# GNG 2101 – Intro. to Product Development and Management for Engineers

## Deliverable B- Needs, Problem Statement, Metrics, Benchmarking and Target Specifications

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# Table of Contents

# Introduction

The goal of this project is to design and manufacture a shower seat that is to be used by a user confined to a wheelchair. The shower seat will be designed to satisfy all users' requirements in terms of functionality, form, usability, and cost; all of which are cited in this report and summarized in the problem statement.

Moreover, in this report, the user's needs, preferences, restrictions, as well as the related metrics, and target specifications were defined and clearly cited. Additionally, benchmarking data was gathered, summarized, and tabulated in order to provide clarity on previous products addressing similar needs and constraints.

Finally, this report with all its attributes serves to focus the attention of the design team on the specifics of the user's requirements, the importance of each requirement, and how each requirement was met in the design of similar products; consequently, keeping them on track throughout the design process.

## 1. List of Translated & Prioritized Customer Needs

Table 1.1 Summary of Client Needs

| # | Part | Client Statement | Interpreted Need | Importance |
|---|---|---|---|---|
| 1 | Seat | Should support a weight of 250 lbs. | Withstand the user's weight | 5 |
| 2 | Entire chair | It should be under 5 lbs. or as light as possible | Lightweight | 5 |
| 3 | Entire chair | ...can fold to fit into a carry-on luggage | Fits into a carry-on luggage | 5 |
| 4 | Material | I'm allergic to latex | Latex-free | 5 |
| 5 | N/A | Expected project cost: $100 | Low-cost | 5 |
| 6 | Seat | It must be waterproof | Waterproof | 5 |
| 7 | Entire chair | I'm afraid it's going to break as soon as I sit | Durable | 4 |
| 8 | Legs | I normally would shower in a bathtub... so a curved floor | Designed for a tub shower | 4 |
| 9 | Seat | Water gets in my seat, and I can hear it "sloshing" | Allows water to flow freely | 4 |
| 10 | Seat | Cushioning would be nice | Comfortable cushion | 4 |
| 11 | Seat | If you could add the triangular cut out, that would be great | Cleaning channel | 4 |
| 12 | Legs | After a short period of time, the non-marking legs wore off | Slip-resistant | 4 |
| 13 | Seat | The optimal height is 21 inches | Comfortable height | 4 |

| | | | | |
|---|---|---|---|---|
| 14 | Backrest | A detachable backrest would be convenient | Detachable backrest preferred | 3 |
| 15 | Entire chair | Yeah, a deployable/retractable chair is nice | Deployable and retractable | 3 |
| 16 | Entire chair | I prefer functionality over aesthetics | Prioritize Functionality over appearance | 2 |
| 17 | Entire chair | I don't need a shampoo holder | No storage unit | 1 |

*This table contains a list of translated customer needs, with a reference to their associated parts and levels of importance. Each need's importance has been prioritized on a 1-5 scale: 1 being the least important and 5 being the most important. It is important to note that many of the needs listed above were not discussed at the client interview, since they were established by the customer in writing.*

## 2. Problem Statement

*A wheelchair bound user requires a bathtub showering seat for when he travels away from home. The need is to be addressed by designing and manufacturing a durable, portable, retractable, lightweight, and low-cost shower seat that can easily fit into his carry-on luggage bag.*

## 3. Establish Metrics and Units

After establishing the scope of our customer's problem and the way in which it should be addressed, our team converted the customer needs into identifiable metrics. In table 3.1, we have listed all quantifiable needs.

Table 3.1 Metrics

| **Metric #** | **Need** | **Metric** | **Importance** | **Functionality** | **Units** |
|---|---|---|---|---|---|
| 1 | 1 | Weight capacity | 5 | Constraint | lbs. |
| 2 | 2 | Total weight | 5 | Constraint | lbs. |
| 3 | 3 | Dimensions of shower seat (when folded) | 5 | Constraint | $in^3$ |

| | | | | | |
|---|---|---|---|---|---|
| 4 | 5 | Manufacturing cost | 5 | Constraint | CAD$ |
| 5 | 6 | Waterproof material | 5 | Functional | Yes/No |
| 6 | 7 | Long lasting | 4 | Functional | years |
| 7 | 9 | Drain system | 4 | Functional | Yes/No |
| 8 | 11 | Cleaning channel | 4 | Functional | Yes/No |
| 9 | 10 | Comfortable cushion | 4 | Functional | Subj. |
| 10 | 12 | Slip-resistant | 4 | Functional | Yes/No |
| 11 | 13 | Comfortable height | 4 | Non-functional | Subj. |
| 12 | 14 | Contains a backrest | 3 | Non-functional | Subj. |
| 13 | 15 | Time to assemble/disassemble | 3 | Functional | s |
| 14 | 16 | Aesthetically pleasing | 2 | Non-functional | Subj. |
| 15 | 17 | Contains a storage unit | 1 | Non-functional | Yes/No |

