Final Proposal - Feasibility Study

NFCart, a Digital Shopping Cart Application

McMaster University
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Introduction

Any trip made to a retail store is typically accompanied with long lineups which reduce customer satisfaction and require the allotment of valuable floor space to people standing around doing nothing. This is an inconvenience to the customer and an inefficiency to the store manager. Currently, there are only a few solutions available to store management. They could hire more cashiers, but this would represent a significant and ongoing increase in costs. They could add self-checkout machines, but that would scarcely reduce the required floor space and they would most likely need to hire more staff to assist customers when they inevitably have trouble with the machines. Our solution, a digital shopping cart application can use a customer's wireless device to build a list of products as they select them and check them all out at the same time.

Customers are currently very receptive to changes to the current system. Specifically, 78% of consumers "agree" or "strongly agree" that self-checkout increases customer satisfaction. [1] This provides ample opportunity to further this progression and increase the quality of the customer's experience. Moreover, the size of Canadian's clothing industry is $21 billion dollars with a growth rate of 25%. [2] For more details on the market, see Appendix 1. The size of the industry paired with the high adoption rate of new technology proves a high chance of success for our product.

The Opportunity

The problem that the retail clothing industry currently has is that cashiers are a highly inefficient and costly aspect of the checkout process. Moreover, they are preforming monotonous tasks which don't maximize the potential of what an employee, and by association, a representative of a company can do. NFCart will allow customers of the store to scan items with an NFC tag via a smartphone application which can bring up information regarding the item including price, quantity, sizing information and reviews. Once scanned, it can be added to the digital cart which can be purchased prior to leaving the store. Scanners will be installed at the exits of the store to identify items as they leave the store and cross reference those items against the purchased ones. To successfully build NFCart, a feasibility study will be performed and the details are outlined in the following sections.

Our Goals

The goals held by the NFCart team can be summarized into phases of the feasibility study. The study will highlight many of the research and development stages as well as detailing market and financial success. The phases are as follows:

- Phase 1: System Architecture and Design
- Phase 2: Software Development and Testing and Manufacturing Contract Negotiations

- Phase 3: Integration and End-to-End Testing
- Phase 4: Initial rollout to subset of customers for feedback
- Phase 5: Iterate on feedback – primarily bug fixes, user experience improvements

Each phase is crucial to satisfy the goals of this study. Phase 1 will satisfy that our system is scalable and to prove NFC will work for the use case required. Phase 2 reinforces the same idea through implementation as well as solidify predictions of market feedback. It will also lay out the foundation for the business approach for new customers. Phase 3 will finish any questions regarding the feasibility of the technology. Phase 4 will provide feedback of the adoption rate and reception of customers. Phase 5 will congregate all the gathered information and technology into one product to move forward with after the study.

Discussion & Analysis

Identified Customer

We expect that this system could be of use to any store selling items above a certain size threshold: while it may not be cost-effective or practical to individually tag low-price items such as a piece of gum, for items of clothing or prepackaged food, the cost of the tag would be almost negligible next to the cost of the item itself. For especially large items such as furniture, television sets, computers, and so forth, the benefit is still greater – but the lineups in stores specializing in such merchandise are already much smaller than in grocery stores, clothing retailers, or other stores specializing in mid-size items. Thus, retailers focusing on this middle-size item group, the clothing retail stores, will be our lead customers.

Our proposed lead customer is H&M. H&M is a chain clothing retail store that falls within our target market. It is popular with a predominantly young demographic (<30 years old), who are more likely to be willing to download our app and are typically early adopters of new technology. This store falls within the middle-size item group, is often busy, and has long line-ups, which makes this store an ideal lead customer for our product.

Value Proposition

An app-based checkout system designed to reduce labour costs for the store, and increase customer satisfaction. Customers will no longer have to wait in line, as they scan items with their phone, and their purchases are charged directly to their account. See Appendix 6 for details included in the business model canvas.

Market Analysis

We have identified 4 drivers of the buying decision for managers of medium size clothing retail stores:

1) Price
2) Efficiency (shopper through-put)
3) Security (theft of merchandise)

4) Use of floor-space

We believe that a retail store manager would choose the option with the best combination of low price, efficiency, security and minimal use of valuable floor-space.

For calculations from which the following conclusions were made, see Appendix 1.

Labour makes up a significant portion of costs for clothing retailers and therefore will be the focus of where we target our product. Based on secondary market research, cutting labour costs by 10% would lead to a 25% increase in total profits. It is the retail stores employing 5-99 people that are likely to have cashiers. We can then refine our market to this segment to be our target.

To make our product attractive to retailers, we propose a preliminary price point that is the same as the annual salary for a single cashier, $24,000. This is ~10% of the current average annual labour cost which should make it attractive option for our customers.

On top of cutting labour costs by a very significant amount, our product will also free up floor-space in the retail location. We can also expect an increase in through-put of customers, which by extension should also increase customer satisfaction by never having to wait in line.

Competitive Analysis

There are two main competitors of our product. The first being cashiers, who are the predominant means for checking out products in clothing retail stores. As outlined above, clothing retailers spend around $4 billion (CDN) per year on labour costs; a large portion of which goes towards paying cashiers. Cashier jobs are high turn-over and easily replaced. Cashiers require some amount of floor-space dedicated to themselves, a cash register, and counter space. When the store is busy, it is common for shoppers to expect to be waiting in line to check out their items. This shows an inefficiency in the current practices. We can consider the cashier job market as currently very healthy, as it is in abundance. The cashier job market also has the advantage of having a long history of having a monopoly on the ‘check-out market’. It is often seen as a necessity without any alternatives. However, it has no way to adapt or change to compete with these new alternatives.

The second competition we face in this market are self-checkout machines. These machines can be found in almost all grocery stores, and some other retail stores, such as Canadian Tire. Self-checkout machines work by having shoppers scan their items in lieu of a cashier. The machine also handles payments. They take up less room than a cashier, so the use of floor-space is more efficient. However, these machines often have errors while scanning items, which necessitates a store employee to be supervising a group of machines at all times. Theft is also an issue with these machines, as security measures are lacking. Installation of 4 self-checkout machines can cost upwards of $125,000 (not including costs of maintenance).

Though self-checkout machines are a concern, clothing retail stores have not adopted this technology. We believe it is the security risks that are preventing self-checkout machines from penetrating the clothing retail market. Thus, these machines are not competition now but it is possible that they can become a competitor in the future and so we must stay conscious of them. We can consider self-checkout machine competition as ‘unhealthy’ since they are not currently used by clothing retailers; they are only a potential future competitor.
Please refer to the Product Strategy Canvas in Appendix 3 to see the comparisons between NFCart and these two competitors.

