



**Industrial Engineering and Management**

**Master's Program: Global Management of Innovation and Technology**

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**A compilation of academic and entrepreneurial practices in  
launching a high-tech baby monitoring device**

Master Thesis

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Professor Ville Ojanen

## Abstract

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<b>Title of the thesis:</b> A compilation of academic and entrepreneurial practices in launching a high-tech baby monitoring device	
<b>Year:</b> 2019	<b>Place:</b> Lappeenranta
<b>Type:</b> Master's Thesis	<b>Department and University:</b> Industrial Engineering and Management, Lappeenranta University of Technology
<b>Specification:</b> 97 pages, 21 figures, 15 tables and 5 appendices	
<b>Examiners:</b> Prof. Leonid Chechurin Prof. Ville Ojanen	<b>Keywords:</b> startup, entrepreneurship, new venture management
<p>Establishing a business has always been a cumbersome task. It often begins with an idea. The steps required to convert the idea to a physical product relies on finding key insights. Finding key insights along with other factors such as product idea and team are of paramount importance in determining the success of a new venture. Key insights often are region specific and varies from one location to another and from one person to another. Not adhering to these region-specific insights could lead to confusion and unfocused efforts in establishing the business. This thesis aims to utilise academic guidelines and employ recommendations from successful entrepreneurs to establish a business. It acknowledges various aspects of establishing a business such as networking, patent analysis, revenue model calculations, marketing techniques as well as financing the business by creating a funding application that was successfully submitted to Business Finland in September 2018. A deductive based research was carried out consisting of both theoretical and empirical parts. Idea validation was conducted with various consultations from experts within Finland. Technology validation was carried out by conducting multiple tests on various subjects during 8 hours of sleep. Business validation was conducted by reaching out to the market and doctors via survey forms.</p>	

## **Acknowledgement**

This thesis was an immense learning experience in understanding the startup ecosystem in Finland and the various criteria required for becoming an entrepreneur. This thesis would not be possible without the contribution and support of various people involved in this project.

Firstly, I would like to thank my thesis supervisors Prof. Leonid Chechurin and Prof. Ville Ojanen for giving me the opportunity to try out a different method to demonstrate the various skills I acquired during my master studies. Their support and guidance has been invaluable and I will be forever grateful.

I would also like to thank Juhani Talvela for his support and guidance during the master thesis. Whether it was intense discussions regarding patents, entrepreneurship or casual conversations, his inputs were vital in gaining a better understanding of the topic. I would also like to thank Jari Varis of Green Campus Innovation for his support and guidance during the discussions with Business Finland.

Acknowledgements would be incomplete without the support of the core project members and my awesome group of friends who have now become as close as family. Lastly, I would also like to thank my parents. I would definitely not be able to do this without their support and motivation. I am eternally grateful for them in this exciting journey studying abroad.

Abhishek Jayaprakash

January 2019, Lappeenranta

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## **Abbreviations**

SIDS — Sudden Infant Death Syndrome

SUID — Sudden Unexpected Infant Death

ASSB — Accidental Suffocation and Strangulation in Bed

CPR — Cardiopulmonary Resuscitation

WIPO — World Intellectual Property Organization

EPO — European Patent Office

OAPI — African Intellectual Property Organization

FTO — Freedom to Operate

IP — Intellectual Property

CTR — Click-through rate

MVP — Minimum Viable Product

NICU — Neonatal Intensive Care Unit

PICU — Pediatric Intensive Care Unit

CME — Continuing Medical Education

SEO — Search Engine Optimization

ICNIRP — The International Commission of Non-Ionizing Radiation Protection

# 1 Introduction

## 1.1 Brief explanation of business idea

The business idea originated during one of the many startup events organized by the university in March 2017. Since then the idea has significantly evolved. After attending numerous ESTIEM (European Students of Industrial Engineering and Management) workshops across Serbia, Germany and Austria and on consulting with various key personnel across Finland, UK, India and Pakistan, the idea has transformed to what it is now. The idea revolves around manufacturing a contactless baby monitoring device that detects the baby's breathing and movement with an aim to analyze respiration patterns to predict and preempt diseases.

