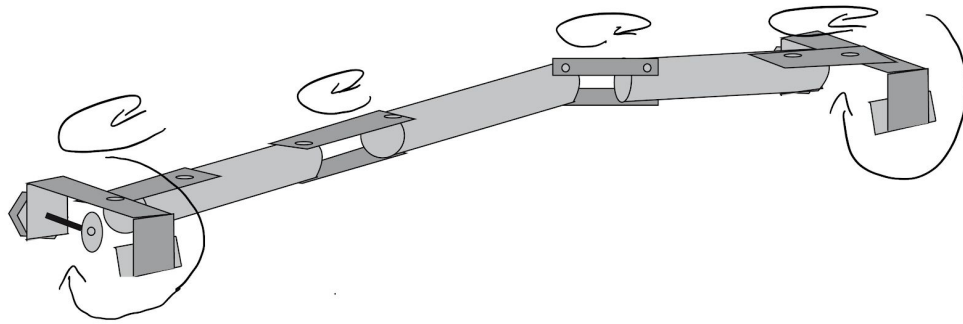


Portable Curtain (A13)

Deliverable M:

Final Report

GNG2101 [A]



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Abstract

The problem that our group was tasked with was to create some type of portable product that can provide privacy and expand several public restrooms; a request from the LIFE program. At the first client meeting, we were able to meet with Ashley, an individual who requires the assistance of a wheelchair. After getting to know her better and asking her questions, our group was able to get a greater understanding of the issue and establish some requirements and constraints as well as rank the prioritized needs. Our group then began to benchmark and found that there were no concrete products that existed that could solve this problem. Our team looked back on the prioritized needs and worked on the metrics and target specs. We then began to individually plan and design concepts. After choosing a concept, we later figured it would actually be several problems in creating it, so we went back and synthesized our individual ideas and integrated them into one new design concept. We then established our concept design we then created a physical prototype as a basic proof of concept as well as a demonstrate a basic test to our client. The second prototype was focused, in which we tested the rods flexibility with the added hinges. The third prototype was a comprehensive one where the entirety of the product was tested, which included the rod's stability and flexibility, the clamps' strength and adjustability, and the curtain's length and coverage. Ultimately, with this final prototype, we were able to fulfill Ashley's expectations.

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Introduction

The project that our group took is the “Portable Curtain”. This is a request from the LIFE program where our clients are looking for a curtain, or any type of covering that is able to provide privacy, that they are able to bring, specifically for public restroom use. The reason there is an issue is due to the fact that not every bathroom stall and porta potties are easily accessible for wheelchair users. Most stalls are too small, which causes privacy issues for these individuals, as they are unable to close the door when occupying these public facilities. The invention of our project request would be able to be used by anyone to allow the users privacy along with the space expansion that it would provide. This invention would most importantly be directed to wheelchair users, however, as they are the key reason to its creation. Our design would be a unique one, as there are no other design that is greatly similar to ours, which tackle the problem. Unlike most other inventions available to help tackle this problem, our design is much more portable, as it is lightweight and compact. It uses the concept of hinges that allows for a length of rod to have flexibility. Likewise, the ends of the rods have hinges, which allow for the clamps attached to the ends of the rod to be mobile. Our product is one that is surely reusable, as well as being easily taken down and cleaned when the time comes. It’s highly flexible as well, since it is able to adjust and combat several public restroom configurations. This adjustability allows for expansions where needed, giving clients extra space, wherein they would also be donned privacy by a curtain, which is also lightweight and adjusts along with the rod it hangs from.

Main Design Process

In this part of the report the reader will be able to grasp our full design process from initial meeting with the client to the full solution and the trials and tribulations along the way. To solve our specific problem, we used the design process which required many important steps. Through this process we first emphasized with the client to understand the problem. From our first initial meeting we then started to define our problem into understandable means. We laid out the specific needs of our client Ashley and began to rank them. This led us to our problem statement to base our solution off of. We as a group then continued to define our problem, laying out target specs for our problem, and benchmarking other solutions to get a base knowledge off of. After we had defined our problem we were ready to start ideating possible solutions. This led to concept drawings and designs of our problem, leaving any possible solution on the table. As a group we used a decision matrix to come up with the best possible solution. From there we kept tweaking our chosen concept to base off of, and were ready to prototype. Our problem included three prototypes ranging from low fidelity to a full final comprehensive prototype. Each prototype required testing for us to measure how well our design was at solving our problem.

Emphasizing:

Needs Identifications, and Product Specs:

This was the first part of our design process and began with our first client meeting with Ashley at the LIFE society. At our first meeting Ashley told us all about her specific problem. We asked her important questions about her problem for us to get a better understanding. We gathered her needs and left with a good starting knowledge of our problem. As a group we identified the needs of our problem, wrote out a problem statement that reflected our problem, benchmarked possible solutions and came up our product specifications.

Observations:

- Portable curtain used for outing purposes where wheelchairs block bathroom door from closing
- Curtain needs to attach to walls, and be sliding to open and close
- Portable enough to fit in a backpack
- Curtain must be 6-8 inches off of ground to prevent tripping for safety
- Must be adjustable to fit many different sized openings (porta-potties, stalls)
- Must be sturdy, but easy to carry

Needs Identification:

Need	Priority
Portability	3
Weight	5
Privacy	1
Ease of Use	4
Cost	6
Adjustability	2
Aesthetic	7

Table 1. Needs Identification

We ranked these needs with privacy being the most important need, closely followed by adjustability, portability. These were the most important needs as our client stressed about needing the curtain to give full privacy, be very portable and adjustable. We now had all the pieces for our problem statement.