Technology

With respect to the technology, no invention is required. Rather, much development will be needed to implement the product to a feasible level. The four elements which make up the project are the server, smartphone applications, the scanner and the process of retrofitting a tagging process into the existing manufacturing facilities. During the feasibility study, each element will need to be proven through development, testing and integrating.
There are several technical capabilities and resources to ensure a successful delivery of the initial version of this product. These resources and capabilities are broken down into 4 main sections: Software Engineering, Electrical Engineering, Manufacturing Engineering and Business Operations.

Software engineers would be required to have a deep understanding of mobile application development, networking, server development, database management, and most importantly UI/UX development. This diverse set of skills will prove challenging to acquire while maintaining a low cost since an ideal candidate would have a blend of these skills. However, leveraging open source projects will ensure that development time and costs is significantly reduced by using proven and widely adopted libraries and frameworks from the community.

The electrical engineer must have a thorough understanding of communications with prior experience in the full development of RFID systems. The engineer must also be comfortable in interfacing with software systems to ensure a seamless integration between the sensors, security gates, and the software systems. This integration will allow for the transmission of the tag information between the scanners, security gates, and the server.

The manufacturing engineer will be required to develop efficient methods of tagging items for the business who choose to adopt our product. Due to the tagging being a necessary added cost, keeping it at a very low minimal is crucial to the success of the product. The engineer must be well suited to handle edge cases as they will be faced with many different operations and must come up with optimal solutions for each.

As for the business operations, prior experience with negotiating manufacturing contracts is vital to ensure that the right scanners, security gates, and potentially any other components are ordered in a timely manner from overseas suppliers and manufacturers. They must also have a basic understanding of data analytics to be able to predict times of high demand and ensure that the supply is at its optimal level to satisfy this demand.

Intellectual property (IP) is an important aspect of any business venture, especially when building technology to use it. When considering this product, research has been done both for Canadian and US patents. After not finding any similar technologies on the Canadian Intellectual Property Office database, the product can safely move forward in Canada. However, a patent (#US8494274B2) was found via Google Patents which does hold the general of idea of our product. [6] The only difference is that this patent protects shopping via an image, where our product plans to identify products via a wireless communication protocol. Also, considering NFC is a universally available communication protocol, there is no restriction on the use of it. Given the uniqueness of our product, we will be applying for a patent in both Canadian and United States upon success of the feasibility study. This will be a utility patent to protect how the system works and is used.

The software written can be copyrighted in Canada under the Copyright Act of Canada. This requires no filing from the development team and protects the distribution of associated software. The name, NFCart, and any associated logos or phrases will need to be trademarked under the Canadian Intellectual Property Office. Similar rules apply for the United States and would thus require similar actions.

Business Model

Our business model is one of subscription: we aim for stores to pay a yearly fee to use our system, a fee which would cover use of the app, supply of NFC tags, maintenance of the scanners and equipment, and hosting a server to cover all the above. We are targeting an average yearly fee per store of $24,000: equivalent to the annual salary of a single cashier [3], this would offer massive discounts to stores that would normally have to employ several cashiers to do the same job. This fee would of course be varied depending on the size of the store, although the precise formula is yet to be determined. It should be noted that all numbers in this report reflect the average case: variations between retail locations is to be expected in practice, and must be dealt with on a case by case basis.

This revenue stream would be bled away in several ways: we estimate $50/month would be required to maintain a sufficient data plan to cover the app, in addition to $1000/year for Bluetooth beacons and associated maintenance, $15,000/year for NFC tags, and $2000 for miscellaneous maintenance and troubleshooting. Deducting all these expenses, we calculate a profit margin of 22.5% to be easily attainable. It should be noted that we will help stores to arrange the initial installation of our systems at cost: by sacrificing some profit in the short term, we hope to entice stores to make the transition in much the same way that cell phone carriers will sometimes offer discounts on their associated devices if you buy a data plan for a certain number of years. As can be seen in Appendix 9, this model combined with several other factors (startup costs, discount rates, etc.) gives us an estimated commercial value of over $2.5 million from our first five years of operation.

In pursuing this basic model, several key resources and partners will be required. Most importantly, we will need to partner with NFC tag and scanner manufacturers to coordinate supply of the required components, as well as retail stores since, as customers, they are large enough to hold considerable bargaining power. Development and running our business will require several software and electrical engineers to maintain the Application and equipment, as well as customer service and marketing personnel to ensure the stores are satisfied with the level of service they are receiving. Further details can be found in Appendix 4 and Appendix 6. By satisfying these requirements, we aim to effectively supply our previously discussed value propositions to the customer while making a not-inconsiderable profit for ourselves and our shareholders.

Social Responsibility Issues

There are several key components that must be considered from the perspective of social responsibility with regards to this product. These points are discussed in greater detail in Appendix 5.

At a high level, the product's lifecycle assessment has lead us to identifying 5 main areas in which corporate social responsibility (CSR) should be exercised, namely: raw material acquisition, manufacturing, shipping, operation, and disposal.

A set of processes and strategy to mitigate or reduce the impact of each of these steps in the product's life cycle will be put in place to ensure minimal impact on the environment and the health and safety of all the involved stake holders. This, in turn, will demonstrate the efforts our company makes to ensure everything from the responsible sourcing of materials to the correct disposal of the product, earning our customer's trust, maintaining our brand, and avoiding any potential legal or political issues.

Scope of the Work

The scope of this Feasibility Study will include the development of the NFCart phone application, sensor development, server development, implementation of the product to a first customer, as well as gathering and analyzing initial data for feedback. For this study, an initial system architecture and software will be designed, developed and tested. After this, the product will be installed at a single store, and the app will be available for store customers. Data will be collected and analyzed, and customer feedback will guide the refinement and adjustments made to the product.

Project Schedule and Resources

For a detailed plan of the feasibility and associated Gantt chart, refer to Appendix G.

