CANtech.

Business Pitch:

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1 Business Description

Our team at CANtech aims to bring innovative solutions to the automotive aftermarket industry for specialty parts and accessories. Our CANnect open source platform is geared towards car enthusiasts and non-enthusiasts alike. It has been developed to provide consumers with a customizable solution for all of their automotive needs. It has been designed to help users monitor the health of their vehicle and track their vehicle's performance. Our product being open source further allows for a community of engineers and car enthusiasts to improve on our design and collaborate on new solutions for the automotive industry.

1.1 Product Analysis

1. 1.1.1 CANnect Reader

CANnect is an open source hardware and software platform, consisting of a CAN bus reader and supporting software application for android devices. The CANnect reader can be plugged into the OBD-II port of a vehicle to access information about the state of a vehicle through the CAN bus system. This information is transmitted via a Bluetooth connection to our smartphone, where the data is interpreted for users to easily learn about the health of their vehicle systems.

2. 1.1.2 CANnect Smartphone Application

The CANnect android application displays Parameter IDs (PIDs) related to on-board diagnostics to the user, on its Vehicle Dashboard page. The user can request specific PID data, select the gauges to visualize this data, and observe real time updates on the app's display chart. The application also supports an interactive map for GPS tracking capabilities.

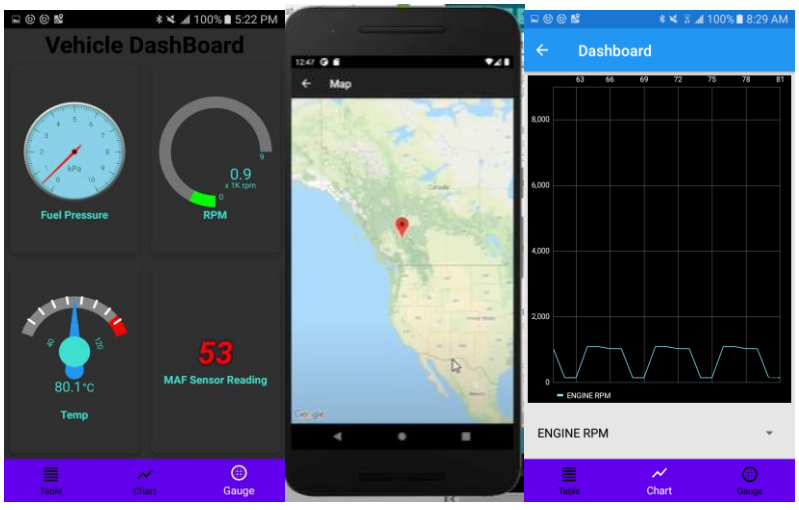

Figure 1.1.2: CANnect Smartphone Application Features

3. 1.1.3 CANnect GPS and Sensor Modules

CANnect also offers modules that communicate additional information to the reader via a stateless WiFi connection. The GPS module provides the user with its location coordinates and other GPS related data which is passed to the user either through Bluetooth or cellular networks. The Sensor module provides the user with data related to the acceleration or orientation and angular velocity on a particular point on the vehicle.

1.2 SWOT Analysis

1. Strengths

1. Open Source: allow users to customize or improve the products
2. Unique: Additional functionalities such as 6DOF and GPS sensors will provide more options for drivers to explore the vehicle related data and performance.
3. No extra purchase required: To use the full functionality of CANnect, customers do not need to pay additional fees unlike most OBD-II readers on market.

2. Weaknesses

1. Device size specifications: Due to additional sensors, the CANnect dimensional is larger than the existing ones.
2. Smartphone compatibility: The CANnect reader can only support Android which could be inconvenient for iOS users. But we have a plan to implement the iOS version of the app in the future.
3. Brand reputation: Since CANtech is a small start-up company, customers will not be familiar with our products. Ability to get support from manufacturers about custom PID information since seen as less reputable.

3. Opportunities

1. Market growth: With current estimation of USD $41.0 billions in 2020, and expected to reach market size of USD $52.9 billions [1], it is the perfect opportunity for CANtech to enter the Automotive Diagnostic Scan Tools market.
2. Funding: Government grants for small business, and BC technology startup competitions

4. Threats

1. Consumer confidence: Since the CANect is entering Existing Market for OBD-II scanner, it will have to compete with hundreds of similar products
2. Small customer base: Since the CANnect is the product for car enthusiasts and hobbyists who want to explore and modify their own vehicle, other general car drivers will have little interest in the product.
3. Competition: Knock-offs or clones of CANnect could affect sales and viability

1.3 Entrance and Exit Strategy

Entering a market with a new product is not an easy feat. The market strategy for CANtech will outline the efforts required to ensure that our goals and objectives line up with those of our key stakeholders [2]. The CANtech team will clearly outline the goals associated with entering the automotive market. Our goal is to enter an existing market, the automotive aftermarket industry with a diagnostic device, offering support for additional sensor and GPS data. Our projected company growth upon entry should be supported by an appropriate financial plan [3].

The strategy will consist of intensive research of the market needs [2]. Our team will conduct online research of the market, understand the market in person, attend trade shows, analyze competitors, and network with business contacts in the market [2]. Since we will be entering an existing market, we will have to bootstrap and niche down to understand the options available for scaling the business [4].

Some strategies to understand the customer base and expand brand recognition include, joining automotive and aftermarket trade fairs to promoting the CANtech products as an affordable open source automotive solution, registering for the aftermarket forum to learn about the current trends and promote our device, and monitoring Auto Industry Blogs to reach out to car enthusiasts. The aftermarket players use digital channels to boost growth [5], thus offering our device for review to automotive tech bloggers or influencers could improve our product reliability among consumers. To encourage the entry into the market, developing customer relations via online or in-person discussion and promotion would be highly stressed. This is done by offering development support of “unofficial features" by users as well as reaching out on social media and forums to generate interest. Partnering up with motorsport clubs and organisations are a key strategy to drum up support.