Problem Statement:

People with disabilities at the LIFE Society have problems with privacy in public spaces and need a curtain to hang outside washroom doors to provide privacy. The curtain needs to be designed to be very portable, sturdy and adjustable to fit washrooms of all sizes and types to offer a suitable solution.

Benchmarking:

We searched for possible products on the market that could possibly solve our problem and came up with the realization that no such solution existed for our problem. All of the products on the market were either too heavy, too bulky, and were not meant to be used outside.

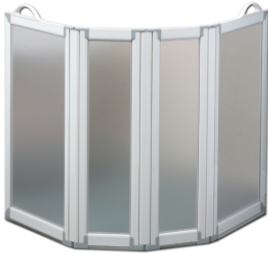

Product	Specifications
<p data-bbox="201 590 748 659">ASW Medicare Portable shower screen “4 Panel”</p>  A portable shower screen with four panels, made of frosted glass or plastic, with a silver metal frame and handles at the top.	<ul style="list-style-type: none">- Foldable hinge design, but bulky, costly and heavy- Not portable- 30 kg- \$357 US
<p data-bbox="245 1037 751 1106">Medicus Health- PVC Portable Privacy Screen with Casters</p>  A portable privacy screen with a blue PVC curtain, mounted on a white metal frame with four casters.	<ul style="list-style-type: none">- Lighter, but still heavy<ul style="list-style-type: none">- 25 lb- Foldable, wheelable- Not adjustable- Not durable- Not a curtain- Costly<ul style="list-style-type: none">- \$259 US

Table 2. Benchmarking

5. Metrics and Target Specs:

After defining our needs and benchmarking we then were able to set out our metrics, and target specifications to be used for our design process. Each need had a constraint to follow in our design process

Need	Metrics	Unit
Portability	The size and dimensions of the entire product. Length/Width	Inches
Weight	The weight of the Rod and curtain combined	Kg
Privacy	The exposed area covered by the curtain	Feet % coverage
Ease of Use	The speed it takes to setup and takedown	Seconds
Cost	The total amount spent on materials	\$CAD
Adjustability	The difference in length that the rod can adjust to	Inches

Table 3. Metrics

Target Specs:

Specifications	Description	Value
Portability	Size and dimensions of product	< 2' x 1' folded size
Weight	Total weight of rod and curtain as a whole	< 10lbs
Privacy	Exposed area covered by curtain	=95% area coverage
Ease of Use	Speed of set up/ Teardown	<1 min
Cost	Price	<\$100
Adjustability	Length rod can extend to	=2-5ft

Table 4. Target Specs

Conceptual Design

After defining our problem we were ready to starting ideating possible solutions. This part of the process included many different ideas and concepts for our portable curtain.

Concept 1:

A curtain rod cut into multiple pieces and attached together with joints. These joints will allow each piece to rotate horizontally and maximize the adjustability and portability. Additionally the end of the rod would be equipped with suction cups to attach to any type of material

Concept 2:

The second design included the same rod properties (joints) as concept 1. But, instead of suction cups, the rod will be held up by another rod containing a 4-wheelbase at the bottom.

- Sturdy, Foldable
- May not fit in a backpack

Concept 3:

Foldable curtain rod that will be able to hook onto tops of washroom doors including porta-potties

- Foldable, and collapsible like tent poles
- Hook design, may not be strong enough
- Light, compact

Concept 4:

A Tensile rod to be twisted to extend and use tension to stay in place. Although, it is adjustable and viable for both stalls and porta-pottys, it would require for the rod to be placed within the porta-potty, leaving little allowance in space for their users. Held to walls with hooks

- Adjustable
- Light
- Privacy issues

After evaluating each concept with a ranked decision matrix based off of our defined needs, and target specs we came up with the conclusion to go ahead with concept 2, the wheelbase portable curtain. This concept proved to be the best solution as it ranked the best with respect to each need of our client. Pictures shown below are what we envisioned as to how the concept would look and function.

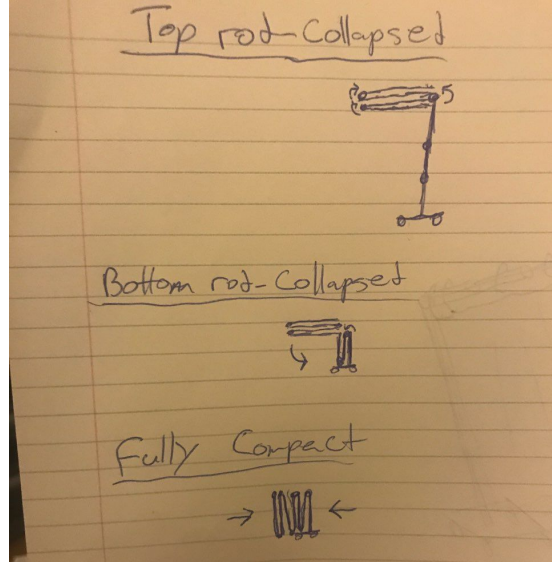
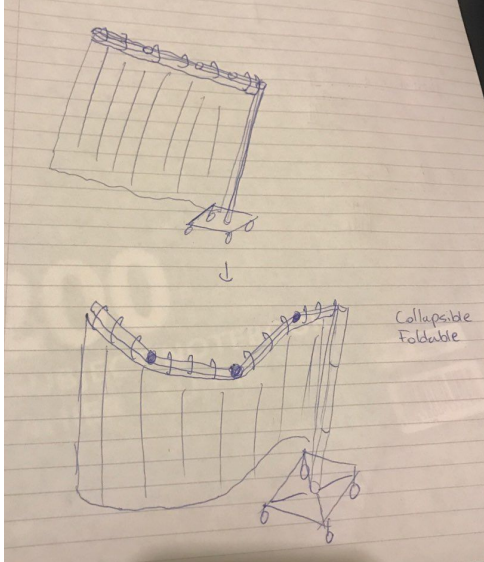


