MEMS CONDUCTIVITY, PRESSURE, AND TEMPERATURE SENSOR BUSINESS PLAN.

by

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Abstract

This project investigates the potential viability of commercializing MEMS sensor technology developed by a UBC doctoral candidate. The aim of this project is to provide a business plan that will act as a tool to help in obtaining funding for the commercialization of this product. This project is presented in five chapters. These chapters will investigate, in order, the product, the market, the business strategy, the financials, and the associated risks.

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Executive Summary

The pulp and paper industry has been manufacturing paper for the last 60 years without having precise measurements, and therefore control, over a key stage of the pulp making process.

Pressure, temperature, and conductivity are measured by using technology at the outer edges of gigantic pulp digesters. These measurements are not timely, and the inner core values can only be extrapolated calculations based on these fringe measurements. This results in having to process wood chips longer than necessary to insure the process is complete. This extra time wastes costly energy and chemicals, and produces lower grade pulp.

The solution to this problem is the flow method of measuring temperature, pressure, and conductivity. Using the flow method, small ‘smart chips’ are mixed in with wood chips during the pulping phase and interact with the internal environment of a pulp digester. These ‘smart chips’ enable mill operators to understand the exact conditions inside a digester. This improved accuracy translates into greater control over the pulping process and allows companies to run at peak efficiencies.

Our company has developed the smart chip technology and is prepared to bring this disruptive technology to the marketplace using a 3 phased approach. Phase one is testing and market awareness, where we make initial contact with potential customers by allowing technical analysts the ability to test our product and become aware of its capabilities. In phase two, we develop our product in

conjunction with a key industry partner. In phase three, we commercialize our polished product.

Our company founders, Mr. Tom Tucker and Dr. Reza Mohammadi, are first time entrepreneurs and are excited to bring their experiences and dedication to this project. We understand that as first time entrepreneurs we will have a lot to learn. With this in mind, we are offering a large portion of our company – 45% stakeholder equity- in exchange for your $2 million investment. Our conservative projections show that this investment will be worth 6.1 million dollars at the end of our five-year plan. We invite you to read our business plan to see how.

Acknowledgements

I would like to thank Reza Mohammadi for his professionalism and patience in explaining MEMS technology to me. I appreciate Reza for always being quick to answer my questions with answers more detailed and thoughtful than I could reasonably expect.

I would like to thank my Senior Supervisor, Sudheer Gupta, not only for his patience while I worked out what particular project I would like to pursue, but also for kindly challenging me to develop a well thought out business plan.

Finally, I would like to acknowledge that throughout my journey of the Management of Technology MBA program, I have had the loving support from my wife Kimberly. Any success I have enjoyed is the result of her love, patience, and coaching.

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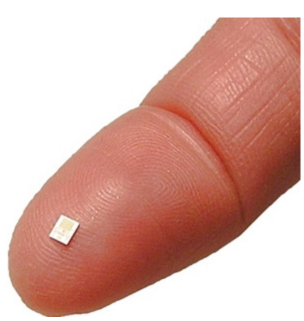
1: The Product

This business plan analyses the economic feasibility of introducing a microelectromechanical systems ("**MEMS**") conductivity, pressure and temperature sensor (the "**Product**") to the pulp and paper industry in Canada. Tom Tucker presents the analysis on behalf of a partnership (the "**Company**") between Tom Tucker and Reza Mohammadi. The University of British Columbia currently holds the intellectual property and ownership rights to the Product.

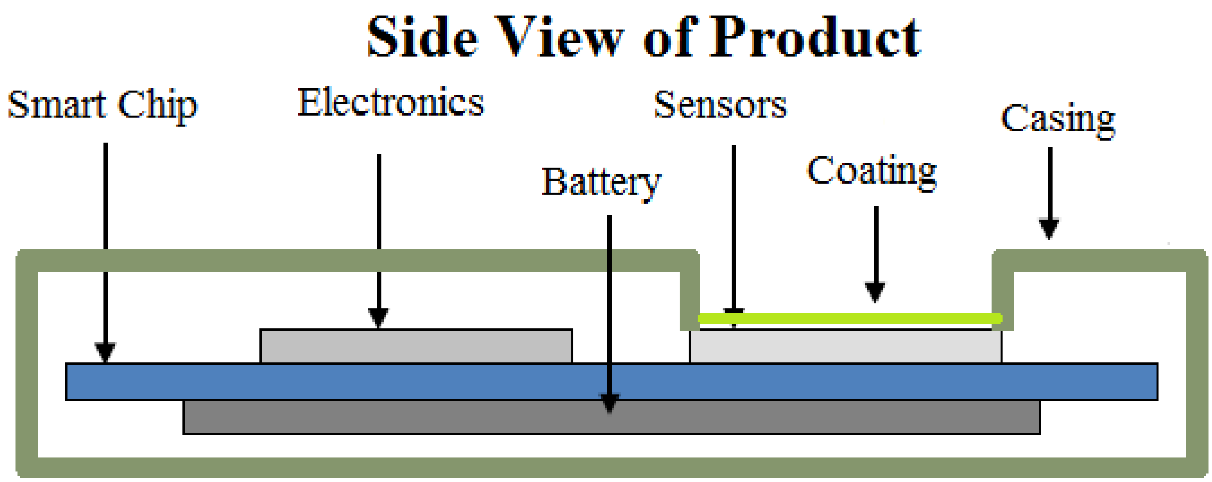
As currently developed the Product can be accurately described in the pulp and paper industry as a "MEMS technology sensor package including a smart chip", where the sensor package could be tailored in the future to match individual customer needs. The Product is a combined sensor for MEMS conductivity (which indirectly measures the pH), pressure and temperature. The sensors range in size from 20 micrometres to 1 millimetre (see Figure 1) and the Product, containing several sensors and additional casing structures, ranges in size from 2cm to 3cm in diameter (Mohammadi, 2011).

Figure 1 A typical MEMS sensor



The smart chip within the Product is a combination of several individual components mounted on a silicon chip (see Figure 2). The three sensors (conductivity, pressure, temperature) are imbedded in the chip. In addition to these sensors, there is a radio frequency identification ("**RFID**") component to allow the chip to broadcast the sensor's readings, and to permit the recovery of the Product after each cycle in production. A battery is attached to the chip to power these components, as well as some basic electronics to store and process low-level instructions between these components. This smart chip, battery and ancillary components are housed in a hard Polyether ether ketone ("**PEEK**") container to stay protected from the harsh environment of the pulp and paper manufacturing process. The PEEK container has specific spots of permeability to allow the sensors to interact and take readings of the external environment in the pulp and paper processing. A thin Parylene coating (a common brand of chemical vapour deposited polymer) is applied to the exposed portion of the sensors in order to extend their usable life in the processor (Mohammadi, 2011).

Figure 2 Side View of the Product



(created by T. Tucker, adopted from Mohammadi, 2011)

In processing, the Product is integrated in a batch of wood chips that then flow with the Product through the pulp and paper producing process in order to accurately measure the environment to which the wood chips were exposed (the "**Flow Method**"). The Flow Method of measuring the internal conditions (within the machinery) during the processing is a deviation from the current method of measurement where measurements are processed by comparatively large sensors (see Figure 3) bolted to the external housing of pulp and paper processors. The Company believes, from its research into pulp and paper processing techniques and initial trials with the Product, that the current large sensors are unable to make measurements of the internal core of wood chips in a processor, and do not report the best data available for the conditions the wood chips are exposed to. These inaccuracies lead to wasted resources in the pulp and paper making process, including both the energy and the chemicals consumed during the pulp and paper manufacturing process. Small percentage gains in either one of these aspects of the process would result in large financial savings for the mill (Champagne, 2005).

Figure 3 A typical external sensor

This business plan includes academic models incorporated to demonstrate potential economic and competitive advantages and disadvantages of the Product. Some of the models that will be used for this purpose include Porter's Five Forces (Porter, 1979) and Moore's Crossing the Chasm (Moore, 2002). In addition to using academic models, this business plan aims to give researched information regarding both the pulp and paper industry and smart chip technology, and apply this research to demonstrate how to market the Product to the pulp and paper industry. In addition, this business plan includes a five-year pro forma of financial projections based on this market research.

In order to bring this research and analysis together in a logical and coherent manner, this business plan is broken into five chapters. Chapter 1 educates the reader about the Product by giving a high-level context of the basics of the pulp and paper industry. From this high level, the business plan delves into the specific details of the manufacturing process that the Product's smart chip technology will enhance. The business plan then focuses on the technology currently in use, and where the Company sees a commercial benefit to customers in switching to the Product.

Chapter 2 focuses on the market for the Product's smart chip technology. The chapter starts by giving a detailed background of the pulp and paper industry. From this context, the paper details the major customers of smart chip product, the suppliers of the components for the smart chip product, competitors, and concludes with a competitive analysis using Porter's Five Forces (Porter, 1979).

The topic of chapter 3 is business strategy and is broken into phases – testing, development, and commercialization. Within each of these phases, the economic feasibility & technical reliability, the operating strategy, marketing, operations & implementation, and conclusion will be discussed and analyzed.

Chapter 4 focuses on the financial information of the Company, assuming that a corporation is created to produce and market the Product. The first part of the chapter covers the manufacturing costs of the Product. The second section discusses how the Company will utilize the proceeds of capital infused into the company. The third part describes a five-year financial forecast and concludes with the expected value of the Company at the end of five years.

This paper concludes with Chapter 5, an assessment of the risks associated with this Product and the Company, the probability of occurrence of each risk, the potential impact level of each risk, and strategies for dealing with each of these risks.

1.1 Pulp and Paper Basics

From packing paper to bathroom tissue, pulp and paper production includes a wide range of products and is a 23 billion dollar international industry. North America is one of the leading producers of lumber, pulp, and paper, producing 42% of the world's pulp and 27% of the world's supply of paper. In 2008 alone, North America produced over 73 million tonnes of pulp and 97 million tonnes of paper (FAOSTAT, 2011).

In the pulp and paper industry there are several methods of separating wood fibres to produce pulp. These methods can be viewed incrementally along a spectrum from a purely mechanical process through to a chemical based process. In purely mechanical pulping, wood chips are ground and rolled into paper products that have low strength requirements such as newspaper, toilet paper, or facial tissue. Thermomechanical pulping is similar to pure mechanical pulping, but the wood chips are steamed during the manufacturing process to produce a slightly more flexible product. In chemithermomechanical pulping, chemicals such as sodium carbonate are applied to break down the wood chips, leaving them easier to refine into paper products. Finally in this spectrum is chemical pulping ("**Kraft process**"). The Kraft process became the most common method of production in the 1940's. (Biermann, 1993) Another major source of pulp, which lies outside this spectrum, is recycled pulp. The recycling process creates weaker pulp material, and therefore this pulp can only be used for products similar to those produced from mechanical pulping (Wikipedia, 2011). The Product's smart chip technology, which is the focus of this paper, is designed for use in the Kraft process (Mohammadi, 2011).