Entering the market as an independent channel, CANnect will have to rely on digital channels for marketing, and create a reliable customer base outside of competitors. Partnership ventures could help smooth the transition into the market, product development, accessing proprietary data, and conforming to industry regulations [6]. CANtech can work with a vehicle manufacturer to market our reader or reader technology as a part of the vehicle’s functionality. We can also look into partnering with small businesses for the purposes of fleet management and tracking.

In the event of the need to exit the market, there are a few strategies CANtech has devised. Because of the open nature of CANtech’s products, the documentation and designs will be maintained for at least 2 years before officially taken down. Continued access to the files may be achieved by visiting archive.org. To get rid of existing stock, CANtech may give away its products to schools and organisations as one of its core components, the ESP32, is widely used as an education medium to teach electronics and programming. Because each product is certified as RoHS, this means that disposal of each individual product will minimize its impact on the environment [7].

Uniting two existing companies into one can be an effective exit strategy to gain market share, expand a company's reach, or grow into new segments; all of which satisfy shareholders and create value for the companies involved. Therefore, CANtech may look for partnership with other companies in the car aftermarket industry or even with manufacturers to compensate for our needs while sharing our service with them.

2 Market and Sales Strategy

2.1 Market Description

The market for aftermarket specialty parts and accessories, including OBD scanners and similar devices, can be segmented into car enthusiasts and non-enthusiasts. Therefore, the market of ODB-II readers can be categorized into two sections:

- Pricy commercial offerings meant for mechanics and car enthusiasts, with subscription and unlocking fees for more features. Generally has good customer support but lacks customizability [8].
- Cheap open-source electronics meant for hobbyists and electronic enthusiasts, that must be assembled and programmed. Very customizable but very dependent on the skill and knowledge of the user [9].

2.2 Competitors

There are a wide range of OBD-II readers available on the market for the purposes of vehicle diagnostics. According to an online review some of the best OBD scanners include products like the BAFX products 34t5 Bluetooth OBDII, ANCEL AD310 Classic Enhanced Universal, or BlueDriver Bluetooth Professional [10]. Key features of the BAFX scanner are Bluetooth support for windows and android devices, where data can be accessed through 3rd party applications, for vehicles manufactured in 1996 and onwards. The ANCEL scanner supports CAN, the OBD-II protocol and comes with an interactive LCD display for diagnostics reports and monitoring. The BlueDriver scanner is a more expensive scanner that supports iPhones and Androids, allows for live sensor data, and offers an accompanying BlueDriver app.

Innova is a company that produces diagnostic reporting and test equipment. Innova has been distributing from their main facilities in the US and Canada for over 15 years. Their closest product to CANnect is the carscan mobile. Its cost is 99$. Key features are app integration, live data, read and clear ECU modules and troubleshoot codes.

Figure 2.2-1 - Innova Reader

Bluedriver is the most selling OBD2 reader on Amazon. It works with all vehicles in the US and Canada with 116 or newer models. It is 99.95$. Product aim focusing on fixing issues, repair reports with an enhanced diagnostics option which allows diagnoses on a wide range of manufacturers.

Figure 2.2-2: BlueDriver Reader

The OpenXC platform offers open source hardware and software, using their OpenXC library for Android or other desktop applications [9]. For Android devices that requires an installation of the OpenXC Enabler, which displays basic UI features. For iOS, the platform provides an app tutorial that assumes users have working knowledge of iOS applications, but also offers a demo application for beginners. The vehicle interface can be reprogrammed with new firmware. Further, for OBD-II support on CAN, they provide the latest firmware release for vehicles sold in the US since 2008, and they include extended support for Ford manufactured vehicles [9].

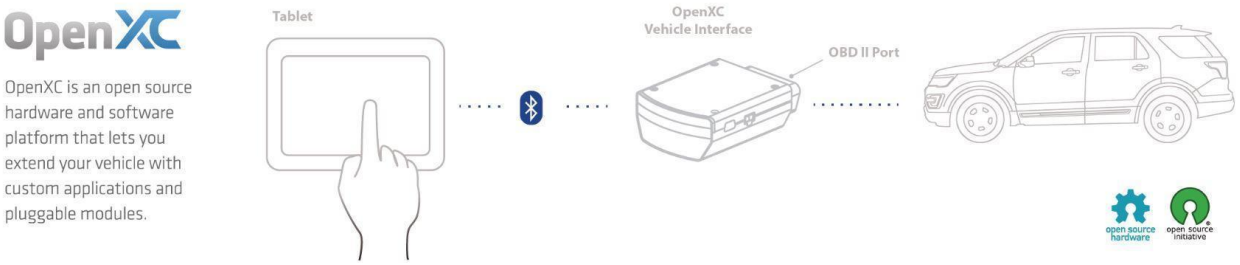

Figure 2.2-3: OpenXC Hardware and Software Platform [9]

As we can see the products in the market are mostly composed of items to repair issues. The key features are common in most of the existing products. They are similar in shape and size, functionality and price. They lack extra features such as GPS tracking and customizability.

2.3 Global Market Size

The automotive aftermarket size in the US, is expected to grow to more than $680 billion by the year 2024 [11]. A positive trend towards enhancing vehicle efficiency and customization also has come as a result [11]. There is also a trend towards enhancing vehicle efficiency and customization [11]. Relative to the on-board diagnostics aftermarket in the US, growth is expected to reach 1.5 billion by the end of the same year [12]. The OBD market is growing with increasing vehicle complexities, which require more efficient diagnostic testing solutions. Further promoting remote technologies for real-time vehicle diagnostics to help technician's and vehicle owners' asses the state of their vehicle systems [12]. The expected growth in the automotive aftermarket for professional, DIY and OEM applications show an increasing trend as observed in figure 2.3 below.