Figure 1. Concept 1

Chosen Concept 2:

Shortly after choosing the wheel based design as our chosen concept for our project we saw some potential problems with its overall design and functionality. As a group we realized that this concept would certainly not fit in a backpack, and that it would be too heavy. Furthermore the wheelbase of the concept would not be sturdy enough to support a curtain, especially on un-level ground. Because of all of this, our group went back into the refinement loop to see if we were misunderstanding anything with our problem. We already knew enough about our problem, and had well defined needs, and specs, we just needed to ideate a better concept. With this understanding we went back to our other concepts and came up with a new design. Our new design took the best of our other concepts and included rotatable joints, for portability, ease of use and adjustable clamps to be able to connect to many different washroom openings. We were now ready to further develop our design and generate prototypes.

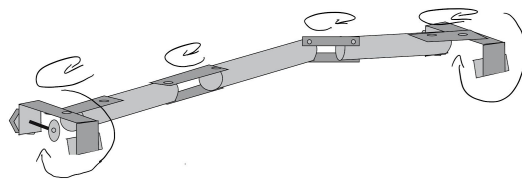


Figure 2. Concept 2

Project Planning and Feasibility Study

Our project needed proper planning since we had such a short deadline to make a functioning prototype. This included many different deliverables, two additional client meets, and three prototypes all within 2 months. As a group we created a project gantt chart to follow our progress. Every week we would work on deliverables, and our product. The gantt chart included a critical path we followed to reach our goal of a functioning prototype by design day on Nov 29th. The Gantt chart below has the critical path we followed in green, with tasks depending on one another to reach success. Although not in the chart below, all deliverables assigned were also considered in planning to ensure our group was on track each week. Also project milestones were significant including finishing prototype 1, 2 and 3 as these milestones helped us stay focused on our path to a full functioning prototype for design day.

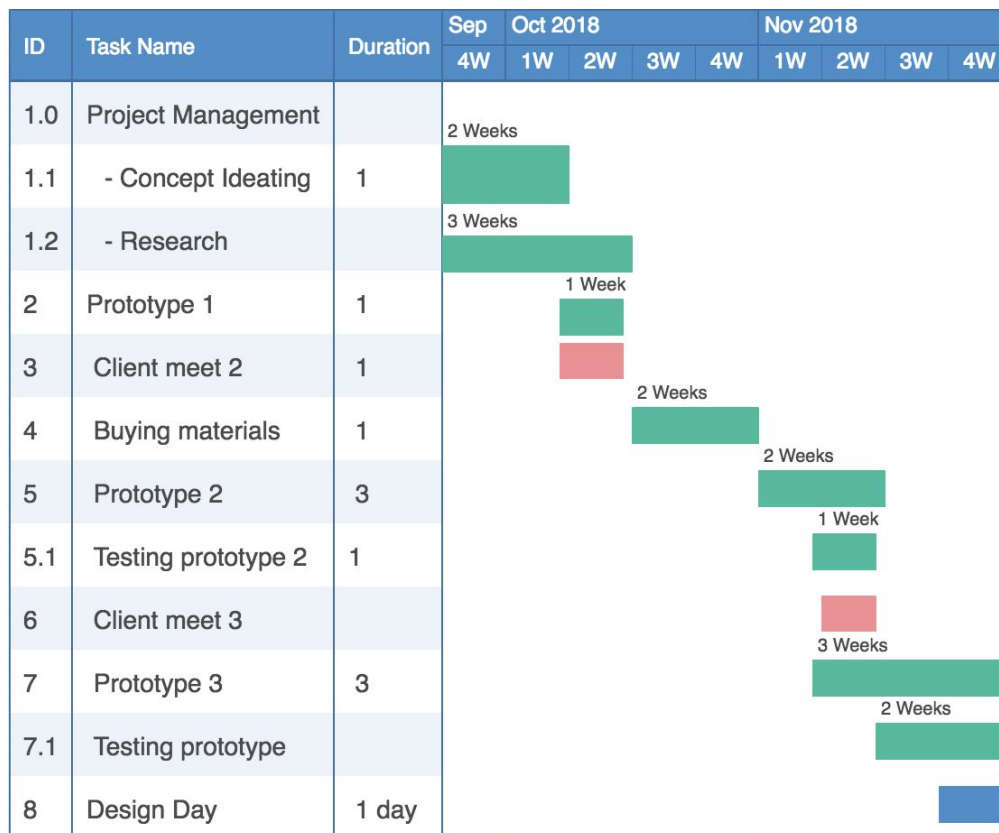


Figure 3. Project Plan

Bill of Materials:

Name	Price	Use	Store	Estimated Time to Receive
Joints (x3)	N/A - We will build using the Mill	Connect the sections of the rod and allow the rod to pivot	N/A	N/A
Aluminum Rod (x2) 3'x1-1/4"	\$32	To hold the curtain and the clamps	Home Depot	In store pickup
Hinges x2	\$8.28	Connect to clamp to provide rotation	Home Depot	In store pickup
Metal Plates x8	\$8			
Lock Nuts x8	\$2	Connect joints, and clamp to rod	Home Depot	In store pickup
Bolts x10	\$6.72	Connect joints, and clamp to rod	Home Depot	In store pickup
Clamps (x2)	\$17.84 x2	To attach the curtain rod to the washroom frame	Amazon	Amazon Prime delivery time: 3-5 days
Curtain and curtain hooks (x1)	\$12.97	To shield the view of the washroom from outside.	Walmart	In-store pickup
Total	\$105.65			

Table 5. BOM

After making the Bill of Materials for the portable curtain, we calculated a final cost of \$105.65. The reason for spending over \$100 was due to aluminum being expensive, and a lack of knowledge and time from group members to make complex parts such as the clamps, and hinges. Therefore, we bought those parts so we could maximize the final product for the customer while also ensuring that we stayed close to the budget. In hindsight we could have used aluminum from Brunsfield centre to reduce costs.

Feasibility Study: TELOS

For our resources we had the labs at the STEM building to use the machines to help build our project. There we used the Lathe, and Mill a to connect our parts together. As a group we had the expertise needed as we have all completed the related labs and have previous handyman experience using these machines.

Our project was reasonably economical, as seen in our Bill of Materials our project costed just over \$100, at \$105.65. We could have been under \$100 by using aluminum from the Brunsfield Centre.

In our research there were believed to be no legal issues surrounding our solutions as the idea is pretty straightforward and did not pose any potential legal risks. Some patents relating to our design existed but their claims did not pose a risk legally.

Similarly there were no organizational constraints that prevented our success in finishing our project as we did not copy any idea and only created our own unique solution.

For deadlines, our schedule displayed in our gantt chart was very reasonable as most our items for our prototypes were bought in store in Ottawa, and did not effect our time frame. We managed our time well and worked from one stage to the other considering the short timeline.

Analysis

As our project was not considerably technical, we believed analyzing was not overall important as we did not analyze many features. Much of our project analyzation was done through our prototypes. In these prototypes we analyzed materials to be used for our project such as aluminum, plastics, and metals. One factor we did analyze was the overall dimensions of porta potties and public restroom door opening spaces. We found that the standard door opening was 30-36” or 3 feet for door frames, and porta potties were typically 43” wide including door frames. This helped us in the development of our product as we knew how long to make our rod able to extend to, and gave us a sense of the space we created.

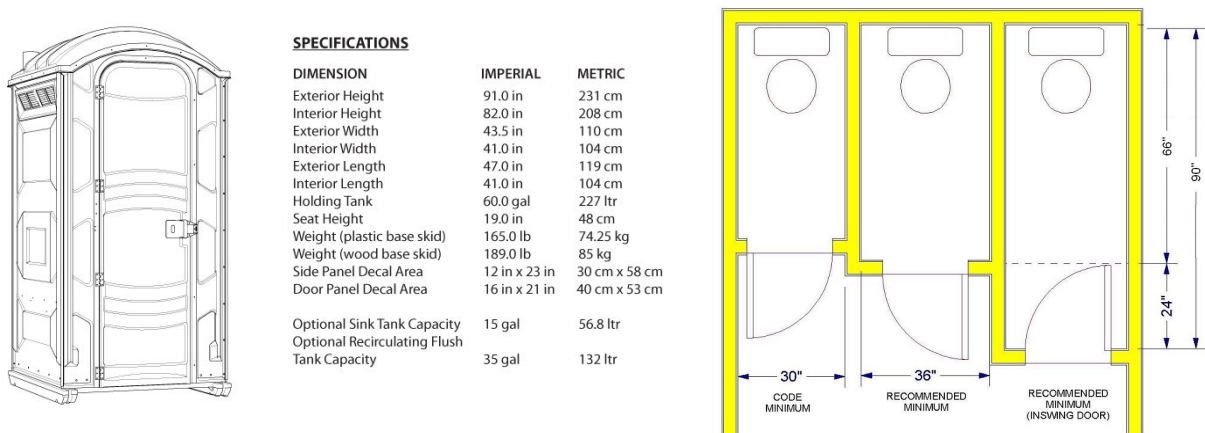


Figure 4. Washroom Dimensions

Prototypes

Prototype I

This prototype was a global proof of concept (low fidelity). We designed a small scale version of our solution to give the client a visual, 3D representation of our idea. Our test for this prototype was proof of concept, testing the general look of our design in a small-scale deployed form. It was a very basic test of the overall design of our final project. We were doing this test to make sure our ideas and assumptions on paper can be physically achieved. Also, by making a small scale 3D model, it helped us envision our solution, and its possibilities.

