C2.2 Project Deliverable F:

Business Model and Sustainability Report, Economics Report and Intellectual Property Report

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F.1 Business Model and Sustainability Report

F.1.1 – Introduction:

The purpose of this deliverable F is to assume that our team's final prototype will be developed into an actual product. This visualization will be conducted using three parts. The first being the business model and sustainability report. As stated, a type of business model will be chosen for our team's product alongside a sustainability report the will outline two major impacts associated with the project. In the next part, a full economics report will be created that will provide data such as all associated costs, an income statement and NPV analysis. The final part contains an intellectual property report which will explore two intellectual properties associated with the product.

F1.2 – Business Model:

Based upon our team's specific product in addition to the various types of existing business models, our team has decided to select a model that closely aligns with the direct sales model. According to The Close Sales Blog, the direct sales business model outlines a method where a business will sell their products directly to their customers via their own sales team. Therefore, the only means of obtaining this product will be through communication or consultation with the sales team. An advantage of the direct sales approach is the greater control over how the products are being sold.

The main reason for choosing this approach over some of the other existing approaches has to do with our team's product and its intended market. Elaborating further, the greater image of the market incorporates wheelchair bound individuals who may not necessarily need a robotic arm for assistance within their daily activities. However, our intended market aims to target wheelchair bound individuals that require a robotic arm for assistance. Since our target market is specific and somewhat smaller, it would be ideal to use something similar to a direct-to-consumer approach where the interaction with the smaller and specific market would be more of a priority.

Link to the information on the direct sales model: https://blog.close.com/direct-sales-model/

F1.3 – Triple Bottom Line Model:

<table>
<tr>
<td rowspan="2">Key Partners

Suppliers (raw materials and components)

Design and engineering firms

Disability organizations

Healthcare providers and hospitals</td>
<td>Key Activities

Research and development

Manufacturing

Sales and marketing

Customer support and maintenance</td>
<td rowspan="2">Value Propositions

Improved quality of life for individuals with disabilities by helping them with everyday tasks independently

High-quality, durable, and adaptable design of the robotic arm

Affordable pricing to make the technology accessible to as many people as possible</td>
<td>Relationships

Partnerships with disability organizations, healthcare providers, and hospital

Customer-centric relationships through personalized support</td>
<td rowspan="2">Customer Segments

Individuals with physical disabilities

Healthcare providers

Hospital

Disability organizations</td>
</tr>
<tr>
<td>Key Resources

Skilled employees

Manufacturing equipment and facilities

Intellectual property</td>
<td>Channels

Online sales

Healthcare provider referrals and distribution

Disability organization outreach and collaboration</td>
</tr>
<tr>
<td colspan="3">Cost Structure

Raw materials and components costs

Employee salaries and benefits

Equipment and facility costs

Research and development expenses

Sales and marketing expenses</td>
<td colspan="3">Revenue Streams

Sales of the robotic arm

Maintenance and repair services

Licensing of intellectual property to other companies in the industry</td>
</tr>
</table>

F1.4 – Core Assumptions:

Assuming there is a significant market demand for a high-quality, durable and affordable robotic arm that can assist people with disabilities in grabbing and holding items.

There are key partners, including suppliers, design and engineering firms, and disability organizations, who are willing and able to collaborate and support the business.

The business can leverage its intellectual property, including patents and trademarks, to protect its competitive advantage and generate revenue through licensing agreements with other companies in the industry.

The cost structure of the business, including raw materials and component costs, employee salaries, manufacturing equipment and facility costs, research and development expenses, can be managed effectively to ensure profitability while keeping prices affordable for customers.

F1.5 –Sustainability Report:

Regarding the product and its sustainability concerning various aspects such as social environmental and economic impacts, two identified influences with the largest impact are: the theoretical lifespan of the product and how it will be disposed of or recycled. Additionally, the overall cost of construction for one unit may also present negative impacts with regards to high labour costs.

