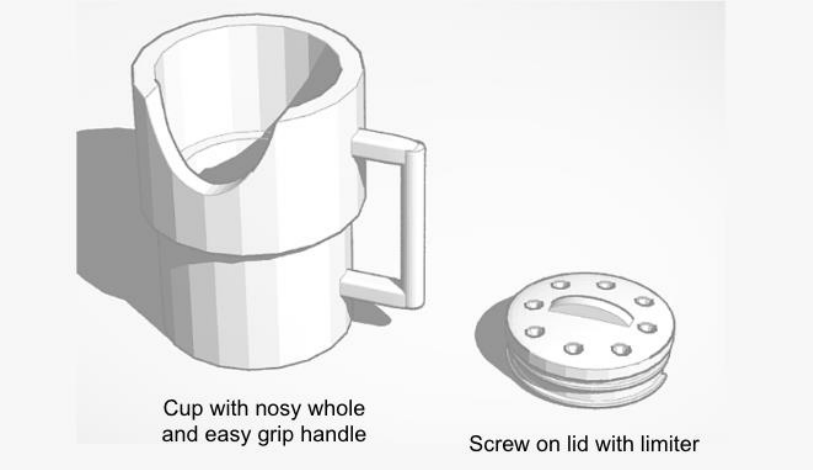


Figure 7, Image of Chosen Concept 1

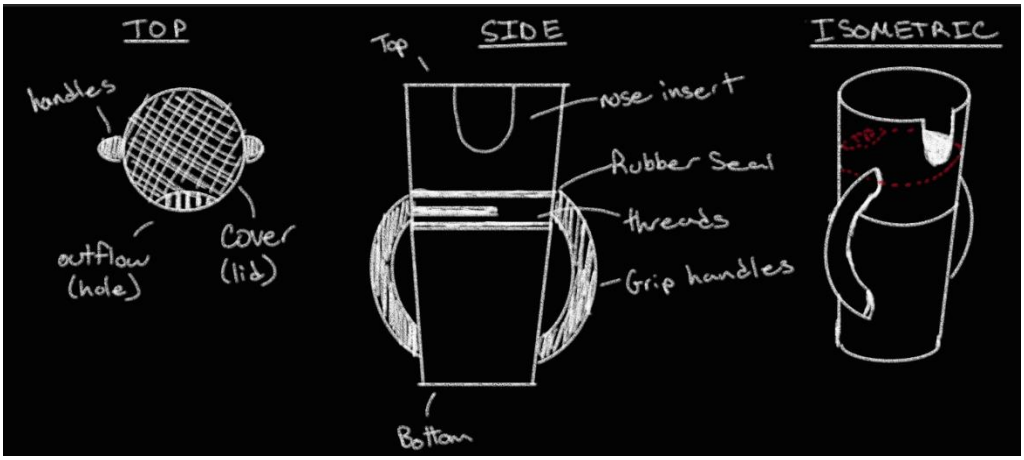


Figure 8, Image of Chosen Concept 2

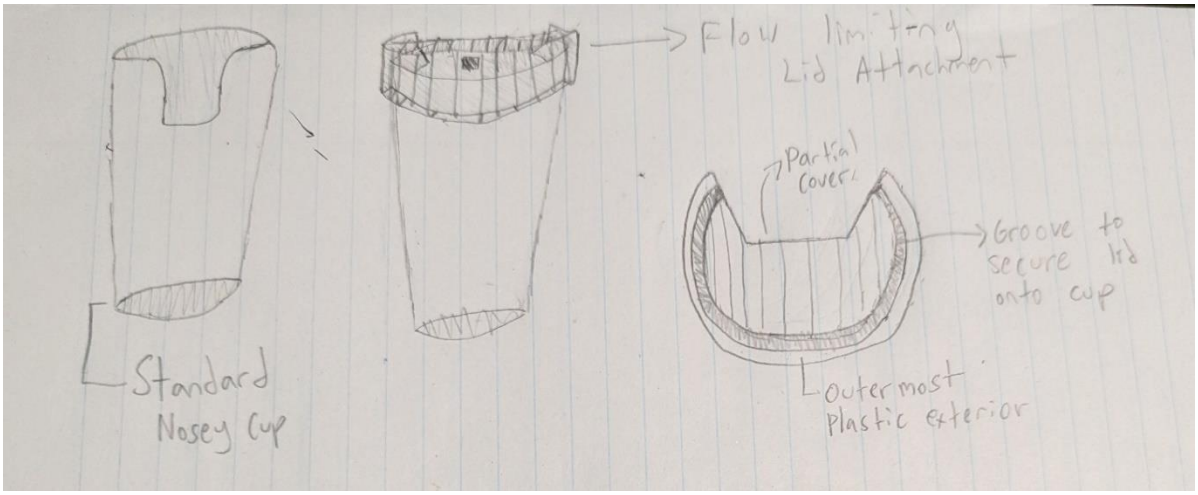


Figure 9, Image of Chosen Concept 3

3.1.1 Global Concept

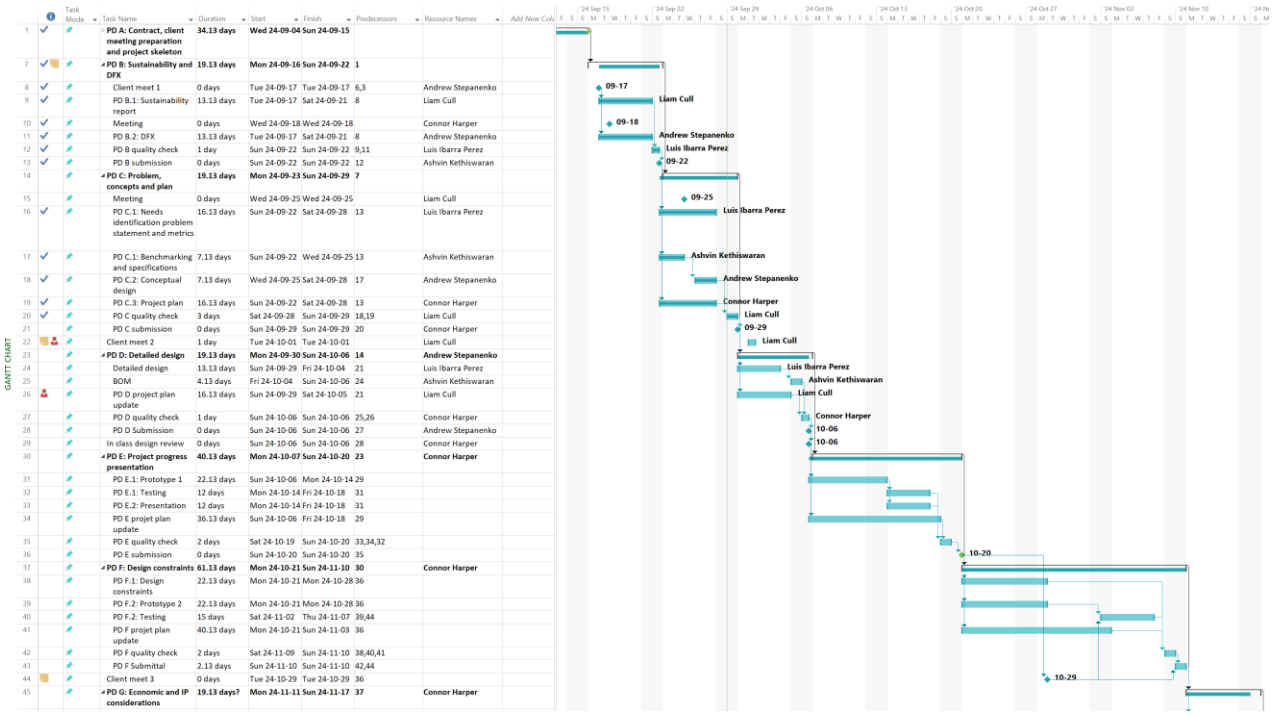
After careful analysis and a team discussion, it was agreed that the first concept, the travel mug style cup, is the best solution for the client. With this idea, the flow limiter is inserted in the middle of the cup, which will limit the flow to the client's satisfaction. Its dimensions are such that the client will be able to grip the handle with enough strength to lift the cup themselves, or with