As we were attempting to create a physical and comprehensive prototype with low fidelity, we decided to construct it out of cardboard and small paper clamps. The first concept we were attempting to test was whether the rod would be able to sturdily hold up the curtain without noticeable downward bend. If so, the design would not be sturdy, which could be catastrophic to the users privacy. To do this we analyzed if the grip strength of the clamps would be strong enough to resist the moment applied by the weight of the rod. It is important to note that we did not use calculations for this test. The second concept we were testing was whether the clamps (used to hold the rod in place) would be able to reliably and consistently hold the apparatus up, and on to a variety of public restrooms. To test this we used them on a variety of surfaces and proportional washroom areas. Their reliability and strength was then analyzed by attaching the rod to the clamps. This would prove to be very important because this showed us its behavior with the rod attached to the clamps. Extra force would then be applied as well to make sure there is some allowance for any unpredictable accidents. This further ensured our device's reliability and durability. The last concept we tested with Prototype I was the sturdiness of the rod. To do this we applied forces onto the middle of the rod while supporting both extremities. We then proceeded to see whether adjustments in our plan were needed to ensure that the rod is able to stay relatively straight. ***Pictures of the Prototype I tests can be seen in the figures below.***



Figure 5. Prototype I: Stability Test



Figure 6. Prototype I: Adjustability & Portability Test

The results of Prototype I showed that it was very successful. The reason for this is that we were able to effectively visualize how the rod will fold and be adjustable. We found that attaching joints to the end of the rods was very effective because it would allow it to collapse and adjust width easily. However, with Prototype I we also realized a crucial flaw with the joints. If the rod folded above and under the middle section the curtain hooks would not be able to slide across the rod. To fix this we decided to make each joint by taking two metal plates and drilling holes in each end. This would allow for each rod section to be of equal height and fold to the left and the right of the middle piece. Hence, theoretically fixing the problem. However, we would need to do further testing of the joint design in Prototype II. The other components that were tested in Prototype I showed no design concerns. The rod was able to easily stay straight with the proportional weight of a curtain applied. Also, the tiny paper pinch clamps were easily able to support the moment created by the weight of the rod and the curtain. All in all, the tests that we did allowed us to learn and visualize how many components would work, making Prototype I a great success.

The client feedback for Prototype I was very positive. Ashley was very impressed by the design we created as it satisfied all of her needs. Also, the cardboard model was very effective in helping her visualize how the rod would be able to adjust and fold. Therefore, no changes needed to be made and we were all on the same page for Prototype II.

Prototype II

The purpose of this prototype was to test physical functionality of the joints, which will determine if a jointed curtain rod would be fit for our design criteria. For this prototype we were mainly focusing on the joint design and also the rod as a whole; size, weight, and portability factors. We made a full scale curtain rod with three aluminum poles each of 18'' in length, combining for a total length of 4.5 feet with 2 joints. The joints are composed of 2 steel plates with 2 screws and lock-tight nuts to prevent the joint from loosening over time. Our goal of the joints was to be as rotatable as possible but seamless too, not taking away from the whole rod itself. The joints provide almost 360 degrees of rotation, making our rod more accessible for different sized washroom openings. This gives the user more access to change the position of the rod to meet whatever space they are in. We also had weight, and portability in mind, choosing lightweight aluminum as our material, with a weight of 1 pound. The joints allow for a full collapse of the rod down to 20'', and we tested if the collapsed rod would fit in a backpack, confirming it will. This prototype shows the full functionality of our curtain rod being able to extend, rotate and collapse to different shapes and sizes, provide easy access to rotate and adjust, and be light enough for use, and travel. Also, we also determined that the rod was very sturdy as the joints did not break when we held the rod up at one end. Therefore, if it is not possible to

attach both clamps to the washroom frame, it would be sufficient to only attach one. *Pictures of the Prototype II tests can be seen in the figures below.*



Figure 7. Joint Design



Figure 8. Rod Adjustability

The client meeting with Ashley went very well. We were able to bring our Prototype II to show her our progress. Ashley was very impressed with our design. The prototype was able to satisfy many needs such as portability and adjustability. The group went to a doorway with Ashley to demonstrate the design. The rod was able to adjust easily to any door size and collapse into a backpack. Since those needs were of high priority, Ashley was ecstatic! However, for the final prototype, Ashley suggested some minor changes. Aesthetically, she would like it if we painted the rod purple. Also, she suggested that we rounded the edges of the joints to increase the safety of the rod (which we have done for Prototype III).

Prototype III

The purpose of prototype III was to test the overall functionality of the design with the clamps attached. This prototype could be described as a physical and comprehensive prototype which has very high fidelity. The reason why the fidelity is very high is because we will be testing the whole product with all the real components (eg. clamps, curtain...). However, since we have tested all components besides the clamps in past prototypes, we put emphasis on the stability, adjustability and strength of the clamps. The first step of Prototype III was to attach the clamps to the rod. To do this we first attached the middle of a metal plate to the rod using a bolt and a lock nut (*figure 9*). This allows for 360 degree rotation of the clamps which makes it able to clamp on to any washroom frame (clamp to the top and the side). Once we attached the plates, we attached the clamps using bolts. With the clamps attached to the rod we could now test the design as a whole.



