ENGNMGT 4A03: Innovation Driven Project Development and Management

Assignment 7 - Final Proposal

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Introduction and Description of the Opportunity

Shopping in a typical supermarket is very time consuming and cumbersome, even though it does not have to be. By far, the most inefficient part of shopping is when it comes time to check out. Customers wait in long lines with shopping carts full to the brim with items for an employee to scan and then pay for them and leave. Stores noticed that this was inefficient, so they implemented self checkout machines, but they were not fast enough. The problem comes from the fact that regardless of the method used, currently, a customer has to wait in a line-up, take all of their items out of the cart, scan each one, and then put them back into the cart. Our group aims to solve this problem by changing how the shopping cart functions.

With our proposed cart, the user would scan each item as they put it into the cart using a barcode scanner built into the cart. Each item would then be displayed on a screen attached to the handlebar of the cart. Using the screen, the user can increase or decrease the number of a particular item they would like to purchase. The user can also delete items if they decide they no longer want to buy it. For produce, the user would scan the barcode on the produce stand and weigh it using the small scale built into the bottom of the cart. When the user is finished shopping, all they would need to do is press “check out” on the cart’s display and pay by inserting their credit card into the screen’s card reader.

To prevent theft of the carts, each screen would have a GPS tracking element built in. To combat theft of products, a store can also choose to have an employee at the door to quickly check the cart in order to ensure that all items have been accounted for. To charge the battery used to power the screen/barcode scanner, the cart stations will be equipped with power cords that will supply power once the carts are connected in series. These power cords will also function as a locking mechanism that connects the carts together, similar to the locking technology that requires a coin to unlock the cart. This way, when carts are not in use, they are being charged to ensure that the carts don’t run out of battery throughout the day. The cart would benefit both the customers and the stores using it. For instance, customers would get the quick and easy service that they desire. Meanwhile, stores would be able to speed up the customer throughput, leading to higher revenues, and replace some or even all of their employees currently employed as cashiers at the checkouts, therefore cutting costs.

In the following document, we propose that we conduct a feasibility study to assess the practicality of the proposed smart cart. Then, we will outline how long the study would take as well as its financial costs.

Goals for the Feasibility Study

A feasibility study is the evaluation of a desired project in order to figure out if it is attainable. It is completed through three processes which are technical feasibility, cost feasibility and profitability. The skills, materials, and time required to implement the prototype were determined by the feasibility study. Also through research, the cost of labour, equipment, materials and legalization (Patents) where calculated and established. Following the financial research, production of a basic prototype and an initiation of the study will need to take place, in order to conduct surveys and settle time studies. The next goal is to pursue patent searching and filing, sketching the design and 3D modeling. Finally, the study will conclude following the value proposition, communication with suppliers and finalizing the

study by assembling prototype and communicating feedback with managers. We believe fifty one days is an appropriate estimation of the duration of the feasibility study.

Market Sizing and Target Market Analysis

The customer for our product will be large grocery stores and potentially big box stores that also use self-checkout systems. Since our product uses similar technology as the self-checkout and will compete with it, we thought it is reasonable to say that they would occupy the same market space. The global market for self-checkouts reached $2.28 billion in 2016 and is expected to grow, with a compound annual growth rate of 10.8%, to $5.85 billion by 2025 (Transparency Market Research 2018). The self-checkout market for North America alone was $813.4 million in 2017 (Transparency Market Research 2018). So, based on our geographic location (ability to ship product and easily communicate with customers) and the size of the North American section of the market (about 35% of the global market) we believe it would be wise to target the North American market first before expanding the product globally. Furthermore, the overall size of the market in Canada includes approximately 8000 “medium” sized grocery stores which include those grocery stores that have 5 to 99 employees and 1250 “large” grocery stores which employ more than 99 workers (The Statistics Portal 2016). Medium sized grocery stores have on average 50 shopping carts, and large grocery stores have closer to 90. We aim to have stores replace their standard shopping carts with our new smart shopping carts.

To target the North American market, we will first attempt to partner with smaller/ medium sized grocery store chains and supermarkets. For example, Fortinos stores fall in that medium sized grocery store range that would make it viable for them to afford our product, however they are also a smaller chain of grocery stores with only 23 grocery stores in Ontario. Fortinos’ is a supermarket brand that prioritizes excellent service and doesn’t sell exclusively on price, such as Wal-mart or no frills. This means that they would be more likely to be open to buying a product such as ours in order to improve the experience of their shoppers. Additionally, because they are relatively small for a chain of supermarkets, it is more likely that we will be able to get to speak with someone capable of making such a decision. We will run pilot runs in a few of these smaller stores to gather feedback/shoppers input and improve the product. Once the bugs have been worked out, we will move to put the carts in all of the stores of smaller chains. Once our carts are in a few smaller chains, we will begin talks with larger chains, citing the cost savings and any other benefits experienced by the smaller chains as a main selling tactic.

Consumer Identification and Value Proposition

Our initial target market includes medium sized grocery stores in North America. Because of the additional complexity of our carts compared to traditional ones, they will have to be more expensive than standard shopping carts. On the other hand, because of the reduced need for cashiers, we also believe that grocers will see the opportunity to reduce variable costs over an extended period of time by investing in our carts. Therefore, we expect customers to pay around $500 per shopping cart. For the average medium sized grocery store, this would be a $25 000 investment to replace their 50 carts. Customers will make this investment because in many places across North America, the minimum wage is increasing. For example, in Ontario the minimum wage will soon to be $15 per hour, these carts will pay for themselves after 1667 hours of saved cashier time, or approximately 70 days if we assume that there are 24 labour hours spent cashing out customers each day.