Costing and Business Case

Based on the feasibility study schedule and resources previously outlined, it is estimated that the feasibility study will cost $200,000, including costs of initial system research and development as well as enough commercialization funds to get the product into the first store. The bulk of this cost will be in labour, although some materials are required for prototyping. The reason for doing the feasibility study is simple: if this product can be launched successfully, and with $500,000 in added financing for commercialization in the second year, it is estimated that we can develop a business which, accounting for risks, would be worth over $2.5 million as of the present time. The details of the model formulation are available in Appendix 9 as well as discussed further in the business model section, but the key points are as follows:

- Ramping market share capture moving from 1% in the second year to 5% in the fifth.
- A profit margin of 22.5% on an average subscription of $24,000 per store per year. As might be expected, given the relatively low margin, this is our area of greatest financial model sensitivity.
- A discount rate of 10%, conservative relative to 8.4% growth in net revenues of Canadian clothing retailers from 2003-2012
- A market growth rate of 4.7%, matching the rate of increase for labour costs of Canadian clothing retailers from 2003-2012
- An estimated commercial success probability of 60% and an estimated technological success probability of 90%

The feasibility study will move us towards this goal in several key ways. First, it will eliminate all the uncertainty from technological success and much of the uncertainty from commercial success: by creating a functioning product we will of course solve all mission-critical technological issues, and by convincing an existing clothing retail chain to run a trial of our product we will demonstrate that the appetite for change exists within the industry and potentially line up a major customer. Also, since we would be approaching retailers as part of the feasibility study to discuss the merits of the product, conducting the study would allow us to gauge market interest more accurately and refine our estimates of market share capture. In addition to elimination of uncertainly, the feasibility study will also help to clarify costs: if a given component ends up costing drastically more or less than expected, this could seriously impact our profit margins. Supplying the NFC tags to stores is a large portion of the costs, so any clarification of their price could have considerable ramifications.

Completion of the feasibility study will also be a key point from a financing perspective: if we hope to obtain the additional $500,000 necessary for commercialization during year two at a reasonable cost, the elimination of risks pertaining to technological and commercial success or failure is critical. By decreasing these risks, we effectively increase the expected commercial value of the company and therefore reduce the percentage ownership required to obtain the additional financing from approximately 20% to approximately 12.5% (assuming complete elimination of technical failure risk and halving of commercial failure risk, all else held constant).

Out of Scope

Implementing the product into further stores is out of the scope of this project. The feasibility project only considers a single store, and it must be considered that the time and money spent implementing the product into a single store will not be an accurate representation of costs of implementation into future stores. The feedback from store customers and the store manager must be taken in the context of only a single store. The evaluation of the product itself should also be considered under the context that it is only the first iteration of the product of this potential business.

Assumptions

The feasibility study will be conducted assuming the following to be true, with the intent to verify them during the study:

1. That the market has some desire to replace cashiers with a more efficient process, even if such requires a significant departure from current practices
2. That the technological components of the proposed system can be made to work together as proposed without significant increase in cost
3. That a sufficient percentage of stores' customer bases will value avoidance of cashier lineups enough to make them use our proposed alternate system, thereby allowing stores to significantly reduce their number of cashiers employed and making the switchover of financial benefit to them.

Next Steps

We are requesting an investment of $200,000 for 8% of the company, corresponding to a current business evaluation of $2.5 million as described previously. This will allow us to conduct the feasibility study. Investment at this stage also comes with a guarantee that should the feasibility study be successful; you will be contacted first regarding any subsequent offers. Should you be interested in supplying part or all of this investment, please contact us via e-mail at zvangalen@gmail.com, or via phone at 289-237-5775 so we can set up a meeting.

Appendix 1

In 2012, labour costs were 20.4% of clothing retailer expenses in Canada. [4] In total, this constitutes $4 billion in labour costs. Total profit of clothing retailers in Canada was $1.6 billion. For example, by cutting labour costs by 10%, this would lead to a 25% increase in total profits.

Based on data from 2012, there were 12,181 clothing retail stores employing 5-99 people in Canada. 70.8% of all clothing stores fall into this category, with 4,304 of them located in Ontario. [5] The remaining retailers employ fewer than 5 people. These small retailers are likely to be small boutique-style stores which would not be an appropriate market to target for our product. It is the retail stores employing 5-99 people that are likely to have cashiers. We propose this segment to be our target market. The average annual salary for a full-time cashier in Canada is $24,000. [6] We can assume that most cashiers are not full-time employees, but we can multiply this annual salary by the number of cash registers in a store to determine the effective cost of labour.

From the data, we can make a rough estimate of the annual average labour cost for our target market. By taking 70.8% of the Total Labour Costs, and dividing by the number of clothing retail stores employing 5-99 people, we come to an annual average labour cost of $233,259 per store. Keep in mind this is an average, and we do not know the distribution of annual labour costs. Since 5-99 employees is a wide range, we can expect a similarly wide range of labour costs among this target market.

Extending research beyond Ontario and based on the success of the feasibility study, the united states would provide prime opportunity to scale this business. The United States offers a $22 trillion (USD) retail market with a growth rate of 4.5% per year. [7] Moreover, excluding sales of automobiles, gas and restaurants, 2015 US retail sales were $1.2 trillion (USD). This would include general merchandise, apparel among other things. [8] Due to our product focusing on those items, we can safely assume the target market is around $1 trillion (USD). This will be the next steps after completing the feasibility study.

Appendix 2

Figure 1: Factors of Competition

Appendix 3

	Cashiers	**Self-Checkout**	**NFCart**
Cost	~$24,000/yr x # of cashiers	~$40,000 each + maintenance	$24,000/yr
Shopper through-put (relative)	low	med	high
Security (relative)	good	low	good
Use of floor-space (relative)	high	med	none

Figure 2: Competitive Analysis Table

NFCart offers significant competitive advantages over both competitors. Our product takes up no floor-space, which can be better utilized as each individual store sees fit. Our product is also the most efficient at customer through-put, and is the least expensive option. We believe that these competitive advantages make our product an attractive alternative for retail clothing stores.