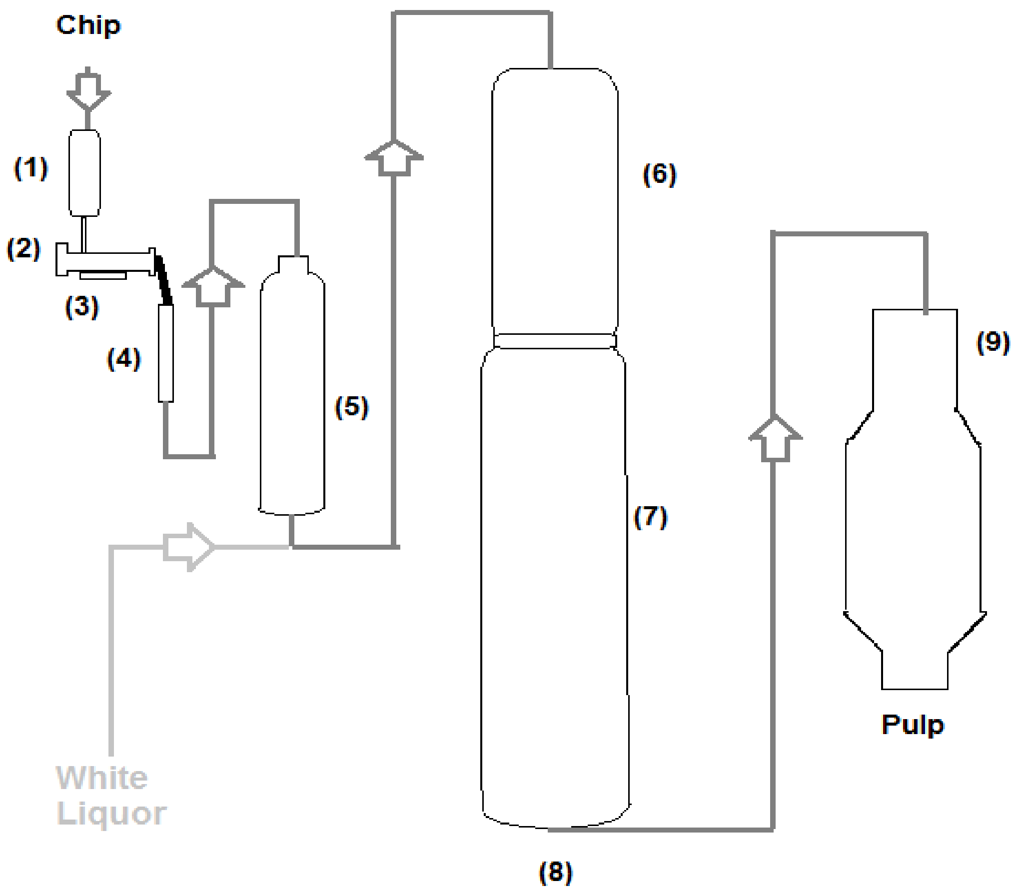
1.2 Kraft Process

The Kraft process can be broken down into six stages. In the first stage, forestry, wood logs are harvested in the forest and transported to a mill by trailer trucks, tugboats or cargo vessels. The second stage, chip preparation, sees these logs debarked and cut into chips approximately 12 to 25 millimetres long by 2 to 10 millimetres thick for the third stage, pulp production. In the third stage, the chips are cooked in a digester with a basic pH solution called white liquor that chemically attacks the chips in order to produce pulp. The fourth stage of the papermaking process is pulp post-processing. During this stage the pulp is washed, bleached, and dyed. The fifth stage drains water from the pulp resulting in paper formation. To remove the initial volume of water, the pulp travels down a moving screen causing water to drain out the bottom of the screen. This results in paper webs, which are compressed between rollers to remove additional water. Once this water removal is complete, the paper is compressed and dried using heated rollers. During the sixth and final stage, these paper sheets are processed through huge rollers and are now ready for consumption (Mohammadi, 2011).

Focusing on pulp production in the third stage of the process, where the Product will be used, requires a more detailed review because the process to convert raw wood into paper at a pulp mill is itself a multistep process. The most important part of this process is how cellulose fibres and lignin in the wood chips are chemically separated from the rest of the wood. The cellulose fibres and lignin are both strengthening components of wood fibres at a cellular level (Lebo, 2001), but lignin binds the cellulose together and is removed in the Kraft process, leaving cellulose to form the paper products (USEPA, 1983). See Figure 4 below for a graphical representation of the third stage pulping process.

Initially, the wood chips enter the pulp mill in a chip bin (Figure 4, (1)) which moistens and preheats the chips at atmospheric pressure. The small size of the chips received at this stage enables the chips to become completely saturated by water. Once the chips have been sufficiently conditioned by the heat and moisture, they are transferred at a uniform rate by a rotating chip feeder into a low-pressure feeder (Figure 4, (2)). This low pressurized feeder acts as a pressure sealer between the chip bin and the steaming vessel (Figure 4, (3)) and acts as a transitory module for the chips, ensuring no loss of moisture from the water saturation and providing the steaming vessel with moderately pressurized chips. In the steaming vessel, air is removed from the wood chips before they are transferred into a high-pressure module (Figure 4, (4)). The next module is the impregnation vessel (Figure 4, (5)) where the chemical reactions necessary to remove lignin are started. Here, white liquor, which consists of mainly of sodium hydroxide and sodium sulfide in water (Gullichsen, 2000), is added to the chips in a highly pressurized environment to allow the white liquor to replace the water in the chips. The resulting solution will be a homogeneous solution of impregnated wood chips (Mohammadi, 2011).

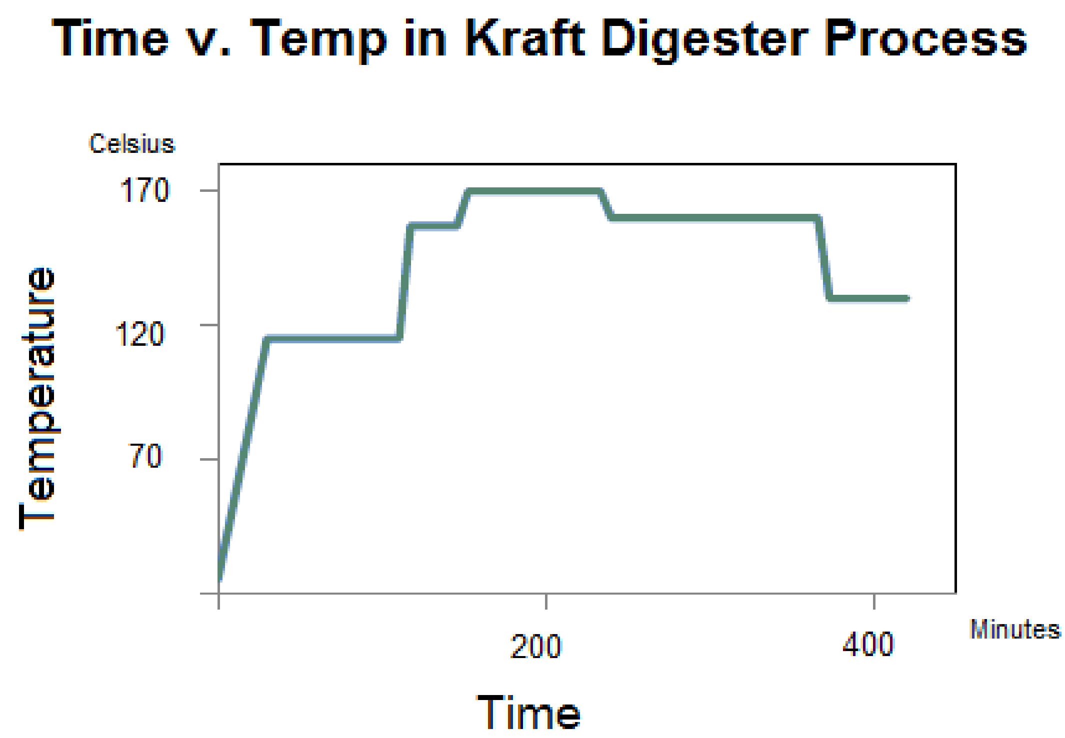
Figure 4 Graphical representation of the steps undertaken at a pulp mill



(created by T. Tucker, adopted from Mohammadi, 2008)

This next step of the process is to move this slurry into a digester (Figure 4, (6)). A digester is most often a 200 foot tall pressurized vat which pulp chips flow through. In the digester, slurry is exposed to temperatures reaching 170^{O} Celsius and pressures as high as 300 pounds per square inch. When combined with the alkaline mixture of wood chips and white liquor, lignin begins to break down. During this delignification the white liquor becomes mixed with organic by-products due to the fragmentation of lignin and becomes a polluted solution called black liquor. This black liquor is extracted from the digester and is treated to recover a portion of the white liquor for further use. As the process in the digester continues, white liquor is moved upwards at a slow rate against the chips moving to the bottom of the digester (Figure 4, (7)) and washes the cooked chips. The black liquor inside the wood chips is replaced with the new white liquor through a diffusion process. The 'broth' inside digesters during the transformation process is generally accepted to have a pH balance of 13 caused by the large amount of NaOH in both the black and white liquor. During the manufacturing process, the time spent in a digester typically ranges anywhere from 400 to 450 minutes (Mohammadi, 2011).

Figure 5 Time and Temperature in the Kraft Process



(created by T. Tucker, with data from Mohammadi, 2011)

The cooked chips are cooled and discharged out of the bottom of the digester and converted to pulp when a small amount of pressure is applied in the blow unit (Figure 4, (8)). The pulp is then washed to remove the remaining black liquor and dissolved lignin (Figure 4, (9)) (Mohammadi, 2011).

1.3 Existing Sensor Technology

The highly basic pH, the extreme temperature and the pressurization in the digester is difficult to accurately measure through the middle of the digester and over the entire processing time of the wood chips in a digester. Most current

Kraft digesters rely on having sensors placed in static locations at the input and output areas of the digester (Emerson, 2008). These static locations are only able to measure the outer layer of the slurry and do not provide accurate information on the pressure, pH and temperature of the middle of the slurry (Champagne, 2005).

By only being able to estimate the outside temperature and alkalinity of a batch of wood chips that is being processed, Kraft digesters are operating inefficiently. The lack of precision given by current sensors means pulp mills must err on the side of caution and process wood chips in digesters longer than may be necessary in order to insure the delignification process is complete. The cost of heating a digester and the cost of chemicals are large operating expenses in the day-to-day operations of a Kraft digester (Champagne, 2005).

1.4 Product Technology and Development

Unlike existing sensors, which are large stationary devices, the Product with its smart chip technology will be mixed in with wood chips during the cooking and washing stages of the pulp making process in the Flow Model. Each batch of wood chips will contain 100 products to allow for a normalization of results. Each Product is designed to make three measurements: the temperature of the slurry to determine optimal heating efficiencies, the conductivity of the slurry to determine the alkalinity of the solution to optimize chemical usage, and the pressure to determine the vertical location of the Product in the typically 200ft tall digester. The Product has been tested at the Howe Sound Pulp and Paper's continuous digester in Port Mellon, British Columbia. The results of these tests show that while the Product is already more advanced than the proven technologies in the market, there will need to be a minor modification to the PEEK housing and an additional pressure sensor added for the Product to have a high enough standard of performance to be economically feasible for commercialization (Mohammadi, 2011).

The pressure sensor, used to measure the vertical location of the smart chip in the digester and thus provide information on the wood chips in the same location, is accurate to within +/- 3.5 metres. In a typical 60 metre tall digester this is more than a 10% deviation and lowers the effective value of the information transmitted from the Product. The Company will be emphasizing the mobility of the Product in the Flow Model as an advantage over current technology, and effective marketing will require greater certainty on position of the Product at all times in the digester. In further development of the Product the Company intends to enhance the product with additional pressure sensors. The pressure sensors have low resource requirements, so addition of more to the Product will not be prohibitively costly (see financial analysis in Chapter 4 of this business plan) and taking the average of several pressure sensors will provide more accurate location data.