The first aspect was mentioned to be the theoretical lifespan of the product and how it will affect the disposal/recycling process. The first aspect to take into consideration is the materials used to construct the product, in this case the product is constructed from aluminum 6061, plastic from 3D printing and the various electronic components. Based on readily available data about these materials and other products and their known lifespans, it can be assumed that this arm can last about 7-8 years. Relative to other arm on the market, it is slightly less than the average 10 years. Therefore, it can be assumed that this product remains competitive and will not have a dramatically worse environmental effect compared to the market. Additionally, all the aluminum can be easily recycled, melted down and reused in other applications via scrap metal companies. The same principle applies to the plastic used in the 3D-printed part where it can be easily recycled and reused. The electronic equipment also meets the standards of the other components where it can be disposed of in an environmentally friendly way via electronics stores. Therefore, this product has a net positive effect regarding the lifespan and disposal process relative to the environmental effect.

The second aspect was mentioned to be the potentially high level of cost and skill level regarding the labour used to create the product which may present a negative economic effect. Accompanying the high labour costs, a diverse set of machines is also necessary to create the product. Machines required include a laser cutter, a brake press capable of bending longer sheets, a drill press and cordless drill. Additionally, employees may be required to be of a high skill level in order to use the various machinery required to construct the project. With that being said, these requirements may create a situation where the combined cost of the skilled employees and the machinery required to competently create this product may be elevated. In terms of material cost, the total material cost excluding the chassis (aluminum portion) is approximately $210. With respect to the price of aluminum of $1.03/ pound, it can be assumed that the total cost will be around $220. Additionally, based on experience spent within a facility with all the necessary equipment and expertise, it can be assumed that the labours costs associated with the creation of one unit may be around $1,500. Therefore, with all the different aspects considered, there will be a somewhat negative effect regarding the economic impact of full-scale production.

To conclude, two identified major impacts are the potential high level of cost and skill level as well as the theoretical lifespan and the disposal process of the product. These two impacts were explored in greater detail in order to conclude on if these effects may be positive or negative. The analysis concluded that the potential high level of cost and skill level may be a negative economic effect due to the increased cost of construction, whereas the theoretical lifespan and disposal process presented a positive effect since all the components can be easily recycled and have a long lifespan.

F.2 Economics Report

F.2.1 – Business Costs:

Business Costs	Classification	Type
Marketing	To successfully market and market our robotic hand the company will need to invest in a variety of advertising strategies. (Online Ads, Trade / Promotional Shows, etc.)	Indirect Cost, Expenses
Material	The company must include budget for a variety of materials to build the hand.	Variable Direct Cost, Material
Equipment & Tooling	Different components need varying equipment. (3D Printer, Laser Cutter, Press-Brake)	Fixed Cost
Salaries	Employees involved with our company will need to be paid.	Fixed Cost, Labour

Employment recreation	Various activities and programs that are implemented to help employees relax, have fun, and build better relationships with their colleagues	Variable Cost
Utilities	The company will have to pay utility services which include telecommunications, electrical utilities, natural gas, certain transportation services, and water and wastewater treatment services provided by private companies.	Indirect
Overhead	The overhead cost is necessary for the operation of our business. Overhead costs include the expense of legal fees, office supplies, payroll, advertising and accounting fees.	Indirect Cost, Expenses
Tax	This is a compulsory contribution to the government's revenue. This will be imposed and levied by the government on our company's income and business profits, or added to the cost of some goods, services and transactions.	Taxation Cost, Expenses
Business Insurance	Business insurance will help us protect our business from unforeseen circumstances that may happen without any notice. The business insurance will cover our risks related to employees, property and legal liability.	Fixed Cost
License renewal cost	For the company's continuing license renewal needs to be done every period based upon ongoing compliance with administrative rules and statutes.	Fixed Cost
Patent registration fees	Our company's patent application is a formal request for the grant of a patent for an invention that is described in the patent specification and a set of one or more claims that are stated in a formal document. The application also includes the necessary official forms and correspondence that is related to the invention	Fixed Cost
Rent	Company buildings / areas will have rent to be paid along with possible equipment rent, etc.	Indirect Cost, Expenses
Electricity	Electricity within buildings, etc.	Semi-Variable Cost, Expenses
Emergency reserve funds	Our company will have cash reserves specifically set aside for unplanned expenses or financial emergencies.	Semi-Variable Cost

F2.2 – 3-Year Income Statement:

Microsoft Word - Robot Technologies_12-13-09.doc (washington.edu)

As our company is hypothetical, we created a speculative income statement for our company where we produce and sells robotic arm; we found the Robot Technologies, Inc. company who manufactures vacuuming robots bomb disposal military robots which almost similar like the product we made for our client to facilitate her with doing daily household works. It is important to note that our 'hypothetical company's' income statement won't be same as Robot Technologies, Inc. as our product's price and manufacturing cost will be way less than Robot Technologies, Inc. Here is a three-year income statement of our hypothetical company.