This approximation is probably on the low end, that is to say, there are probably more than 24 labour hours spent at the cash register each day however this is a conservative estimation.

The cart will reduce the total average shopping time for each customer, allowing the store to serve more customers in the same period of time. Increased customer throughput will lead to an increase in sales/revenue as more customers will be able to shop.

Finally, the cart implements cart tracking services in the store as well as the ability to display ads on the display of the cart. This results in a huge marketing opportunity for the store, as it can use shopper's position in the store to target certain ads to them. This increases the likelihood of the shoppers making more purchases based off the ads, and would lead to an increase in the store's revenue.

Competitive Analysis, Product Strategy

Our competitors include Walmart and Focal Systems, who have designed carts similar to ours, as well as creators of traditional carts. They offer products that fall into two categories, traditional options and similarly innovative products. Of the innovative options, we will compare with Walmart to see why our option is best on the market (Appendix A). We will also do a comparison with traditional shopping options to see why this kind of technology will be able to compete against those options (Appendix B).

Ultimately, since the number one drive for store managers is customer satisfaction and sales, then our indirect customers are really the store customers/ the shoppers themselves. Accordingly, the appeal of our product comes from a few distinguishing factors that include its ability to save costs for customers, time saving for users, and the innovative combination of technologies.

Purchasing our shopping carts will have a high initial cost compared to similar products on the market. The price however, is a one time expense that allows for long term savings over the lifetime of a cart. As discussed during the preliminary technical assessment, a store equipped with these carts will be able to reduce hours of cashiers, compensating over a period of time for the increased initial expense and eventually saving the store money.

The next selling feature of our cart is the user experience. Very often, shoppers are in a rush and a particular grocery store can increase its appeal by offering the possibility of significantly quicker check out times even during peak hours. The self checkout cart, once purchased by a store will increase the number of shoppers they get coming to make use of the added convenience and this will lead to an opportunity for increased revenue for store owners.

Lastly, getting consumers to try new products is often very expensive. Many companies will spend a lot of money per new customer. For some consumers, the innovative combination of technologies will be enough to prompt them to try a new store for the first time. This is especially true for the first adapter of this technology in a given area.

Technology

Everyday we see technological advancement in our modern world. Technology becomes better and easier for people everyday as automation develops. For our product to occur, there are key technologies required to deliver the product such as streamlining the supply chain through the use of the Internet of Things, security asset trackers and touch screen display with payment terminal.

The Internet of Things is a disruptive technology that enables the connection, collection and exchange of data between physical devices and the system software. This is a key technology that can be used to the advantage of both customers and supermarket managers. The IoT can benefit customers as it makes it easier for customers to purchase groceries, considering one feature that sends the receipt of purchase to the account instead of printing physical copies. As for companies, by using IoT, stores are able to determine the quantity of specified products and evaluate if there is a shortage. From inventory management to quality control, this technology will enhance productivity and efficiency.

Security asset Trackers are another important component for the the cart. Although some customers might think it violates their privacy, it is used for security reasons and feedback. The tracker acts as a GPS for both the customer and the market manager. It directs customers where they want to go and assists store managers with identifying what products mostly attract customers. This is a navigation system that will make it easy to identify where shoppers are in the store and track the exact location of the shopping cart. The tracker will allow store managers to optimize shelf space based on accurate consumer behavior data in order to identify the location and length of time of customers on a visual store-map. This helps store managers decrease overall shopping time for people in store as they can group most demanded products in one isle or bundle it with other merchandise that customers purchase. The tracker would also track potential thieves if the cart leaves the premises. This will most likely prevent theft of the carts as the cart will lock in place if it passes over the cable underneath the shop perimeter. The device could also be used to locate where the carts are inside and outside of the store.

Finally, touchscreen display with the connection to a payment terminal is a key technology which decreases time in store where a customer can display everything recorded using the barcode scanner and will be able to make a payment through the cart. The wired payment terminal comprises an all-in-one payment solution that features everything the store needs to easily and securely accept debit, credit and all other types of digital payments. The display is connected to a barcode scanner, that logs the items being placed in the cart, allowing the user to keep track of the items being purchased. Finally, the display has built-in peripheral functions including advertising sales, price checker, shopping list, product search and many more. This way, it can attract customers more into purchasing other stuff and make it easier for customer to control what they want to buy.

As a conclusion, all these technologies combined make the CCart a unique product that will decrease the time customers spend inside the store. Significant invention would not be involved to assemble our product as all of these products have been created, but an intensive engineering design will be mandated to connect all components and systems collectively (Appendix C).

Intellectual Property and Regulatory Issues

Our product design will be an improvement to the existing shopping cart and checkout service, hence can be protected by a patent. This is achievable considering that our product meets the four basic requirements to apply for a patent, these are subject matter, utility, novelty, and non-obviousness. It qualifies as subject matter by reason of composition of multiple components to produce the final design and an improvement to an existing machine. It has utility as it is useful to a great number of people that can benefit from its simplicity and time saving capabilities. Accompanied by novelty, as this idea has not yet been implemented in any vendor or merchant store. Finally the product is non-obvious to the common consumer as lining up at the cashier to check-out is the mainstream shopping process nowadays. In that field of design, as it is not simply an aesthetic or geometric enhancement from a previous design.

The intellectual property we will protect is a shopping cart that allows you to scan the barcodes of items, displays price and information on an LCD touch screen, weigh produce, and self-checkout. It will be battery based that will be recharged by generating power through the rotational motion of the wheel, and will have a wirelessly charging feature.