Once the device is plugged in, it analyses and records the baby's breathing and movement. In case the device detects an abnormality, it immediately sends a notification to the parents on their mobile application. Parents will then have the ability to either view their baby via a video camera (also present on the device) or could check on the baby themselves. The application will also include information of the baby's doctors, emergency contact information as well as Infant CPR (Cardio-Pulmonary Resuscitation) guides.

Apart from the above-mentioned features, parents will also receive monthly reports of their baby's respiration patterns. Information such as monthly comparison of respiration patterns, seasonal variances in the baby's respiration rates, abnormal or irregular breathing patterns, if any, as well as trends in respiration patterns likely to lead to an illness will be translated to parents in an easy-to-read format. The more the parents use the device, the more beneficial it is for them, to accurately be able to provide vital information to their doctors when needed.



## 1.2 Justification of the business idea

One of the most important factors in monitoring a patient's care and diagnosis is monitoring vital signs. Vital signs could consist of but is not limited to blood pressure, temperature, respiration rate and heart rate to name a few. These vital signs enable doctors to make the right decisions and prescribe the necessary treatments based on these parameters. Among these parameters breath/respiration rate and heart rate are more important as they are continuously monitored either in the Emergency Room (ER) or in the Intensive Care Unit (ICU). Most of the methods that are currently being employed for detecting heart rate and breathing rate are in contact with the patient's body. These devices include pulse oximeters, electrocardiograms (ECG) and piezoelectric sensors to name a few. There are also a few companies that have developed devices, where the sensor is in contact with the patient's body but transmits this data wirelessly via a mobile device. This set up eliminates the use of wires between the patient and device, however, the major drawback of using such a device is its limited battery life. (Hall et al., 2017)

Though contact methods of vitals monitoring are often preferred, there are some instances where that may not be possible. Contact methods of vitals monitoring become a serious concern especially when the patients are newborn babies or burn victims. Newborn babies that are required to be placed in an ICU could suffer from skin problems arising due to electrode contact, adhesive tapes and other devices in contact with the baby's skin. There is also a possibility to leave scars on their skin due to this physical contact. New challenges arise when burn victims are concerned. It could be difficult to locate an area where the skin is not compromised to attach these contact devices. In such cases esophageal ECG electrode is used and in extreme cases the electrode could also be stapled to the skin. Using non contact methods could significantly reduce further harm to the patient. (Boric-Lubecke et al., 2016)

Continuous monitoring of vital parameters could be of significant importance to doctors and other healthcare practitioners alike. One in five adults is estimated to suffer from mild obstructive sleep apnea (OSA). Furthermore, one in fifteen adults is estimated to suffer from moderate OSA, experiencing hypertension, cognitive impairment and daytime sleepiness as side effects. (Hall et al., 2017) Moreover, Sudden Infant Death Syndrome (SIDS) is the third

leading cause of infant mortality linked with sleep apnea. Doppler radar technology would not only enable contactless solution for vital sign monitoring but could also be immensely beneficial for the detection and treatment of other medical conditions that use these vital signs as a basis of diagnosis. (Hall et al., 2017) One such possibility of SIDS is discussed in sub chapter 1.5.

### 1.3 The aims of the thesis

The aim of this thesis is to utilize academic guidelines and employ recommendations from successful entrepreneurs to develop the above-mentioned idea to business. Aspects such as business and marketing plans, go-to market strategies, breakeven and patent analysis will be thoroughly evaluated using techniques based on academia as well as tools recommended by serial entrepreneurs. Such an approach aspires to collate the best practices of both worlds in this thesis. The final objective of this thesis will also be to use the learnings to apply for financing for the mentioned business idea, to eventually establish the company.

