GNG2101

Design Project Progress Update

Group B2.3

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List of Acronyms and Glossary

Provide a list of acronyms and associated literal translations used within the document. List the acronyms in alphabetical order using a tabular format as depicted below.

Table 1. Acronyms

|  |  |
| --- | --- |
| Acronym | Definition |
| DFX | Design for X |
| BOM | Bill of Materials |
|  |  |
|  |  |
|  |  |

Provide clear and concise definitions for terms used in this document that may be unfamiliar to readers of the document. Terms are to be listed in alphabetical order.

Table 2. Glossary

|  |  |  |
| --- | --- | --- |
| Term | Acronym | Definition |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

# Introduction

The project's main goal is to create a soft cervical collar that is designed for swimming, comfortability, chemical-resistance, and for being waterproof. Physical activities like swimming and Aikido require the collar to be resistant to exposure to saltwater and chlorine while still allowing for flexibility and comfort for the wearer. Important presumptions include that the collar should be dryable, not overly rigid, and able to be switched between use in a pool and on dry land based on the client’s feedback. To ensure that the collar is both supportive and forgiving, the design must also be bendable and rollable for effortless portability. The structure of the document takes the reader step-by-step through the entire design process. First comes the introduction which leads to the sustainability report and design for X sections, which describe the environmental factors and design limitations. The project plan, problem definition, concept development, detailed design, and bill of materials (BOM) are covered in the following sections. The project is then summarized in the Conclusions section. The document's objective is to provide a thorough roadmap for the creation of the product, guaranteeing that all customer demands, and technical specifications are met in full.

# Sustainability Report and DFX

## Sustainability Report

### Objectives and Scope

The primary objective of our cervical collar is to design a collar that is comfortable, durable and highly resistant to chemicals such as being waterproof, able to withstand washing machines, and resistance to chemicals such as chlorine. The collar must also be portable and flexible enough that the client can also do activities such as Akido without jeopardizing his health. The scope of this project is to design, develop, and test a prototype of the soft cervical collar that fits the requirements and needs of the clients outlined above. Additionally, sustainable and eco-friendly manufacturing will also be taken into consideration if time or resources allow, as the client expressed his interest and importance of being environmentally friendly.

### Inventory Analysis

The research materials used in this project are:

* Silicon Rubber: Silicone is a material that is extremely resilient, long-lasting, and resistant to water and a variety of substances, including chlorine. Additionally, it gives the brace a smooth, skin-friendly surface that makes wearing it more comfortable.
* Neoprene: Neoprene, a material frequently found in wetsuits, is heat and chemical-resistant and waterproof. Its cushioning qualities give it flexibility and comfort and make it perfect for braces.
* Polyurethane: Polyurethane is extremely strong, flexible, and waterproof. It provides resistance against deterioration due to chemicals such as chlorine and wear and tear.
* Thermoplastic elastomer: Thermoplastic elastomers are long-lasting soft feel and water resistance, the material is frequently used in medical applications. TPEs provide strong resistance to chlorine chemicals.
* Teflon: Teflon is a material that is frequently used as a coating because of its exceptional resistance to heat, chemicals, and water. It can be applied to specific regions of the brace to improve abrasion and chlorine resistance.
* Spandex: When combined with other materials, spandex is known for its water-resistant qualities, comfort, and flexibility. When properly treated, it can withstand chlorine, which makes it appropriate for use as braces in aquatic environments.

### Impact Assessment

The positive and negative environmental, economic, and social impacts are listed in the triple bottom-line table below.