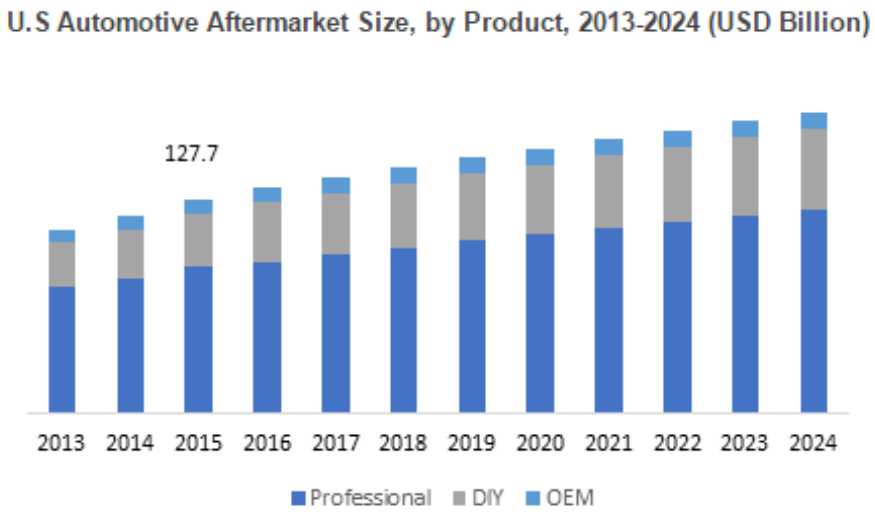

Figure 2.3: US Automotive Aftermarket Projections by Product [11]

The hardware segment contributed 40% to the OBD aftermarket in 2017, as the use of OBD scanners and similar scan tools became more widely adopted [12]. It has also been mandatory for more passenger vehicle manufactures to be OBD compliant, in both the US and China. It is projected that with the age of new smartphone technologies, the OBD remote applications will contribute to 25% of growth in the OBD aftermarket [12].

In a study conducted by SEMA – a specialty equipment market association for the automobile aftermarket – non-enthusiasts were found to make up 58% of the consumers [11]. The non-enthusiasts either made purchases for vehicle customization, for DIY, or for vehicle accessorizing, for the purposes of maintenance.

2.4 Market Share

Ultimately, we would like to strategically increase the market share and win the competition against the competitors. One factor that we believe could enter the market and increase the market share is to make our product open-source and establish good customer services and support services similar to the way OpenXC is introduced in section 2.2. With the open-source platform, customers can customize and modify the product and we believe that it could potentially could grow the community, and eventually lead to the increase of market share as stated in the article that open-source could be used to win against the competitors as well as an an effective way to grow the community [13] .

Another factor to advance the market share from the specific OBD point of view is that according to the authors A. Bhutani, P. Wadhwani, the competition in the market for the OBD is characterized by the new product development, innovative product, and finally the partnership with the global technologies companies [14].

The automotive diagnostic scan tools market is estimated to reach a market size of USD 52.9 billion by 2025 [15]. We believe that our product is innovative such that it has the combined functionalities of the reader as CAN access, GPS module to track the vehicle location, and finally the 6DOF sensor module to measure external forces acting on a vehicle. Since most of our competitors don't have all these functionalities in one product according to the list of top OBD2 scanners developed by our competitors [16], CANnect product is unique in Automotive Diagnostic Scan Tools Market. Hence, we could increase the market share by the innovative aspect of our product.

Believed Market Share

Since CANtech has planned to form a partnership with car dealerships to sell CANnect as a form of product bundling, the number of cars sold determined the CANnect unit sold. According to Static Canada, the total cars sold in British Columbia in January 2020 is around 12000[reference]. Thus, the estimated number of target customers is 12000. At mass production, each CANnect will be valued as USD $145. Therefore, the market value is $125 x 12000 = $1.5 mil. Thus, 1.5mil of $52.9bil is 0.002%. The formula used is from [17].

2.5 Barriers to enter the Market

One of the biggest barriers to entry is the requirement for getting regulatory approval to sell products which is dependent on CANtech's target region(s) as each may have different requirements. Since FCC Modular Approved components (eg. ESP32 and Sparkfun LTE module) were used with relevant regional certifications [18], these do not need to undergo additional

emissions testing for intentional RF radiators (ie. FCC CFR 47 Part 15 Section 247, IC RSP-100) [19]. Therefore, host certification (CANnect) is not required as an intentional radiator [18]. As well, Industry Canada allows FCC certifications under specific requirements which reduces the cost to re-verify again [20]. For European certification (CE), this is more stringent with ESD testing and would require a separate laboratory to test.

However, unintentional emissions testing is still required for the equipment as a whole. This does not require an accredited lab but it is strongly advised to choose one that is. As well, there is no need to register with such bodies under the condition that CANtech can provide documentation provided by the test lab that CANnect is compliant - this is referred to as the Supplier's Declaration of Conformity (SoDC) by IC [21] and FCC [22]. For CE in the EU, the certification process is more involved [23].

Having these tests done for compliance is critical given that larger retailers may require them and that being caught could lead to mandatory recalls and jeopardize CANtech. The relevant tests applicable to CANnect are:

- FCC CFR 47 Part 15 (Subpart B) Section 109 - Radiated Transmission Limits (Unintentional)
    - Testing to ensure that reader doesn't emit erroneously beyond certain thresholds
- Industry Canada ICES-003 - Unintentional Radiators for Information Technology Equipment (including Digital Apparatus) [24]
    - Can be approved with FCC CFR 47 P 15 S 109 if Canadian-specific requirements are also met
- EU 2014/30/EU - Electromagnetic Compatibility (EMC) Directive [25]
    - Regulation for unintentional RF emitters and ESD in the EU.

Another barrier to entry is finding partners and manufacturers to build the devices as the aftermarket automotive and consumer electronics markets are competitive. Due to this, the cost and reliability of such sources may be difficult to acquire if CANnect is to be a reliable product. Depending on the manufacturer or if CANtech were to make it themselves, additional equipment and tooling to make the product may drive up the capital cost to get started.