After performing a preliminary patent search, our group got an insight of what other innovators and developers have thought of. The interface utilized to perform the patent search is the Canadian Intellectual Property Office (CIPO). After analyzing many patents revolving around the same idea, a common concept between all of them is the implementation of the barcode scanner on the shopping cart. Except each idea exploited various other systems to make the shopping experience more smooth and rapid. For instance, patent application: **2682541** comprises a shopping cart constituting a frame, a basket, a handle, a base tray, a plurality of wheels, a read component for performing a proximity scan, a GPS tracker, and a display component for displaying at least one advertisement based on the location of the shopping cart within the store. Another patent application: **2168919** encompasses an apparatus of a mobile shopping cart that can automatically keep track of objects selected and dropped in the cart using a sensory radio transmitter and also provides information to the customer like the total price of the items carried. The list goes on but the main idea of innovating the self checkout procedure is consistent throughout all the patents. The good news is our idea is still confirmed as valid and novel, considering that none of the previous patents took advantage of the payment terminal being embedded in the display screen for easier self checkout, the utilization of kinetic energy storage in the rotary motion of the wheels, and finally the shopping cart wireless charging bay.

Searching the USPTO, the following patents were the closest to the discussed idea: There are early patents on barcode scanners built on a shopping carts such as **US 7,036,725**, which involved a screen and buttons that displays consumer product information such as pricing etc. The patent also mentions the customer having the ability to check out and pay for purchased items. However, it does not mention the means as to how the screen will be charged or the power source. It also does not mention a special process for produce such as what we designed with the scale system.

Another Patent **US 10,032,197,** similar to patent **2168919** discuss the idea of using the user's personal mobile device connected to a portable scanning system that send product information to the mobile. This does not mention using the mobiles camera to scan the items. It does, however, discuss using the mobile device to assist in speeding out the checkout process.

As a result, we believe there is “freedom to operate”, as none of the patents discussed above discuss a shopping cart with a built-in LCD touch screen that displayed product price when scanned with the built-in barcode scanner and has a built in weighing scale for produce. The shopping cart also allows customer to check-out, without the assistance of a employee(unless needed). In addition, none of the patents discuss shopping carts being powers by a battery that is charged through wheels’ rotational motion and/or wireless charging.

Business Model

- Technology licensing: Supermarkets and Shopping centers will have the opportunity to licence our product, if they choose to “upgrade” their pre-existing shopping carts. By upgrading their carts, they will pay the company to licence and install the “smart” technology on their shopping carts, without having to buy new shopping carts.
- Shopping cart sales to merchant stores: for new stores that don't have shopping carts yet, or have shopping carts, but want to buy more,CCart can also provide that. In this case, we will also have a profit on the carts that we will sell to the customers.
- Service and maintenance: as ll electronics, with use, they may breakdown/ need preventative maintenance. We will provide servicing and maintenance to our customers, which will be billed when completed.
- Commission of targeted advertising: as discussed earlier, the screen will show targeted advertising to customers while they are shopping. A possible share of the advertising revenue can be negotiated by CCart.

Scope of the Feasibility Study

There are many tasks and objectives we wish to complete with the design idea. However not all of these are possible given the limited time and resources allotted to this project. The main scope of the project will focus on building a basic prototype, gathering information through surveys, perform regulatory assessments, propose the idea to industry professionals and managers as well as negotiate quotes/estimates from suppliers and manufacturers.

Although the prototype will not encompass all the envisioned features of the final product, we are planning on developing an elementary phase product that displays the key features of the final product and to outline the general design of the shopping cart. We will also gather relevant information through surveys, such as conducting time studies in regards to wait time associated with the cashier lanes. Such information (ie. which method is faster) will further allow us to determine the feasibility of the product. Regulatory assessments will also be done to ensure that the product will meet all relevant standards and regulations. For example, shopping cart safety regulations as well as communication and high frequency safety standards will be considered, which will be relevant due to the electronics associated within the product. Finally, we are also aiming to propose this idea to supermarket managers and negotiate quotes with certain suppliers and manufacturers for a more realistic view on developing the concept for the project.

Feasibility Study Plan

Please refer to Gantt Chart in Appendix E for Feasibility Study Plan.

Feasibility Study Cost and Resources

Resource	Price/ 1 Quantity	Duration	Quantity	Description
A) Labour				
Project Manager	$40/hour	156 Hours(Refer to Gantt Chart)	1 Manager	Team leader and manager
Engineers	$25/hour	Average 246 Hours per Engineer, Refer to Gantt Chart)	5 Engineers	help design and build the project
Welder	$22/hour	56 Hours	1 Welder	Assemble the shopping cart
Electrician	$30/hour	50 Hours	1 Electrician	Will connect all of the electrical components of the cart.
B) Equipment				
Computer & IT's Equipment	$1000	One time purchase	5 Computers	Used for project creation/ software development and office financial use
Touch screen Display	$35	One time purchase	1 per cart	Displays items being purchased with price.
Metal working machine	$20/hour	56 hours	1 machine	Machine used by welder to reshape steel of shopping cart
Barcode Scanner	$38	One time purchase	1 per cart	Obtains items price and record it for the user.
Security Tracker	$100	One time purchase	1 per cart	Used to identify where cart is and stop beyond certain radius
C) Materials				
Nuts and Bolts	$5	One time purchase	20 of each per cart	Used to assemble the cart

Coil	$8	One time purchase	1 per cart	Used during cart's assembly
Plastic	$10	One time purchase	1 per cart	A necessary component for the cart
Battery	$50	One time purchase	1 per cart	Energy given to the LCD, Barcode scanner and Tracker
Wheels	$10	One time purchase	4 per cart	Mobility of the cart
Steel	$21.08	One time purchase	31 Kg per cart	Used for the Cart
		Total Price	$46,149.08	

(40*156)+(25*246*5)+(22*56)+(30*50)+(20*56) +$5307.08(total cost of one time purchase items (i.e bolts, steel,...)) = $46,149.08

Financial Model

A great way to analyze the financial viability of the project is to analyze its expected commercial value (ECV). The ECV calculation takes many variables as inputs and uses them to forecast the financial success in the first five years of operations.