Table 3. Triple bottom-line table

|  |  |  |
| --- | --- | --- |
| Triple Bottom Line | Positive Impact | Negative Impact |
| Economic | The collar can increase the market for medical assistive devices, causing economic growth in this industry. | There can be high compliance costs since the assistive device needs to meet regulatory standards to be safe and usable in water. |
| Healthcare institutions can invest in these products to use for water-therapy rehabilitation for their patients. | Developing and testing new foam materials that are waterproof, chlorine resistant, and provide comfort to users may be expensive. |
| Using recycled materials to make this product could reduce costs and bring new customers that want eco-friendly products. | If the product is not covered by insurance, less people would be able to afford the product, bringing customers and profits down. |
| Environmental | If the materials used to make the collars are recyclable, they can be reused after the end of their cycle to make new products. | Microplastics could leach into the water supply if the collars are not properly disposed of, which could endanger marine wildlife. |
| Making this product environmentally friendly can motivate other companies to use eco-friendly practices. | The production of synthetic materials can produce harmful chemicals that pollute the water, soil, and air. |
| Using eco-friendly packaging for this product could reduce plastic waste going into the environment. | The emissions from the manufacturing processes can contribute to air pollution. |
| Social | The soft cervical collar can improve the quality of life of people with neck injuries. | Waterproof cervical collars can be costly, especially if they are new products entering the market. |
| People with neck injuries can participate in water sports activities, which promotes inclusivity. | The collars might make abled individuals think that people with disability need special equipment to function in society. |
| The product can increase awareness of people with neck injuries. | There could be safety concerns if users misuse the product during swimming. |

### Interpretation

The cervical collar we are designing has the potential to bring growth to the medical sector with better cervical collars if we design a unique and effective prototype. However, to launch the product on the market we must meet strict regulatory standards and high compliance costs. The product has the potential to be environmentally friendly if the materials used are sustainable and recyclable, however plastics should be avoided, if possible, to prevent microplastics harming our client’s health and to prevent it leaching into the environment if it thrown out. Social impacts are immense as the product can bring a significantly enhanced quality of life to our client and allow him to take part in activities such as swimming and Akido, if costs are kept low and reasonable.

## Design for X

The problem presented offers a unique challenge of creating a product that meets the personality and beliefs of the client. From an interview and research, many different statements and qualities were identified. From this, 5 designs for x (DFX) statements were created.

### Design for Comfort

After information was gathered, a trend appeared, which was the need for comfort. The client addressed multiple times how his current neck brace was uncomfortable and the many different situations in which the discomfort occurred. The client mentioned the materials that he found uncomfortable and identified the parameters that the collar needs to have. This information made us realize how important the comfort of the collar was to our client, which is why we decided that comfort is the most important feature to design towards.

### Design for Quality

After meeting the client, there is a strong need for a strong quality of materials, because of the need for the cervical collar to withstand harsh conditions such as being submerged in water with chemicals. The client also expressed frustrations with the cervical collar being soaked with sweat, so the cervical collar needs to use quality breathable materials to be able to handle high loads of sweat and moisture. The cervical collar must also be able to handle washing machines. For the collar to be able to handle these conditions, there needs to be effort put into the quality of the cervical collar.

### Design for Portability

The cervical collar must be portable and easy to carry as the client needs to always have access to the cervical collar. For any device used to help with injuries and the health of a person, it must be accessible and easy to move. We do not want to put any extra stress on our client or make him use any extra effort when moving and setting up the cervical collar. For these reasons, we want to emphasize design for portability. The cervical collar must be lightweight, meaning it needs to weigh less than 500 grams.

### Design for the Environment/Sustainability

The client is passionate about environmental impacts and environmental sustainability, making design for environment/sustainability a necessary design factor. It was discovered that the client frequently visits local environmental protection rallies and made it clear that he values the way we create this product. This clarifies that the way we create this product, and the material chosen must have a low ecological footprint. This means an emphasis on sustainability and the environment must be considered when designing the cervical brace.

### Design for Accessibility

The client’s routine involves intense physical activity. It must be easily accessible for the user to remove the collar himself for easy wiping. Ideally, the collar is removable by its user with one hand, avoiding too much shoulder contortion when reaching behind the head. The client also participates in a variety of activities, so adjustable tightness levels are also especially important. This means that we need to consider accessibility when designing this product.