The temperature sensor on the smart chip tested as accurate within +/- 1.9%, which did not fall within the expected accuracy of +/- .25 degrees Celsius for the temperature sensors in other applications. The Company believes that the accuracy of the temperature sensor could be improved by adding a second sensor that measures temperature in a different way, and using both measurements to interpret the data. The current temperature sensor used in the Product is a piezoresistive sensor (a diaphragm which bends with applied pressure), and the Company proposes adding a resistive thermal device ("**RTD**") sensor. A RTD is a temperature sensor that measures the predictable change of electrical resistance of a material based on the change in temperature. RTD sensors are more expensive than piezoresistive sensors because their functionality is based on exploiting specific properties of platinum, and platinum is required to produce the sensors. The theory to be explored by the Company in further development is that comparing the piezoresistive temperature to the RTD temperature sensor would enable the Product to give a more accurate result. However, while the Product's current temperature sensor does not provide data within the expected accuracy for the sensor, the information on temperature is still valuable to the process because the Product is in the Flow Model and measuring within the wood chip slurry, rather than only on the outside as a current sensor would (Mohammadi, 2011).

The conductivity sensor, used to measure the strength of alkali (pH) within the digester indirectly through measurements of conductivity, tested extremely accurately in low concentration levels of NA_2O (a component of the white liquor), but as the concentration increased the sensor accuracy showed a total uncertainty of ±16%. The Company believes that the conductivity sensor is compromised at different vertical levels in a digester due to the compaction of woodchips on the sensor electrodes. Further development of the Product will include testing a secured housing with screening for the conductivity sensor to minimize the build-up of the wood chips on the sensor electrode.

There is commercial uncertainty in further developing the Product to meet the standards that the Company had expected from the three sensors. At this time, there is potential to market the Product as-is in the industry on the basis of the Product being part of the Flow Model and measuring the internal temperature, pressure and pH (through conductivity) of the wood chip slurry because producers will be interested in adjusting processing formulas based on this information despite the inaccuracies. Currently, the internal state of a digester is equivalent to an airplane's "black box" and any information of reasonable accuracy has value. However, the Company does not intend to bring the Product to market without further research and development, including the additional mechanics described above. The Company intends to involve the industry in generic testing of the Product, and develop the Product further based on industry feedback (see Chapter 3, Marketing). With the research and development skills of the Company's management and the necessary capital from industry investors, the Company believes that a more accurate product will be created and can form the basis for the future development of the Company.

The business plan developed herein is based on the current version of the Product and development costs to produce and industry-test the Product to later create a version that the Company will be able to take to an expanded market with greater confidence.

1.5 Company Management

The Company's management team is Abdolreza Rashidi (Reza) Mohammadi and Thomas Tucker. Dr. Mohammadi and Mr. Tucker were introduced through an initiative of the British Columbia Innovation Council and have come together to pursue the development and marketing of the Product in Canada.

Dr. Mohammadi is a postdoctoral Fellow at the Department of Electrical and Computer Engineering at the University of British Columbia ("UBC") and developed the Product's smart chip in connection with his PhD thesis. Prior to his time at UBC, Dr. Mohammadi was a research engineer and department supervisor at the Niroo Research Institute. The Niroo Research Institution is located in Iran and is a major research organization affiliated with the Ministry of Energy of Iran. Dr. Mohammadi will use his experience with MEMS technology to develop the Product's accuracy and advise the Company on what is technically possible for future models of the Product, including expansion into other industries. Dr. Mohammadi is also positioned to consult with other experts in MEMS technology, source components for the Product, and supervise production. Obtaining rights to develop and market the Product from UBC may require Dr. Mohammadi and Mr. Tucker to establish a corporate entity affiliated with UBC to hold appropriate licenses and rights for production and Dr. Mohammadi's current position with UBC will facilitate any such arrangement.

Tom Tucker is a current Masters of Business Administration (MBA) candidate from Simon Fraser University who has successfully utilized his business intelligence skills and experience across several industries, including his recent time with the Vancouver Organizing Committee for the 2010 Winter Games (VANOC). Mr. Tucker's business career started with 14 years of managerial business experience in the grocery industry. Mr. Tucker will use his experience to manage the marketing of the Product, analyze and control the Company's interaction industry competitors, and supervise the financial position of the Company.

Together, Mr. Tucker and Dr. Mohammadi will be responsible for obtaining start-up funding for initial production and industry testing of the Product, and further development of the Product to commercial production in the first five years of the Company. Contractors, advisors and suppliers will be sourced and engaged as necessary. The Company does not have current plans to expand the management team or hire permanent employees, but recognizes capital investment for further development may require shared ownership with investors.

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2: The Market

In order to describe the market for the product, this chapter is broken into four sections. The first section of this chapter will explain the industry background from its origins to modern times and will end with the current size of the pulp and paper market. The second section of this chapter will describe the major customers of digester sensors, while the third section of this chapter will deal with suppliers of components for the product. The fourth section of this chapter will use a Porter's analysis as part of a competitive analysis.

2.1 Background of Pulp and Paper Industry

2.1.1 History

The origins of papermaking in Canada are in Quebec. It was here that the first mill was built in the 1840's, followed soon in 1864 by the first chemical pulping mill. In the following decades, pulp mill growth continued along the St. Lawrence River and throughout the Maritimes (Minnes, 2011). By the end of the First World War, Canada was the world's largest exporter of pulp and paper. In the 1920's pulp mills were developed in Northern Ontario and throughout regions in Quebec, and while the economic depression of the 1930s slowed, and in some cases stalled, the need for pulp the Second World War rejuvenated the pulp industry in Canada. Growth continued at a steady pace through 1965 when the rate of new pulp mills, in particular Kraft digesters, peaked. From 1965 until 1970, 16 new Kraft digester pulp mills opened in British Columbia alone (Boughner, 2005). Growth levelled off during the 1970s and 1980s as the industry in Canada became fully mature. In the mid to late 1980's, Canada's pulp and paper exports were valued at $14 billion annually, accounting for 3% of the Gross Domestic Product. While these numbers show how important pulp and paper was to the Canadian economy, Canada now finds itself in constant competition with traditional international markets to sell pulp products (Minnes, 2011).

2.1.2 Canada's Pulp and Paper Market

In today's pulp industry in Canada 95% of the fibre found in pulp, paper, or paperboards comes from Canadian forests. The pulp and paper industry uses 90,000,000 m^3 of wood annually, and 90% of material consists of softwoods such as spruce, fir, or pine. This raw material is converted into pulp and paper at mills, which have become increasingly complex as high-speed machines and systems of control are developed for these capital-intensive operations. There is also a noticeable change in the source and type of wood chips used in the pulp and paper industry. In the early 1960's, approximately 10% of materials came from wood parts (reject lumber, and other left over material from sawmills). Today that amount is close to 50% (Minnes, 2011).

Internationally, Canada ranks second only to the United States in terms of pulp and paper manufacturing by volume. Quebec is the highest producing province with 35% of total production, followed closely by Ontario and British

Columbia with 25% and 22% of total production respectively. Canada utilizes approximately 140 mills to maintain this high level of production. From this, 79% of the gross production is exported, and 52% of this is exported to the United States (Minnes, 2011).

2.1.3 Innovation Initiatives

In order to stay abreast of technological innovations and be competitive in the global production market, Canada has collaborated internationally on many scientific research initiatives aimed at improving innovation in the industry. This research is undertaken by a number of Canadian firms aimed at scientific advances in the pulp and paper industry. It is estimated that in recent years $100 million to $150 million is spent annually on pollution reduction alone. The Pulp and Paper Research Institute of Canada and The Forest Engineering Research Institute of Canada both acted as co-operatives for Canadian manufacturers to facilitate the sharing of scientific research (Minnes, 2011).

The Pulp and Paper Research Institute of Canada and The Forest Engineering Research Institute of Canada amalgamated along with Forintek Canada Corporation and Canadian Wood Fibre Centre to form FPInnovations. FPInnovations is a non-profit organization that carries out scientific research for the Canadian forest industry. In addition, the pulp and paper division of FPInnovations, Paprican, offers technology transfer services to its 80+ members (FERIC, 2007).

Sharing scientific research between pulp and paper manufacturers is not limited only to Canada. Canadian manufacturers have long shared knowledge with manufacturers around the world. Traditionally, major advances in the pulp and paper industry have been the result of research work conducted in multiple locations worldwide. Canada was a driving force behind the research and development of the chemical recovery system used in the chemical pulping process. This development alone spurred a major growth of Kraft digester pulp mills internationally (Minnes, 2011).

2.2 Pulp and Paper Companies

The Canadian pulp and paper industry has several top comparable companies based both on net sales and production capacity. The four top Canadian based companies account for approximately 70% of the market share based on production capacities. These companies are AbitibiBowater, Domtar, Canfor, and Tembec (Patrick, 2006).

2.2.1 AbitibiBowater

AbitibiBowater is the result of a 2007 merger between forestry companies Abitibi Consolidated and Bowater (CBC, 2007). At the time of the merger, AbitibiBowater was the third largest publicly traded paper and forest products company in North America, trailing only Weyerhaeser and International Paper (Patrick, 2006). In 2009, AbitibiBowater declared Chapter 11 bankrupcy in the United States, claiming debts over $4 billion. Shortly afterward, it won court approval for $206 million in financing from Fairfax Financial Holdings Ltd (Hols, 2009).

In the 2010 fiscal year, AbitibiBowater lost $106 million on $4.7 billion in sales; however, the pulp division recorded a $137 million profit on $715 million in sales. In Canada, AbitibiBowater has eight active pulp mills in Ontario, Quebec, and Nova Scotia (Bowater, 2011).

2.2.2 Domtar

Domtar is the amalgamation of Domtar Inc. and Weyerhauser Fine Paper Business. Domtar began operations on March 7, 2007. Currently, Domtar is the second largest marketer of uncoated freesheet paper in the world and has pulp and paper operations across North America. In 2010, Domtar produced 1.5 million metric tonnes of pulp (Domtar, 2011).

In the 2010 fiscal year, Domtar recorded a $603 million profit on $5.9 billion in sales. In Canada, Domtar has pulp and paper mills in British Columbia, Ontario, and Quebec (Domtar, 2011).

2.2.3 Canfor

Canfor (and its subsidiary CanforPulp) is an integrated forest products company based in Vancouver with Canadian operations in BC, Alberta, and Quebec and has over 4,500 employees. In the 2010 fiscal year, Canfor recorded net earnings of $161 million dollars on $2.4 billion dollars in sales.

2.2.4 Tembec

Tembec is an integrated forest products company based in Quebec. The company has over 6000 employees and operates in Canada, the United States, and France. In the 2010 fiscal year, Tembec recorded net earnings of $64 million on $1.88 billion in sales (Tembec, 2011). Recently, Tembec announced a new initiative in conjunction with FPinnovations to build a pilot plant to produce a structural metiral with unique strength-to-weight properties created from pulp, lingnosulfonates and a modified phenolic resin (FPInnovations, 2011).

2.3 Suppliers of Smart Chip Technology

There are several suppliers for smart chip technology components, and the abundance of suppliers of MEMS sensors has led to their commoditization (Grace, 2011). In the field of electronics, there are over 300 distributors in North America alone (Digikey, 2011). From the several online vendors available, we have chosen to use Freescale.com, scscoatings.com, roccarbon.com, digikey.com, newwark.com, apcircuits.com, mcmastercarr.com and analog.com. Initially, we plan to utilize the lab space and expertise we have with UBC to manufacture our smart chip product.

2.3.1 Freescale

Freescale is advertised as a global leader in embedded processing solutions. It currently lists microcontrollers, processors, analog and power management, digital signal processors and controllers, radio frequency, sensors, and software and tools as the major products it sells. In fiscal year 2010, Freescale had $4.46 billion in sales, and has offices located in Asia, Europe, and North America (Freescale, 2011).