ECV Inputs:

Market size and growth rate: Market size was chosen as $2.3 billion and growth rate was 10.8% (these values are justified in the "Market Sizing and Target Market Analysis" section).

Probability of technical and commercial success: We estimate the probability of technical success to be 80% since the development path is not very complex, we are not "inventing" new technology (just piecing it together into one cohesive unit), and our IP landscape looks good (as discussed above). Our probability of commercial success is estimated to be 30% since there is already a market full of products that seek to solve the same problem, and the market is dominated by large firms like Toshiba and IBM(PS Market Research, 2018).

Market share per year: It is reasonable to assume that for the first couple of years, our product will not hold any of the market share. Once grocery stores realise how much money they could save by using our carts, our market share will begin to increase (year 3=5%, year 4=10%, year 5=20%).

Costs and selling price: The materials for each cart will cost around $310 (refer to "Feasibility Study Cost and Resources" section for breakdown). Assuming labour cost of $22/hour for a skilled welder, $30/hour for an electrician, and overhead cost of $20/hours for machine that shapes steel into steel cart shaped steel rods, for electricity, rent...etc. Assuming one hour to take one electrician and welder to manufacture the steel into a cart results in 22 + 30 + 20=$72. Then shipping will be around $20. Therefore, it will cost around $410 to get each cart to a customer. It is reasonable to assume that we would want to make

at least a 30% margin, putting the cost for the consumer at $533. We estimated that the product would cost $39,040 to develop (engineer/management salaries (5*$25/h*246h+1*$40/h*156h and prototypes (5*410)). We can then assume that we would need to keep three engineers employed for the next two years to work out bugs and issues should they arise (3*$25/h*40h/week*50 weeks). This would mean that we would incur $150,000 of development costs each year. So, year 1 development costs are $39,040 + $150,000 = $189,040 and year 2 development costs are just $150,000.
Marketing: In our first year of development, we expect to work on developing the product and run trials in smaller supermarkets. Then, in our second year, we expect to expand into more chains. Based on this plan, we believe that it is reasonable to estimate spending $100,000 and $250,000 on marketing in our first and second year respectively.

Finally, plugging all these numbers into our ECV calculator, we get the figure shown in Appendix D. This figure shows the ECV is approximately $58 million, with the break even occurring at about 2 years. Due to this level of potential return, and the relatively low level of initial investment, we believe the cart would be a good investment from a financial perspective.

Risk Analysis

We have identified 6 main risks threatening our successful launch of this product, in order to effectively manage these risks, we will first describe them, then determine their relative severity by considering the likelihood and the impact of each happening. Lastly, we will discuss options for mitigating or avoiding the risks.

The first risk identified is the possibility of breakdown in the supply chain. Due to the complexity of our cart, we will be receiving supplies from many dealers. If any one of the many suppliers makes a late delivery then we risk losing productivity until the supplies do arrive. The theft of carts is the next risk, having carts with more integrated technology makes them a more valuable target. Again, because of the complexity of our technology, we have identified the risk that our carts breakdown frequently.

We are also making some very bold promises around what we can offer in terms of database integration to customers. There is a risk that we won't be able to accomplish the promised level of integration quickly or efficiently. While our target customer is grocery stores, it would be a serious problem if the end user didn't like using our product. And lastly, we have identified the risk that users don't like the buying habits and store pathing tracking features that we plan on providing to store owners. Some people may see this as an invasion of privacy (Appendix F).

Risk Management Plan:

The risks will be discussed in order of descending severity such that, if not all the following measures can be afforded, they should be implemented in this order in such that risk reduction will be maximized.

Our strategy for handling the most serious risk - supply chain breakdowns - will include a few layers of risk mitigation. In order to prevent the production line from coming to a halt for a lack of materials, we will order extra materials with each order so that we always have a surplus on hand. Next, if a specific supplier fails to meet commitments on more than 1 out of every 5 deliveries, we will find a new supplier for that part of our supply chain.

It would be a huge detriment to our chances at success if our users didn't like our product. In order to ensure that shoppers enjoy using our carts, we will need to conduct

extensive research after creating the prototype and before making our first sale. These tests will include ergonomic studies, ensuring that the carts aren't too heavy or otherwise uncomfortable to use, as well as focus groups, to make sure that the interface is intuitive. We will implement changes to improve the user experience until at least 70% of users give a satisfactory or above rating of the cart. If this cannot be achieved during the feasibility study, then we should consider aborting this endeavour.

Next, we'll discuss the risk that we are unable to deliver on our sophisticated technological promises. We don't want to lose any contracts because we weren't able to meet our promises. Because we won't have full functionality be the end of our feasibility study, we won't be certain about how the database integration will go until we are implementing it with our first customer. We will therefore not make additional sales and time commitments to customers until we have succeeded in implementing the database integration with our first client. If we find that we are unable to meet this promise with a client, we will remove it as a feature and reintroduce it in later iterations when we have the capacity to hire software engineers or database experts.

If we find that our carts are breaking down frequently, we will have to address it. Testing during the feasibility study will ensure that our design is robust, however if we find that greater than 4% of carts (2 in every order of expected average size) are breaking within the first year of operation then we will find higher quality materials or processes for assembly to correct for the most common modes of failure.

