

**Project Deliverable H: Economics Report and 1 Minute Video  
Pitch**

**GNG 2101 - Introduction to Product Development and Management for  
Engineers**

Faculty of Engineering - University of Ottawa

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## **Introduction:**

In Deliverable G, the second prototype was successfully built and tested. Client feedback received during the third meeting was summarized, and possible areas of improvement were clearly stated. Based on this feedback, the team built the second prototype and documented it using visual representations. Its purpose and function were explained, and prototype testing was then conducted. Performance was analyzed and evaluated compared to the target specifications developed in Deliverable B. In addition, testing results were clearly explained and documented into organized tables that listed the “expected vs. actual” results. Finally, the design team outlined what it intends to present on Design Day and further developed a method to ensure that the “Solution Works Really Well.” The next step in the engineering design process is to develop an economics report that includes a forecasted income statement based on the “Direct Sales Business Model” that was chosen in Deliverable F, as well as a video pitch. First, the design team lists the variable, fixed, direct, and indirect costs associated with the business based on the manufacturing and sales of the product. A three-year income statement is then included, and the break-even point is found by performing an NPV analysis. Subsequently, the team provides a detailed explanation and justification of the assumptions made while developing the economics report. A one-minute video pitch that would be used to promote investments in the potential company is then created. The video includes a brief introduction to the team and its members, an explanation of the problem that is being solved, an emphasis on the importance of solving it immediately, and a discussion of the proposed solution along with its competitive advantages. While recording the video, the design team ensured that the presentation of visual information is clear and comprehensive. The team members were prepared for the video, confident, relaxed, organized, and concise. Furthermore, each member was aware of facial expressions and body posture. These measures were taken in order to ensure the production of a high-quality video pitch with the aim of attracting investors into wanting to learn more about the product and the team.

### **1. List of Costs**

**Table 1.** List of Classified Costs for the Potential Company.

<b>Cost Number</b>	<b>Cost</b>	<b>Cost Description</b>	<b>Cost Type</b>	<b>Direct/Indirect</b>	<b>Fixed/Variable /Semi-Variable</b>
1	Production Materials	Materials used to produce the adapter, including: 3D Printers, Laser Cutters, PLA Filament, Acrylic Sheets, Steel Support Bar, PVC Cement, Cushioning Pad, and Adjustment Pin.	Material	Direct	Variable
2	Wages	Wages of five employees (team members).	Labour	Indirect	Variable
3	Marketing	Amount spent on convincing people to buy the product.	Expense	Indirect	Fixed
4	Electricity	Consuming electricity for operating 3D printers, laser cutters, and laptops.	Expense	Indirect	Semi-Variable
5	Rent	Renting a place for working and producing.	Expense	Indirect	Fixed
6	Overhead	Overhead expenses other than rent and electricity. Some examples include: transportation costs,	Expense	Indirect	Fixed/Variable

		insurance, repairs, and licenses.			
7	Depreciation	Amount deducted from revenues to allow for a reduction in the value of something because of its age or how much it has been used.	Expense	Indirect	Fixed

## 2. Income Statement

For the following income statements, interest expenses and income tax expenses were not included. In addition, the methods by which the costs were calculated, and the assumptions behind them are clearly listed in the “Core Assumptions” section.

### Income Statement 1 - First Year

Sales (Revenue)	\$400,000
Cost of Goods Sold	\$133,750.23
Gross Profit	\$266,249.77
Operating Expenses	
Marketing Expenses	\$30,000
General and Administrative Expenses	\$237,051.062
Depreciation	\$1500
Total Operating Expenses	\$268,551.062
Operating Income	-\$2301.292
Interest Expenses	-
Earnings Before Tax	-\$2301.292
Income Tax	-
Net Income	-\$2301.292

Due to one-time costs that would be incurred in the first year (such as 3D printers and laser cutters), the net income is not positive. This is expected for a company in its first year of operation.

#### **Income Statement 2 - Second/Third Year**

Sales (Revenue)	\$400,000
Cost of Goods Sold	\$118,750.23
Gross Profit	\$281,249.77
Operating Expenses	
Marketing Expenses	\$30,000
General and Administrative Expenses	\$237,051.062
Depreciation	\$1500
Total Operating Expenses	\$268,551.062
Operating Income	\$12,698.708
Interest Expenses	-
Earnings Before Tax	\$12,698.708
Income Tax	-
Net Income	\$12,698.708

#### **Income Statement 3 - All 3 Years**

Sales (Revenue)	\$1,200,000
Cost of Goods Sold	\$371,250.69
Gross Profit	\$828,749.31
Operating Expenses	
Marketing Expenses	\$90,000
General and Administrative Expenses	\$711,153.1861
Depreciation	\$1500
Total Operating Expenses	\$802,653.1861
Operating Income	\$26,096.1239
Interest Expenses	-
Earnings Before Tax	\$26,096.1239
Income Tax	-
Net Income	\$26,096.1239

The net income is positive overall, which indicates that the potential company will be successful if the assumptions are valid.