Appendix 4

Proposed Supply Chain

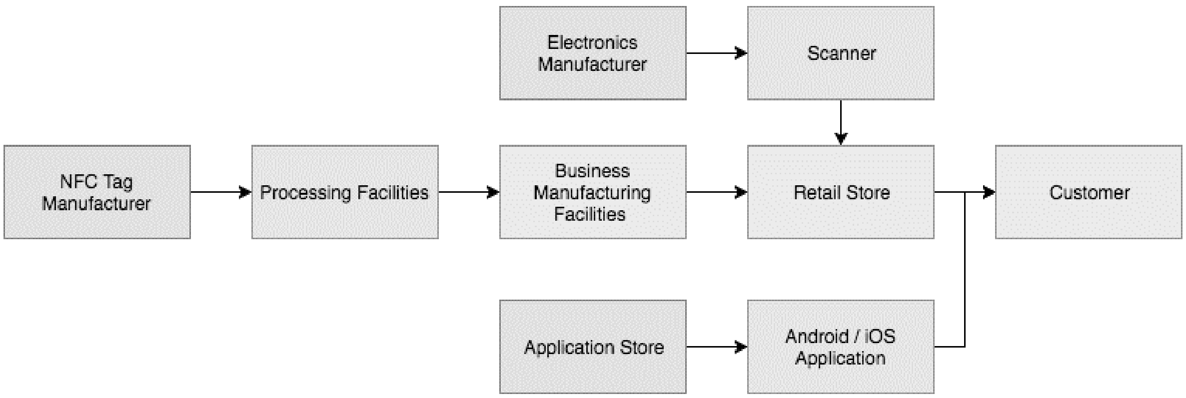


Figure 3: Supply Chain

Estimate of COGS

Estimated COGS is $15,600 per year, per store. Expected to decrease with expansion into further stores.

Item	Cost	Comment
NFC Tags	$15,000/year*store	$0.33 per tag. (high cost estimate) Corresponds to sales volume of 75,000 items
Data	$600/year*store	
Total	**$15,600/year*store**	

In the COGS estimate, shipping, storage, overhead and labour costs are not included. Depreciation does not apply, as the value of the NFC tags does not factor into the price we charge for our service.

It would be reasonable to expect that as we expand into further stores, and our NFC tag order quantities increase, that we would be able to receive discounted prices due to order size. This would result in a reduced COGS while we expand our business over time.

Appendix 5

There are several different components that must be considered in the cradle-to-grave value chain for this product which have an impact on the environment as well as health and safety risks.

Raw material acquisition

This stage is most directly related to the RFID tags and scanners. The mining of minerals used to produce these components can have an adverse effect on the environment including water pollution, land disturbance, and toxin exposure to the surrounding areas. In addition to this, the health and safety of the miners could potentially be at risk due to lung diseases and collapsing mines. The effects of mining are also seen in local populations who suffer the adverse effects of the toxins released into the atmosphere causing a variety of lung, kidney and pulmonary disease [11]. While raw material acquisition can be indirectly tied into the process of manufacturing and running the server infrastructure, we will defer these impacts to the operation section as these impacts are not immediately caused by the product itself and are instead a service provided by the server hosting company. To combat these issues, we aim to partner with sustainability organizations to responsibly source these minerals and ensure a proper auditing framework is in place so that there is minimal risk to the miners, locals, and the environment.

Manufacturing

The manufacturing process requires a significant amount of energy that will have an adverse effect on the environment. This in turn causes pollution and contributes to global warming, a heavily discussed issue. For this reason, it is crucial to ensure that the manufacturers comply with energy standards and meet the necessary certifications for efficiency to reduce the impact on the environment.

Another issue in the manufacturing process that must be considered is the treatment of workers. Proper pay and working conditions are not always the case in some developing countries and it is our responsibility to purchase the products components from a manufacturer who takes these matters seriously and has proof of long-standing good-faith towards their employees.

Shipping

Shipping is a costly component of the LFA (life cycle assessment) that must be considered in terms of its environmental impact. Fossil fuel emissions are damaging to the environment causing pollution and results in global warming. While the options are limited for transportation means in cross-continental shipping, low emission modes of transport can be used within the countries to reduce environmental impact.

Operation

Operating the servers running the backend systems and the scanners requires a significant amount of energy. This energy consumption, will, as mentioned earlier, have an adverse effect on the environment. To reduce the impact of these systems we will select energy efficient components for the scanners and low-energy consumption servers, in turn reducing the cost of cooling these systems – the highest cost both environmentally and economically.

Disposal

E-waste is a major issue causing pollution in our atmosphere and bodies of water, especially when incorrectly disposed. This in turn has a direct effect on the population surrounding these areas and indirectly on neighboring ones. Incentivizing the correct disposal of these components, primarily the RFID tags, coupled with the use of recyclable and biodegradable materials we can reduce our environmental footprint as an organization and display corporate social responsibility (CSR) through our actions.