Second last, is the possibility of our carts being stolen from stores. We will turn this risk into an opportunity by having added security features available for purchase to our customers. These features include integrating locks into the charging cables that link carts when they are charging. In other words, a user can insert a toonie to take a cart and then when they are done with the cart they will be incentivized to return it to the charging station and locking it together with the other carts. Another available security feature will be a parking lot perimeter locking mechanism, whereby any cart brought out of the parking lot (or out of the shop perimeter) will automatically engage locks in the wheels.

Lastly, privacy concerns have been raised. This risk falls in the unlikely and not very threatening category, mainly because we believe that the liability would actually fall on the grocery store. This being said, consumer behaviour is regularly monitored and doing so is not illegal, so as long as we don't draw too much attention to it, this risk can essentially be ignored.

Assumptions

Since a feasibility study was done and most of our research was based on online resources, some assumptions were made, mostly around costs. Our first assumption was that the allocated engineers employment in the operations stage to work out bugs and issues should they arise. Shipping and handling costs were also estimated, considering an exact price isn't easy to calculate. On the other hand, if we contact the outside distributors to ship us the parts an exact distribution cost could be calculated. Time was also estimated, considering an exact period would be difficult to obtain. An example would be the time required for research and development. To ensure research and development is complete, deadlines are set in place, the time for completion is estimated based on those deadlines. Another assumption that was used is the market growth for CCarts, considering we used the market projected growth for self checkout systems. Finally, we estimated that the project will

make thirty percent profit margin, which is a fair approximation based on markets of similar forecasts.

Summary and Next Steps

How much would you need to invest?

- Based on the market growth rate on the self-checkout technology and several other assumptions, we estimated the total development costs and total commercialization costs. Analyzing those costs we were able to come up with the total investment required to get into production/sale of the product.
- Total investment required: $340,000. This investment will be used to pay for the development and commercialization costs in the first year of operations. This includes the cost to do the feasibility study, develop prototypes, and get into smaller chains to do trial runs.

Why would you invest?

- To understand why you would invest in this product you need to have a clear perspective on the wide range of features that our product offers and come to an agreement that this product will revolutionize the whole shopping experience. This product is going to be turning point to the future of the shopping industry.

References

Transparency Market Research. “Self Checkout Systems Market.” *Transparency Market Research*, Feb. 2018, www.transparencymarketresearch.com/self-checkout-systems-market.html.

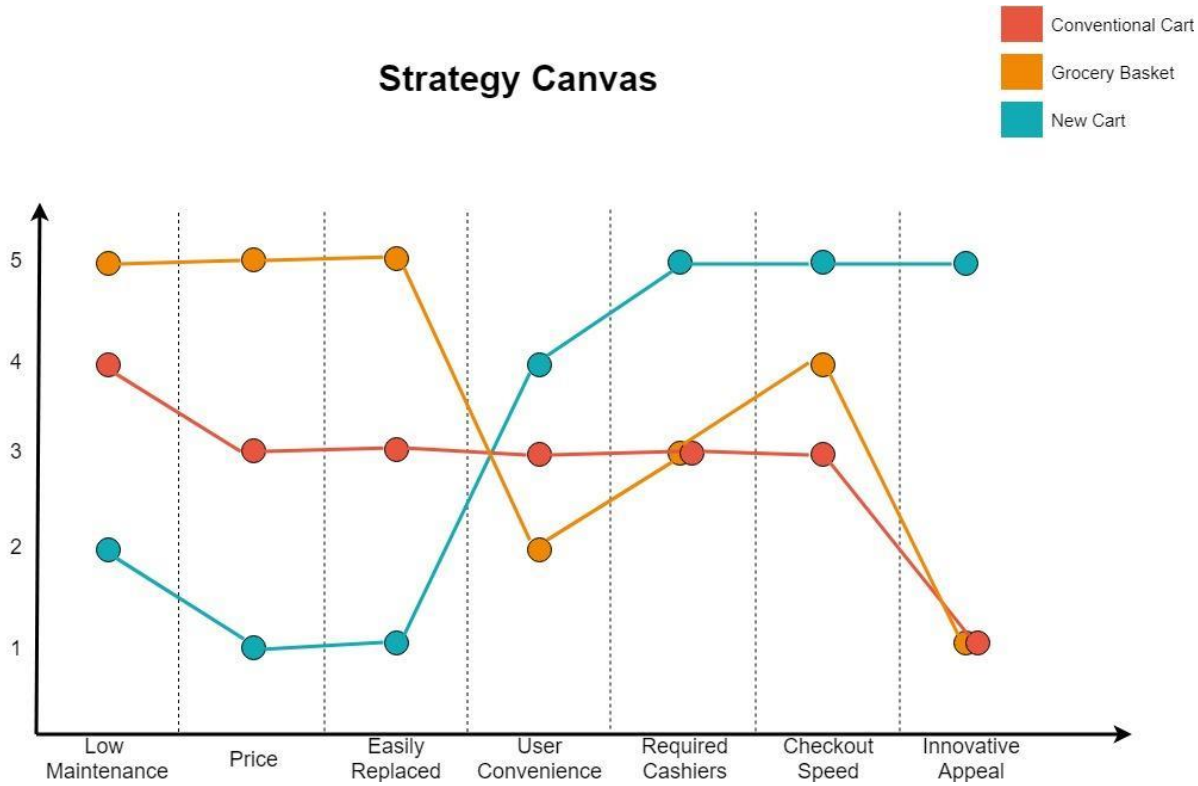
The Statistics Portal “Grocery Stores by Size Canada 2016 | Statistic.” *Statista*, Dec. 2016, www.statista.com/statistics/459536/number-of-grocery-stores-by-employment-size-canada/.