# Problem Definition, Concept Development, and Project Plan

## Problem Definition

### Client Needs

* The collar resists sweat, high loads of water, chlorine, and other chemicals during its use.
* The collar is machine washable.
* The collar is not too firm, reasonably soft, and flexible to allow for activities such as swimming and Aikido.
* The collar is comfortable on the skin, ensuring the outer layer is made of materials other than wool or other irritating cloths with allergens.
* The collar is to follow the client's old collar dimensions: maximum height of 4.75 inches at the front (chin-neck area) and maximum height of 3 inches at the back.
* The collar withstands the summer heat and prevents overheating through its breathable design.
* The collar can be folded or rolled into a small package for easy portability when not in use.

### Problem Statement

A soft cervical collar is to be designed for a client with a damaged vestibular system who enjoys swimming and other physical activities. This collar is to be resistant to sweat, water, chlorine, and other chemicals produced in these activities while also providing comfort and breathability to the client. The client will be wearing the collar during their physical activities, which can last for a few hours, thus the size of the collar is expected to be similar to their current cervical collar. Machine washability and portability are also expected for this product by the client.

### List of Metrics

1. Metric: Resistance to chlorine and water after extended use.   
   Units: Time of exposure without damage (hours), Chlorine concentration (ppm).
2. Metric: The ability to resist damage from machine washing.   
   Units: Number of wash cycles, Temperature (°C).
3. Metric: The ability to withstand high temperatures, like those found in hot tubs or the summer heat, without losing material integrity.   
   Units: Temperature (°C).
4. Metric: Lightweight for comfortable wear and travel.   
   Units: Weight (grams).
5. Metric: Comfortable material that doesn't irritate after extended use and allows for breathability.   
   Units: User comfort rating on a scale (1-10).
6. Metric: The ideal height to allow for flexibility and provide sufficient neck support.  
   Units: Height (inches).

### Benchmarking

Table 4. Benchmarking table

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Products** | **Water and Chlorine Resistance** | **Machine Washability** | **Firmness and Flexibility** | **Skin Comfort** | **Heat Resistance** | **Weight and Portability** |
| [The Core flex Neck Brace](https://www.coretechortho.com/category/all-products/) | Not water-resistant | Withstands 10 wash cycles at 40°C | Compressible by 12% under 40N | 9/10 comfort rating | Withstands 50°C for 1 hour | 200 grams, rollable |
| [Aquafit Neck Collar](https://www.theraquatics.com.au/product/aquafit-neck-collar/) | Withstands 1 hour in 3 ppm chlorine | Not machine washable | Compressible by 20% under 50N | 7/10 comfort rating | Withstands 45°C for 45 minutes | 180 grams, lightweight, non-rollable |
| [Ortho Neck Soft Collar](https://www.orthomed.ca/back-spine/back-braces-supports/neck-spine-collars?srsltid=AfmBOopniwV_nmyw3ZwpO9TX1P5d3nukzs75OsjluLOUvVYJTuiJcvWO) | Not water-resistant | Withstands 10 wash cycles at 40°C | Compressible by 15% under 45N | 9/10 comfort rating | Withstands 45°C for 1 hour | 220 grams, foldable |
| [Velpeau Neck Brace](https://www.velpeau.com/products/vp0205-velpeau-neck-brace-silicone-version) | Waterproof | Only hand washable | Soft And Elastic | Reduce pressure on skin and keep neck cool/dry | Water temperature to be less than 30°C | [439 grams](https://bargainfox.com/en/products/b0989hngxm), can be rolled or folded |

### Target Specifications

1. Must be able to tolerate exposure to swimming pool chlorine concentrations and submersion in water for 30-60mins without degrading or irritating the skin. This guarantees that extended swimming sessions in highly chlorinated environments, such as pools or hot tubs, can be conducted while wearing the collar.
2. The collar must withstand a minimum of five machine wash cycles at 40°C without experiencing any deformation or loss of material properties. Due to the exposure to sweating and chlorine, frequent cleaning is required, and durability is essential to extending its life.
3. For around 45-60 minutes, the collar should be able to tolerate temperatures as high as 40°C-60°C without degrading or becoming uncomfortable. This includes situations in which the collar will be exposed to extreme temperatures found in warm baths or hot tubs. The collar should also be able to keep the neck cool and dry during physical activities that can cause the user to sweat and produce heat.
4. To make storage and transportation easier, the collar should be collapsible or rollable and weigh 250-500 grams. When traveling or swimming, lightweight and portable designs improve user comfort and convenience of usage.
5. Perform a user trial skin irritation test with a comfort grade of 90% or higher. Since the collar must be worn for extended periods, skin irritation must be avoided and compliance must be maintained, so excellent comfort is crucial.
6. With an adjustable fit, the maximum height is 5 inches at the chin-neck region and 3 inches at the back of the neck. The collar needs to be fully supportive and adjustable to properly accommodate different neck sizes and postures.