Appendix 6

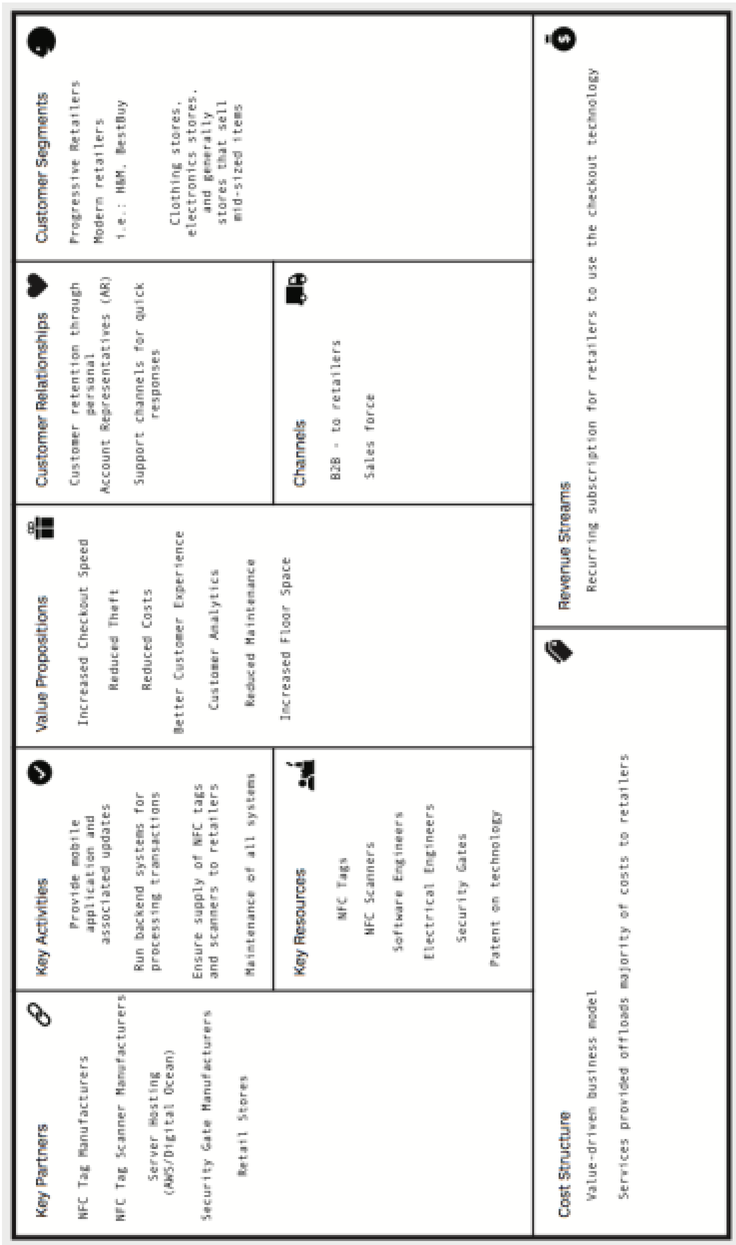


Figure 4: Business Model Canvas

Appendix 7

GANTT CHART

	Tas Mc	Task Name	Duration	Start	Finish	Predecessors	Resource Names
1		**Stage 1: System Architecture and Design**	**28 days**	**Fri 16-11-18**	**Tue 16-12-27**		
2		Software Architeture	7 days	Fri 16-11-18	Mon 16-11-28		Software Engineer Lead
3		Server Application Design	14 days	Tue 16-11-29	Fri 16-12-16	2	Software Engineer 1,Software
4		iOS and Android App Design	14 days	Tue 16-11-29	Fri 16-12-16	2	Software Engineer 1,Software
5		Server/Client Integration Design	7 days	Mon 16-12-19	Tue 16-12-27	3,4	Software Engineer 1
6		Tag Reader Design	14 days	Fri 16-11-18	Wed 16-12-07		Electrical Engineer 1
7		**Stage 2: Software Development and Testing**	**2 mons**	**Wed 16-12-28**	**Tue 17-02-21**	**1**	
8		Server Development	1 mon	Wed 16-12-28	Tue 17-01-24	1	Software Engineer 1,Software
9		Application Development	6 wks	Wed 16-12-28	Tue 17-02-07	1	Software Engineer 1,Software
10		Server Application Integration	2 wks	Wed 17-02-08	Tue 17-02-21	8,9	DevOps IT 1
11		Tag Reader Development	1 mon	Wed 16-12-28	Tue 17-01-24	1	Electrical Engineer 1
12		**Stage 3: Integration and end-to-end Testing**	**1 mon**	**Wed 17-02-22**	**Tue 17-03-21**	**7**	
13		Server, App, and Tag reader Integrated Testing	1 mon	Wed 17-02-22	Tue 17-03-21	7	Software Engineer Lead
14		**Stage 4: Initial Rollout to Subset of Customers for Feedback**	**3 wks**	**Wed 17-03-22**	**Tue 17-04-11**	**12**	
15		Install at first store	1 wk	Wed 17-03-22	Tue 17-03-28	12	Electrical Engineer 1
16		Release Software to first subset of customers	1 wk	Wed 17-03-22	Tue 17-03-28	12	Software Engineer 1
17		Gather Customer Data and Feedback Analysis	2 wks	Wed 17-03-29	Tue 17-04-11	15,16	Software Engineer 2
18		**Stage 5: Post Feasibility Study: Bug fixing, user experience improvements**	**30 days**	**Wed 17-04-12**	**Tue 17-05-23**	**14**	
19		Changes to App	4 wks	Wed 17-04-12	Tue 17-05-09	14	Software Engineer 1
20		Changes to Server	4 wks	Wed 17-04-12	Tue 17-05-09	14	Software Engineer 2
21		Changes to Tag Reader	4 wks	Wed 17-04-12	Tue 17-05-09	14	Electrical Engineer 1
22		Regression test	1 wk	Wed 17-05-10	Tue 17-05-16	19,20,21	Software Engineer 2
23		Alter Test Suite	1 wk	Wed 17-05-17	Tue 17-05-23	22	Software Engineer 1
24		End	0 days	Tue 17-05-23	Tue 17-05-23	18	