PS Market Research. “Self-Checkout Systems Market Industry Share Report 2023.” *PS Market Research* June 2018, www.psmarketresearch.com/market-analysis/self-checkout-systems-market.

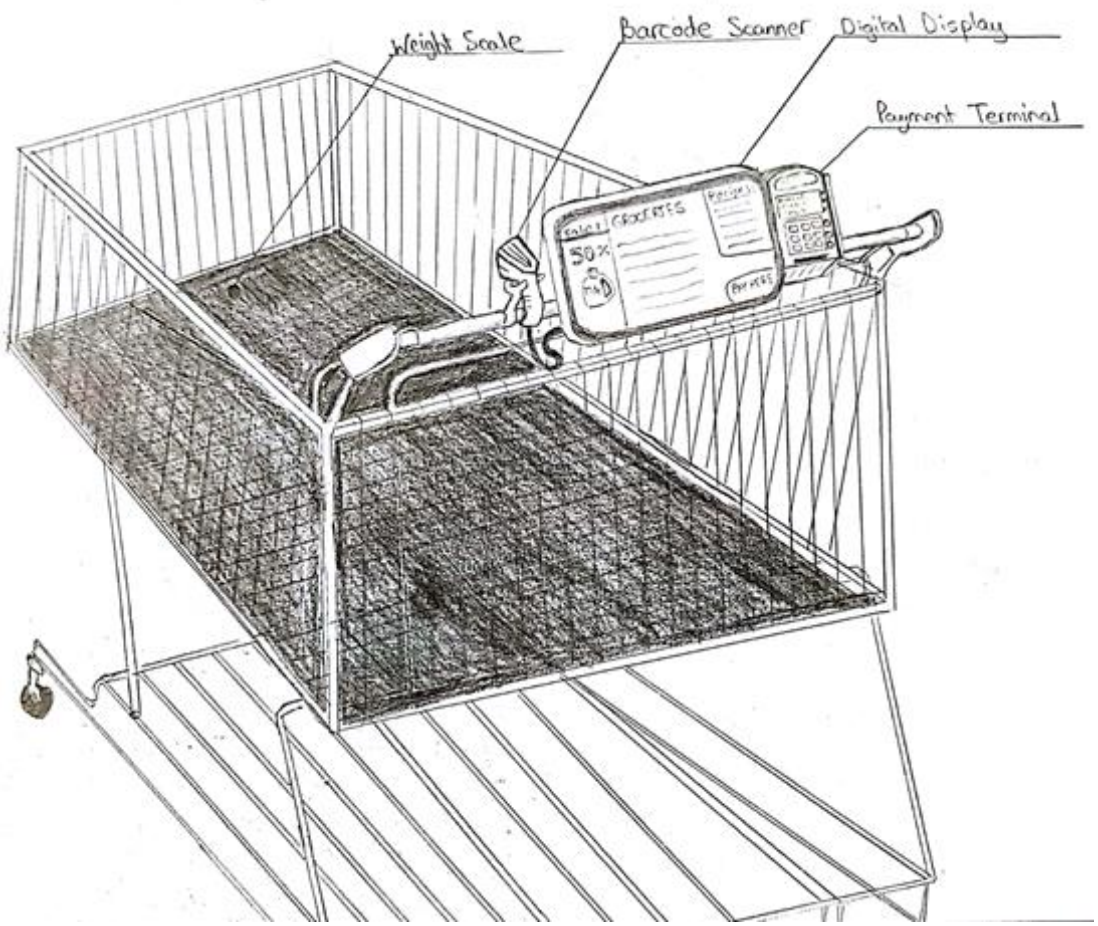
Appendix

Features	CCart	Walmart
Biometric Feedback Sensor	✗	✓
Advertising/Special Offers	✓	✗
Navigation	✓	✓
Payment Terminal	✓	✗
Barcode Scanner	✓	✗
Charging Station	✓	✓
Shopping List	✓	✗
Product Search	✓	✗
Recipes	✓	✗
Product Information	✓	✗
Security Asset Trackers	✓	✓

Appendix A



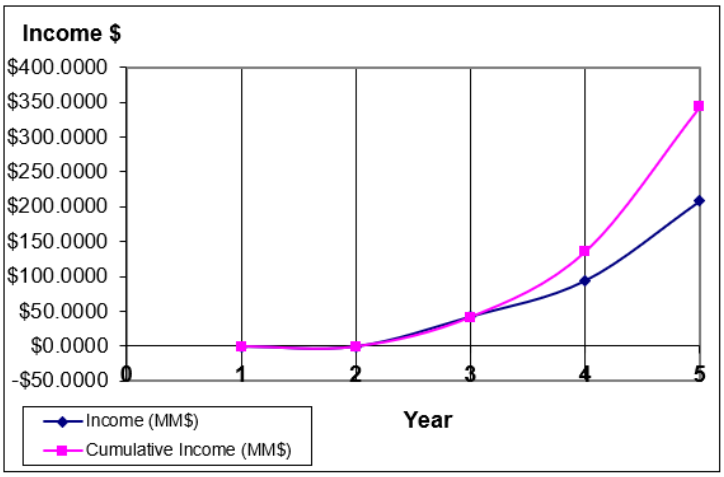
Appendix B


Weight Scale
Barcode Scanner
Digital Display
Payment Terminal

Appendix C

Project Financial Calculator

Market Growth Rate (%)	10.8
Probability of Technical Success	80.00%
Probability of Commercial Success	30.00%
Discount Rate	8.00%
Net Present Value (Income only) (MM$)	$244.1634
Total Development Costs (MM$)	$0.3390
Total Commercialization Costs (MM$)	$0.3500
Expected Commercial Value (MM$)	$57.9802