minimal assistance. Additionally, the volume of water it can hold and the weight of the cup itself would be ideal in this cup. Since the client has mobility impairments, it is crucial that the cup is not too heavy, or that too much water can fit in the cup, since it would cause difficulty for the client to lift the cup. With this cup, the team has taken the client's mobility into consideration to develop a product that the client will be able to hold. Finally, a big desire of the client was to make the cup look as 'normal' as possible. This concept closely resembles other water bottles available in the market, which would satisfy the client. The only difference would be its size, and the fact that there is a water flow limiting mechanism inside the bottle, where no one else can see it. In contrast, a drawback of this concept is the difficulty in ensuring the flow is limited enough for daily use. Once the flow limiter mechanism is installed in the cup, the user will not be able to change how much flow is limited. This means that lots of testing has to be done to ensure that the water flow coming out of this new product is appropriate for the client in most scenarios.

Furthermore, this concept was designed and developed using the DFX factors identified earlier in this report. Firstly, we are designing for ease of use. The goal is to make sure the client doesn't choke when drinking or spill the liquid. With this design, the team has ensured that the flow will be limited to just enough so that the client can safely drink from it with minimal risk of choking. The team also designed for durability and safety. This was a very important aspect of the concept generation as the product needs to withstand being dropped as the client has difficulty gripping handles. Keeping this in mind ensured that the cup that was chosen has a small enough diameter that the client can hold the cup without a big risk of dropping it. In addition, the cup is made of durable plastic, which can withstand being dropped multiple times without breaking. Moreover,

another important design factor to keep in mind is cleanability. Benchmarking informed the team that the cup needs to be dishwasher safe. The durable plastic chosen to make this cup meets this criterion, so that the client and their families have an easy time cleaning this product to avoid bacteria build up. One last important design factor that helped the team ultimately settle on this concept is the design for aesthetics and usability. The client explicitly stated that the cup should look as similar as possible to other 'normal' cups, otherwise the cup would be rejected. This was kept as a top priority when brainstorming and is a big factor as to why this particular cup was chosen. As seen in the image above, the chosen travel cup style mug looks like any other travel mug one can buy in any store. Any flow limiting mechanism is on the inside of the cup, where no one can see it. This will ensure that all the other safety considerations are being met while helping the client keep the normalcy they asked for.