Due to their low costs, we initially plan to use Freescale as our source of pressure and temperature sensors; however, we would be equally happy changing our supplier to a rival such as Sensonor (www.sensonor.com) if any price fluctuations occur.

2.3.2 SCSCoatings

SCSCoatings is advertised as the world leader in parylene conformal coatings for the Medical, Electronics, Automotive and Military industries. It has been in the parylene industry for 40 years and has 10 worldwide locations. SCSCoatings head office is located in Indianapolis (scscoatings, 2011). We chose SCS coatings due to their expertise in parylene coating and North American proximity.

2.3.3 Roccarbon

Roccarbonis is advertised as the premiere service-oriented carbon manufacturer worldwide, providing quality products and exceptional service. It currently lists turbine rings, bearings and bushings, seal faces, seal repair, compressor rings, specialty parts, and raw materials as the major products it sells. Roccarbon is located in Houston (roccarbon, 2011).

We plan to use roccarbon as our source of PEEK packaging for our smart chip because of their expertise in unique modifications to part design and geometry. Our sensor packaging must be large enough to house all of the smart chip components while remaining small enough to fit through propeller blades in a digester sensors (Mohammadi, 2011).

2.3.4 Digikey

Digikey is advertised as a rapidly growing customer centric electric component distribution company. Digikey claims to be the 5th largest electric component distributor in North America, with annual sales of $1.5 billion. products and exceptional service. Digikey's catalogue contains half a million products and ships 99.9% of its products in the same day as they are ordered. Digikey is located in Minnesota (Digikey, 2011).

We plan to use Digikey as our source of microcontrollers, batteries, and RFID components. In addition to being domestically located, Digikey has competitive prices and a fast and reliable order fulfilment system.

2.3.5 Newark

Newark is advertised as having the broadest electronics selection and most innovative services since 1934. Newark claims have 400,000 parts in its warehouse with access to an additional 4 million more. All 4.4 million parts are available through their online catalogue. Newark is located in Chicago (Newark, 2011).

We plan to use Newark as our source of flash memory due to their low costs. Digikey and Newark are interchangeable suppliers for many smart chip parts. Cost will be the overriding decider between these two suppliers.

2.3.6 APCircuits

APCircuits is advertised as being a manufacturer of double-sided, plated-through hole, printed circuit boards with a specialty in quick-turn, small quantity orders. In addition to low quantity specialty created orders, APCircuits has the capability of performing production level runs of manufacturing. APCircuits is located in Alberta (apcircuits, 2011).

We plan to use APCircuits as our source of printed circuit boards due to their low cost and their ability to quickly create low quantity level order runs. Low product level runs are important when in prototyping and early development stages.

2.3.7 Analog

Analog is advertised as defining innovation and excellence in signal processing. Analog lists amplifiers, data converters, audio/video products, broadband products, power management, mems and sensors, and fibre optics as items they currently carry. In 2010, Analog had revenues of $2.8 billion and has offices worldwide (analog, 2011).

We plan to use Analog as our source of analog-to-digital converters due to their low cost and wide selection. Having a wide variety of analog-to-digital converters will help provide flexibility in product design as the product matures into becoming commercially viable.

2.3.8 McMasterCarr

McMasterCarr is an online retailer of light industrial and mechanical parts. McMasterCarr lists fasteners, joiners, power transmission parts, seals, sealants, filters, and electrical wiring & connectivity among the items they carry in their 480,000-part catalogue. McMaster is a privately owned company (McMaster, 2011).

We plan to use McMasterCarr as our source of pins to manufacture conductivity sensors due to the low cost and wide selection of small pins. Having a diverse selection of pin sizes will provide allow for changes in product design without relying on the need to customize pin sizes as the product evolves.

2.4 Kraft Digester Sensor Manufacturers

In the pulp and paper industry, a few top competitors share a disproportional amount of the market share (Patrick, 2006). In the pulp and paper equipment market, there are a limited number of competitors (Metso2, 2011). We have identified two of the top competitors that sell substitute sensor products as being BroadlyJames (BroadleyJames, 2011), and Emerson Process (Emerson, 2011).

2.4.1 BroadleyJames

BroadleyJames is a North American and European designer, manufacturer, and marketer of measurement and control products for industrial and scientific use. The industries that BroadleyJames actively markets to are agricultural, food & beverage, mining, waste water, and pulp & paper. BroadleyJames is a privately owned company (BroadleyJames, 2011).

BroadleyJames manufactures probe style sensor packages which measure temperature, pressure, and ph. These probes are protected in a canister like housing, which is mounted to the sidewalls of a digester or pipe. These probes are mechanically levered into the digester environment as far as 2" to allow for readings. These probes come in three industrial grade levels (BroadleyJamesProcess, 2011).

2.4.2 Emerson Process

Emerson Process is an international manufacturing company that provides innovative solutions by combining technical and engineering expertise. Emerson provides process management, industrial automation, climate technologies, and tools and storage services to its customers. Emerson has process management divisions in the chemical, food & beverage, life sciences, liquefied natural gas, oil & gas, power, pulp & paper, refining, and waste & wastewater industries. Emerson is headquartered in St.Louis and currently employs 127,000 people worldwide. In fiscal 2010, Emerson had profits of $2.2 billion on revenues of $21 billion dollars.

EmersonProcess produces a line of stationary sensors that measure either the pressure or temperature of digester contents at the intake and output areas (Emerson, 2008). This line of industrial sensors is branded as Rosemount. Rosemount consists of a variety of industrial grade mounted temperature sensors and pressure sensors. A Rosemount pressure sensor can withstand pressures of up to 300 psi while temperature sensors can measure furnace level temperatures (EmersonProcess, 2011).

2.5 Competitive Analysis

To perform a competitive analysis, this paper will utilize Porter's Five Forces model. Porter's model views the internal and external environment of a company across five dimensions and determines whether each dimension is classified as being either high or low. The five dimensions of Porter's model are the threat of substitute products, the threat of new entrants, the bargaining power of customers, the bargaining power of suppliers, and the intensity of rivalry among competitors (Porter, 1979).

2.5.1 Threat of Substitute Products

The threat of substitute products or services refers to what degree alternative products exist in order to understand the likelihood of a customer using different means of meeting their needs (Porter, 1979). The threat of substitute products in this industry is low.

Currently, the pulp and paper industry uses proven technology in the form of stationary sensors to measure and control their processes. While the Product is differentiated from traditional sensors by its ability to use the Flow Method, this alone does not make it a substitute technology for stationary sensors. At the time of this paper, there does not appear to be a practical alternative for measuring the pressure, temperature, and conductivity of a Kraft digester.

2.5.2 Threat of New Entrants

The threat of new entrants will directly correlate to the profitability of a market. For example, if a market is extremely profitable, this will encourage competitors to risk more resources to gain entry in the market. Balancing these enticing profit margins are barriers to entry, which help offset the attractiveness of a given market (Porter, 1979). The threat of new entrants in this industry is high.

The capital costs required to develop and market industrial grade sensors is somewhat high. To help lower this barrier to entry, Canadian pulp mills have a history of partnerships with research institutions such as FPInnovations, which help bring innovative technologies for the pulp and paper industry to market in an economical manner. These potential joint partnerships would act as independent entities from the parent companies that created them and would be companies of their own (FPInnovations, 2011). To help decrease the threat of these potential new entrants, the company plans to acquire a patent for the smart chip technology. Unfortunately, patents like this typically do not significantly increase the entry barriers in the electronic-based market.

2.5.3 Bargaining Power of Customers

The bargaining power of customers refers to the ability of customers to leverage their buying power against the firm (Porter, 1979). The bargaining power of customers in this industry is high.

The pulp and paper industry in Canada is served by a handful of large corporations, which account for the majority of the production (Patrick, 2006). As this paper has listed in section 2.2, these top firms have revenues in the range of billions of dollars and are therefore able to purchase quantities of smart chips that would outstrip current production capacities. To help lower the bargaining power of Customers, the added control, and therefore manufacturing cost savings, provided uniquely by the Product must be highlighted and emphasised during marketing and sales processes. Further, given the high cost of pulp mill infrastructure, the cost of white liquor used in the manufacturing process, and the cost of energy to operate a Kraft digester, the price sensitivity of the Product to the pulp mills can be considered low; therefore, the pricing levels for the smart chip can be aggressively priced.

2.5.4 Bargaining Power of Suppliers

The bargaining power of suppliers refers to the ability of suppliers to leverage their selling power against the firm (Porter, 1979). The bargaining power of suppliers in this industry is low.

The abundance of competitors in the microelectronics marketplace has led the technology to become commoditized (Grace, 2011). As this paper has listed in section 2.3, there are hundreds of firms in North America competing in the electronics market (Digikey, 2011). With low switching costs, we intend on periodically resourcing our materials to insure we are capitalizing on our cost savings as much as possible.

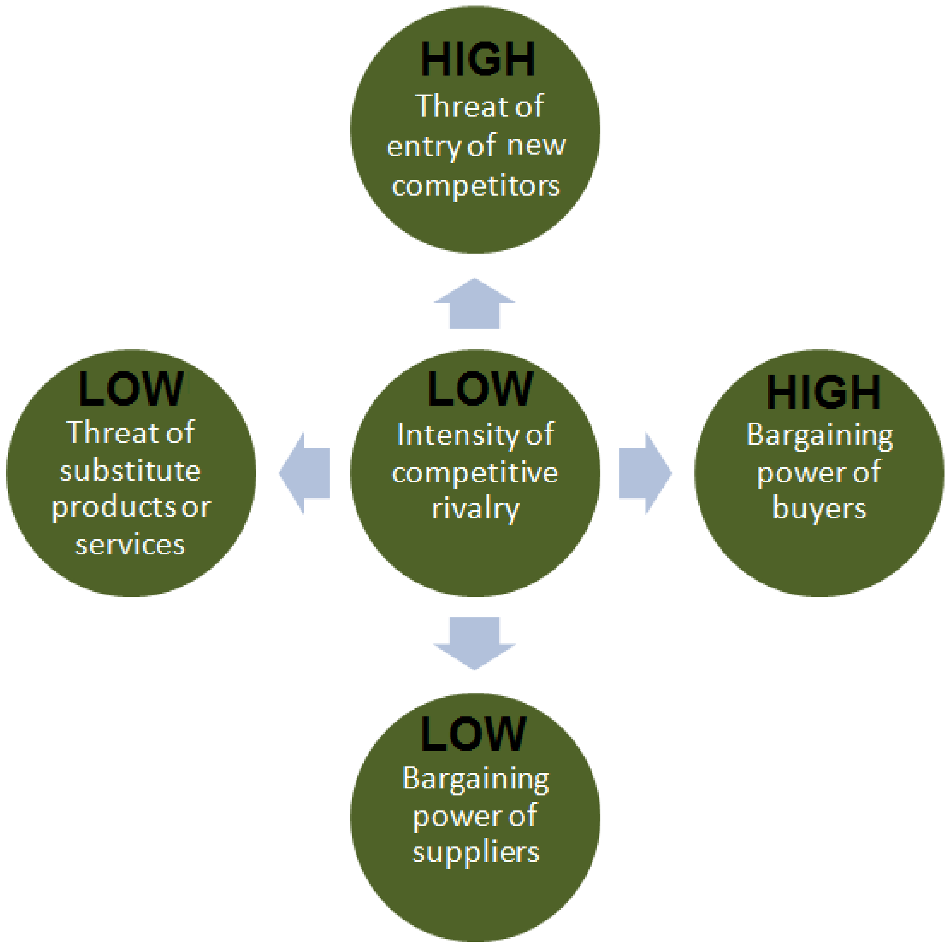
2.5.5 Intensity of Competitive Rivalry

The intensity of competitive rivalry plays a large factor in the competitiveness of the entire market (Porter, 1979). We view the intensity of competitive rivalry as being low. Segmenting the market into flow following sensors compared to stationary sensors will allows the firm lower the intensity of competitive rivalry with the few, large competitors listed in section 2.4.