## Concept Development

Using the client's needs and benchmarking some existing soft cervical collars, a few concepts were created to solve the problem statement. Below are some of the concepts developed by our team:

**Concept 1:** This concept follows a similar design of the client’s previous neck collars. This “traditional” design will allow for the client to easily get familiar with the product and integrate it into their everyday routine. The main difference is the materials used to make this collar which make it usable in swimming pools and other water-based activities. The concept uses polyurethane foam to provide great support and comfort with some pliability. The foam is surrounded by silicone to ensure that it is waterproof, sweat proof, and chlorine resistant. There are Velcro straps to secure the collar to its user and to also provide adjustability. Some drawbacks to this concept are that it is not very breathable since it will trap sweat and heat inside the wearer’s neck. The straps are also not fully waterproof, and they can get soggy over long use in the water.

A diagram of a diagram of a product

Description automatically generated with medium confidence

Figure 1 'Traditional' concept sketch

**Concept 2:** This concept is different from the first as the brace is entirely made of silicone rubber to provide good support while being elastic. Instead of Velcro, this design uses button snaps to secure the different sub-systems of the collar such as the neoprene strap and the cushion support. Since silicone it used, the collar is fully waterproof and can be adjusted to various sizes. It can also be washed by hand. Polyurethane foam surrounded by neoprene is used for the cushion. This concept is also breathable since there are holes around the neck to allow for air flow, which could provide relief when doing physical activities. This concept is not without its flaws. Since the silicone brace has a complex shape, it could be prone to breakage if too much force is applied.

A drawing of different types of objects

Description automatically generatedA drawing of different types of objects

Description automatically generated

Figure 2. 'Alien' concept sketch

## Project Plan – PD C

A screenshot of a computer

Description automatically generated  
A screenshot of a computer

Description automatically generated

Figure 3. Project plan for PD C

# Detailed Design and BOM

## Client Meeting Feedback

* Liked the second concept's detail and buttons but noted the lack of adjustability (which is commonly found in Velcro straps).
* Mentioned difficulty using buttons due to manual dexterity issues (magnetic buttons may be a potential solution).
* Emphasized the importance of breathability.
* Appreciated the idea of removing the cushion for swimming and placing it on top and bottom of the brace.
* Had concerns about flexibility but preferred the first design overall.
* Placed importance on breathability and waterproofing (to increase breathability we can incorporate neck holes from the ‘alien’ concept into the ‘traditional’ concept).

Key takeaways include concerns about the lack of adjustability with buttons, preferences for breathability and swimming compatibility, and a general interest in combining aspects of the traditional and alien concepts, with a preference placed on the traditional.

## Detailed Design

A close-up of a plastic object

Description automatically generated A drawing of a neck brace

Description automatically generated

Figure 4. CAD model of the soft cervical collar

A blueprint of a ring

Description automatically generated

Figure 5. Detailed drawing of the soft cervical collar (dimensions are in inches)

**Relationship to Target Specifications:**

* The silicone rubber layer is resistant to chlorine and is expected to survive submersion in chlorinated water for 30-60 minutes at a time
* The silicone layer and polyurethane foam are durable materials and are expected to survive at least five wash cycles at 40 degrees Celsius
* Silicone and polyurethane foam have a high melting point and can withstand high temperatures environments. The holes in the design allow for breathability so the product is expected to survive the 40-60 degree celsius temperature range and be wearable at hot temperatures because of the breathable design
* The adjustable clasps at the back of the collar allow for portability as they can be removed to allow the compression and bendability of the collar
* Silicone can be irritating to people who have allergies with silicone, we have discussed with the client if he has any allergies, and she has indicated that he is fine with silicone, therefore we expect the product to pass the skin irritation test
* The product can support many different neck widths due to the adjustable clasp located at the back of the concept