3.2 Project plan



	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resource Names
1		**PD A: Contract, client meeting preparation and project skeleton**	**34.13 days**	**Wed 24-09-04**	**Sun 24-09-15**		
7		**PD B: Sustainability and DFX**	**19.13 days**	**Mon 24-09-16**	**Sun 24-09-22**	**1**	
8		Client meet 1	0 days	Tue 24-09-17	Tue 24-09-17	6,3	Andrew Stepanenko
9		PD B.1: Sustainability report	13.13 days	Tue 24-09-17	Sat 24-09-21	8	Liam Cull
10		Meeting	0 days	Wed 24-09-18	Wed 24-09-18		Connor Harper
11		PD B.2: DFX	13.13 days	Tue 24-09-17	Sat 24-09-21	8	Andrew Stepanenko
12		PD B quality check	1 day	Sun 24-09-22	Sun 24-09-22	9,11	Luis Ibarra Perez
13		PD B submission	0 days	Sun 24-09-22	Sun 24-09-22	12	Ashvin Kethiswaran
14		**PD C: Problem, concepts and plan**	**19.13 days**	**Mon 24-09-23**	**Sun 24-09-29**	**7**	
15		Meeting	0 days	Wed 24-09-25	Wed 24-09-25		Liam Cull
16		PD C.1: Needs identification problem statement and metrics	16.13 days	Sun 24-09-22	Sat 24-09-28	13	Luis Ibarra Perez
17		PD C.1: Benchmarking and specifications	7.13 days	Sun 24-09-22	Wed 24-09-25	13	Ashvin Kethiswaran
18		PD C.2: Conceptual design	7.13 days	Wed 24-09-25	Sat 24-09-28	17	Andrew Stepanenko
19		PD C.3: Project plan	16.13 days	Sun 24-09-22	Sat 24-09-28	13	Connor Harper
20		PD C quality check	3 days	Sat 24-09-28	Sun 24-09-29	18,19	Liam Cull
21		PD C submission	0 days	Sun 24-09-29	Sun 24-09-29	20	Connor Harper
22		Client meet 2	1 day	Tue 24-10-01	Tue 24-10-01		Liam Cull
23		**PD D: Detailed design**	**19.13 days**	**Mon 24-09-30**	**Sun 24-10-06**	**14**	**Andrew Stepanenko**
24		Detailed design	13.13 days	Sun 24-09-29	Fri 24-10-04	21	Luis Ibarra Perez
25		BOM	4.13 days	Fri 24-10-04	Sun 24-10-06	24	Ashvin Kethiswaran
26		PD D project plan update	16.13 days	Sun 24-09-29	Sat 24-10-05	21	Liam Cull
27		PD D quality check	1 day	Sun 24-10-06	Sun 24-10-06	25,26	Connor Harper
28		PD D Submission	0 days	Sun 24-10-06	Sun 24-10-06	27	Andrew Stepanenko
29		In class design review	0 days	Sun 24-10-06	Sun 24-10-06	28	Connor Harper
30		**PD E: Project progress presentation**	**40.13 days**	**Mon 24-10-07**	**Sun 24-10-20**	**23**	**Connor Harper**
31		PD E.1: Prototype 1	22.13 days	Sun 24-10-06	Mon 24-10-14	29	
32		PD E.1: Testing	12 days	Mon 24-10-14	Fri 24-10-18	31	
33		PD E.2: Presentation	12 days	Mon 24-10-14	Fri 24-10-18	31	
34		PD E projet plan update	36.13 days	Sun 24-10-06	Fri 24-10-18	29	
35		PD E quality check	2 days	Sat 24-10-19	Sun 24-10-20	33,34,32	
36		PD E submission	0 days	Sun 24-10-20	Sun 24-10-20	35	
37		**PD F: Design constraints**	**61.13 days**	**Mon 24-10-21**	**Sun 24-11-10**	**30**	**Connor Harper**
38		PD F.1: Design constraints	22.13 days	Mon 24-10-21	Mon 24-10-28	36	
39		PD F.2: Prototype 2	22.13 days	Mon 24-10-21	Mon 24-10-28	36	
40		PD F.2: Testing	15 days	Sat 24-11-02	Thu 24-11-07	39,44	
41		PD F projet plan update	40.13 days	Mon 24-10-21	Sun 24-11-03	36	
42		PD F quality check	2 days	Sat 24-11-09	Sun 24-11-10	38,40,41	
43		PD F Submittal	2.13 days	Sun 24-11-10	Sun 24-11-10	42,44	
44		Client meet 3	0 days	Tue 24-10-29	Tue 24-10-29	36	
45		**PD G: Economic and IP considerations**	**19.13 days?**	**Mon 24-11-11**	**Sun 24-11-17**	**37**	**Connor Harper**