Since the current market is already saturated with competing solutions, going against other more established players in the market will be a challenge. These players often have a greater amount of resources, manpower and money. Combining this with closer car manufacturer relationships, established technology stack and stronger customer retention would make it difficult to go head to head against. Since CANtech would be a new name, getting recognition in the market would be difficult especially since customers are less likely to choose an unknown brand with less visibility as they would be trusting a foreign device to a sensitive part of their vehicle.

Another challenge to enter the market is having the distribution network necessary to sell CANnect. Since larger players are already established and may have agreements with retailers or distributors to only carry a specific product type from their brand, this poses a challenge. As

well, managing distribution to multiple regions (eg. Canada and US, or overseas such as the EU) also poses a barrier in itself through costs to have it stored in warehouses elsewhere, tariffs, customs duties and/or shipping costs.

2.6 Costs

With respect to regulatory costs for the US and Canada as mentioned previously in Section 2.5, the primary cost is getting unintentional emissions testing completed by a lab. This would likely be a third-party accredited lab which can comply with both IC and FCC regulations which would test each subsystem (ie. reader, LTE/GPS, sensor). See Table E for these costs in Section 4.4.

If CANTech were to manage its own sales, there would need to manage a website and any related services such as payments and shipments. This could be achieved by using Wordpress as they can manage security, the web domain and infrastructure-related configurations. Since there is integration between Wordpress, Paypal and Canada Post, this streamlines the sales workflow for CANtech and eliminates most of the complexity in setting it up. These costs are listed in Table D in Section 4.3.

If CANtech were to use a third-party online distribution service such as Amazon, most of the costs for self-managed sales would not apply, but having them could help with customer presentation. This could be useful for overseas sales as Amazon could manage distribution and sales in other markets such as the EU through Amazon Global Selling. In this case, CANtech could manage local sales in Canada and the US while Amazon handles other global markets.

In terms of capital costs to start production of CANnect, costs such as equipment were identified in the case that CANtech is performing the initial manufacturing. Additional costs relating to the establishment of CANtech as an incorporation were also identified and are in Table 4.4 in Section 4.4.

For advertising on digital platforms, CANtech would focus on advertising and forums relating to automotives. For the latter, this would require committing time and effort to go onto forums and finding situations where CANnect could meet the person’s needs. While there is no monetary cost that is necessarily required, it does involve a potentially significant opportunity cost in the form of time and effort. Another approach is to do a promoted or review segment by a well-known or reputable automotive accessory reviewer, but this would involve not only sending a unit for free, but also additional money if it were to be sponsored. CANtech could also use online advertising platforms like Google Adsense, although the cost of this is highly dependent on the bidding for ad spots by competitors. An alternative is to pass this role to a third-party advertising agency, although the cost is likely to be significant. Physical advertising could be done at local car events where interest in CANnect is likely to be present.

For customer support in the production phase, having timely and effective responses are important to differentiate CANnect from other solutions. However, this is likely going to be time-consuming as there may be lots of customers with less technical expertise which would make

troubleshooting difficult. A way this could be resolved is to have dedicated support staff with CANtech, or have it outsourced to a third-party firm.

2.7 Sales Strategy

According to research conducted by SEMA, figure 2.7 shows the age groups and channels used to purchase aftermarket accessories [11]. It is observed that online and physical channels are the most common among all ages.

WHERE PARTS ARE BOUGHT % OF PART PURCHASES

Source: 2016 SEMA Consumer Market Data

	TOTAL ACCESSORIZERS	AGES 18 - 29	AGES 30 - 39	AGES 40 - 49	AGES 50 - 59	AGES 60+
Online Channels	36%	37%	38%	37%	31%	29%
Physical Channels	52%	51%	52%	51%	55%	54%
Other/Mixed Channels	12%	12%	11%	12%	13%	18%

Figure 2.7 : Consumer Ages and Purchase Channels for Aftermarket Accessories [11]

It will be important to have a strong online presence, as most consumers tend to research accessories online before purchase. The most common methods of research include Google or Bing searches, visiting online auto retailer or manufacturer sites, and referencing automotive forums [11].

Also, we will reach out to potential buyers using the 3-sale system which is a method composed of explore, present and action phrases to introduce the product. The strategy is to first explore the customers' needs, then present with how our product fills the needs that they addressed. Next step is to persuade customers into buying the product including showing demos, presenting customer ratings (if any) and providing useful documents that show how they can benefit with using such a device. However, the disadvantage of this strategy is that it is time consuming and our team doesn’t have a member who has experience in this field.

Additionally, we may delegate sales to someone else since the team lacks expertise on entrepreneur skill. Hiring a marketing consulting team will help with planning and executing our sales strategy. While their expertise will guarantee a better chance at success and frees up human resources towards other endeavors, it is costly. Once we have enough customer base, we will ask for referrals to expand our network without hurting our relations with the consulting team.

3 Customer Base

CANtech's customer base is catered to a mix of car enthusiasts and people who are interested in finding their own solutions to their automotive needs. This base can be extended to the electronic hobbyists who wish to begin exploring car electronics to data hoarders who wish to capture the telemetrics of their car for their own purposes.

The growth for automotive aftermarket solutions has been steadily increasing with the rise of cheap computing power, increased community support and a better adoption of technology. This appeals to our primary demographic of car enthusiasts who regularly find ways to obtain more information of their vehicle in order to tune their car further or to share their experiences with the community. This is achieved by using CANnect reader as a starting platform that talks directly to the car's OBD-II system. Car enthusiasts may add additional modifications to their car and plug in various aftermarket electronics either directly to the reader or to the sensor module. The sensor module itself directly appeals to their taste to measure the driving experience felt from the forces acting on the car through its various motions on the road. The ease of modification and open source material allows care enthusiasts to comfortably make necessary changes to fit their needs.