**Relationship to DFX Factors:**

* Design for Comfort: The product is designed to be comfortable with a soft but rigid polyurethane foam filling that provides structure, with a silicone rubber layer for chemical resistant but soft layer.
* Design for Quality: The product is designed with quality in mind as indicated by quality chemically resistant materials used.
* Design for Portability: The product is designed to be portable as indicated by the removable adjustable clasps at the back to allow the object to bend into shapes and make it portable.
* Design for Environment/Sustainability: The product is designed to last a long time and is designed to withstand wash cycles, hence making it a sustainable solution as it does not have to be replaced as much as other collars that are not washable.
* Design for Accessibility: The product was designed to be very accessible and easy to use, the adjustable clasps at the back are easy to readjust and the product can be worn easily.

## List of Skills

Table 5. List of skills

|  |  |  |
| --- | --- | --- |
| Skill | Purpose | Possess |
| Sewing | To connect the different parts of the design and create a piece that has a sleek finish. | Two members of the project group will attend a CEED sewing workshop to learn the necessary skills for the completion of the design. |
| Cutting | To build the product, many different materials will need to be cut at precise measurements and angles to ensure the design meets its required specifications. | The group contains members with these necessary skills and methods to ensure the specifications are met. |
| Blueprint Creation | There is a need for detailed blueprints to ensure each material is dimensioned correctly. | Talents with AutoCAD and SolidWorks software. Access to the creation of sectional view drawings. |
| Medical Knowledge | Need for an understanding of the purpose and application of the brace. The brace needs to be designed with the medical condition and medical purpose in mind. | Research has been conducted to ensure that the sections of the design meet the medical requirements and will be beneficial to use. |

## Prototype Test Plan

Table 6. Test plan 1

|  |  |
| --- | --- |
| *Test Number* | 1 |
| *Communication, Performance Measurement, Risk Management, Learning/Understanding* | Performance Management |
| *Target Measurable Attribute* | Strength, performance, and durability of the Velcro |
| *HiFi/LoFi Focused, HiFi/LoFI Comprehensive* | LoFi Focused |
| *Visual, Analytical, Physical* | Visual and Analytical |
| *Metric* | Time (s), Force (qualitative) |
| *What Specifically Test* | Performance of Velcro when submerged in water and when it is wet compared to when it is dry. |
| *How Test* | Velcro will be placed into water and left to soak for 15, 30, and 45 minutes respectively. The Velcro will be removed and tested on the strength of the bond and how well it stays together. As well, a test of how long it takes for the Velcro to dry at room temperature will also be conducted. |

Table 7. Test plan 2

|  |  |
| --- | --- |
| *Test Number* | 2 |
| *Communication, Performance Measurement, Risk Management, Learning/Understanding* | Environmental Sustainability |
| *Target Measurable Attribute* | Lifecycle report |
| *HiFi/LoFi Focused, HiFi/LoFI Comprehensive* | HiFi Focused |
| *Visual, Analytical, Physical* | Analytical |
| *Metric* | Ecological footprint |
| *What Specifically Test* | The lifecycle of the materials planned to use. |
| *How Test* | Research conducted on the properties and structure of the materials, along with research of the sustainability and recyclability of the materials. |

Table 8. Test plan 3

|  |  |
| --- | --- |
| *Test Number* | 3 |
| *Communication, Performance Measurement, Risk Management, Learning/Understanding* | Learning/Understanding |
| *Target Measurable Attribute* | Comfort |
| *HiFi/LoFi Focused, HiFi/LoFI Comprehensive* | HiFi Comprehensive |
| *Visual, Analytical, Physical* | Visual |
| *Metric* | Scale 1-10 |
| *What Specifically Test* | The comfort of the design will be tested. |
| *How Test* | A physical survey will be conducted by having members of the public try on the brace and move around for 30 seconds with it on. A series of scale-based questions will be asked, and feedback will be asked for. |