### Formulas for Calculations of Certain Components of the Income Statement:

1. Sales (Revenue) = # of units sold \* sales price per unit
2. Cost of Goods Sold = # of units sold \* cost per unit
3. Cost per unit = Cost of production materials for one unit
4. Gross Profit = Sales (Revenue) - Cost of Goods Sold
5. General and Administrative Expenses: Wages + Overhead + Rent + Electricity
6. Depreciation = Equipment Cost / Useful Life
7. Operating Income = Gross Profit - Total Operating Expenses

### **3. Break-Even Point**

In order to determine the break-even point, an NPV analysis is performed. As shown in the income statement,

#### Year 1:

$$\begin{aligned}\text{Total Cost} &= \text{Cost of Goods Sold} + \text{Total Operating Expenses} \\ &= \$133,750.23 + \$268,551.062 = \$402,301.292\end{aligned}$$

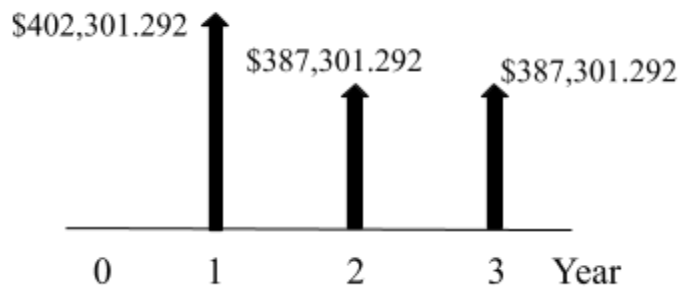
#### Year 2:

$$\begin{aligned}\text{Total Cost} &= \text{Cost of Goods Sold} + \text{Total Operating Expenses} \\ &= \$118,750.23 + \$268,551.062 = \$387,301.292\end{aligned}$$

#### Year 3:

$$\begin{aligned}\text{Total Cost} &= \text{Cost of Goods Sold} + \text{Total Operating Expenses} \\ &= \$118,750.23 + \$268,551.062 = \$387,301.292\end{aligned}$$

A discounted cash flow diagram can be constructed as follows.



**Figure 1.** Discounted Cash Flow Diagram.

The present value is calculated as follows:

$$PV = \sum \frac{FV}{(1+i)^n}$$

where PV is the present value, FV is the future value,  $i$  is the annual interest rate, and  $n$  is the number of years under consideration.

Assuming an interest rate of 5% per year,

$$PV\ 1 = \frac{\$402,301.292}{(1 + 0.05)^1} = \$383,144.0876$$

$$PV\ 2 = \frac{\$387,301.292}{(1 + 0.05)^2} = \$351,293.6889$$

$$PV\ 3 = \frac{\$387,301.292}{(1 + 0.05)^3} = \$334,565.418$$

$$NPV\ (\text{Net Present Value}) = PV\ 1 + PV\ 2 + PV\ 3 = \$1,069,003.195$$

To break-even in terms of total cost,

$$\$1,069,003.195 = N * \$400\ (\text{sales price} / \text{unit})$$

$$N = \frac{\$1,069,003.195}{\$400} = 2672.5\ \text{units} \approx 2673\ \text{units}$$

Therefore, the company needs to sell 2,673 units in order to break-even in terms of the total cost. This is a realistic value since it is highly unlikely that the company will break-even in the first year due to large one-time costs (such as 3D printers and laser cutters).

#### **4. Core Assumptions**

In developing the economics report, several assumptions were made. These assumptions are described in detail below.

- The company will sell 1,000 products per year (3,000 products in 3 years). This is an estimate, and it is realistic for a start-up company.