People who wish to achieve their own solutions to their automotive needs but are not as eager as car enthusiasts may be appealed by the CANnect reader; not only does the CANnect reader support all legislated OBD-II protocols but it also supports MS-CAN and SWCAN which are not offered by all OBD-II readers available in the market. Its price will also be cheaper than similar solutions offered by other manufacturers. Furthermore, the GPS/LTE module aims to bring peace of mind to users by offering them a method to track their vehicle's location, bringing security and convenience in the palm of their hand.

CANtech's secondary base is the growing electronic hobbyists who want to hack and learn more about electronics. CANnect readers offer a method for hobbyists to take a renown microcontroller, the ESP32, and learn more about the cars they drive. It also offers a good incentive as an education medium to learn more about electronics, software development and app development through the lens of a car. Finally, the CANnect reader, sensor modules and GPS/LTE module offer a way for data hoarders to collect more information from their car in a relatively cheap manner.

The risk to our customers demographic will be that people can hack the car by manipulating the CAN [26]. According to the author R. Lemos, the connected-car market is growing and a majority of vehicles are connected to the internet in the United States as of 2020 and thus they are susceptible to the cyber attack. He mentioned 388 digital, electronic, and cyberattacks, which is more than 45% last year according to UpStream. Specifically, accounts hackings, stealing of customer information have actually happened in the past [27]. Since our product Cannect is also utilizing the connected-car technology such as Internet for accessing the data from the databases such as Firebase, SQLite, and also Bluetooth technology for remote data transferring to the Android device and hence the customer information could be stolen by the hackers. Therefore, in

order to prevent this cyber attack, we ought to enhance the cybersecurity in our product so that customer information stays secure.

4 Finances

It is important to note that CANtech is a startup company, and CANnect and its accessories will be its main source of revenue. Therefore, this document will highlight the incurred expenses for the development of the products as well as hypothetical scenarios for projected finances for the next 10 years. Note that the currency used in this document is in Canadian Dollars ($CAD) unless stated otherwise.

4.1 Gamma Prototype

The gamma prototype calculation is determined from actual expenses spent and projected expenses that will be spent in the future. The cost of research and development (R&D) is summarised in table 4.1, with each prototype cost broken down further.

R&D Item Cost	**Vendor (if applicable)**	**Cost**
OBD-II Development Kit	OBD Solutions	$164.30
OBD Simulator	Freematics	$ 751.32
Reader Prototype Rev A	N/A	$1,045.88
Reader Prototype Rev B	N/A	$838.88
Sensor Prototype	N/A	$33.00
GPS/LTE Prototype	N/A	$11.00
Total Cost of Reader R&D		$2,844.38

Table 4.1: R&D Cost of Reader

The OBD-II Development kit was purchased from OBD Solutions for the development of the reader's software and app [30]. The kit was chosen specifically from OBD Solutions as they were the manufacturers from the OBD chip chosen for the reader [28]. The OBD Simulator was sourced from Freematics due to its cheap price as well as its ease of testing and verification of software [31].

4.1.1 CANnect Reader

Current expenses incurred in producing an engineering prototype is listed in Table 4.1.1-1. 3 engineering prototypes are commissioned to provide redundancy. For a complete breakdown of the reader components, see Appendix A.

Prototype Item Cost	Quantity	Price per Board	Vendor	Total Cost per Item
STN 2120	3	$16.13	OBD Solutions	$48.38
Reader Components	3	$63.50	Digikey	$190.50
ESP32 Dev Kit	3	$11.00	Amazon Canada	$33.00
Reader PCB	3	$258.00	Canadian Circuits Inc.	$774.00
Total Cost of Reader Rev A				$1,045.88

Table 4.1.1-1: Incurred Cost for Gamma Prototype Rev A

Note that most of the expenses are related to the reader PCB. This is due to the call to rush manufacturing to meet deadlines as it is determined that the need for a quick turnaround time is more beneficial than saving cost. This is due to the nature of hardware development where possible, future, revisions may be needed to be done after verifying the implementation. At time of writing, it is determined most likely to be a PCB-redesign. If another hardware prototype is determined to be needed, the projected expenses are listed in Table 4.1.1-2.

Prototype Item Cost	Quantity	Price per Board	Vendor	Total Cost per Item
STN 2120	3	$16.13	OBD Solutions	$48.38
Reader Components	3	$63.50	Digikey	$190.50
Reader PCB	3	$150.00	Canadian Circuits Inc.	$450.00
Reader Shell	3	$50.00	3DSmith	$150.00
Total Cost of Reader Rev B				$838.88

Table 4.1.1-2: Projected Cost for Gamma Prototype Rev B

Because the ESP32 is expected to be reused, the cost will not be attributed to the prototype revision B. For prototype B, the development of a reader shell will be undertaken. If it is determined from hardware verification tests that a PCB revision is not needed, the only projected cost will be the development of the reader shell.

4.1.2 Sensor

Prototype Item Cost	Quantity	Price per Board	Vendor	Total Cost per Item
ESP32	3	$11.00	Digikey	$33.00
Sensor Components	3	$13.00	Digikey	$40.00
Sensor PCB	3	$15.00	OshPark	$45.00
Sensor Shell	3	$30.00	3DSmith	$90.00
Device Enclosure	3	$7.58	Digikey	$23.00
Total Cost of Sensor Prototype	(3D Printed Shell) $208.00 (Pre-Manufactured Encasing) $141.00			

Table 4.1.2: Sensor cost for gamma prototype

To reduce the prototype costs associated with 3D printing, we could opt for an existing box enclosure or encasing manufactured for generic devices of the specific size required. The simple design for the sensor would mean a reduced number of PCB layers for functionality. Purchasing sensor components in bulk may reduce their associated unit prices.