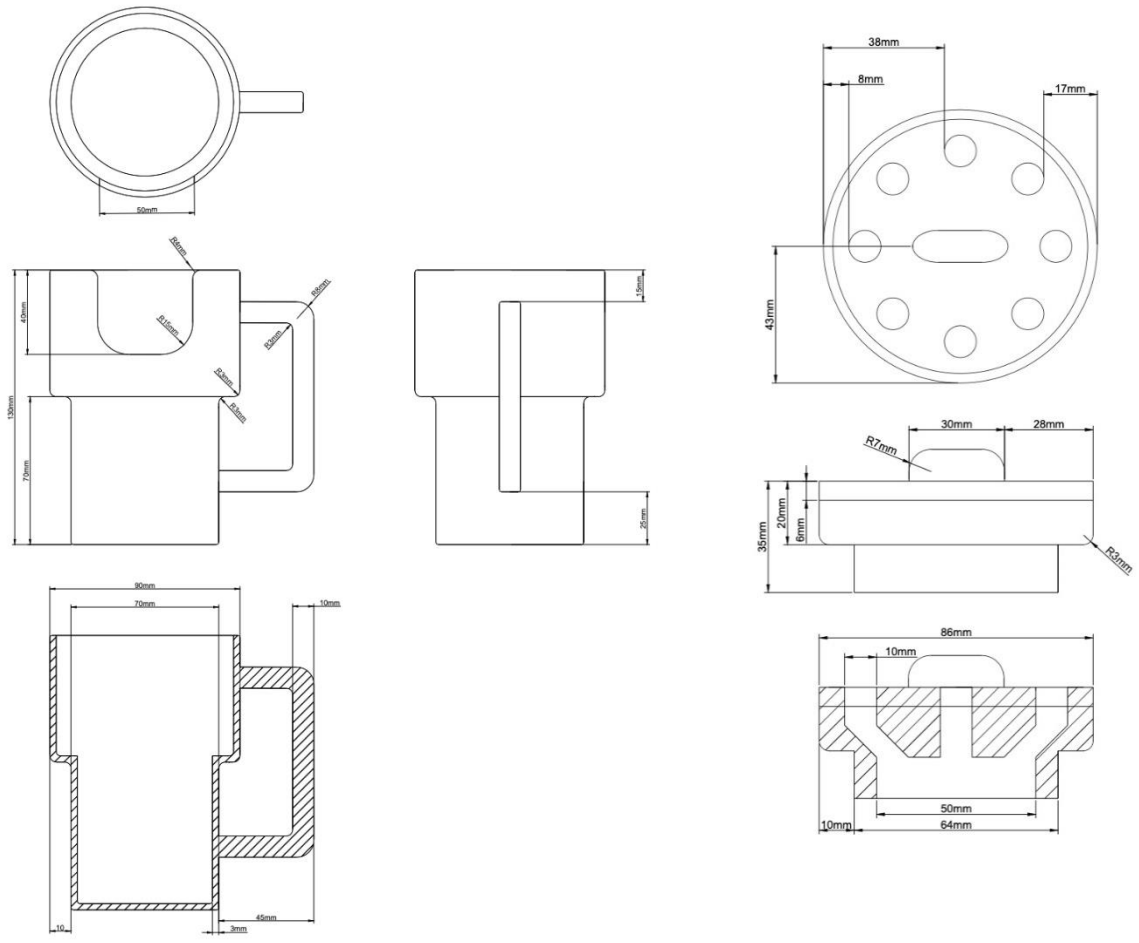
Figure 10, Up to date Gantt Chart (2024/09/29)

4 Detailed Design and BOM

4.0 Detailed design

The client gave concept one favorable feedback during the second meeting, praising the screw-on lid and travel mug design with the Nosey cup-style cutout. They did, however, ask for a few changes to enhance the design. They stressed that in order to provide greater control over the liquid flow, a variable flow mechanism like to a Thermos is required. The customer also mentioned that they liked the concept of attachments for further functionality and that they would like a see-through region to improve observation of the liquid level.

We updated the design in response to these comments, keeping the travel mug's appearance, robustness, and dishwasher safety. The screw-on lid was modified with an adjustable flow mechanism that allows the liquid flow rate to be adjusted by turning the lid's top like a salt shaker. This change guarantees that the product maintains its user-friendliness while satisfying the client's need for variable flow control.



4.1 Considerations to meet DFX factors

Considering the updated detailed design there are some considerations to meet our existing DFX factors. To begin, the ease of use with the new design must still be apparent. The screw on lid modified to allow variable liquid flow must be very simple to manipulate with minimal force needed. Other considerations regarding durability, safety, and cleanability still run true from our last concepts. Due to the nature of the product and with client feedback, the cup system must be durable enough to withstand drops with no damage. This aspect is reliant on the chosen material to manufacture the cup, and the subsequent process designated to fulfil the design. Safety is also paramount considering the client's needs with being able to drink water safety. Lastly, cleanability is a concern as the client will be using this cup on a regular basis throughout the day exclusively with Pediasure. With the multiple components of the cup, and the grooves present in the screw on lid, the ability to clean it effectively is also important.

1. Ease of Use
2. Durability and Safety
3. Cleanability
4. Material Selection
5. Aesthetics and Usability

4.2 BOM

Item Description	Supplier/Link	Quantity	Price per Unit (CAD)	Total Price (CAD)
Polypropylene Plastic Sheet (for cup body)	Shop3D	1	$11.00	$11.00
Threaded Lid (screw-on adjustable flow)	Walmart	1	$7.99	$18.99
Silicone Gasket (for sealing the lid)	McMaster Carr	1	$16.50	$35.49
Handles (attachable, lightweight)	Amazon	1	$10.18	$45.67
Food-grade Adhesive (for attaching handles and window)	Home Depot	1	$9.98	$55.65
Dishwasher-safe Paint (purple/blue theme)	Amazon	1	$17.00	$72.65
Shipping Costs	Misc.	1	$10.00	$82.65