*This table displays the same needs and their levels of importance as in Table 1.1. It also indicates the metric number, the units used to quantify each metric and the functionality of each metric.*

# 4. Benchmark on Metrics

**The PCP Shower Chair,** this model is very similar to what the user currently has. The chair has a padded seat with a channel cut out for hygiene. The backrest gives the user support needed to stay upright and support their core. The legs of the chair are rubber to ensure the chair does not move or slip while in use. The height of the chair is adjustable.

*Figure 4.1: PCP*

**The AquaSense** shower seat has a simple design. It has a seat with drainage holes, so water does not accumulate. There are rubber ends on the legs to prevent the chair from moving in the shower. This chair does not have a backrest, or adjustable height.

*Figure 4.2: AquaSense*

**The MJM Knockdown Shower Chair** has a seat with a hollow center for hygiene. There is a backrest and arm rest to support the user. There are wheels that lock into place for easy transportation. The chair chairs can be taken apart and reassembled for travel.

*Figure 4.3: MJM 118-3TW-KD Transportable Commode Shower Chair*

Table 4.1: Benchmarking of PCP, AquaSense and MJM KNOCKDOWN Shower Seats

| | | | | | PCP | | AquaSense | | MJM KNOCKDOWN | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Need** | **Tol.** | **Imp.** | **Units** | Rating | Score | Rating | Score | Rating | Score |
| Weight capacity | 1 | > 250 lbs. | 5 | kg | 1.00 | 5.00 | 1.00 | 5.00 | 1.00 | 5.00 |
| Total mass | 2 | < 5 lbs. | 5 | kg | 0.00 | 1.00 | 1.00 | 5.00 | 0.00 | 0.00 |
| Time to assemble/disassemble | 3 | Complexity | 3 | s | 0.60 | 1.80 | 1 | 3.00 | 0.20 | 0.60 |
| Dimensions of shower seat (when folded) | 4 | = 21 in | 5 | in | 1.00 | 5.00 | 1.00 | 5.00 | 1.00 | 5.00 |
| Cost | 6 | CAD$ | 5 | CAD$ | 0.60 | 3.00 | 1.00 | 5.00 | 0.00 | 0.00 |
| Long lasting | 7 | Yes/No | 4 | years | 1.00 | 4.00 | 1.00 | 4.00 | 1.00 | 4.00 |
| Cleaning Channel | 11 | Yes/No | 4 | Yes/No | 1.00 | 4.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Drain system | 9 | Yes/No | 4 | Yes/No | 1.00 | 4.00 | 1.00 | 4.00 | 1.00 | 4.00 |
| Waterproof material | 10 | Yes/No | 4 | Yes/No | 1.00 | 4.00 | 1.00 | 4.00 | 1.00 | 4.00 |
| Comfortable cushion | 11 | Subj. | 4 | Subj. | 0.40 | 1.60 | 0.25 | 1.00 | 0.20 | 0.80 |
| Slip resistant legs | 13 | Yes/No | 4 | Yes/No | 0.50 | 2.00 | 0.50 | 2.00 | 0.00 | 0.00 |
| Comfortable height | 14 | Subj. | 4 | Subj. | 1.00 | 4.00 | 1.00 | 4.00 | 0.75 | 3.00 |
| Aesthetically pleasing | 16 | Subj. | 2 | Subj. | 0.80 | 1.60 | 0.50 | 1.00 | 0.00 | 0.00 |
| Total | 49 | | | | 41 | | 43 | | 26.4 | |

*The above table compares the PCP, AquaSense and MJM KNOCKDOWN shower seats using a weighted matrix system. Each of the products' metrics were rated based on their technical performance, with some metrics requiring our teams' subjective opinion. The score was then created, using the formula: Score = Rating x Importance. The individual scores were summated, resulting in the final score. In the bottom row, we see that the highest possible score is 49, and the PCP, AquaSense and MJM KNOCKDOWN seats earned points of 41, 43 and 26.4 respectively. Therefore, one may conclude that out of the 3 shower seats, PCP's product is the best solution.*