4.1.3 GPS/LTE

Prototype Item Cost	Quantity	Price per Board	Vendor	Total Cost per Item
Ublox Neo-M8Q-01A	1	$37.91	Digikey	$37.91
ESP32 Dev Kit	1	$11.00	Amazon	$11.00
Ublox SARA-R410M	1	$79.95	Sparkfun	$79.95
Total Cost of GPS/LTE Board				$128.86

Table 4.1.3: LTE/GPS cost for gamma prototype

For the GPS/LTE prototype, this is achieved via devkits for each respective item. A custom hardware design was deemed to be infeasible for this phase due to hardware complexity for RF communication, the technical expertise required and the turnaround time for PCB design which is long.

4.2 Mass Production

When considering mass production, it is important to consider the economies of scale as an increased production will lead to lower unit cost. It is also important to consider several assumptions when modeling mass production cost.

Due to sourcing of some parts and services from the United States, the exchange rate will be assumed to be $1.30CAD to $1.00USD. With relation to shipping, prices are determined using Regular Parcel within Canada for 0.50 kg with Canada Post for small businesses from BC to ON [29] with the minimum discount price of $14.90 being split across the reader, sensor and GPS/LTE modules.

OBD Solutions has a reseller program which allows companies to resell their products and represent their interests in exchange for technical knowledge on their OBD chips as well as discounts on their products (i.e STN2120), up to 45% [32]. For the numbers related to mass production, it is assumed that CANtech is successful in partnering up with OBD solutions and acquiring a discount of 30% on STN chips.

It is assumed that the assembly and labour cost for assembly of each product generally lowers with an increase in production as each product can be made more quickly and more skillfully, lowering overall cost. It is also assumed that there are no lead times in manufacturing and shipping is handled by CANtech.

Note that the app development and release will be directly tied to the reader's cost.

4.2.1 CANnect Reader Mass Production

Product Cost	**Unit Cost of 0-99 boards**	**Unit Cost of 100-499 boards**	**Unit Cost of 500-999 boards**	**Unit Cost of 1000+ boards**
STN 2120	$13.95	$8.84	$8.46	$8.08
Reader PCB	$100.00	$25.00	$15.75	$6.50
Reader Components	$51.14	$38.85	$35.38	$31.91
ESP32	$6.00	$5.36	$5.36	$5.36
Reader Shell	$3.00	$2.00	$1.25	$0.50
Shipping by Canada Post	$5.65	$5.65	$5.65	$5.65
OBD-II to DB15 Cable	$5.00	$3.00	$2.50	$2.00

Assembly & Labour	$5.00	$3.00	$2.00	$1.00
Packaging Cost	$4.50	$3.80	$3.80	$3.80
Total Production Cost per Unit	$194.10	$95.50	$80.15	$64.80

Table 4.2.1: Mass Production Breakdown of Reader

Table 4.2.1 lists the mass production breakdown of the reader. There is supplementary documentation provided to support these claims.

4.2.2 Sensor Module Mass Production

Product Cost	**Unit Cost of 0-99 boards**	**Unit Cost of 100-499 boards**	**Unit Cost of 500-999 boards**	**Unit Cost of 1000+ boards**
ESP32	$6.00	$5.36	$5.36	$5.36
Sensor Components	$8.60	$7.22	$6.30	$5.90
Sensor Shell	$2.00	$1.00	$0.63	$0.25
Sensor PCB	$1.50	$0.70	$0.65	$0.55
Shipping by Canada Post	$3.60	$3.60	$3.60	$3.60
Assembly & Labour	$5.00	$1.00	$0.55	$0.10
Packaging Cost	$4.50	$3.80	$3.80	$3.80
Total Production Cost per Unit	$31.20	$22.68	$20.89	$19.56

Table 4.2.2: Mass Production Breakdown of the Sensor

Similarly from 4.1.1 for the reader, the mass production breakdown of the Sensor module is listed above in the table 4.2.2.

4.2.3 GPS/LTE Module Mass Production

Product Cost	**Unit Cost of 0-99 boards**	**Unit Cost of 100-499 boards**	**Unit Cost of 500-999 boards**	**Unit Cost of 1000+ boards**
Ublox SARA-R410M-02B	$48.03	$33.36	$33.36	$33.36
Ublox Neo-M8Q-01A	$30.69	$20.19	$20.19	$20.19
PCB	$100.00	$36.00	$25.00	$17.50
Module Components	$55.87	$43.14	$40.56	$38.77
ESP32	$6.00	$5.36	$5.36	$5.36
Shell	$2.00	$2.00	$2.00	$2.00
Shipping by Canada Post	$5.65	$5.65	$5.65	$5.65
Assembly & Labour	$5.00	$3.00	$2.00	$1.00
Packaging Cost	$4.50	$3.80	$3.80	$3.80
Total Production Cost per Unit	$257.74	$152.50	$137.92	$127.63

Table 4.2.3: Mass Production Breakdown of GPS/LTE Module

Table 4.2.3 lists the mass production of the reader. Prices are listed in CAD with some component pricing from Digikey. Note that PCB and module component pricing are estimated based on the expected hardware complexity of the system.

4.3 Operating Cost

As noted in earlier sections, the business operating cost. For the considerations later when calculating the breakeven point, the operating cost is fixed as it does not change with the production numbers.

Item Cost	**Cost per Month**
Website and Server Upkeep	$60.00
Domain	$20.00
Server Upkeep	$20.00

Marketing	$410.78
Third-party distributor (Amazon) - Optional	$30.00
Operating Cost per Month (No Third-Party Distributor)	$1,544.03

Table 4.3: The company's operating cost

4.4 Upfront Cost

Before mass production can truly begin, it is important to address the upfront cost as outlined in Table 4.4.