4.3 Critical Product Assumptions

There are critical production assumptions that are made for the sake of time or based on the current level of knowledge of the group. These could have an impact on the ability to implement the chosen design. The table below shows different categories of the project, along with an assumption and the potential risk of making the assumption:

Table 16, Assumptions and Potential Risks of Chosen Concept

Category	**Assumption**	**Potential Risk**
Material selection	A durable, affordable plastic will meet the durability, safety, and sustainability requirements. The material must also be food-safe, non-toxic, and dishwasher-friendly.	If the chosen plastic does not meet food safety regulations or is not sufficiently durable, it could affect product performance and user safety.
Manufacturing	The available manufacturing tools (3D printer, laser cutter, vacuum forming, mill, lathe, drill press) will be sufficient to produce a prototype with the required tolerances and precision.	Some designs, especially the dynamic flow control mechanism, may require more advanced or precise manufacturing methods that are not readily available. Additionally, the use of these tools may affect the scalability of production beyond prototyping.

Component Functionality	The dynamic flow limiter will function as intended, allowing smooth adjustment of flow by covering the holes.	If the dynamic component becomes stuck, is hard to operate, or doesn't seal properly, the product may fail to meet flow limitation requirements, leading to user frustration or choking hazards.
Hygiene and durability	The plastic and design will endure frequent dishwashing without compromising durability or hygiene.	Some plastics may degrade over time when exposed to dishwasher cycles, or may show wear after frequent drops, affecting the product's usability and lifespan.
Flow Rate	The flow limiter mechanism will precisely control the flow rate within the specified target (1–2 drops per second).	If the hole size, number of holes, or dynamic control mechanism doesn't match the fluid dynamics calculations, the device may allow too much or too little liquid flow, compromising its primary function.
Sustainability	The plastic used will be sustainable or recyclable.	Finding a balance between sustainability and durability/affordability could limit material choices.
Design Compatibility	The cup flow limiter will be compatible with a standard cup or a Nosey cup.	If the design doesn't fit all common cup types, it may reduce the usability of the product.

4.4 Skills and Resources

An analysis of our team members skills is crucial to understand the capabilities that everyone has and may need to accomplish their given task. Our skills and resources identify the tools we need to construct the product, the materials needed, and the skillset that each member must operate or acquire these materials:

Table 17, Skills and Resources with Capabilities of Each Member

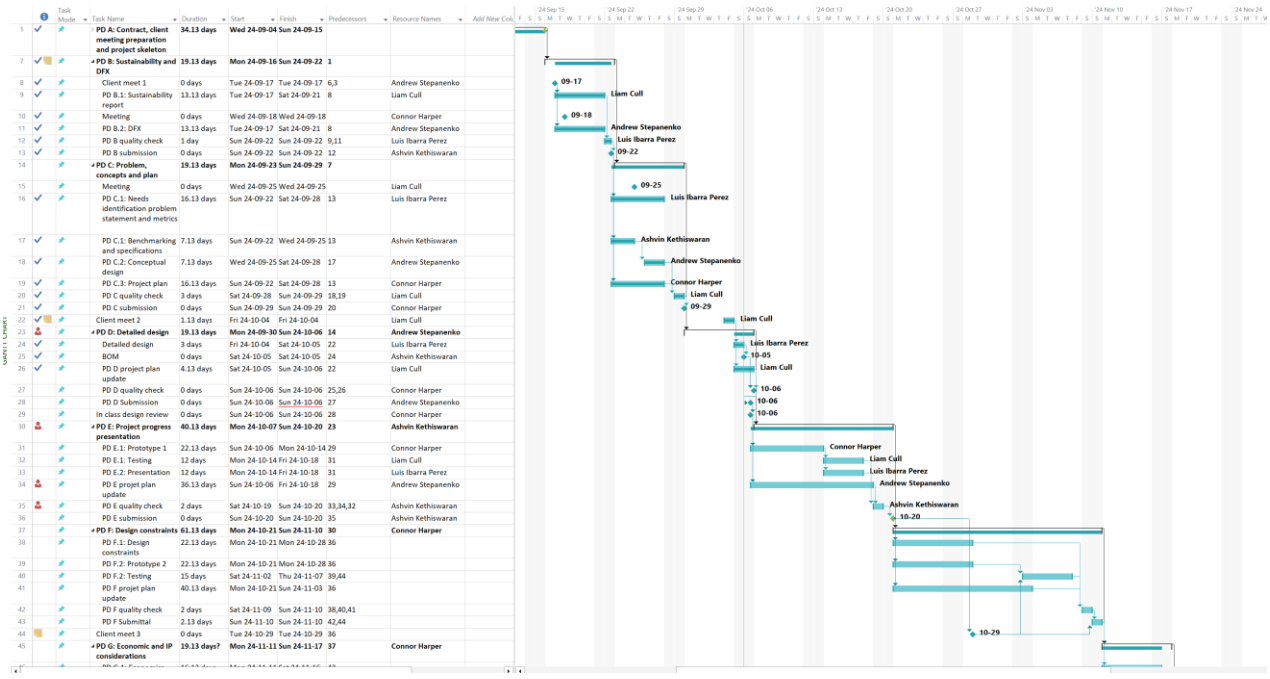
Skills/Resources	**Use**	**Possible Use**	**Members Capable**
3D Printing	Used to create small, detailed design out of PLA plastic	To create parts of the cup that are hard to manufacture, creating small detailed parts for the flow limiter or holes	- Andrew - Luis - Liam