2.6 Summary

In this chapter, we analysed the market by looking at the industry background, customers, and suppliers before concluding with a competitive analysis. In the industry background, this paper showed how the pulp and paper industry has grown to be a major component of the Canadian economy, and how the industry embraces innovative solutions. This chapter then looked at how the Canadian pulp and paper industry is dominated by a handful of key competitors. This chapter then looked at a few of the many potential suppliers of parts for the Product. This chapter concluded by performing a competitive analysis of the Kraft Digester sensor industry to find that the threat of new competitors and the bargaining power of buyers is high while the intensity of competitive rivalry, the threat of substitute products, and bargaining power of suppliers are all low.

Figure 6 Summary of Competitive Analysis using Porters 5 Forces



(created by T. Tucker, adopted from Porter, 1979)

3: Business Strategy

In order to describe the business strategy for smart chip technology, this chapter is broken into three sections. The first section is an analysis and business strategy for bringing the product to the industry for testing. The second section is an assessment of potential industry partners and further financing based on the test results. The third section is an analysis and business strategy for bringing the Product to the commercial market in Canada. For each phase, the analysis will involve determination of economic feasibility, marketing strategy and operations and implementation required for the Company to succeed.

3.1 Phase I – Industry Testing

3.1.1 Economic Feasibility and Technical Reliability

The Company's management has determined that, at this time, the Product is not sufficiently accurate to sell to the large pulp and paper industry customers that the Company has identified as its target market (see Chapter 2). A formal application of the commonly used S-curve theory below shows that the technology is economically feasible in its current state and with the proposed modifications indicated by early testing, but not technically reliant, in agreement with management's initial conclusions.

The first of the two criteria – economic feasibility - can be judged by comparing the cost/benefits of implementing a new technology. The Company has estimated costs to produce the Product from the costs of individual components in the current market. The Company's management estimates the current cost to manufacture the smart chip and casing at $105 per unit (see Chapter 4, Financials, for component and cost information). The Company's management believes a conservative estimate of the Product's lifetime expectancy to be one (1) week in a typical Kraft digester. This one-week estimate is used in this chapter of the business plan, but may be refined after the industry testing is complete. Each batch of wood chips will require approximately 100 individual Product sensors to allow for data normalization, and the Company intends to conduct industry testing and to market the Product in the future on the 100 per batch basis. Therefore, an estimate of the total cost of the new technology, per digester, per year is ($105 * 100 * 52) $546,000.

The Canadian pulp and paper industry produces $7.449 billion worth of pulp annually. Splitting this gross figure across the 140 pulp mills actively operating in Canada gives an average of $53 million worth of pulp per year per mill (FAOSTAT, 2011). The Company does not have sufficient data prior to the industry testing to evaluate the percentage improvement in efficiencies that the Product will produce, and is assuming for the purpose of this business plan and marketing a conservative average estimate of 3% efficiency improvement in the Kraft process for each mill. The efficiency may arise from decreased use of energy in the process, decreased use of white liquor and other consumables, and improved efficiency in extracting the lignin, which results in greater production from smaller batches of wood chips, each of these factors a potential decrease in production costs. Alternately, the Product may improve efficiency by decreasing production time for each batch of wood chips, leading to increased production and increased sales. After the industry testing the Company will be better placed to analyze the economics of the Product. The 3% estimate of increased efficiency represents a cost savings to each mill of approximately $1.59 million dollars per year in gross pulp production.

The calculated annual cost benefit for each mill is $1,044,000 ($1,590,000 increase in gross production minus $546,000 cost of Product). Based on these assumptions, there is an annual cost benefit of 191%, creating the ability for the Company to profit from production of the Product while marketing the Product on a cost-saving basis to the producers.

The Company has not conducted a price analysis and comparison with the existing external sensors primarily used in the industry because the Product is not designed to be equivalent to such sensors at a lower cost, but to improve processing and efficiencies, showing a direct profit to producers from use of the Product. The costs of existing external sensors may be deducted from the operating costs of a mill, and could represent further benefits to a producer, but the Company will not be emphasizing these savings in connection with the industry testing of the product, or at any time prior to the fully developed Product being in commercial production and use in the Canadian market.

The second criteria for determining if a technology has crossed the threshold for commercial application in the S-curve theory is whether the Product is technical reliant. The pressure, temperature and pH (indirectly through conductivity) sensors were discussed in Chapter 1, along with the initial test data for each sensor and proposed mechanisms to improve the sensors. The initial test data did not meet the Company's expectations, and has motivated several technical changes that will affect the costs (further described in the paragraph below), and the concept of the additional industry testing as a marketing and development step. While the Company acknowledges that the Product, in its current state, is a more advanced technology than the existing external sensors and provides data based on the flow of the slurry, the Company believes that it is in its own best interest to pursue further development before bringing the Product to commercial production.

The Company proposes to implement 2 of the technical changes for the industry testing phase. At a cost of $50 per RTD temperature sensors, the company does not feel the cost justifies the small gain in accuracy. The changes and associated costs are:

- Pressure Sensor
    - add an additional pressure sensor at cost of $5 per sensor
    - result: increased cost to $110 per unit
- Conductivity Sensor

- add a basic housing or ‘cage’ to the sensor to prevent wood chip blockage at a cost of $5
- result: increase cost to $115 per unit

At a price per unit of $115, the analysis above for economic feasibility is revised as follows: The calculated annual cost benefit for each mill is $992,000 ($1,590,000 increase in gross production minus $598,000 cost of Product). Based on these assumptions, there is an annual cost benefit of 166%, which maintains the ability for the Company to profit from production of the Product while marketing the Product on a cost-saving basis to the producers.

However, the Company has still determined that the Product is not technically reliant and cannot be made so without further testing after the additional components are added, and this is the basis of the Company’s decision to pursue the industry testing. The Company’s business strategy is based on its belief that, because the Company is unknown in the industry, and because management wants to build goodwill with a reliable first product, the Product must be developed further prior to effective marketing which would benefit the Company in the long run. The Company’s management does not want to commercially produce and market a product that is not fully developed and in which it does not have complete confidence.

3.1.2 Operating Strategy

The Company's operating strategy in this first phase (industry testing) is to produce: (i) the current Product for distribution to low-end customers; and (ii) the modified Product for distribution and testing to middle and high-end customers. This approach is based on management's analysis of the Disruptive Technology model developed by Clayton Christensen (Christensen, 1997).

Christensen differentiates between customers based on a gradient of their performance needs (low-end, middle, and high end). The theory suggests that targeting low-end customers who presumably have lower profit margins, with a product that fulfils their lower-performance needs while providing enhanced features at a lower cost is the key to establishing an innovative product. Once the innovation has a foothold in the market, the Company would work on improving performance to capture more of the market share from middle and high-end customers.

Within the concept of the Disruptive Technology model, the Product can be leveraged: (i) in its current state to low-end customers where the pulp produced in the digesters is not a premium product, and all process measurements can be approximate (i.e. for batches of low grade paper products); and (ii) in its modified state to high-end customers. This approach adopts the Christensen model at the low-end level in order for the Company to commence operations and start market exposure, and also incorporates the remainder of the industry for the testing necessary to improve the Product.

In each case the Company proposes to supply the Product to the producer at no cost in exchange for the producer's data from the sensors and a return of the used sensors for examination. Having both the current state sensors and the modified sensors used in the market will give the Company better information on whether the modifications performed as expected. Specifically having low-end users test the current state sensors will determine if the Product is viable in any capacity in the current state. Recovering the units from the producers will enable the Company to consider the physical wear on the sensors and units, and consider further development.

The operating strategy of starting with an undeveloped product and a small production run for industry testing will have several benefits for the Company. The Company itself is in its infancy with two owner/operators who have little experience working together and working in this market. The industry testing will allow the firm to allocate scarce resources to:

- building initial distribution channels
- allow for customers to give feedback at a time when the firm is nimble enough to rapidly make changes
- build rapport between the owner/operators

3.1.3 Marketing

The Company has analyzed the Product for marketing based on the Crossing the Chasm model developed by Geoffrey A. Moore (Moore, 2002). Moore's chasm theory argues that the technology lifecycle can be broken into progressive customer market segments based on adopter profiles, and moving from one segment to another requires unique marketing strategies must be executed in order to fulfill the wants and needs of that particular group. At the industry testing phase the Company is looking for: (i) an investor to provide capital for production of the test units; (ii) participation from the industry in general for the testing; and (iii) one of the producers at the large, high-end level to endorse the Product and commit to further research and development with the Company (see Section 3.2).

First, the Company must successfully market the Product and the business plan of the Company to an investor to secure production costs for the research and development. The opportunity will be presented as an early-market research and development investment, in exchange for an equity interest in the Company. Management estimates that a capital investment of $2 million (see Chapter4) is required to produce the Product for the industry testing.

The Company will market this investment opportunity to:

(a) UBC, in connection with its negotiations for use of the required intellectual property and development rights. The Company's management has contacts at UBC and anticipates that in-person meetings will be easily obtained to discuss the development of the Product as a partnership or joint venture. UBC is also a likely source of start-up funds and resources for production space, as well as a good place to seek out any labour force required for development.

(b) Private investors and local equity funds. The Company's management will look within the Canadian market for small high-risk equity funds and private investment groups and approach the potential investors with the business plan and presentation. Management will locate investors through personal contacts in research and development and the business community, primarily in British Columbia. The Company will also correspond with pulp and paper industry associations to obtain information on potential private investors.

(c) Public Grants. The management team was introduced in connection with a public grant from British Columbia Innovation Council. The Company will actively canvass the sources of public funds for entrepreneurial projects, and will consider formal research grants from academic institutions.

(d) Bank Debt. An alternative to equity financing is conventional bank debt. The Company will consider this if no equity investors are located and the management decides to continue with development without a strategic partner.

Second, and concurrently in time with the marketing of the investment opportunity, the Company will begin marketing the Product as a test-product in the industry. The Company will build industry contacts by attending events, will raise awareness for the product by attempting to publish the initial testing results and other information in industry publications and journals, and will utilize the services of the FPInnovations for information on which producers and pulp mills may be best suited to test the Product. The Company intends to test at only 12 of the 140 pulp mills in Canada, and will focus on pulp mills in British Columbia to decrease travel costs when working with the producers. Because the Company is offering an effective ‘free-trial’ of its product and can show the initial testing results and product, management believes that participation from 12 pulp mills is obtainable through the efforts of the current management.

In connection with the distribution of the Product for testing, a website will be set up with technical details and contact information provided to allow the testing producers to learn from and interact with the Company’s developers. Management will be available to discuss the testing on an ongoing basis, and will be involved in analyzing data as it is produced. Test data from the pulp mills will be transmitted to the website or on paper, based on the preference of the test producer. The Company contemplates that each producer’s data will be private to such producer and the Company, and are aware that industry competition must be respected in dealing with different competing producers during the testing phase.

3.1.4 Operations and Implementation

To implement the industry testing the Company will need to: (i) secure rights to develop the Product; (ii) establish relationships with suppliers for the components (see Chapter 2 for discussion on suppliers) of the Product; and (iii) either create an in-house workforce for assembly, or outsource assembly of the test units.