**Please note that many of the metrics could not be implemented for the 3 shower seat competitors' products, since the required testing information was not available. **

## 5. Target Specifications

Target specifications for the portable shower chair can be found in table 6.1; this table includes 4 columns: Need Column, Target Specification Column, Tolerance Column, and Reasoning Column. The Needs Column contains numbers that correspond to the client needs summarized in Table 1.1; which will, subsequently, aid in the tracing of the origins of the target specifications. Moreover, the Target Specification Column lists specifications and metrics in which the prototypes will be based on. Furthermore, all the specifications and metrics cited in the Target Specification Column were gathered from Table 4.1. The Tolerance column indicates the acceptable margins of error for each target specification. Finally, the Reasoning column explains the reasoning behind the Target Specifications and the Tolerance columns.

Table 5.1 Citing Target Specifications, Tolerance, & Reasoning for the Portable Shower Chair

| Need | Target Specification | Tolerance | Reasoning |
|---|---|---|---|
| 1 | Supports 250 lbs. | +/- 15 lbs. | The customer stated that the shower chair needs to support 250 lbs. Also, the customer made it clear that this was a minimum. So, there is no acceptable tolerance lower the 250 lbs. |
| 2 | Weighs 5 lbs. | +/- 2 lbs. | The customer stated this item would be used for travel. The target weight was set to five lbs. so that the shower chair doesn't make the carry on heavy. |
| 3 | Volume of 780 $in^3$ | +/- 50 $in^3$ | As this item needs to fit in a carry-on with other items it can take up a maximum of half the carry-on's volume. |
| 5 | 100 CAD | - 10 CAD | The max manufacturing cost of this shower chair is 100 CAD. It is acceptable if the manufacturing cost is less, but it can't be more. This is a constraint specified by the customer is non-negotiable. |
| 6 | Waterproof material | none | The shower chair must be made of waterproof material. |

| | | | |
|---|---|---|---|
| 7 | Lasts 10 years | +5 years / -1 year | As a group we strive to make a shower chair that is of high quality and will last a long time. Our target is 10 years, 9 years is acceptable as this requirement has an importance of 4/5. Of course, lasting longer is always better so, any amount greater than 10 years is acceptable as well. |
| 9 | Has drain system | Extremely important but not essential | If this requirement needs to be sacrificed to meet all the other requirements that is acceptable even though it is very important. |
| 11 | Has cleaning channel | Extremely important but not essential | If this requirement needs to be sacrificed to meet all the other requirements that is acceptable even though it is very important. |
| 12 | Is slip resistant | Extremely important but not essential | If this requirement needs to be sacrificed to meet all the other requirements that is acceptable even though it is very important. |
| 14 | Has backrest | Isn't necessary | This item is of little importance (3/5) and will only be included if nothing else is sacrificed. |
| 15 | 30 seconds | -15 seconds / +30 seconds | As a group we want to make a shower chair that can be set up quickly. This is not of the utmost importance and that's why the tolerance is so large. |
| 17 | Contains a storage unit | Isn't necessary | This item is of very little importance (1/5) and will only be included if nothing else is sacrificed. |

## 6. Reflection & Conclusion

Our group firmly believes we have successfully empathized with our client. We applied direct and indirect questioning techniques to gain useful facts and insights about our user. Our team then translated and prioritized customer needs and used these needs to benchmark competitive market solutions. Before our interview, we understood the scope of the problem; however, we were unsure of the way in which it should be addressed. After having spoken with Darcy, we understood the importance of safety and durability in shower seats, while also discovering flaws and features in his shower seat at home. He explained that his Airway surgical PCP Padded bath safety seat lacked a drain system and that the legs' slip resistance quickly wore off. In addition, Darcy asked our team to implement the same seat dimensions as his PCP seat and to also include a hygienic cutout for bathing convenience. Darcy said he prefers functionality over aesthetics and stated that additional features such as armrests and shampoo holders are unnecessary. After analyzing the customer's needs, establishing the problem at hand and benchmarking competitor products, our team currently has sufficient information to begin the conceptual design process. Nevertheless, once we investigate, research and analyze the product constraints, new questions and concerns may arise. If this does occur, our team will refer once more to our customer, to ensure that our shower seat design will effectively satisfy the user's needs.

# 7. Bibliography

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