As our budget to manufacture this item is 300 CAD, we will be selling our product for 400 dollars as the retail price of Robotic Technologies vacuuming robots are 399 dollars. We hypothetically assume we will sell 50-60-55 robots respectively in each year of our three-year period.

- We hypothetically assume that cost of goods sold is equals to "sales/2."
- Average Operating Expense is 0.6 times of the gross profit.

Year Ends Dec.31	**Year 1 (2023)**	**Year 2 (2024)**	**Year 3 (2025)**
Sales ($)	20000	24000	22000
Cost of goods sold ($)	10000	12000	11000
Gross Profit ($)	10000	12000	11000
Operating Expenses ($)	6000	7200	6600
Operating Income ($)	4000	4800	4400

F.2.3 – Break-Even Point - NPV Analysis:

Assumptions:

- Selling Price / Unit = $400
- Variable Cost / Unit = $300
- Fixed Costs / year = $6000
- Estimated Units Sold / year =
- Discount rate = 10%

Break Even Point = Fixed Costs / (Price / Unit – Variable Costs / Unit)

= $6000 / ($400 - $300)

= 12,000 units

Year 1 Cash Flow:

Expenses:
- → Fixed Costs ≈ $6000
- → Variable Costs/Unit ≈ $300
- → estimated Units Sold ≈ 60

} Total Expenses = $24,000

Incomes:
- → Unit Price = $400
- → estimated Units Sold ≈ 60

} Total Income = $24,000

Year 2 Cash Flow:

Expenses:
- → Fixed Costs ≈ $6000
- → Variable Costs/Unit ≈ $330
- → estimated Units Sold ≈ 66

} Total Expenses = $21,780

Incomes:
- → Unit Price = $400
- → estimated Units Sold ≈ 66

} Total Income = $26,400

Year 3 Cash Flow:

Expenses:
- → Fixed Costs ≈ $6000
- → Variable Costs/Unit ≈ $363
- → estimated Units Sold ≈ 73

} Total Expenses = $26,499

Incomes:
- → Unit Price = $400
- → estimated Units Sold ≈ 73

} Total Income = $29,200

Year 1 NPV:

Expenses: −$6000
Incomes: $21,818
NPV: $15,818

→ Cumulative NPV after 1 year
= $15,818 − $24000
= −$8182

Year 2 NPV:

Expenses: −$6000
Incomes: $23,008
NPV: $17,008

→ Cumulative NPV after 2 years
= $32,826 − $45,780
= −$12,954

Year 3 NPV:

Expenses: −$6000
Incomes: $24,880
NPV: $18,880

→ Cumulative NPV after 3 years
= $51,706 − $72,279
= −$20,573

* $NPV = CF/(1+r)^n$
- $r = 10\%$
- n = # of years

F.2.4 – Assumptions:

Pricing Strategy: We predicted our robotic arm's pricing policy by gathering knowledge of the Robot Technologies Inc.'s market's willingness to pay as well as the cost of the manufacturing. We determined our pricing like Robot Technologie's vacuum cleaner pricing. We decided to keep the same price so that our pricing is competitive enough to win a substantial market share while also being profitable enough to maintain the company over the long term.

Demand for the product: According to preliminary market research, it is assumed in our calculations, comparison and assumption that there is enough demand for the product in the target market. Customers are presumptively willing to buy the product at the anticipated price.

Sales projections: Based on the above assumptions, our team made hypothetical projections about the number of units we can sell, as well as the profit we expect to generate. Our projections are also based on comparing the consumer behaviour, pricing and other external factors with Robot Technologies Inc.

"Based on these calculations, it appears that our company will not break even and start generating profit within the first three years. The cumulative NPV remains negative throughout all three years, indicating that the company is not earning enough income to cover its costs and generate profits. The break-even point of 12,000 units per year may be too high given the selling price and variable cost assumptions. We may need to consider adjusting and variable cost to improve profitability."