In one year:

### Production Materials:

- 3D Printers are needed to create the product.
  - It takes 20 hours of 3D printing to make one product. This value was obtained based on the number of 3D printing hours that are expected to be needed for the development of the team's final prototype.
  - Assuming there are 261 workdays in a year, 4 products need to be made each day ( $1,000 / 261 = 3.8 \approx 4$ ).
  - Therefore, four 3D printers are needed to make 4 products per day since each 3D printer will be operating for 20 hours.
  - Each printer is assumed to cost \$3,250 (Ultimaker 2+ 3D Printer).
  - Therefore, the total cost of the printers is  $4 * \$3,250 = \$13,000/\text{yr}$ .
- Laser cutters are also needed to create the product.
  - Laser cutting for each product takes a maximum of 30 minutes. This value was obtained based on the time it took to laser cut the acrylic sheets made for the second prototype.
  - Two laser cutters are needed. One laser cutter could do the job, but it is quicker and more efficient to use two. Also, buying one laser cutter is risky because it could have malfunctioning issues at any point in time, which can hinder the production of the adapters.
  - Each laser cutter is assumed to cost \$1,000 (Ten-High CO2 Engrave Machine).  
<https://www.omnicoreagency.com/best-laser-cutter-engraving-machines/>
  - Therefore, the total cost of the laser cutters is  $2 * \$1,000 = \$2,000/\text{yr}$ .
- Building Materials (BOM).
  - The cost is \$100.23 per product.
  - Therefore, the total cost per year is  $\$100.23 * 1,000 = \$100,000.23$ .



**Table 2.** Bill of Materials (BOM).

Item Number	Part Name	Description	Quantity	Unit Cost	Extended Cost
1	Steel Support Bar	½” x 36” Steel Rod	2	\$6.88	\$13.76
2	Acrylic Sheets	24” x 18” Sheets	2	\$20.00	\$40.00
3	PVC Cement	8 oz Container	2	\$7.99	\$14.99
4	Cushioning Pad	24” Foam Roller	1	\$19.99	\$19.99
5	3D Printed Support Blocks	6” x 1” x 1” PLA Filament	8	\$0.00	\$0.00
6	3D Printed Attachment Head	Hollow Frame	1	\$0.00	\$0.00
7	3D Printed Handle Attachment	Solid Semi-dome and Ball	2	\$0.00	\$0.00
8	Adjustment Pin	¾” x 4”	2	\$1.16	\$0.00
Total: \$88.74 + (HST: \$11.54) = \$100.23					

- PLA Filament.
  - Cost: \$25/kg <https://3dinsider.com/3d-printing-filament-cost/>
  - It is assumed that all the 3D printed pieces of one product weigh a total of 0.75 kg. This is an estimate based on the pieces that were 3D printed for the second prototype.
  - For one product: 0.75 kg \* \$25/kg = \$18.75.
  - For 1,000 products: \$18.75 \* 1,000 units = \$18,750/yr.

**Total Production Materials Cost: \$133,750.23**

#### Labour:

- It is assumed that 5 team members are needed.
- They are paid \$20/hour and work 40 hours per week (full-time). The labour rate was chosen to reflect the rate typically paid in Canada to entry-level engineers.
- $40 \text{ hrs} * 52 \text{ weeks} = 2,080 \text{ working hours/yr.}$
- 1 person will be paid \$41,600 per year ( $2,080 \text{ hr} * \$20/\text{hr}$ ).
- Therefore, for a five person team, the total labour costs will be \$208,000 per year ( $\$41,600/\text{person} * 5 \text{ members}$ ).

**Total Labour Costs: \$208,000**

#### Marketing:

- Estimated yearly cost of \$30,000.  
<https://www.bdc.ca/en/articles-tools/marketing-sales-export/marketing/pages/what-average-marketing-budget-for-small-business.aspx>

**Total Marketing Costs: \$30,000**

#### Overhead:

- Estimated total cost of \$5,000. This is a rough approximation based on possible transportation costs, repairs, insurance, etc.

**Total Overhead Costs: \$5,000**

#### Rent:

- Assuming a monthly cost of \$2,000.  
[https://www.ottawarealestate.ca/search/results/?city=all&subdivision=all&list\\_price\\_min=2000&list\\_price\\_max=2000&beds\\_min=all&baths\\_min=all&type=com\\_r](https://www.ottawarealestate.ca/search/results/?city=all&subdivision=all&list_price_min=2000&list_price_max=2000&beds_min=all&baths_min=all&type=com_r)
- Total yearly cost for rent will be \$24,000.

**Total Rent Costs: \$24,000**

#### Electricity:

- 3D printers are estimated to use 0.05 kWh for a 1 hr print.  
<https://3dstartpoint.com/3d-print-power-consumption-how-much-power-does-a-3d-printer-use/>
  - For 20 hrs: 1 kWh/day ( $0.05 \text{ kWh} * 20 \text{ hrs}$ ).
  - For 261 days: 261 kWh ( $1 \text{ kWh/day} * 261 \text{ days}$ ).