CAD Software	Simulating a design in 3D using software to visualize and prototype.	To create a detailed prototype of our concept to easily make changes and upload, also important for use with 3D printer to print desired 3D designs.	- Andrew - Connor - Luis - Liam
Lathe	To finish/polish an object, to take slowly take material off an abject to get a desired shape.	To shape and model our material/cup to create grooves for the liquids inside to be held and to carve out parts of our cup to fit on supplementary parts that are going to be attached.	- Andrew - Connor - Luis - Liam
Milling	To create holes and take material off an object.	To create holes in our material/cup to attach other components to and to take material off the cup to shape into our product.	- Luis - Ashvin - Liam
Saw/Bandsaw	To cut material into parts, can cut through various types of materials (metals, plastics, ext.).	To cut off unnecessary parts from our design from production, to cut into our product for various grooves.	- Andrew - Connor - Liam
Vacuum Former	To form plastics into shapes using immense force designed by the user.	To create the shell of our cup that hold the water in, ensuring an air/watertight container to protect the client.	
Laser Cutter	To engrave detailed designs into wood and other materials.	To create a pleasing design to imprint on to the product to ensure that they enjoy using it.	- Andrew - Connor - Luis - Liam

Acrylic/Polycarbonate	Strong plastics that are see-through, can be formed into an abundance of shapes.	Material can be used to create the product as it is durable and safe to consume from.	- Liam
Cordless Drills/Impacts	Used to create holes and screw in screws.	Can be used to create holes faster than to use a bigger machine. Also to drill in screws into the product if necessary.	- Andrew - Connor - Luis - Liam

Although some of the listed are limited in terms of expertise within our group, we strive to accomplish the product regardless. Through our lab works in our class (GNG2101) and our growing knowledge outside of school, we will be capable of using the skills that we do have to finish. Some of these skills are not available as of now but are important to mention for mass production or for exceeding our requirements for the product. To compensate for this, we will look for alternatives such as ordering parts online or finding other ways to model our part.

4.5 Project plan update



Realistically its going to take a week of the groups combined efforts to create the first prototype. After the first prototype has been completed, it will likely take another week to properly test and make notes of the design of the initial prototype. The group has a wide range of skills to their use with lots of overlap in ability between teammates, therefore the first prototype should be made fairly quickly leaving most of the time to testing and possibly small iterations on the design of the initial prototype.

2. Conclusions

We were given the task of creating a flow-limiting cup that would satisfy our client's particular requirements. We have investigated a number of design ideas that strike a balance between usability, longevity, and daily practicality using a cooperative, user-centered methodology.

The client was pleased with our initial design, but we made some important changes based on their suggestions, like adding variable flow control and a translucent portion for improved use. We are currently finishing the bill of materials (BOM) and detailed design to represent the changing product vision after incorporating these enhancements into the current design.

Our emphasis on client involvement and iterative improvement has built a solid basis, even though there is still more work to be done. We have faith that this method will result in a finished product that is both useful and efficient.

3. References

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