Table 9. Test plan 4

|  |  |
| --- | --- |
| *Test Number* | 4 |
| *Communication, Performance Measurement, Risk Management, Learning/Understanding* | Performance Measurement |
| *Target Measurable Attribute* | Portability |
| *HiFi/LoFi Focused, HiFi/LoFI Comprehensive* | HiFi comprehensive |
| *Visual, Analytical, Physical* | Physical |
| *Metric* | Portability: Ease, dimensions |
| *What Specifically Test* | The portability of the brace |
| *How Test* | The brace will be rolled up multiple times. The ease of rolling up will be recorded. The dimensions of the brace rolled up will be recorded as well. Lastly, the maintainability of the shape of the brace after it has been rolled will also be analyzed. |

Table 10. Test plan 5

|  |  |
| --- | --- |
| *Test Number* | 5 |
| *Communication, Performance Measurement, Risk Management, Learning/Understanding* | Performance Measurement |
| *Target Measurable Attribute* | Durability, withstand 3 washing cycles |
| *HiFi/LoFi Focused, HiFi/LoFI Comprehensive* | HiFi Focused |
| *Visual, Analytical, Physical* | Visual |
| *Metric* | See if properties still hold afterward. |
| *What Specifically Test* | If the brace can withstand 3 washing cycles and retain its properties |
| *How Test* | The brace will be placed in the washing machine and washed 3 times before a visual and physical inspection will occur to see if any performance issues are introduced to the brace. |

## BOM

Table 11. BOM

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Item Name** | **Description** | **Units of Measure** | **Quantity** | **Unit Cost** | **Extended Cost** | **Link** |
| Polyurethane foam | 16x12 inch sheet, 1.5 inches thick | Sheet | 2 | $11.50 | $23 | [Link](https://www.amazon.ca/Polyurethane-Cuttable-Inserts-Packing-Toolbox/dp/B0C711NBD6/ref=sr_1_7?crid=2XQS7IMEOVO1F&dib=eyJ2IjoiMSJ9.vS8UywLvvsmBVs9Ymk9yb38iaW7p0KXmq3NjEZtoDlPsuoTHtPL5dMQktBiEgCCG2PxJp3A5OYoLpUFHCMBoZCkk7sZTGz6MU4acsANocx81YoM29EHXNqH4LRS0RJrXwxRaroyU31QQIPKs1wwsZpcl5qtHep1nrsHZvQLvRSvlqku4J16_pn9ghmtigDZjzrBwntLOP67FaauWIrQ-jxqu3wxo0n-IaXq7eSAFbrAdr1e3tb9RDuAcWFUQ1zR1ZuEeO1crn2Dqv-RXEpOJlOEqwWCeFM0sF31q3Abmh3I.TMNOgq2XDRGwbLgl9nz4IH_sN1SODrxg0BH6g6APFZE&dib_tag=se&keywords=polyurethane%2Bfoam&qid=1728343993&sprefix=polyurethane%2Bfoam%2Caps%2C88&sr=8-7&th=1) |
| Waterproof Heavy-duty strips | Adhesive Velcro strips to attach anywhere, 1 inch x 24 feet | Strip | 1 | $12 | $12 | [Link](https://www.amazon.ca/dp/B0B2NPZS45?ref=cm_sw_r_apan_dp_FV5ENNP0N9AMV1JF5722_1&ref_=cm_sw_r_apan_dp_FV5ENNP0N9AMV1JF5722_1&social_share=cm_sw_r_apan_dp_FV5ENNP0N9AMV1JF5722_1&starsLeft=1&skipTwisterOG=1&th=1) |
| Silicone Rubber | Liquid silicone kit to pour over the polyurethane foam, 21.16 Oz two-part bottles | Kit | 1 | $23 (with prime) - $26 without | $23 (with prime) - $26 without | [Link](https://www.amazon.ca/Silicone-Making-Rubber-Elastic-Liquid/dp/B09BFGQ37Q/ref=sr_1_5?crid=3E9S152ITLDTA&dib=eyJ2IjoiMSJ9.fudUPi5UyzbDw2nBkLXMuxrYUEsbtFW3XlNgjBaIS2aT9kEHHoE_5UJ49_EE_NE6YKNTFtwtDE4e76HP7M93k_2FGsKTUaBUcPGfqjHBeKwu_4viSvXmKjf0xHohCgbKX6Wjx6XL6XHwPFebozveko_zvPMj4xjEmzjqh1qi2nURme38-eL6iq0DhSCRuLxCdEEFc_DFgULyj77RAZeslCFNvaVn-LgcqaASiWeEuZ4uCbcqdQdl6AEMV85KKK-z4bJ7w-zFmgk0JIcCl2GqpTBzenum2y6N4Cay648Y_9U.HSpj9NOfIcv4lKpCZJpXM5UqVKPDt3vDACXlRKS43AM&dib_tag=se&keywords=liquid+silicone+rubber&qid=1728343107&sprefix=liquid+si%2Caps%2C93&sr=8-5) |
| Total Product Cost (without taxes or shipping + prime membership) | | | | | $58 |  |
| Total Product Cost (with taxes + shipping + prime membership) | | | | | $65.54 |  |