Figure 5: Gantt Chart Details

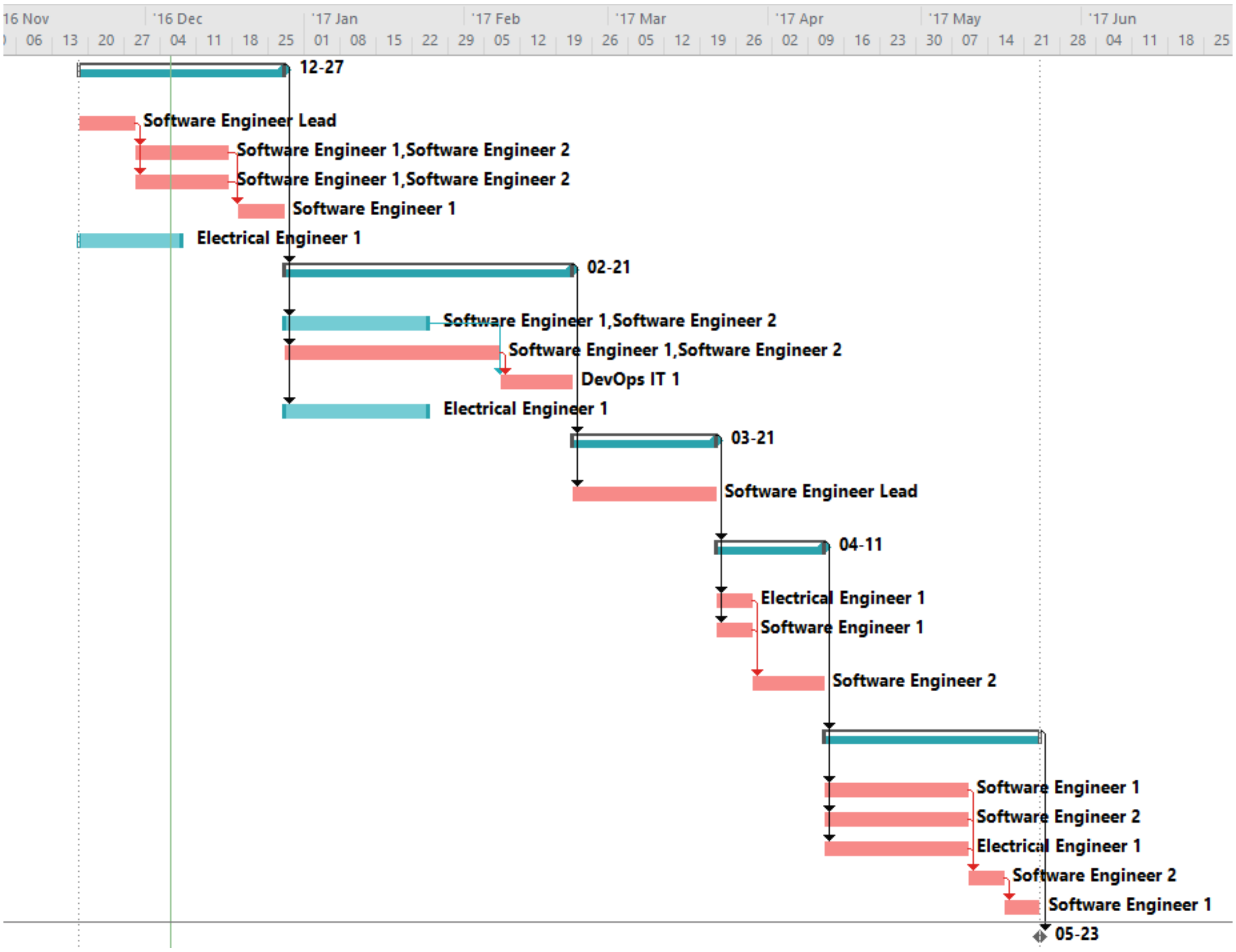


Figure 6: Gantt Chart Visual

Detailed Resource Plan

	Task	Resource Type	Source	Skill Level	Quantity	Hours Required	Controller
Stage 1	**System architecture and design**						
1.1	Software Architecture	Software Engineer Lead	Internal	5+ years experience in system design	1	40	Business Operations
1.2	Server Application Design	Software Engineer	Internal	Fluent in Node Server Development (or Django, CakePHP, ...)	2	80	Software Engineer Lead
1.3	iOS and Android App Design	Software Engineer	Internal	Fluent in Android + App App Development	2	80	Software Engineer Lead
1.4	Server/Client Integration Design	Software Engineer	Internal	2+ years in managing Cloud infrastructure	1	40	Software Engineer Lead
1.5	Tag Reader Design	Electrical Engineer	Outsource / Contract	5+ years in wireless communication signal processing	1	120	Business Operations
Stage 2	**Software Development and testing. Manufacturing contract negotiations**						
2.1	Server Development	Software Engineer	Internal	Fluent in Node Server Development (or Django, CakePHP, ...)	2	240	Software Engineer Lead
2.2	Application Development	Software Engineer	Internal	Fluent in Android + App App Development	2	480	Software Engineer Lead
2.3	Server-Application Integration	DevOps IT	Internal	Fluent in Node Server Development (or Django, CakePHP, ...)	1	160	Software Engineer Lead
2.4	Tag Reader Development	Electrical Engineer	Outsource / Contract	5+ years in wireless communication signal processing	1	240	Business Operations

Figure 7: Feasibility Study Plan I

Stage 3	**Integration and end-to-end testing**						
3.1	Tie together Server, Applications and Tag Reader	Software Engineer Lead	Internal	5+ years experience in system design	1	160	Business Operations
Stage 4	**Initial rollout to subset of customers for feedback**						
4.1	Install in 1 Store	Electrical Engineer	Outsource / Contract	2+ years installing electrical components for customers	1	40	Business Operations
4.2	Release software to subset of Customers	Software Engineer	Internal	Deployed to Apple App Store and Google Play Store	1	40	Software Engineer Lead
4.3	Gather customer data and feedback	Software Engineer	Internal	Familiar with building data sets off of digital reviews	1	80	Software Engineer Lead
Stage 5 (Post Feasibility)	**Iterate on feedback – primarily bug fixes, user experience improvements**						
5.1	Make changes to Application	Software Engineer	Internal	Fluent in Android + App App Development	1	40-120	Software Engineer Lead
5.2	Make changes to Server	Software Engineer	Internal	Fluent in Node Server Development (or Django, CakePHP, ...)	1	40-120	Software Engineer Lead
5.3	Make changes to Tag Reader	Electrical Engineer	Outsource / Contract	5+ years in wireless communication signal processing	1	40-120	Business Operations
5.4	Regression Test	Software Engineer	Internal	Familiar with variety of testing frameworks (Karma, Gulp, jUnit) and System / Unit / Regression testing principles	1	20	Software Engineer Lead

Figure 8: Feasibility Study II

Appendix 8

As with all innovation projects, there will be associated risks that a project has that can influence the success of it. To classify risks into categories, each risk will receive a probability and impact level. The higher any task rates on either scale, the bigger the risk is to the success of our project. The risks for out project are as follows;

1. Theft from store
2. NFC API patches which require redevelopment to meet standards
3. The power from the store is cut or goes out
4. A significant portion of potential users don’t download application due to time / data constraints

5. Security of server is compromised due to defense breaches; intruder could have read/write access to store and purchased product information or user information including credit cards
6. Servers crash resulting in an undetermined amount of downtime
7. The Sensors installed in the store are not powerful enough to read chip-enabled items
8. Apple does not allow developer access to NFC API

The above risks can be classified into a risk assessment matrix found below.

Risk Assessment Matrix		**Likelihood of Event**				
		Rare	**Unlikely**	**Possible**	**Likely**	**Certain**
Level of Impact	**Negligible**	Theft from Store	NFC API Patches Require Redevelopment	**4. Store Power Going Down**		
	Marginal		Many Users Don't Download App	**5. Server Crash**	**2. Sensor Towers can't read well enough**	
	Critical			**1. Apple doesn't have NFC API**		
	Catastrophic		**3. Security, getting hacked**			

Figure 9: Risk Matrix

The most important risks have been bolded and renumbered. These were chosen based on their probability, likelihood or combination of the two.

Risk Management Plan

For each risk a trigger point, a mitigation plan and backup plan has been provided.

Risk 1: Apple does not provide NFC API support
This risk will be encountered during the design stage of development. During this stage, the team will have the most up to date knowledge on the iOS development kit and can decide regarding whether they can use NFC on iOS. This risk will be ignored until the design stage as it could cause significant change to the product and price of implementation. If encountered, the team will use the backup plan of using 2 bar codes on every tagged item. The first barcode will identify what the product is and the second will identify the ID for the product.