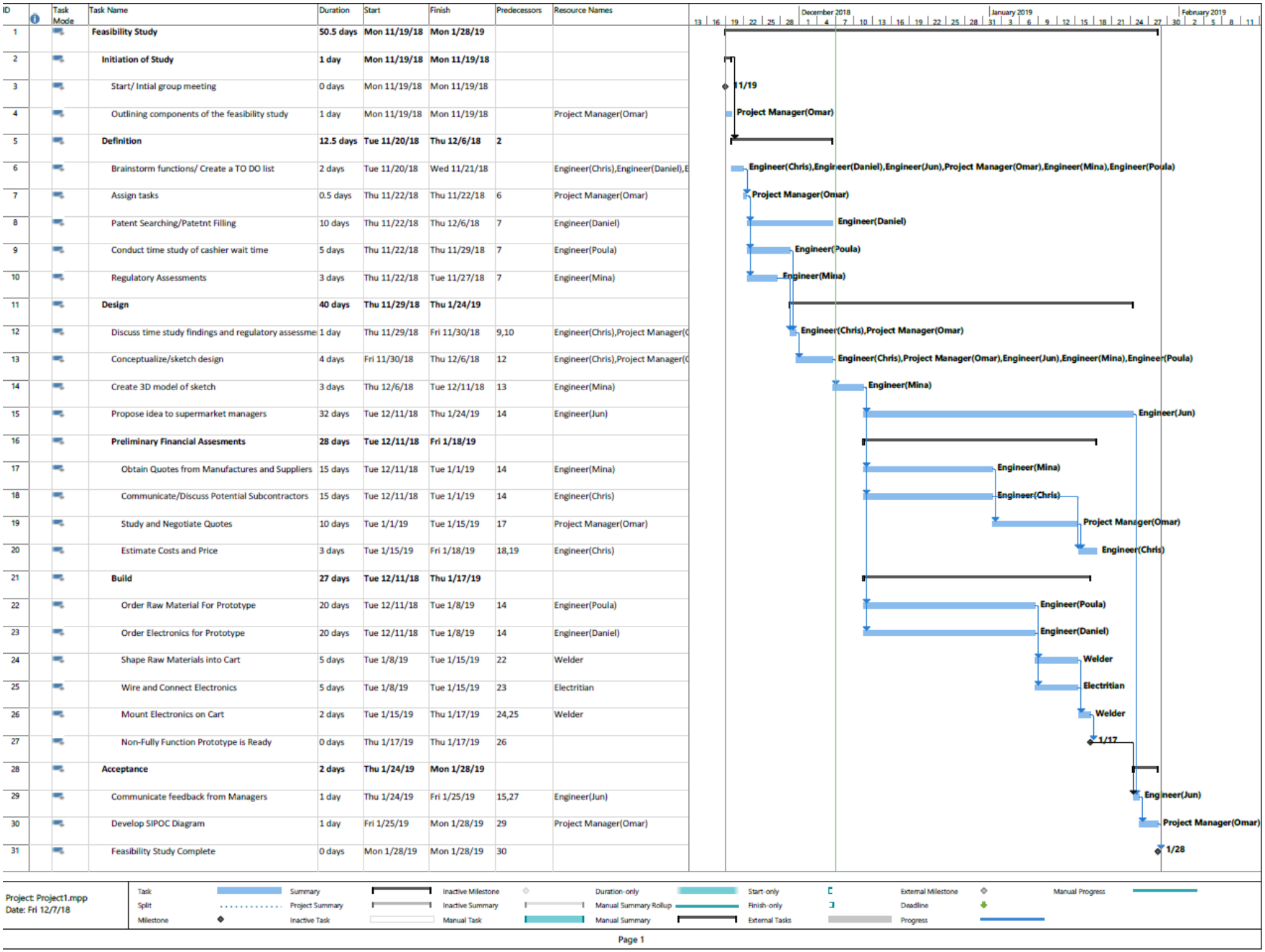


Year	1	2	3	4	5
Market Size (MM$)	$2,300.00	$2,548.40	$2,823.63	$3,128.58	$3,466.47
Market Share (%)	0	0	5	10	20
Revenues (MM$)	$0.00	$0.00	$141.18	$312.86	$693.29
Margins (%)	30	30	30	30	30
Margins ($)	$0.00	$0.00	$42.35	$93.86	$207.99
Development Costs (MM$)	$0.1890	$0.1500			
Commercialization Costs (MM	$0.1000	$0.2500			
Income (MM$)	-$0.2890	-$0.4000	$42.3544	$93.8574	$207.9879
Cumulative Income (MM$)	-$0.2890	-$0.6890	$41.6654	$135.5227	$343.5107