The Company anticipates that management’s connections with UBC and UBC’s progressive attitude to industry partnerships (UBC, 2011) will be sufficient to obtain a licence or other right to research and develop the Product. The exact legal relationship cannot be predicted, but the Company is also interested in utilizing UBC's resources to the greatest extent possible, including for start-up capital, production space, and workforce sourcing. These issues and potential for collaboration will be pursued by management in discussions with UBC.

To a great extent relationships with suppliers for the components will be internet based, as all of the components except the conductivity sensor are commoditized and easily obtained. Rather than purchase off the shelf conductivity sensors, it is much more feasible to install small pins directly attached to the electronics on the Product. The actual pins required for this installation will also be procured through an online retailer.

Decisions to create an in-house workforce or to outsource production will depend on the specific equity investor and whether such investor has available resources to contribute. If the investor has facilities appropriate for production that they are willing to contribute in lieu of a corresponding portion of the development costs, the Company may product the Products for testing at the investor's facilities. This could be the case if the investor was an academic or industry participant, or if the investor was a private individual or group with other similar production investments and available facilities. The Company is also able, through management contacts in the research and development field, to contract for production space and to hire temporary skilled employees to produce the test Products. Costs for such production are discussed in Chapter 4. A final choice is to outsource production to an independent company. Management is the least confident in this approach because it will not have daily direct supervision over quality control, and will pursue facilities from the investor or from known sources in research and development prior to engaging an independent contractor.

3.1.5 Conclusion of Industry Testing

At the conclusion of the testing phase the Company will have exhausted its capital from the initial investor, and the Company (now with the equity investor involved), will need to consider the data to determine if the Product is commercially viable to low-end users in the current state, and if the modified Product with the additional sensors and caging for the pH (conductivity) sensor meets performance expectations for the high-end users. Financial parameters will need to be re-assessed.

3.2 Phase II – Development with Technical Enthusiast

At the conclusion of industry testing the Company intends to focus on one of the large high-end producers that participated in the testing and develop a specific relationship with the producer as a participant in the further development of the Product, and as the Company's first customer receiving individual and customized services. The Company is again basing its approach to the market on the Crossing the Chasm model developed by Geoffrey A. Moore (Moore, 2002). Specifically, the Company is seeking to engage an "Innovator" or a "visionary" from Moore's chasm theory to try out and learn the new technology and be interested in additional research and development of the Products. Innovators are technical enthusiasts that are willing to provide knowledgeable feedback if they are in contact with the technically knowledgeable people at the Company. Visionaries are looking to match a new technology with a strategic opportunity to move their organization forward (typically newly minted executives with large cash budgets) (Moore, 2002).

3.2.1 Economic Feasibility and Technical Reliability

The market conditions and component costs will be assessed to determine economic feasibility and the industry test data will be analyzed to determine if the Product, as currently constituted and as modified with additional sensors and caging, is technically reliant.

The Company anticipates that over the one to two year testing period the cost of the individual components will remain the same or decrease based on further commoditization of such parts. The production of the conductivity sensor should certainly commoditize over the same time period as technology develops, and the Company will build up its expertise in producing this component. The Company will also spend time resourcing lower supply costs and expects to discover, through the production of the units for the industry testing, at least some minor adjustments to the product assembly stages that would reduce production time for each individual unit. Conversely, costs for raw materials of the underlying components may increase. Overall, the Company estimates that the production costs for the individual Product units will remain the same over this time period and the Product, as modified, will continue to be economically feasible in this Phase II.

In order for the Company to proceed with the current business plan, the Product as currently constituted or the modified Product must meet the expected ranges for the three sensors (described in Chapter 1), or the test market must indicate an interest in the Product at lower sensitivities. If the modified Product is not technically reliable and the market is not interested in the Product at its test performance levels, the Company will have to reassess the Product and the market, and anticipates that creating a viable product would require a significant re-focussing and a potential change in industry away from the pulp and paper market into a market with less specific production requirements. The Company's management is confident that the modified Product will be sufficiently accurate and represent a technically reliable Product that the Company can be confident in marketing and developing, and the Company's business plan is predicated on the success of the industry testing phase. However, as described below, the Company is still taking a slow and orderly approach to further development and recognizes that the modified Product may require further research and development.

3.2.2 Operating Strategy

The Company's operating strategy in this second phase (development with a technical enthusiast) is to select and engage one of the high-end test producers (the Technical Enthusiast Customer or "**TEC**") in a strategic partnership for further development of the Product. The TEC will be, by necessity, a technical enthusiast, and will be one of the industry test producers that the Company was able to establish a successful relationship with during the testing phase.

The Company will enter into further development and testing of the modified Product with the TEC, with the intent of refining the Product for the remainder of the pulp and paper market. The Company will not supply the Product and conduct the analysis for free as it did in the test phase, but will negotiate the research and development at cost plus an insubstantial mark-up (30%). Alternately, the Company may offer other financial incentives to the TEC if the TEC supports the development costs, including a discounted Product after successful development, or an interest in future profits of the Company. The Company will not seek to involve the TEC as an equity investor.

The TEC will have the advantage of becoming the Company's first customer and the Company intends to incentivize the TEC further by customizing the Product for the TEC. Over time and future commercialization, the Company expects to be creating customized products for all customers, but the TEC would enjoy this market advantage months, if not years, prior to its competitors. Individualization of the Product will be beneficial to the TEC because each batch of wood chips and intended paper product could receive specific treatment in the digester, rather than one setting for all products, further lowering the TEC's costs and potentially improving the TEC's paper products. Whether the Company can offer customization to the TEC will depend on the industry testing results and the TEC's appetite for exploring new technology.

The Company believes that this phase of the development will be necessary to refine the Product and to break-open the market by establishing a successful supplier-customer relationship with a large high-end industry participant. It is possible that after industry testing the Product would be endorsed by so many of the test producers that this phase is not necessary, but the Company would still require additional capital to produce and market the Product, and the small size of the Company dictates a cautious approach to the commercialization process. The Company's management believes that working with one TEC is preferable to a scattered approach with multiple customers that each have a specific request to customize the Product, and where the Company is forced to obtain debt financing to produce multiple Products rather than focus on perfecting the Product at the cost of the TEC, marketing the standard product, and approaching customization in the future (see phase III, Commercialization).

3.2.3 Marketing

At the development with a TEC phase, the Company must market the modified Product as an opportunity to its industry test producers. The Company will identify the TEC based on the developed relationship, and will consider: (i) producer's history of commitment to internal research and development; (ii) producer's placement in the market; (iii) producer's available cash flow; (iv) stability of producer's business. Additional factors may include the producer's willingness to be involved with an external supplier (which the Company intends to become), and the Company's growing industry knowledge of the corporate personalities of the large, high-end producers.

Marketing the development opportunity to the chosen TEC will involve management presentations, technical data exchange, and negotiation of the further research and refinement costs. The Company is confident that a TEC will be identified from the industry test producers, as the Product (assuming technical reliability and economic feasibility as discussed above) offers the TEC an industry advantage. Large, high-end producers have a history of research and development and may budget for these opportunities. (Moore, 2002)

If the Product is commercially feasible but the Company cannot partner with a TEC, the Company would consider marketing the Product to additional private investors on a future profit or royalty basis, and may consider incurring debt financing to produce the Product for market. These options are not developed in this business plan.

At the same time as the development of the Product with the TEC, the Company will continue to promote its branding within the industry by publishing compilations of the test results in academic and industry publications, marketing at trade shows, presenting at conferences, and working within the industry associations and societies to self-promote. The Company will consider commercial advertising to the extent that it has excess resources (from the initial capital infusion for the test phase or from other sources). The Company will maintain a strong presence on the internet at this stage, and intends to continue communication with the industry test producers on a regular basis through corporate email updates and personal contact.

3.2.4 Operations and Implementation

To implement the second phase of the business strategy the Company will need to: (i) establish a relationship with the TEC; (ii) maintain existing research and development facilities and utilize the TEC's pulp mills; and (iii) maintain supplier relationships.

The Company's approach to developing a relationship with a TEC is discussed above. The Company's management will be responsible for establishing the relationship.

The business strategy of this second phase is to utilize the TEC's economic resources for development, and to also use the TEC's pulp mills as the test facilities. The Company does not anticipate requiring other test sites for this TEC specific development, but would plan on maintaining any research and development facilities that the Company owned or leased during the test phase so such would be available in phase three (commercialization).

With respect to obtaining supplies and creating the Product, the Company expects that the relationships developed in phase one will be used. The Company's approach to suppliers will be to build long term relationships, rather than to switch suppliers. The Company's management sees a potential advantage in long term relationships if the Company (in commercialization) is seeking a slightly modified product or is beginning to branch into new markets and wants to negotiate with a supplier to create a new type of sensor.

The Company will require a smaller workforce to create the Product during this phase. This workforce may be supplied by the TEC, may consist of the Company's managers, who have the required technical skills, or the Company may retain a small portion of its original workforce. The specific approach would be discussed with the TEC and would be based on available facilities.

The Company's other activities (marketing, other research) would be conducted by the Company's management.

3.2.5 Conclusion of TEC Development Phase

The Company's goal at the conclusion of the TEC development phase is to have one large, high-end customer that endorses and has found economic advantages in the Product, whether customized further form the modified Product in phase one or not. This is consistent with Moore's theory that one innovative TEC can open a market to new technology and provide the Company with a starting point for commercialization.

At this time in the Company's relationship with the TEC, the Company will transition to profiting from the sale of the Product to the TEC on the terms negotiated, including any incentives the Company provided to the TEC as an inducement to participate.

As at the end of phase one, at the conclusion of phase two the Company will have limited capital and cash flow, and will need to determine if the Product is ready for commercialization. Financial parameters will need to be re-assessed.

3.3 Phase III – Commercialization

Commercialization of the Product (including any modifications from the TEC development stage) will only occur if the technology has proven to be economically feasible. To succeed with commercialization the Company will have to penetrate the market and convince the industry to switch to the new technology. Looking further into Moore's theory the shift in operating strategy will be to cross the chasm from the TEC innovator and of the low-end early adopters that continued to use the sensor in its initial state, to the primary market in Canada. These untouched market segments will make up the bulk of the revenue from the Product's lifecycle, but the customers will not be as willing to adopt the technology (Moore, 2002).

3.3.1 Economic Feasibility and Technical Reliability

As discussed in phase one and phase two of the business operations discussion above, the Company has estimated the economic feasibility of the Product based on current components and proposed modifications. A further assessment will have to be conducted based on any structural or component changes from the phase two research and development. The Company's current business plan as set out herein assumes, based on the current cost of components and production, that the Product will remain economically feasible even with substantive changes. It is a reality that the component costs are low and the Product is expected to show substantial cost savings to pulp and paper producers, leaving the Company with a safe profit margin. If the Product is not commercially feasible after the TEC research, the Company may choose to abandon the technology or look for new applications for the Product's smart-chip technology.

If the Product does not reach technical reliability standards that the Company's management believe are sufficient to enable increased efficiency in the Kraft process, the technology may be abandoned and the Company's resources focussed on other markets. The phase two research with the TEC should provide sufficient data to the Company for this final assessment. The Company's current business plan assumes that the Product is technically reliable at the commercialization stage.

3.3.2 Operating Strategy

The Company's operating strategy in this third phase (commercialization) is to (i) target all of the industry test producers from phase one (the "**Known Customers**") with the Product in the marketable state; and (ii) initiate contact with the remaining producers (the "**Unknown Customers**") in the Canadian market.

The Company will have continued contact, and will have been providing update reports on the technology, to Known Customers throughout the second phase of the Product development, and will be able to personally notify these customers of the commercialized product and how it can be purchased. The Company will allocate a specific sales team to this group, see further discussion on marketing below.