Figure 9. Clamp Design

As a group we went to a regular washroom stall (that was not handicap accessible) and set up our prototype. By doing this we found many components that worked well and a few that needed to be modified. The components that worked very well were the joints, the rod and the curtain and its hooks. The joints allowed the rod to go from a size that can easily fit in a backpack to approximately three times the width of a washroom (when fully extended). Also, since the rod is so wide, when it is clamped to a washroom frame it will extend the washroom significantly. This gives the user a lot more space inside. The curtain and the hooks provide 100% privacy to the user when deployed and the hooks slide easily over the rod. However, we trimmed the bottom of the curtain by 6 inches to avoid feet and wheels to get caught in the fabric. The parts that needed to be modified were the plate that connected the rod to the clamp

and the clamps hinge. The reason why the plate needed to be modified was because the bolts that were connected to the clamp (on the extremities) were too low and did not allow for the plate to rotate 360 degrees. The fix to this was very easy as we simply raised the plate to a height that was longer than the bolt. We did this by putting a nut in between the rod and the plate. The second problem was that the hinge was not strong enough to support the weight of the rod and curtain. To stop it from collapsing we stuck erasers between the plate and the hinge. This easily fixed the problem as the eraser stopped the hinge from collapsing. After fixing these problems, the design worked perfectly and satisfied all customer needs. *Pictures of the Prototype III tests can be seen in the figures below.*



Figure 10. Prototype III

Final Solution & Results

The final product satisfied all but one client needs. The curtain was able to cover at least 90% of the opening to the stall. The reason why it does not cover 95% of the area is because we needed to cut 6 inches off the bottom to make the design safer. The rod is also very adjustable as it can adjust to any washroom door width while also extending the area inside. The rod can also easily fit inside a very small backpack, allowing it to be very portable. Another feature that makes it very portable is the very low weight of the design. With the use of aluminum rod and a light curtain, the design as a whole weighs approximately 3 pounds. It also satisfied the ease of use criteria as the set up time was far less than a minute. Furthermore, the design was aesthetically pleasing as the curtain was a blue color (clients request), the edges of the plates were rounded and the bolts were filled down to be smooth. In spite of satisfying all these criteria, we were not able to satisfy the cost of lower of \$100. The reason for this was because the aluminum rods and the clamps were quite expensive. In hindsight, we should have got the aluminum rods from the maker store or the brunswick center. This would have significantly reduced our cost to the requirements. Also, since this was simply a prototype, if we were to mass produce this product we could significantly reduce the cost of the product.

Here are the pictures describing how the final product works:



Figure 11. Final Product (Deployed)



Figure 12. Final Product (Compact)

Business Model

How?	What?	Who?
<p><u>Key Partnerships</u></p> <ul style="list-style-type: none"> -Partnership with curtain and curtain rod manufacturers -Partnership with hospitals and organizations (such as the LIFE program) in need. -Partnership with joint and clamp manufacturers -Partnership with shipping company 	<p><u>Value Propositions</u></p> <ul style="list-style-type: none"> -Quality at a low price -Privacy -Portability -Adjustability -Durability -Able to fit and extend any washroom types and sizes and provide privacy using a curtain. 	<p><u>Customer Relationships</u></p> <ul style="list-style-type: none"> -24/7 service -Free shipping after \$100 -1-year warranty -We will integrate the customer relationships using the phone line and website. These activities will be quite costly as we will have to employ employees to run these services. However, we expect the revenue to make this service worth-while.
<p><u>Key Resources</u></p> <ul style="list-style-type: none"> -Curtain rods, curtains, joints and clamps -Manufacturing line (factory) and employees -Sales/manufacturing personnel -Shipping personnel -Equipment to construct product 		<p><u>Channels</u></p> <ul style="list-style-type: none"> -Website -Field sales -Phone line -Social media (eg. Twitter)
<p><u>Key Activities</u></p> <ul style="list-style-type: none"> -Product development -Repair team of broken products -Recurring and service revenue 		<p><u>Customer Segments</u></p> <ul style="list-style-type: none"> -The most important customers will be hospitals and other organizations as they will buy the product in bulk and be repeat customers. -We will also provide the product to individuals in need but, they will not provide as much revenue.

Cost	Revenue
<ul style="list-style-type: none"> -Marketing and sales -Services such as website, phone line... -Shipping -Product development -Paying Employees -Repairs/warranty 	<ul style="list-style-type: none"> -Marketing solutions -Sales -Funds by other organizations, the government...

Table 6. Business Models

To develop our business model we made many assumptions on how the company will function. In today's time, technology has become the most popular and efficient way to communicate. Therefore, we assumed that a website and social media would be very useful for customer communication. Although it will be quite costly to operate these services 24/7, it will prove to be useful in customer satisfaction which, will increase revenue. Also, we assumed that our key customers will be hospitals and other organizations such as the LIFE Program. The reason why we assumed this is because our objective is to provide privacy to people with disabilities while they use the washroom, and the highest concentration of those people are located there. These organizations will buy in bulk, be repeat customers and request other services provided by the company. Therefore, we will offer a cheaper price for those buying in bulk and put less emphasis on those buying individually. We also assumed that curtain rods, curtains and other materials will be provided by many suppliers. This will reduce the manufacturing cost as we will not need to buy equipment and hire employees to construct these materials. Also, as we will be buying these materials in bulk, we assume that the supplying companies will also give us discounted prices. In the end, receiving our materials will increase the companies revenue. The last assumption we made was that we must provide customer with hands-on support. These services include repairs, installations and beginner instructions on how to use the product. These services will also increase customer satisfaction, and in return our revenue will also increase. Without providing these services, customers would not be fully capable of using the product efficiently. Hence, they would likely switch to another similar provider.