## Project Plan Update – PD D

A screenshot of a computer

Description automatically generated

Figure 6. Project plan for PD D

# Conclusions

We have a more in-depth understanding of the client’s needs and requirements from our first and second client meeting. Research has been conducted on materials that are resistant to water and chemicals, as needed by the client and we have developed a list of six resistant materials that can be used for developing our first prototype. Five DFX principles have been identified after meeting with client, allowing us to focus our prototyping and benchmarking around these principles. We have established a clear list of the most important client needs as well as measurements for the first prototype such as the maximum height for the neck, as the client has expressed discomfort of his current cervical collar. Additionally, we have also established benchmarking metrics that can clearly be procedurally measured using quantitative data. Clear and concise target specifications outlining technical requirements and goals have been created, they can be easily measurable using objective quantitative data during the prototype’s testing period. The iterative process of refining our design based on DFX guidelines, research of the materials, establishment of benchmarking metrics, and client meetings allowed us to create multiple versatile prototypes that have the potential to be chemically resistant, machine-washable, easily portable, and most importantly satisfy the client’s needs. A list of skills required to complete a final design has been identified and a plan has been put forward to improve the skills that are lacking. As well, a detailed digital drawing was produced, highlighting the key dimensions and idea behind the design. Next, the BOM was created, which is the identification of the costs, and the materials involved, and the distribution of the budget. The next step in the product development is to create a list of prototypes and their test plans, to ultimately create the first prototype.

# Bibliography

*Aquafit neck collar*. Theraquatics. (n.d.). <https://www.theraquatics.com.au/product/aquafit-neck-collar/>

BargainFox. (n.d.). *Velpeau silicone neck brace - waterproof cervical collar for neck pain an*. <https://bargainfox.com>. <https://bargainfox.com/en/products/b0989hngxm>

*High quality cervical (neck) collars - orthomed Canada*. High Quality Cervical (Neck) Collars - OrthoMed Canada. (n.d.). <https://www.orthomed.ca/back-spine/back-braces-supports/neck-spine-collars?srsltid=AfmBOopniwV_nmyw3ZwpO9TX1P5d3nukzs75OsjluLOUvVYJTuiJcvWO>

*Neck Brace - silicone version*. VELPEAU. (n.d.). <https://www.velpeau.com/products/vp0205-velpeau-neck-brace-silicone-version>

Omnexus. (n.d.). *Silicone rubber: Types, Structure & Properties - Omnexus*. Silicone Rubber: Complete Guide on Highly Durable Elastomer. <https://omnexus.specialchem.com/selection-guide/silicone-rubber-elastomer>

Vivehealth. (n.d.). *All products*. Coretech. <https://www.coretechortho.com/category/all-products/>