The Company's work in the industry during phase one and two will have positioned management to contact executives, technicians and buyers for the Unknown Customers: potential customers that have yet to test the Product. Management will have personally met these people when attending trade shows, presenting articles published in websites, and some Unknown Customers will have heard about the Product in use during industry testing and the TEC development phase. Having the Product in use by the TEC and the industry test producers was a part of the deliberate marketing process to show Unkown Customers the potential of the Product.

The Company's operating strategy will be to establish itself as the leading supplier of flow-following micro sensors for pulp and paper digesters. The Company may emphasize the potential further customization of the Product for individual customers if that was successful in the TEC development stage.

3.3.3 Marketing

In the phase three, commercialization, the Company has completed research and development and feels comfortable that it has a valuable product for its identified market (pulp and paper producers in Canada). Marketing for the Product will be similar to marketing for innovative products in other industries, with the added advantage that the Company will have one large, high-end customer (the TEC) as a success story for other potential customers.

The goal of the Company is to position itself as a high-end technology producer for this industry, with potential to market flow through smart-chip technology products into other industries in the future. The Company's Product is innovative and would supersede the existing external sensors used in the Kraft process, and based on the Company's research into the current industry there is no competitive flow through sensor for the market. See further analysis of competitors in Chapter 2.

The Company's marketing strategy with Known Customers will be the first prong of marketing, and will involve direct management supervision to identify targets and capitalize on existing relationships. A dedicated team of highly commissioned sales persons will focus first on these Known Customers. Looking at Moore's marketing theory, to be successful with this group the Company will have to present itself as established, with a proven technology. Leveraging the relationship with the TEC will be valuable, as will the Company's exposure in the development years through industry functions and publications. Increased frequency of exposure to the Company's name over time will enhance the sales' staff ability to sell the Product. The Company also believes that there will be value in the relationships the management has built during the years of Product development. This segment of the market will be the beach-head, or a niche market to which one allocates all resources, of the Company's marketing scheme (Moore, 2002). The Company will also segment this market geographically, first approaching pulp mills in the same Province as the TEC who may be more familiar with the Company's success.

The key to the Company's economic viability is to secure the Known Customers. This first stage of marketing will be the sole focus of the Company until the majority of the Known Customers have purchased the Product, or the Company has exhausted reasonable avenues of communication.

The second phase of the Company's marketing plan will involve a targeted approach to the Unknown Customers. The Company's management views these potential customers as the late majority from Moore's theory (Moore, 2002). The two keys to successfully marketing to the late majority are:

1. Present a complete solution. Where the TEC understood and accepted raw technical solutions, the late majority will want a polished product that meets all of their needs. By the time the Company is marketing to the Unknown Customers, the Product will be fully developed and in use by a large percentage of the market.
2. Low overhead. The late majority will be more price sensitive than the early majority (Known Customers) and will not be willing to pay premium prices for what may have become older technology. When the Company reaches this stage of marketing, it will assess the cost of the Product to the Unknown Customers if the technology is no longer the best available.

Marketing to the Unknown Customers will be conducted by a high-commission sales staff who have the necessary technical knowledge of the Product.

The Company intends to continue its general marketing to the pulp and paper industry through the channels it established in the development phase: conferences, presentations, articles, personal contacts, internet sites and publications, and will initiate user feedback channels for its customers. The Company's management will focus throughout phase three on the corporate branding and will consider working with public relations specialists and other branding techniques. Finally, the Company's management will continue to look into other industries for development and marketing opportunities for the Product or a related flow-through smart-chip sensor.

3.3.4 Operations and Implementation

To implement the third phase of the business strategy the Company will need to: (i) create a sales staff; (ii) create marketing materials (e.g. electronic, paper) (iii) obtain funding for production; (iv) expand or maintain existing production facilities; (v) maintain supplier relationships.

The Company's management will identify and hire skilled sales staff through existing connections in the sales market. The sales staff will be directly supervised by a manager, and will be responsible for meeting targets, with basic incentive structures for high sales. The Company may incentivize employees with stock options, but such a structure would have to be considered at the start of commercialization. Sales staff will, ideally, be located in an office environment either at the Company's production facilities or the Company's head office, if such are different locations. The sales manager will be the first hired, and the management and the sales manager will jointly develop the sales strategies and marketing materials for the Known Customers. Secondary marketing materials for the Unknown Customers will be developed later, when the manager and the management have refined the sales process.

Funding for production is expected to be obtained through conventional bank and commercial financing for businesses. The Company will operate with an operating line of credit, and likely a commercial loan. Accounts receivable will be pursued by sales staff if outstanding. Alternatives to the debt financing would be to involve an additional investor on a profit or royalty basis, but the Company would only be looking for a short term relationship with such investor to initiate production, and this would be an unconventional arrangement. If none of the above options are available the Company's management will consider shareholder loans (personal debt) or involving another equity investor for the necessary capital to start the first six months of commercial production.

The Company wants to, at this phase, locate and lease its own production and office facilities, which may be the same location. Production facilities will be small if the Company is only pursuing additional research and development for customization and has out-sourced the physical production of the standard Product, or will be larger if the Company is assembling the Product from the components in-house. The Company's management will base the location of the assembly on economic parameters and current demand for the Product – this may be a fluid part of the business. A small conventional office space will be established for the sales team and management.

The Company will continually assess its relationships with suppliers and the market for the components, trying to create long term relationships where they are economically beneficial to the Company, and switching suppliers when required. At the commercialization phase the Company will specifically re-assess the economics of each supplier it has used and negotiate bulk prices for the upcoming increase in production.

The Product will be priced based on an updated assessment of the production costs and the efficiency benefit to a pulp mill, see section 3.1.1 for an example. At this time the Company intends to market the Product based on the maximization of the Company's profits while leaving the customer with an efficiency increase. If the Company is not successful with the Known Customers on this basis, profit margins for the Company may be relaxed. The Known Customers will be offered the Product at individual prices, requiring negotiation with each customer. The Company may offer bulk incentives, time commitment incentives, and contracts with different terms regarding customization, guaranteed performance, or other requests at a customer's initiative. When the Company begins to market to Unknown Customers, the Product will be a standard unit at a standard price, with options to customize in the future, and the initial contract will be a standard form. The approaches reflect the risk tolerance of each of these groups (Moore, 2002).

Customer service will be expanded based on the experience of the Company from needs of the producers in the industry testing and the TEC phase. The Company anticipates that Unknown Customers, and potentially some Known Customers, will require initial set-up in the mills with the Company's assistance. The Company's management may handle this aspect as a client relations promotion, or hire technicians to work with customers on initial batches. All customers will have access to the Company's website and phone resources, and will be able to ask questions. The Company anticipates that the production staff, or research and development staff, at the production facilities will be responsible for these queries, but would consider allocating other resources based on demand. Customer service will be very important in introducing the new technology, and the Company anticipates that the first two years of commercialization will be the most labour and resource intense in this area, after which it may be able to scale down set-up visits and resources allocated to trouble-shooting.

3.3.5 Conclusion of the Commercialization Phase

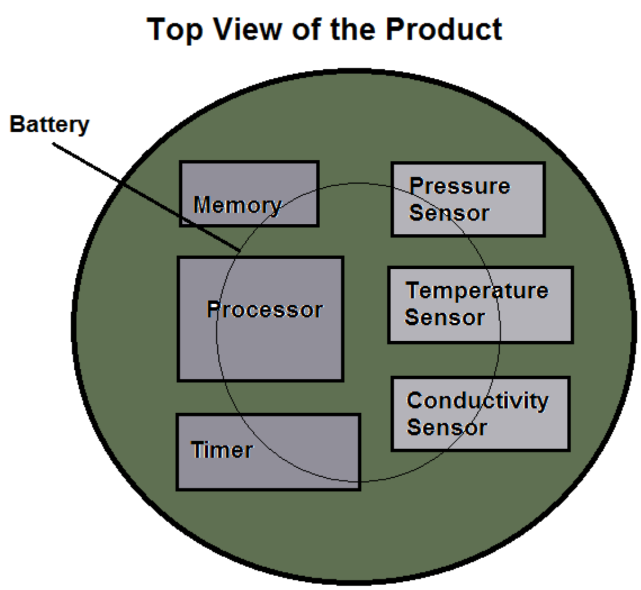
The Company is not in a position to commercialize the Product at this time, and the business plan for commercialization will remain flexible during the first two phases of the Product's research and development. Marketing and operations decisions discussed herein are based on the management's analysis of the Product and potential market (as described in Chapter 2) when viewed as an innovative technology in Moore's theory. The Company will, realistically and based on the preliminary phases, have to evaluate the commercialization phase in the future.

4: Financial Information

4.1 Manufacturing Costs

The smart chip is currently in the industry testing phase of development. The product consists of a batch of sensors to measure the temperature, pressure, and conductivity levels of the slurry. The sensors are connected each other by a printed circuit board, which also houses a battery and small amount of electronics.

Figure 7 Top View of the Product



(created by T. Tucker, adopted from Mohammadi, 2011)

On the smart chip, there are two different types of sensors: a pressure/ temperature sensor and a conductivity sensor. The price for a double temperature/pressure sensor is $9.54 (Freescale, 2011). The second sensor on the smart chip is a conductivity sensor. Conductivity is measured as an indirect way of determining the ph balance of a solution. The range of a conductivity sensor is from 100-800 mS/cm. The cost of raw materials to produce the conductivity sensors is $4.12 (McMaster, 2011). These conductivity sensors are installed at the science labs at the University of British Columbia as part of the manufacturing process.

The primary protection from the harsh environment in a pulp digester comes from PEEK containers that have a cost of $20.00 (roccarbon, 2011). In addition to this hard casing, a paralyne product (Nova HT) is used to coat the exposed sensors on the chip. The parylene coating provides a barrier to chemical and moisture ingress while at the same time offering an exceptional increase in temperature stability. The cost of coating the sensors on a single chip in a paralyne product is $25.00 (scscoatings, 2011).

There are several small electronic components in the product, mirroring those found in a personal computer. The cost of a MCU (microcontroller) for the smart chip is $5.35 (Digikey, 2011). The flash memory required for the smart chip will cost $0.93 per chip. Each chip also requires an ADC (analogue-to-digital converter) will costs $3.10 (Analog, 2011) as well as a PCB (Printed circuit board) at a cost of $3.40 (apcircuits, 2011). In order for the chip to communicate with the external terminal, a RFID module must be included at a cost of $23.00 (Digikey, 2011). Finally, a suitable battery to power the components on the chip will cost $0.93 (Digikey, 2011).

Assembly labour of a smart chip will take roughly 45 minutes, which this paper approximates to be $20.00. With this labour cost included, the cost of a single smart chip will be approximately $115.37.

4.2 Use of Proceeds/Capital Structure

In order to establish the company, we believe that there will need to be two infusions of capital. The first round of financing will be for $2 million dollars and will be needed to initiate the testing phase of our strategy. This $2 million dollars will gain 45% equity in the company. During the first six months of year one, the business will need $70,000 to finish research and development of the smart chip technology. In addition, the business will need an addition $30,000 to correspond and potentially meet the initial testers of the product.

The second six months of the first year will require the business to produce and distribute 3 months' worth of smart chips to 12 pulp and paper mills in Canada based on the recommendations of FPInnovations. In addition to distributing these smart chips, a website will be set up with technical details and contact information provided to allow technical personnel from our test phase to interact with our smart chip developers. The total cost for producing these chips will be $1.8 million dollars.

The second phase of funding will be at the start of year three. We will need $500,000 to cover operating expenses as we start the commercialization phase. The majority of this capital will be allocated to inventory production. With a viable commercial product at this point, we anticipate being able to find cheaper sources of funding during this phase.