Economic Analysis

Privacy Solutions Inc.		Income Statement		
		For the Years Nov. 4th 2018 to Nov. 4th 2021		
Revenue		2019	2020	2021
Sales revenue		75,000	375,000	750,000
(Less sales returns and allowances)				
Service revenue		250	1,500	3,000
Other revenue		-	200	300
Total Revenues		75,250	376,700	753,300
Expenses				
Cost of goods sold		25,000	125,000	250,000
Total Expenses		25,000	125,000	250,000
Gross Profit		50,250	251,700	503,300
Operating Expenses				
Advertising		10,000	5,000	5,000
Commissions		3,763	18,835	37,500
Depreciation		500	1,500	3,000
Employee benefits		5,000	10,000	20,000
Furniture and equipment		500	500	-
Insurance		750	750	750
Maintenance and repairs		200	500	1,000
Office supplies		10,000	10,000	10,000
Rent		25,000	25,000	25,000
Research and development		-	1,000	5,000
Salaries and wages		100,000	150,000	200,000
Software		-	-	-
Travel		-	1,000	2,000
Utilities		1,400	1,400	1,400
Web hosting and domains		500	500	500
Other		500	1,000	1,000
Total Expenses		158,113	226,985	312,150
Operating Income		Loss of 107,863	24,726	191,150

Figure 13: Income Statement

NPV-Analysis

From our income statement for the future 2 years, we have a income of \$75 250 for the first year,

$$\begin{aligned}
 \text{Cash Inflow} &= (\text{revenues} - \text{costs}) * (1 - \text{tax rate}) \\
 &= (\$75,250 - \$158,113)(1 - 0.15) \\
 &= -\$70,433.55
 \end{aligned}$$

Now with NPV= C/(1+r) where r is the rate of return expected

$$\text{NPV} = -70433.55 / (1 + 12\%)$$

NPV = \$-62 887.1 for Year 1, \$191 022 for Year 2, \$381968.75 for Year 3

Break Even

For our company and product to break even we would need to sell 382 units. If we were able to sell our anticipated goal of 500 units our profit would be \$11,850. With a variable costs per unit of \$50, and a sales cost per unit of \$150.

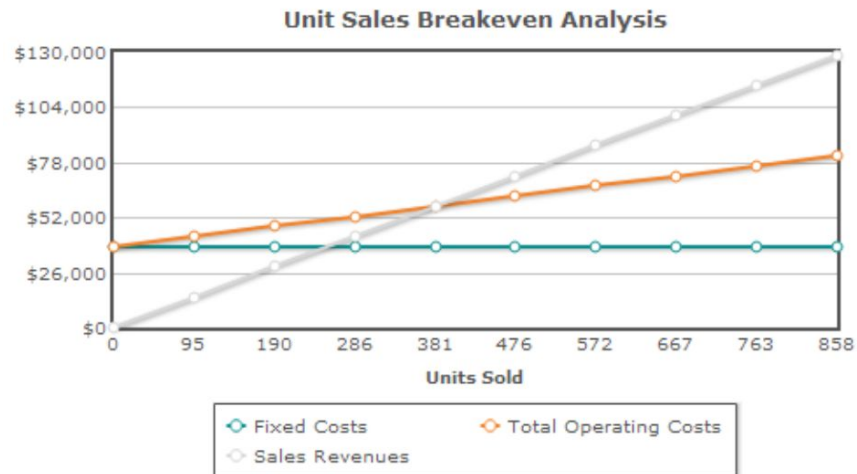


Figure 14: Break Even Analysis

One of the bigger assumptions that have been made in developing the economics is that the company would start off with financial debt for some time. This is due to the fact that the company is new and that little to no financial partners and clients have been established yet. Another assumption in making this economics report is that there will be a significant increase in NET profit once this company has become more recognized and when financial partners and more clients have been established, which would allow for the company to sell more goods. The final assumption that was made in developing this economics report is that, over time, less expenses will have to be made, such as for advertising, and that better discounts will be available for buying in bigger bulks.

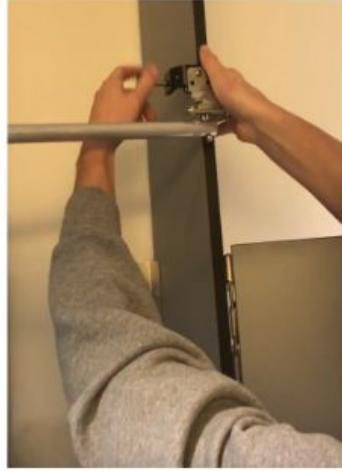
User Manual

Portable Rod User Manual



First adjust the rod to the width of the bathroom stall

1.



Tighten the clamps firmly to both sides of the bathroom stall frame

2.



Close the attached curtain to completely cover the bathroom stall

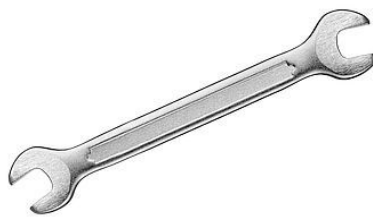
3.



Enjoy your privacy!
:)

4.

Troubleshooting:



It is important that all the screws and bolts of the portable rods are tight. If loosening does occur and is causing issues with the performance of the rod, joints or clamps be sure to tighten the screws with a screwdriver and the bolts with a small wrench.