Item Cost	**Cost**
3D Printer	$500.00
Assembly Tools	$300.00
Incorporation Provincial Fees	$380.00
Incorporation Federal Fees	$200.00
Regulatory Fees	$1,338.00
Research & Development	$3,145.24
Google Play Store	$33.25
Total Upfront Cost	$5,896.49

Table 4.4: Upfront Cost

The research and development cost is part of the upfront cost that must be addressed. The regulatory fees must also be addressed to properly certify the CANnect reader, sensor module and LTE module. The 3D printer is purchased in order to mass produce the protective shells for the products.

4.5 Break Even Point Calculation

The breakeven point is defined as where the cost of the project equals to the revenue of the project. To properly model the breakeven point calculations, several assumptions must be made.

It is assumed that the research and development cost and business fixed cost will be paid by in the first year. It is also assumed that the unit cost stated in the following tables scale accordingly. It is also assumed that the total cost and the total revenue comes in at once at the end of the year to simplify the cash flow process. The number of units produced will be the number of units sold directly. Finally, the unit sales prices are generally inferred from our customer base and market research.

Determining the new break even point calculation due to a bank loan and interest will be done in the Appendix A.

4.5.1 Package Calculation

Considering selling the CANnect reader, sensor module and LTE modules as a package, Table 4.5.1 outlines several possibilities of the number of packages sold and its associated cost, and the unit sales price inferred from market research for the number of packages sold, incurred the respective revenue.

# of Packages Sold	Unit Cost	Operating Cost	Upfront Cost	Total Cost	Unit Sales Price	Total Revenue	Loss/Profit before Interest
20	$475.08	-$42,172.91	-$ 5,896.49	-$ 57,570.96	$400.00	$8,000.00	**-$49,570.96**
50	$475.08	-$42,172.91	-$ 5,896.49	-$ 71,823.29	$350.00	$17,500.00	**-$54,323.29**
70	$475.08	-$42,172.91	-$ 5,896.49	-$ 81,324.84	$300.00	$21,000.00	**-$60,324.84**
90	$475.08	-$42,172.91	-$ 5,896.49	-$ 90,826.39	$290.00	$26,100.00	**-$64,726.39**
100	$265.75	-$42,172.91	-$ 5,896.49	-$ 74,644.45	$290.00	$29,000.00	**-$45,644.45**
300	$265.75	-$42,172.91	-$ 5, 896.49	-$127794.548	$280.00	$84,000.00	**-$43,794.55**
500	$225.25	-$42,172.91	-$ 5,896.49	-$160695.261	$280.00	$140,000.00	**-$20,695.26**
800	$225.25	-$42,172.91	-$ 5,896.49	-$228270.777	$270.00	$216,000.00	**-$12,270.78**
1000	$207.54	-$42,172.91	-$ 5,896.49	-$255612.351	$270.00	$270,000.00	**$14,387.65**

1500	$207.54	-$42,172.91	-$ 5,896.49	-$359383.826	$260.00	$390,000.00	**$30,616.17**

Table 4.5.1: First Year Calculation of Package

From this, it is determined through interpolation that the breakeven point of production is 892 units. This is the point where approximately the total cost will equal the total revenue for that year.

4.5.2 Reader Calculation

Due to the importance of the CANnect reader as a product to CANtech, it is natural to only consider the break-even point calculation. In this scenario, it is assumed that the sensor module and LTE module does not factor into the calculations at all for simplicity. This is because the sensor module and LTE module are meant to be complementary products to the CANnect reader. The outline of the first calculation is defined in Table 4.5.2.

# of Readers Sold	**Unit Cost**	**Operating Cost**	**Upfront Cost**	**Total Cost**	**Unit Sales Price**	**Total Revenue**	**Loss/Profit before Interest**
20	$194.24	-$39,172.91	-$5,896.49	-$48,954.16	$200.00	$4,000.00	**-$44,954.16**
50	$194.24	-$39,172.91	-$5,896.49	-$54,781.29	$190.00	$9,500.00	**-$45,281.29**
70	$194.24	-$39,172.91	-$5,896.49	-$58,666.04	$180.00	$12,600.00	**-$46,066.04**
90	$194.24	-$39,172.91	-$5,896.49	-$62,550.79	$170.00	$15,300.00	**-$47,250.79**
100	$95.49	-$39,172.91	-$5,896.49	-$54,618.45	$160.00	$16,000.00	**-$38,618.45**
300	$95.49	-$39,172.91	-$5,896.49	-$73,716.55	$150.00	$45,000.00	**-$28,716.55**
500	$70.90	-$39,172.91	-$5,896.49	-$80,517.76	$140.00	$70,000.00	**-$10,517.76**
800	$70.90	-$39,172.91	-$5,896.49	-$101786.777	$120.00	$96,000.00	**-$5,786.78**
1000	$64.80	-$39,172.91	-$5,896.49	-$109872.351	$110.00	$110,000.00	**$127.65**
1500	$64.80	-$39,172.91	-$5,896.49	-$142273.826	$100.00	$150,000.00	**$7,726.17**
2000	$64.80	-$42,172.91	-$5,896.49	-$177675.301	$90.00	$180,000.00	**$2,324.70**

Table 4.5.2: First year Calculation of the Reader

Similarly, the breakeven point calculation is determined to be 995 units where the total cost and revenue equals each other.

4.6 Margin Determination

To meet CANtech's objective of bringing open source electronics to the world, the strategy will be to increase production numbers. This will both increase CANtech's profit margin as well as make it possible to lower the price further, leading to mass adoption among our target audience.

This margin was determined to be the breakeven point where there was profit after interest - this value is at 981 units of the packaged solution (reader, LTE/GPS and sensor) being sold at a sales price of approximately $270.00. See Appendix A for the full breakdown.

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6 APPENDIX

6.1 Appendix A – Bank Loan and Interest for Breakeven Calculation

One of the major assumptions when calculating the breakeven point with a bank loan and interest is that the total cost of the project will be covered fully by the bank. There will be a 5% effective interest on the principal, the total cost of the project, and is paid at the end of the year. The scope of this calculation is only to determine the new breakeven point, which may differ from the original calculations or even not exist.