Risk 2: Sensor Towers can't read the tags well enough
The risk will be encountered during system testing of every aspect of the product together. The team is aware of this issue and will mitigate the risk by developing the towers with sufficient reading capabilities to provide ample room of uncertainty. As a backup plan, the development will be outsourced to specialty companies rather than made in-house. Alternatively, the team may try increasing power and thus increasing the cost to meet the requirements.

Risk 3: Breached Security
The risk will be encountered at any point after the first release of the system. The team is aware of this issue and will build the server application in accordance with risk. With sufficient protection, it can mitigate risk and damage if the event does arise. As a backup plan, on-call Software Engineer's will respond to alerts from the intrusion detection system (IDS), block the attacker's connections to the system, and temporarily suspend the accounts that the attacker gained access to avoid further damage. Detailed logging will allow the engineers to detect anomalous activity, trace the attackers' actions in the system, and revert any changes or transactions made by the attacker.

Risk 4: Store Power Going Down
This risk will be encountered at any point a store has the system installed. If a store's power goes out, our system will not be functional. To mitigate this risk, the server can poll the sensors to find any unresponsive systems. Once a system is unresponsive, it will notify the store accordingly. As internet is not guaranteed, a 4G signal and backup power will be required to operate but the added cost would make the product infeasible.

Risk 5: Server Crash
The risk will be encountered at any point when the system is live. This could happen during extreme bandwidth loads or human error and thus extremely hard to predict. To mitigate risk, the team will build enough servers to handle estimated loads of requests. Some padding will be incorporated to handle any anomalies. As a backup plan, many servers will be built at varying locations to ensure fault tolerance. Alternatively, an IaaS company may be used (e.g. AWS, Azure) as they ensure 99.99% uptime for any server. The costs of an IaaS platform such as Amazon's EC2 is rated per hour of usage at an average of $0.50/hour for our requirements [10]. Data replication and hot standby servers will be used to ensure a smooth failover in the event of a server crash, hence minimizing the impact on our users.

Appendix 9

Strategic & Competitive Rationale

There are many market space factors to be considered to position this product strategically in the market. While some of these factors are more important that others, it is important to find the right balance to successfully maintain a sustainable competitive advantage.

Being an innovative product that is meant to rethink the way the checkout process is handled through the use of software and smartphones, a significant portion of the added value comes from the convenience, cost savings, and data collection opportunities created which will be discussed in further detail in this section. The specific market space factors identified were:

- Checkout speed: the time taken for a consumer to pay for their desired items and exit the store
- Theft prevention: the ability to detect items that have not been paid for and are being taken out of the store
- Costs: the cost to operate the devices, hiring costs, and upfront costs
- Customer experience: the overall experience of a customer when using a checkout system
- Customer analytics: the ability to perform analytics based on the customers purchasing habits, demographic, etc. and build predictive models
- Maintenance: the cost to upkeep and maintain a checkout system
- Floor space: the amount of floor space required to install the checkout system

These factors are seen from the perspective of our primary customer: the retailer. While it is true that the consumer's (the shopper) experience is essential, they are not the direct customers of this product as they are not making the purchasing decision. The product will be designed with the consumer's experience at its core which will reflect on the retailer's decision to either go with our product or not.

We aim to position the product as an innovative, low cost solution to the checkout process. This is illustrated in the strategy canvas as we see a dramatic improvement in the checkout speed due to the ability for an individual to check-out completely assisted from their mobile device. This eliminates the need to stand in lines for the traditional checkout process and the need to look for an empty self-checkout station. This improvement in speed will allow for a quick turnaround time, less crowded stores, and a greater overall employee and customer experience.

Preventing theft is a core feature of this product through the use of RFID tags to uniquely determine which items have been paid for and which have not. This is advantageous over the traditional checkout method as a customer can easily hide an item if it is not tagged and leave the store. Similarly, the self-checkout system is easy to fool and even easier to choose not to scan an item making it only appropriate for low cost items. Having a robust means of theft prevention will differentiate this product from the current solutions out there and reduce losses due to theft in stores.

The reduction in costs comes from eliminating the need to hire additional cashiers and purchasing costly self-checkout systems. The only costs will be the recurring subscription fee to our service which is significantly lower than the monthly salaries of cashiers and the upfront and maintenance costs of self-checkout machines. In turn, this will be an essential portion of our competitive advantage and in differentiating the product from the current solutions in the long-run.

The customer experience in the traditional checkout process is adequate except for queuing up in lines. Whereas the self-checkout process can prove to be frustrating and unreliable at times. The solution we are proposing aims to tackle both these issues to offer the best customer experience in a reliable, consistent, and scalable manner. In addition to this, the ability to perform tasks such as a price lookup, item reviews, and item information is easily addressed by our solution at a fraction of the cost with no additional infrastructure. Having a good customer experience will reflect positively on the retailer thus creating a stronger business justification for purchasing the product.

The ability to perform analytics on customer data is limited with both the current solutions which we aim to address with this solution. A customer profile will allow stores and retailers to perform analytics on customer buying habits, make more accurate supply forecasts, and provide the customer with relevant products.

Maintenance of the traditional checkout system involves the upkeep of the POS (point of sale) systems. Similarly, the self-checkout systems will require regular maintenance to ensure adequate functionality. However, the maintenance costs of our product are almost negligible and the bulk of which is shifted onto us (the company) as opposed to the retailer. This business model of offering a managed service with potential on premise deployments will cut maintenance costs and burdens on the retailer as part of their subscription to our service. Finally, the additional floor space made available through the elimination of bulky self-checkout systems and traditional POS terminals will make more room for inventory or reduce rental costs.

The combination of the factors listed above make this product an innovative solution that aims to cut costs and offer a better overall customer experience. This gives us a competitive advantage over the current solutions and allows us to grow, develop, and innovate with the product by taking advantage of being first-to-market in this space.

Preliminary Financial assessment:

In the construction of our financial model, several key assumptions were made. The market growth rate was assumed to be identical to the historical rate of increase (2003-2012) for labour costs in Canadian clothing retailers at 4.7% [4]: since our product supplants a portion of that expense, we expect that a comparable rate of growth in potential revenue from our product would be not unreasonable. The market size of $292 million was calculated based on data included in our previous report [4], as our intended price point (the current salary of a single cashier) times the number of Canadian clothing retailers (our initial target market). It should be noted that this assumes we would sell our product as a subscription service, with initial installation being performed at cost on a store-by-store basis. It was assumed we could capture essentially no market share in the first year, 1% in the second year, 2% in the third, 3.5% in the fourth, and 5% in the fifth. This projection is based on the massive cost savings we offer, which once we begin distribution could make following suit a competitive necessity, weighted against the sheer size of the market.