"Noteworthy that these assumptions we made may change over time as the market behaviour changes and as new information becomes available. Therefore, our business will regularly review and update assumptions to ensure that our calculations and economic report remains relevant and accurate."

F.3 Intellectual property report

F.3.1 – Samples:

1. Here are a few intellectual properties related to our product, the Robotic Arm:

    - **Robotic Arm patent** created by *Microdot Inc,* in 1985. The patent is incredibly detailed, it includes a general statement for the product, 6 images with specific dimensions, 25 claims (mentioning the limitations and alleged inventions by the company), and a very specific manual of how it was built. As well, there are the essentials in the document, such as: patent citations, non-patent citations and who they were cited by (including priority & publication date).

The patent can be found through the following link: https://patents.google.com/patent/US4806066A/en.

- **Meca500** Six-Axis Industrial Robot Arm, created by *Mecademic*. This intellectual property is an actual product that has a copyright, which ensures that the creators have exclusive rights to their work. Briefly, Meca500 is a robot that can be utilized using any programming language, it is a simplistic design that permits the user to control the arm with a high degree of precision.

It can be found through the following link: https://www.mecademic.com/en/meca500-robot-arm.

Documentation can be found and downloaded here: https://www.mecademic.com/en/downloads.

- **MOTUS** - Open-Source 3D Printed Robotic Arm, created by *Alatorre*. This is an open-source project, meaning that anyone can take ideas, calculations, and code to use in their own work and claim it as their own intellectual property. *Alatorre* goes in detail with the steps he took to complete the project:
    1) Design the parts using Fusion360.
    2) Calculations for torque, moment of inertia…etc.
    3) 3D printing all the parts.
    4) General assembly.
    5) Solutions to engineering problems, for instance: reductions for excessive torque, bearings for smooth rotation…etc.
    6) Electronic/Circuit aspect.
    7) Arduino coding.

The project can be found through the following link: https://www.instructables.com/MOTUS-Open-Source-3D-Printed-Robotic-Arm/

F.3.2 – Legal Constraints:

2. Principally, the objective of an intellectual property is to protect the creation of a product, this is very important for new inventions, trademarks, creative content and much more since it permits the ability to prove possession of a product. This affects our own project and places legal constraints on us since there are a set of rules that must be followed concerning ownership of intellectual properties. However, there are various

ways that we could integrate other people's ideas/property into our own product without breaking any laws and regulations. This is known as "leveraging legal exceptions", many businesses do so to do what's beneficial for them without breaking any laws and facing repercussions. Some consequences include but are not limited to paying a fine and even serving time in prison.

For instance, in the examples shown above in F.3.1, we notice that some inventions have patents, such as the Robotic Arm by *Microdot Inc*. However, by examining in depth the details of the patent, it is observable that the patent is expired. In other words, we may use all the information and incorporate it in our product without facing any legal repercussions. It is important to note that there may be trademarks associated that are still protected. Regardless, there are still many constraints that are imposed. As an example, Meca500 by *Mecademic* has a copyright, which means that their work is not free to use. In fact, if a substantial portion of a work is copied without permission, it may be considered an infringement or a copyright violation. This company undoubtedly brings a threat to our product since they market and sell their Robotic Arm abroad, meaning we have to offer better quality and/or cheaper product in order to compete against them. Finally, there are many open-sourced projects related to our product (such as the example provided in F.3.1 – MOTUS). These are incredibly beneficial as there are little to no constraints, we may copy, modify, and distribute the information in any way that we wish. This is to our advantage because many open-source projects, such as MOTUS, contain incredibly specific details, including blueprints, calculations and even the code for the functionality of the robot. This means that if our team is facing complications, we can verify what the correct solution is using the information from MOTUS, as well as other open-sourced projects. Nevertheless, it is crucial to credit the owner for their work even if it is open sourced to prevent possible plagiarism due to undisclosed legal limitations.

F.3.3 – Conclusion:

The purpose of this deliverable F was to paint a picture where our team's final prototype will be developed into an actual product. This visualization was conducted and done through three parts. The first being the business model and sustainability report. As stated, a type of business model will be chosen for our team's product alongside a sustainability report the will outline two major impacts associated with the product. The next part entailed a full economics report will be created that provided data such as all associated costs, an income statement and an NPV analysis. The final part contained an intellectual property report which explored two intellectual properties associated with the product.