Design Files

MakerRepo Link to project:

<https://makerepo.com/andrewpetrasek/portable-curtain-gng2101-fall-2018>

Conclusion

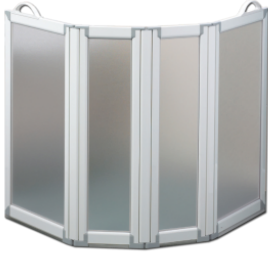

Overall we view our project as a success as we were able to meet and incorporate our clients needs and design target specifications. We learned alot about teamwork as the majority of our group do not know each other on the first day. We grew to develop trust and understanding in each other and create a strong capable team to carry out our project.

Being that each member in the team had a very different schedule we learned to overcome it by figuring out the best ways to organize our time and meetings. Though we believe we had a successful project if we were to do our project over we would make sure we improve our planning and cost management. We did not thoroughly plan out exactly what we might need down to every detail which unfortunately caused us to spend a lot more than we expected and to exceed our cost limit.

For future work we would focus a lot more on aesthetic and how we could possibly simplify our design to make it look less bulky and more appealing to users and the public. We would also put a lot of focus into how the joints , bolts and screws are attached. This would be to make sure everything is attached extremely tightly and to greatly reduce or remove the need to ever tighten any part of the portable rod. Removing that problem would highly increase the product life of the product for users.

Bibliography

Benchmarking

Product	Specifications
<p data-bbox="201 558 748 625">ASW Medicare Portable shower screen “4 Panel”</p>  A portable shower screen with four panels, made of a translucent material, mounted on a silver metal frame with a curved base.	<ul data-bbox="873 558 1349 741" style="list-style-type: none">- Foldable hinge design, but bulky, costly and heavy- Not portable- 30 kg- \$357 US
<p data-bbox="245 1003 751 1071">Medicus Health- PVC Portable Privacy Screen with Casters</p>  A portable privacy screen with three panels, made of blue PVC material, mounted on a white metal frame with casters at the base.	<ul data-bbox="873 1003 1211 1297" style="list-style-type: none">- Lighter, but still heavy<ul data-bbox="967 1045 1081 1071" style="list-style-type: none">- 25 lb- Foldable, wheelable- Not adjustable- Not durable- Not a curtain- Costly<ul data-bbox="967 1268 1130 1297" style="list-style-type: none">- \$259 US

BOM

Name	Price	Use	Store	Estimated Time to Receive
Joints (x3)	N/A - We will build using the Mill	Connect the sections of the rod and allow the rod to pivot	N/A	N/A
Rod (x1)	\$8.82	To hold the curtain and the clamps	Walmart https://www.walmart.com/ip/Mainstays-5-8-Cylinder-Curtain-Rod/49672258	In store pickup
Clamps (x2)	\$17.84 x2	To attach the curtain rod to the washroom frame	Amazon https://www.amazon.ca/dp/B018RLY6B2/ref=sspa_dk_detail_6?psc=1&pd_rd_i=B018RLY6B2&pf_rd_m=A3DWYIK6Y9EEQB&pf_rd_p=0c4797d7-01ae-4f2b-9625-15b63bbba1db&pf_rd_r=R8W0CTWWY4GCKV6PXZX5&pd_rd_wg=ljSSW&pf_rd_s=desktop-dp-sims&pf_rd_t=40701&pd_rd_w=imACH&pf_rd_i=desktop-dp-sims&pd_rd_r=9014b97e-c831-11e8-86db-611134cc7459	Amazon Prime delivery time: 3-5 days
Curtain (x1)	\$12.97	To shield the	Walmart	In-store pickup

		view of the washroom from outside.	https://www.walmart.ca/en/ip/maintays-microfiber-fabric-shower-curtain-liner-black/6000195530850	
Total	\$57.47			

Business Model

How?	What?	Who?
<p><u>Key Partnerships</u></p> <ul style="list-style-type: none"> -Partnership with curtain and curtain rod manufacturers -Partnership with hospitals and organizations (such as the LIFE program) in need. -Partnership with joint and clamp manufacturers -Partnership with shipping company 	<p><u>Value Propositions</u></p> <ul style="list-style-type: none"> -Quality at a low price -Privacy -Portability -Adjustability -Durability -Able to fit and extend any washroom types and sizes and provide privacy using a curtain. 	<p><u>Customer Relationships</u></p> <ul style="list-style-type: none"> -24/7 service -Free shipping after \$100 -1-year warranty -We will integrate the customer relationships using the phone line and website. These activities will be quite costly as we will have to employ employees to run these services. However, we expect the revenue to make this service worth-while.
<p><u>Key Resources</u></p> <ul style="list-style-type: none"> -Curtain rods, curtains, joints and clamps -Manufacturing line (factory) and employees -Sales/manufacturing personnel -Shipping personnel -Equipment to construct product 		<p><u>Channels</u></p> <ul style="list-style-type: none"> -Website -Field sales -Phone line -Social media (eg. Twitter)
<p><u>Key Activities</u></p> <ul style="list-style-type: none"> -Product development -Repair team of broken products -Recurring and service revenue 		<p><u>Customer Segments</u></p> <ul style="list-style-type: none"> -The most important customers will be hospitals and other organizations as they will buy the product in bulk and be repeat customers. -We will also provide the product to individuals in need but, they will not provide as much revenue.

Cost	Revenue
<ul style="list-style-type: none">-Marketing and sales-Services such as website, phone line...-Shipping-Product development-Paying Employees-Repairs/warranty	<ul style="list-style-type: none">-Marketing solutions-Sales-Funds by other organizations, the government...