4.3 Forecasts

Using a five year pro forma, we used aggregated 6 month estimates for the first 3 years, followed by yearly estimates for years four and five to determine our forecasts. As covered earlier, we anticipate the need for two rounds of financing.

In year one, we anticipate losing $1.9 million dollars to distributing our technology to our initial 12 test mills. Included in our estimates is close to $100,000 for development and initiating contact with co-operative agencies. In year two, we anticipate breaking even, as we anticipate our TEC will assume a large portion of our operating costs. We intend on synthesising the feedback received from various technical enthusiasts and combining this feedback with the business needs of our TEC during this time.

During the second half of the second year, we anticipating operating costs plus 30% will be picked up by the TEC. This capital will be used to further develop the smart chip. Costs for this aspect are high to facilitate rapid turnaround on the incremental changes that will be developed in conjunction with the early adopter. We anticipate the average lifespan of a smart chip to be 3 days rather than the current 7 days due to the expected changes and testing required. We anticipate using the 30% mark-up to cover operating expenses and remain revenue neutral for the year.

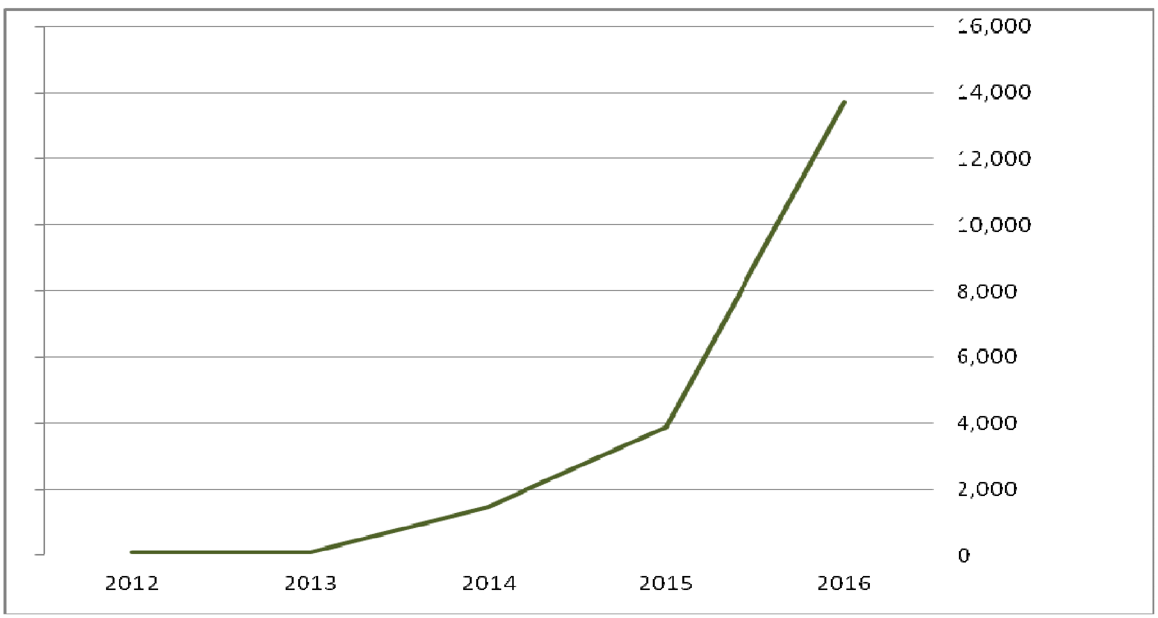
Year three sees the company move out of the early adopter phase and cross the chasm into the early majority. This beachhead will consist of tight market segments to allow the smart chip technology to establish a presence in this market. The pricing for the product during this phase will be 3.5 times cost. This pricing can be justified by being an innovative solution to market that gives a competitive advantage to the companies that first adopt it. Internally, the largest operating expenses will be on commissions for the sales staff to custom market these first crucial implementations. We have budgeted 10% sales commissions based on initial yearlong signed contracts. We have staggered our revenue projections throughout the year as we anticipate signing an agreement with a pulp and paper mill once every two months during the year three.

During year four we anticipate adding 12 customers; however, we will reduce our prices from 3.5 times cost to 2.5 times cost to reflect both the age of the technology and the market appetite for premium prices. Commission resulting from sales will remain the largest operating expense at 10% of initial sales based on a yearlong contract. During year five we anticipate adding an additional 36 customers at our new standard rate of 2.5 times cost, while commissions will remain at 10% of initial sales based on a yearlong contract. Years four and five have very similar operating expectations. During year 5 we anticipate adding an additional 36 customers. Again, the largest expense will be the combined $3.5 million dollars in sales commissions. Operating expenses over these two years will be $750,000

4.4 Valuation

At the end of our five year pro forma, we anticipate the company being having an ending cash balance of just over $13 million dollars with $0.5 million in outstanding debt.

Figure 8 Shareholder Value



The key to this enterprise will be the initial investment of $2 million dollars. In exchange for this seed capital, we are offering 45% equity in the company, which we show will project to $6.1 million after 5 years. Using a discount rate of 7%, our figures show a net present value of $2.4 million dollars for the initial investment.

5: Assessment of Risks and Challenges

The Company faces a variety of risks and challenges to overcome in implementing the business development and marketing plan. Primary risks are discussed below, including an assessment of probability and impact level of each risk and the Company's approach to addressing the risk.

5.1 Development Stage Product

The Product is currently in development and the Company does not have sufficient data on the strengths of the Product to bring the Product into commercialization. The Company believes that implementation of the technical solutions discussed in Chapter 1 will be effective to improve performance, but this will not be known until the industry testing phase. The risk that the Product will not be developed to commercialization is high because established industry producers will be difficult to engage in the industry testing and may resist new technology, and it will be challenging for the Company to effectively allocate the internal resources of such producers in tests for the Company's benefit, regardless of the potential upside to the producer in the long term. However, the Company believes that the risk of not securing producers to test the Product can be reduced by a comprehensive approach to all of the producers in the Canadian market. The Company intends to secure testing at only 50 of the 140 working pulp mills in Canada and believes that this is achievable if the Company's management is dedicated to development by working full time from the time of initial funding. If the Company is not successful in improving the accuracy of the Product for the pulp and paper industry, it will have to consider other potential uses for the Product to identify a viable economic business.

5.2 Financial Position

The Company must locate and secure initial financing for the production of the test Product, initial marketing to the industry for testing, and further development when the industry testing is complete. At this time the Company does not have the required capital to produce the test versions of the Product to be distributed to the industry for evaluation. The Company will seek an equity investor for these production costs, without which it cannot proceed. Management is committed to marketing the Product and the future development of MEMS sensor products, and though obtaining capital investment to proceed is the greatest challenge the Company currently faces, the Company is poised to meet and market to potential investors through contacts and support from the British Columbia Innovation Council, the Pulp and Paper Research Institute of Canada, The Forest Engineering Research Institute of Canada, UBC and SFU. Management would also consider public grants for research and development if suitable investors or business partners cannot be located in the private market.

After completion of the industry testing, the Company will have to re-asses its production and development needs and anticipates considering further equity investors, commercial loans, and direct partnerships with industry customers and further personal investment in the Company.

5.3 Rights to the Product

The Company must obtain the intellectual property and development rights to the Product and associated technology from UBC. Management contacts at UBC will be approached to discuss the best mechanism for establishing a corporation to use and licence the technology while protecting UBC's ongoing rights. An alternative is for the Company to attempt to purchase the technology from UBC, but this is likely a more expensive approach and, as discussed herein, the Company does not have capital to proceed with operations at this time. In either case the Company cannot proceed to produce or market the Product without the corresponding legal rights, and will endeavour to set up a long-term relationship with UBC. UBC recognizes that it is not a commercial enterprise and partnerships are necessary with the private sector to commercialize university discoveries and to see UBC owned research translated into production (UBC, 2011).

Management has experience with start-up corporations working within UBC's facilities, and there is a possibility of obtaining additional resources in the way of production space or contact employees to develop the Product when negotiating any licence or rights agreement. Though negotiations with UBC may be protracted over time, Management views obtaining technology rights as a primarily technical risk, rather than a potential halt to all operations.

5.4 Barriers to Market Entry

A major challenge for the Company are some of the typical market-entry barriers, in this case an established market with a competitive product, limited industry knowledge of Management, limited industry contacts, no established corporate branding, and significant development and start-up costs. Established competitive products and development and start-up costs are discussed as separate risk factors.

The Company's management has extensive experience in academic markets and research, in the mining industry and in the grocery industry but limited exposure to the pulp and paper industry. The Company's ability to succeed will be based in part on establishing and maintaining contacts with policy makers and management within some of the Canadian pulp and paper producers. In order to make these contacts management will have to invest in active participation in the industry, potentially including attending or exhibiting at trade shows, attending industry specific conferences, and participating in activities of the primary industry associations: the The Pulp and Paper Technical Association of Canada and The Forest Products Association of Canada, among others. In connection with establishing contacts, the Company will have to promote brand awareness as a priority. The Company's target market of large, high-end pulp and paper producers are established businesses with established relationships. Introducing a new product, produced by a new company, will be challenging. However, Company's management is confident that the lack of a brand name will not matter if the Company is able to prove that the Product can help pulp and paper mills save money or give them a competitive advantage. The Company expects to have this statistical information after the industry-testing phase, and further support for the economics after the TEC customer stage of the business plan.

To help mitigate the lack of brand awareness, the Company is willing to give up more shareholder equity to their initial investor in order to attract the best possible candidate. Utilizing the brand reputation of the initial investor will help move the company along until the marketing strategies as outlined by Moore's theory (Moore, 2002) gain momentum and establish the Product as a preferable alternative to the existing external sensor technology.

Appendices

Appendix A

Figures in Thousands

Income Statement	2012	2013	2014	2015	2016
Net sales	$0	$990	$2,665	$5,157	$17,616
Funding	$2,000		$500		
Cost of goods sold	$1,799	$750	$277	$1,308	$5,150
Net Operating Income	$201	$240	$2,888	$3,849	$12,466
Operating expenses	$100	$240	$200	$300	$450
Sales Commisions			$831	$1,188	$2,376
Net Income	$101	$0	$1,857	$2,361	$12,016

Appendix B

Cash Flow Statement	2012	2013	2014	2015	2016
Beginning balance	$0	$101	$101	$1,958	$4,319
Cash inflow	$2,000	$990	$3,165	$5,157	$17,616
Cash outflow	$1,899	$990	$1,308	$2,796	$7,976
Ending Cash Balance	$101	$101	$1,958	$4,319	$13,960

Appendix C

Figures in Thousands

Balance Sheet	2012	2013	2014	2015	2016
Cash	$101	$101	$1,958	$4,319	$13,960
Accounts receivable	$0	$0	$0	$0	$0
Inventory	$0	$0	$14	$65	$257
Prepaid expenses	$0	$0	$0	$0	$0
Total Current Assets	$101	$101	$1,972	$4,385	$14,217
Fixed assets	$0	$0	$0	$0	$0
Total Assets	$101	$101	$1,972	$4,385	$14,217
Accounts payable	$0	$0	$0	$0	$0
Short-term notes	$0	$0	$0	$0	$0
Accrued & other liabilities	$0	$0	$0	$0	$0
Total Current Liabilities	$0	$0	$0	$0	$0
Long-term debt	$0	$0	$500	$500	$500
Other long-term liabilities	$0	$0	$0	$0	$0
Total Long-term Liabilities	$0	$0	$500	$500	$500
Shareholders' equity	$101	$101	$1,472	$3,885	$13,717
Total Liabilities and Equity	$101	$101	$1,972	$4,385	$14,217

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