Our probability of technical success was estimated to be 90%, since most of the technology upon which our business would rely already exists and is in use for other applications. Our probability of commercial success was estimated to be lower, at 60%, because our product would represent a significant departure from current practices and so might be viewed with some suspicion initially. The discount rate used for our business will be 10%, a conservative estimate given that the growth in net revenues for clothing retailers in Canada from 2003-2012 was 8.4% [4].

Development and commercialization costs related to development and the feasibility study should occur primarily during the first year, as elaborated upon in the previous report. The proposed team of three software engineers, one electrical engineer, one business operations manager, and one sales representative were assumed to be working full-time through the full 6-month proposed product development schedule, as a matter of conservatism since the details of the schedule are still subject to change. Assuming all can be hired for an hourly wage corresponding to the average annual salaries typical to their respective positions, the development costs are estimated to be $145,000 and the commercialization costs are estimated to be $55,000. In addition to this, we are allocating $500,000 to as-yet unelaborated commercialization costs during year two, to capture a reasonable market share and get the ball rolling, as it were.

When calculating margins, it was assumed that for each store, the $50/month data setup outlined in the previous report would be required – although this is almost certainly an overestimate; given the relatively low cost of data compared to other factors, it was judged to be of little consequence. It was further assumed that 10 Bluetooth beacons would be required for each store, totaling $1000 per location and assuming annual replacements would be required as the technology changes. The largest items of concern, however, would be the cost of the NFC tags themselves and the cost of system maintenance: since the system has not yet been designed and sales volumes vary so widely, it is near-impossible to obtain accurate estimates for either. Thus, $15,000 per store per year is allocated to cost of NFC tags, corresponding to a sales volume of 75,000 items. Based on total revenues of clothing retailers across Canada combined with the number of those retailers, this would correspond with an average item price of $22.77 – not unreasonable, given that a pair of women's jeans at H&M can easily cost $30 or more [9], depending on type. In addition, an estimated $2000 per store per year is allocated to cost of maintenance. Together, these assumptions result in a percentage margin of 22.5%. Since installation of our system is to be performed at cost on a store-by-store basis, it is irrelevant to model.

The key results of this model are as follows: an expected commercial value of 2.54 million dollars, with the first profits being seen in year 2. For details, see the attached spreadsheet. This implies that the proposed business has the potential to be financially viable. The model is also relatively non-sensitive: any single parameter can be doubled or halved and leave the company with a positive valuation more than half a million dollars, proving it is an opportunity worth pursuing. However, it should be noted that percentage margin is calculated based on costs for which a doubling or halving could have a much greater effect than doubling or halving the margin itself, potentially pushing the company into non-viability – and furthermore, that the profit margin is the single most significant determinant of overall value, with percentage changes in it producing slightly amplified percentage changes in expected commercial value.

Business Risks and Hurdles

The most significant concern for this project, as explained above, is a lack of customer interest. Because our system represents a significant change from what both consumers and the stores themselves are used to using, some skepticism is to be expected. It is our hope that the sheer potential profit for our customers will be enough to outweigh that: if a store can replace several cashiers with a system that costs only as much as one, that represents a significant reduction in labour costs. Notably, our projected market share could be half what it is or less without our expected commercial value becoming negative. There is also the risk that development or commercialization cost overruns could occur – in fact, for something like this, minor overruns are almost to be expected. While this is a concern, it should be noted that either of these costs could be quintupled without the business becoming nonviable.

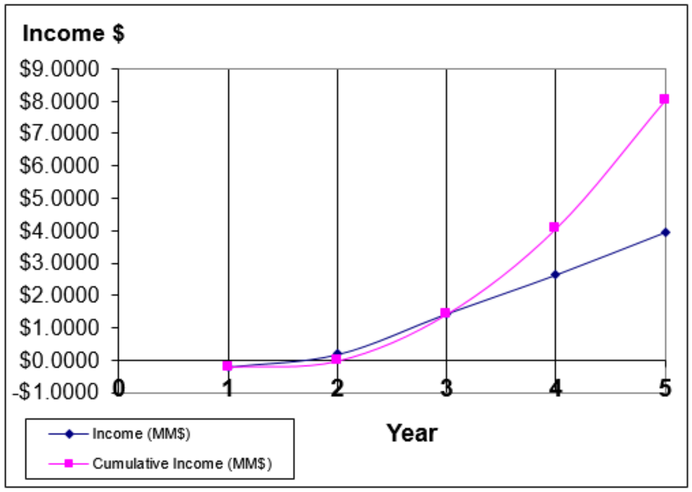
In terms of core competencies and life cycle management, since almost all the technologies and devices we rely upon already exist, the risk of being unable to find qualified personnel or of undue difficulty in addressing any given stage of the product lifecycle is considered negligible. Because we intend to focus our operations on Canada alone during the initial phases, we do not consider cultural differences a significant concern. For the same reason, we do not consider the existence of a patent for a similar (but not identical) technology in the United States [3] to be a significant concern, although it does suggest that we should consider the possibility of filing for a patent in Canada to ensure that similar competition will not appear in our home market further down the line.

Spreadsheet

Project Financial Calculator

Creatd by Dr. David K. Potter

Market Growth Rate (%)	4.7
Probability of Technical Success	90.00%
Probability of Commercial Success	60.00%
Discount Rate	10.00%
Net Present Value (Income only) (MM$)	$5.9044
Total Development Costs (MM$)	$0.1450
Total Commercialization Costs (MM$)	$0.5550
Expected Commercial Value (MM$)	$2.5439



Year	1	2	3	4	5
Market Size (MM$)	$292.00	$305.72	$320.09	$335.14	$350.89
Market Share (%)	0	1	2	3.5	5
Revenues (MM$)	$0.00	$3.06	$6.40	$11.73	$17.54
Margins (%)	22.5	22.5	22.5	22.5	22.5
Margins ($)	$0.00	$0.69	$1.44	$2.64	$3.95
Development Costs (MM$)	$0.1450	$0.0000			
Commercialization Costs (MI	$0.0550	$0.5000			
Income (MM$)	-$0.2000	$0.1879	$1.4404	$2.6392	$3.9475
Cumulative Income (MM$)	-$0.2000	-$0.0121	$1.4283	$4.0675	$8.0150

Legend

(cyan)	Input by User
(yellow)	Calculated Output
(pink)	Key Observable

Figure 10: Financial Statement

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