- On-peak rate in Ontario is 13.4 cents per kWh.  
<http://www.ontario-hydro.com/current-rates>
- Total electricity cost for 3D printing is:  $\$0.134/\text{kWh} * 261 \text{ kWh} = \$34.974$ .
- Laser cutters are estimated to use 0.08 kWh.  
<https://www.troteclaser.com/en/knowledge/faqs/optimal-laser-power/>
  - For 2 hours of laser cutting (4 products/day with each product requiring  $\frac{1}{2}$  hr of laser cutting, so  $4 * \frac{1}{2} = 2$  hours):  $0.08 \text{ kWh} * 2 \text{ hrs} = 0.16 \text{ kWh/day}$ .
  - For 261 days:  $0.16 \text{ kWh/day} * 261 \text{ days} = 41.76 \text{ kWh}$ .
  - Total electricity cost for laser cutting is:  $41.76 \text{ kWh} * \$0.134/\text{kWh} = \$5.59584$ .
- Laptops are estimated to use 0.05 kWh.  
<https://smarterbusiness.co.uk/blogs/how-much-energy-do-my-appliances-use-info-graphic/>
  - Assuming usage for 6 hours per day (there are 8 working hours per day, and laptops are not needed for all tasks):  $0.05 \text{ kWh} * 6 \text{ hrs} = 0.3 \text{ kWh/day}$ .
  - For 261 days:  $0.3 \text{ kWh/day} * 261 \text{ days} = 78.3 \text{ kWh}$ .
  - Total electricity cost for laptops is:  $78.3 \text{ kWh} * \$0.134/\text{kWh} = \$10.4922$ .

### **Total Electricity Costs: \$51.06204**

#### Depreciation:

- Depreciation is defined as the equipment cost / useful life.
- 3D printers: Assuming that 3D printers have a useful life of 10 years (<https://www.fabbaloo.com/blog/2018/1/17/how-long-does-a-3d-printer-last>), depreciation costs =  $\$3,250 / 10 \text{ years} = \$325/\text{yr}$ . For four 3D printers: depreciation costs =  $\$1,300/\text{yr}$  ( $\$325/\text{yr} * 4$ ).
- Laser Cutters: Assuming that laser cutters have a useful of 10 years as well (<https://www.depreciationrates.net.au/laser>), depreciation costs =  $\$1,000 / 10 \text{ years} = \$100/\text{yr}$ . For 2 laser cutters: depreciation costs =  $\$200/\text{yr}$  ( $\$100/\text{yr} * 2$ ).
- Total depreciation costs =  $\$1,300 + \$200 = \$1,500$

### **Total Depreciation Costs: \$1,500**

Therefore,

Total Costs: Total Production Material Costs + Total Labour Costs + Total Marketing Costs + Total Overhead Costs + Total Rent Costs + Total Electricity Costs + Total Depreciation Costs.

Year 1: \$402,301.292

Year 2: \$387,301.292

Year 3: \$387,301.292

In the second and third year, 3D printers and laser cutters do not have to be bought again. Therefore, the total costs in Year 2 and Year 3 would be:  $\$402,301.292 - (\$13,000 + \$2,000) = \$387,301.292$ .

Also, the selling price was chosen to be \$400 per unit. This is in order to remain competitive with other similar products in the market. For instance, the Adapt2Row Product costs \$761.25 as mentioned in Deliverable B when performing the Benchmarking analysis.

As shown in the income statements, there would be no profit in the first year, but rather a net loss of \$2,301.292.

However, there would be a profit of \$12,698.708 in each of the second and third years, and a net profit of \$26,096.1239 over 3 years.

## **5. Video Pitch**

The one-minute video pitch can be accessed via the following link:

[https://youtu.be/Dz1E6o\\_N78I](https://youtu.be/Dz1E6o_N78I)

(It is also attached as a separate file)

Important Note: The video pitch was recorded individually by each team member and put together as one. The design team recognizes that the video would have been more professional and of better quality if it was recorded with all team members in one place. However, for the safety of all team members following the COVID-19 outbreak, it was recorded using this method.

## **Conclusion:**

A detailed economics report and video pitch were successfully completed. Initially, a list of costs associated with the business was included, and these costs were classified into different

categories (direct, indirect, variable, and fixed). The team then developed a three-year income statement and determined the break-even point using an NPV analysis. The development of these components required some assumptions and estimations to be made; these core assumptions were clearly stated and justified, along with the methods of calculation of each cost included in the income statement. The result over three years is a net positive income; this means that the potential company will be profitable as long as the assumptions made are valid and realistic. Additionally, the design team created a one-minute promotional video pitch with a brief introduction to the team members and the problem that is being solved, as well as an explanation of the design and its competitive advantages. Further steps will include a final prototype update and a user manual.