Legend

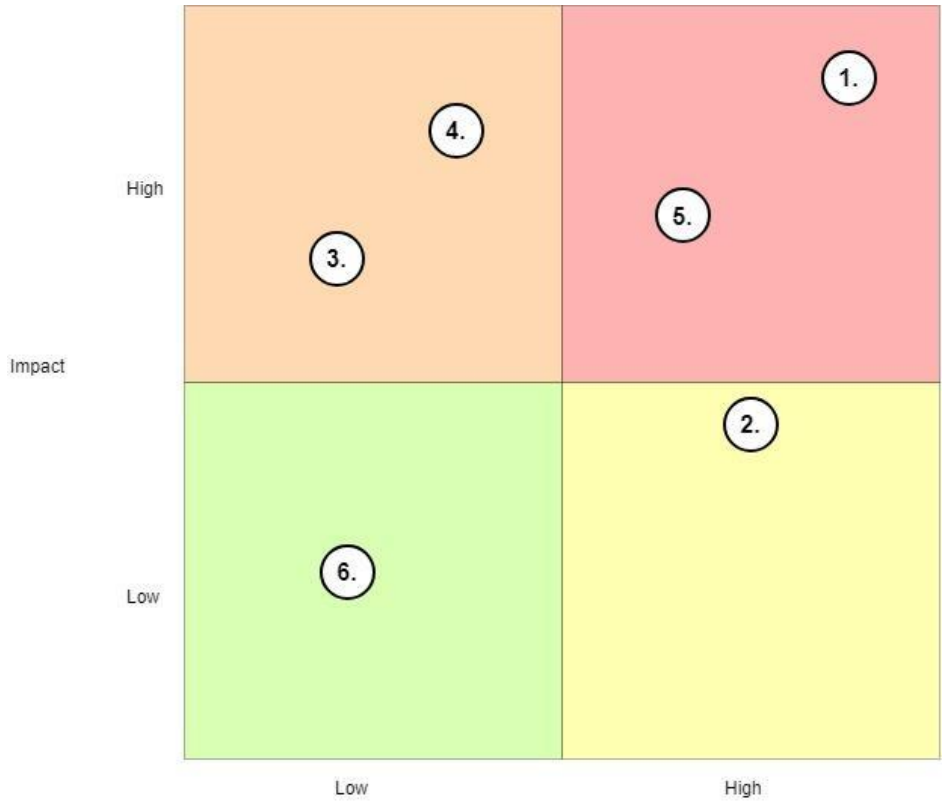
	Input by User
	Calculated Output
	Key Observable

Appendix D



ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resource Names
1		**Feasibility Study**	**50.5 days**	**Mon 11/19/18**	**Mon 1/28/19**		
2		**Initiation of Study**	**1 day**	**Mon 11/19/18**	**Mon 11/19/18**		
3		Start/ Intial group meeting	0 days	Mon 11/19/18	Mon 11/19/18		
4		Outlining components of the feasibility study	1 day	Mon 11/19/18	Mon 11/19/18		Project Manager(Omar)
5		**Definition**	**12.5 days**	**Tue 11/20/18**	**Thu 12/6/18**	**2**	
6		Brainstorm functions/ Create a TO DO list	2 days	Tue 11/20/18	Wed 11/21/18		Engineer(Chris),Engineer(Daniel),E
7		Assign tasks	0.5 days	Thu 11/22/18	Thu 11/22/18	6	Project Manager(Omar)
8		Patent Searching/Patetnt Filling	10 days	Thu 11/22/18	Thu 12/6/18	7	Engineer(Daniel)
9		Conduct time study of cashier wait time	5 days	Thu 11/22/18	Thu 11/29/18	7	Engineer(Poula)
10		Regulatory Assessments	3 days	Thu 11/22/18	Tue 11/27/18	7	Engineer(Mina)
11		**Design**	**40 days**	**Thu 11/29/18**	**Thu 1/24/19**		
12		Discuss time study findings and regulatory assessme	1 day	Thu 11/29/18	Fri 11/30/18	9,10	Engineer(Chris),Project Manager(
13		Conceptualize/sketch design	4 days	Fri 11/30/18	Thu 12/6/18	12	Engineer(Chris),Project Manager(
14		Create 3D model of sketch	3 days	Thu 12/6/18	Tue 12/11/18	13	Engineer(Mina)
15		Propose idea to supermarket managers	32 days	Tue 12/11/18	Thu 1/24/19	14	Engineer(Jun)
16		**Preliminary Financial Assesments**	**28 days**	**Tue 12/11/18**	**Fri 1/18/19**		
17		Obtain Quotes from Manufactures and Suppliers	15 days	Tue 12/11/18	Tue 1/1/19	14	Engineer(Mina)
18		Communicate/Discuss Potential Subcontractors	15 days	Tue 12/11/18	Tue 1/1/19	14	Engineer(Chris)
19		Study and Negotiate Quotes	10 days	Tue 1/1/19	Tue 1/15/19	17	Project Manager(Omar)
20		Estimate Costs and Price	3 days	Tue 1/15/19	Fri 1/18/19	18,19	Engineer(Chris)
21		**Build**	**27 days**	**Tue 12/11/18**	**Thu 1/17/19**		
22		Order Raw Material For Prototype	20 days	Tue 12/11/18	Tue 1/8/19	14	Engineer(Poula)
23		Order Electronics for Prototype	20 days	Tue 12/11/18	Tue 1/8/19	14	Engineer(Daniel)
24		Shape Raw Materials into Cart	5 days	Tue 1/8/19	Tue 1/15/19	22	Welder
25		Wire and Connect Electronics	5 days	Tue 1/8/19	Tue 1/15/19	23	Electritian
26		Mount Electronics on Cart	2 days	Tue 1/15/19	Thu 1/17/19	24,25	Welder
27		Non-Fully Function Prototype is Ready	0 days	Thu 1/17/19	Thu 1/17/19	26	
28		**Acceptance**	**2 days**	**Thu 1/24/19**	**Mon 1/28/19**		
29		Communicate feedback from Managers	1 day	Thu 1/24/19	Fri 1/25/19	15,27	Engineer(Jun)
30		Develop SIPOC Diagram	1 day	Fri 1/25/19	Mon 1/28/19	29	Project Manager(Omar)
31		Feasibility Study Complete	0 days	Mon 1/28/19	Mon 1/28/19	30	

Appendix E



RISKS:

1. Supply chain breakdowns
2. Cart theft from stores
3. Carts break down frequently
4. Can't deliver on sophisticated technology
5. Users don't understand or like the new features
6. Privacy concerns

Appendix F