# of Packages Sold	Unit Cost	Operating Cost	Upfront Cost	Total Cost	Unit Sales Price	Total Revenue	Loss/Profit before Interest	Interest	Loss/Profit After Interest
20	$475.08	-$ 42,172.91	-$ 5,896.49	-$ 57,570.96	$ 400.00	$ 8,000.00	**-$ 49,570.96**	-$ 2,878.55	**-$ 52,449.50**
50	$475.08	-$42,172.91	-$ 5,896.49	-$ 71,823.29	$ 350.00	$ 17,500.00	**-$ 54,323.29**	-$ 3,591.16	**-$ 57,914.45**
70	$475.08	-$42,172.91	-$ 5,896.49	-$ 81,324.84	$ 300.00	$ 21,000.00	**-$ 60,324.84**	-$ 4,066.24	**-$ 64,391.08**
90	$475.08	-$ 42,172.91	-$ 5,896.49	-$ 90,826.39	$ 290.00	$ 26,100.00	**-$ 64,726.39**	-$ 4,541.32	**-$ 69,267.71**
100	$265.75	-$ 42,172.91	-$ 5,896.49	-$ 74,644.45	$ 290.00	$ 29,000.00	**-$ 45,644.45**	-$ 3,732.22	**-$ 49,376.67**
300	$265.75	-$ 42,172.91	-$ 5,896.49	-$ 127794.548	$ 280.00	$ 84,0	**-$ 43,794.55**	-$ 6,389.73	**-$ 50,184.28**

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500	$225.25	-$ 42,172.91	-$ 5,896.49	-160695.261	$ 280.00	$ 140,000.00	**-$ 20,695.26**	-$ 8,034.76	**-$ 28,730.02**
800	$225.25	-$ 42,172.91	-$ 5,896.49	-228270.777	$ 270.00	$ 216,000.00	**-$ 12,270.78**	-$ 11,413.54	**-$ 23,684.32**
1000	$207.54	-$ 42,172.91	-$ 5,896.49	-255612.351	$ 270.00	$ 270,000.00	**$ 14,387.65**	-$ 12,780.62	**$ 1,607.03**
1500	$207.54	-$ 42,172.91	-$ 5,896.49	-359383.826	$ 260.00	$ 390,000.00	**$ 30,616.17**	-$ 17,969.19	**$ 12,646.98**
2000	$207.54	-$ 42,172.91	-$ 5,896.49	-463155.301	$ 250.00	$ 500,000.00	**$ 36,844.70**	-$ 23,157.77	**$ 13,686.93**

Table A.1: Calculations of the package, with interest considered

The new breakeven point is 710 packages. This is expected as the new interest leads to an increased need for higher production numbers for the interest. The peak profit range lies between 1500 units and 2000 units, suggesting that merely increasing production does not directly correlate to increased profits after interest; further growth in profits may require reduction of cost.

# of Readers Sold	**Unit Cost**	**Operating Cost**	**Upfront Cost**	**Total Cost**	**Unit Sales Price**	**Total Revenue**	**Loss/Profit before Interest**	**Interest**	**Loss/Profit After Interest**

20	$ 194.24	-$ 39,172.91	-$ 5,896.49	-$ 48,954.16	$ 200.00	$ 4,000.00	**-$ 44,954.16**	-$ 2,447.71	**-$ 47,401.86**
50	$ 194.24	-$ 39,172.91	-$ 5,896.49	-$ 54,781.29	$ 190.00	$ 9,500.00	**-$ 45,281.29**	-$ 2,739.06	**-$ 48,020.35**
70	$ 194.24	-$ 39,172.91	-$ 5,896.49	-$ 58,666.04	$ 180.00	$ 12,600.00	**-$ 46,066.04**	-$ 2,933.30	**-$ 48,999.34**
90	$ 194.24	-$ 39,172.91	-$ 5,896.49	-$ 62,550.79	$ 170.00	$ 15,300.00	**-$ 47,250.79**	-$ 3,127.54	**-$ 50,378.33**
100	$ 95.49	-$ 39,172.91	-$ 5,896.49	-$ 54,618.45	$ 160.00	$ 16,000.00	**-$ 38,618.45**	-$ 2,730.92	**-$ 41,349.37**
300	$ 95.49	-$ 39,172.91	-$ 5,896.49	-$ 73,716.55	$ 150.00	$ 45,000.00	**-$ 28,716.55**	-$ 3,685.83	**-$ 32,402.38**
500	$ 70.90	-$ 39,172.91	-$ 5,896.49	-$ 80,517.76	$ 140.00	$ 70,000.00	**-$ 10,517.76**	-$ 4,025.89	**-$ 14,543.65**
800	$ 70.90	-$ 39,172.91	-$ 5,896.49	-$ 101786.777	$ 120.00	$ 96,000.00	**-$ 5,786.78**	-$ 5,089.34	**-$ 10,876.12**
1000	$ 64.80	-$ 39,172.91	-$ 5,896.49	-$ 109872.351	$ 110.00	$ 110,000.00	**$ 127.65**	-$ 5,493.62	**-$ 5,365.97**
1500	$ 64.80	-$ 39,172.91	-$ 5,896.49	-$ 142273.826	$ 100.00	$ 150,000.00	**$ 7,726.17**	-$ 7,113.69	**$ 612.48**

2000	$ 64.80	-$ 42,172.91	-$ 5,896.49	-177675.301	$ 90.00	$ 180,000.00	**$ 2,324.70**	-$ 8,883.77	**-$ 6,559.07**

Table A.2: Calculations of the Reader, with interest considered

The first breakeven point is 1335 reader units while the second breakeven point is 1667 reader units, suggesting that the sweet spot of reader production is between these two points. From this the peak profit production number is most likely to be 1500 reader units, yielding a peak profit of $2179.93. Any further increase in profits will require cost reduction.