### 1.4 Research Methods

A deductive based research is employed and consists of both theoretical and empirical sections. The theoretical sections include data from known academicians as well as up to date scientific articles and journals. Moreover, various business tools recommended by startup professionals and start up organizations within Finland such as Business Finland and Wirma is also utilized to reinforce the research. Empirical part consisting of qualitative data is generated via two methods. The first is via semi-structured surveys conducted with doctors (either Pediatricians, Pulmonologists or General Physicians) across four countries around the world to understand their perspective on non-invasive medical devices and the second is generated via research surveys directed to the target market. A mixture of heterogeneous and snowball sampling techniques is used in the above methods.

## 1.5 Sudden infant death syndrome

Sudden Infant Death Syndrome or SIDS is also known as cot death or crib death. It is the sudden death of a healthy infant during his/her sleep. This was one of the most mysterious disorders in medicine till the 1990's. Though the cause of SIDS is still unknown, recent studies in the field of medicine indicate that enabling infants to sleep on their backs significantly reduces the possibility of SIDS. However, it still remains as one of the leading causes of infant death between the ages of zero to twelve months around the world with majority of its deaths occurring when the infant is less than 6 months old. Rates of SIDS in countries around the world varies significantly ranging between 1 in 1000 to 1 in 10000. (Kinney and Thach, 2009) (Moon et al., 2011)

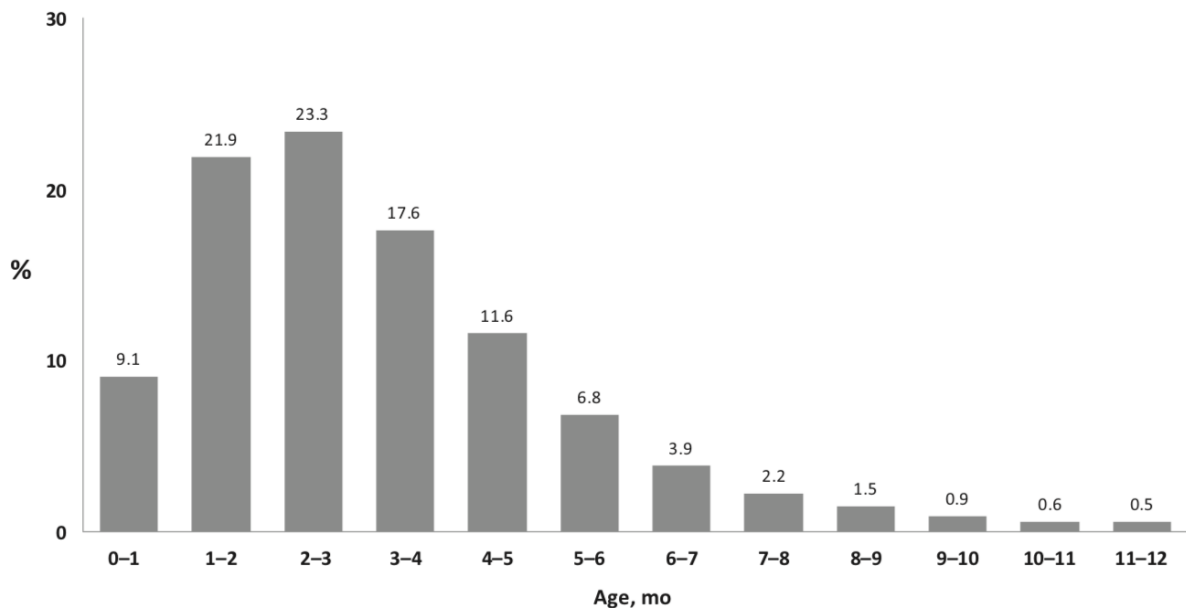


Figure 1. Percentage of distribution of SIDS deaths according to age at death in the US between 2004-2006. (Source: Moon et al., 2011)

Sudden Unexpected Infant Death or SUID is also a term that is closely associated with SIDS. According to the American SIDS Institute (Sids.org, 2019), the Center for Disease Control defines SUID as all unexpected infant deaths including deaths occurring due to SIDS, accidental deaths (strangulation, suffocation etc.) and natural deaths (Infections, neurological

complications etc.). Furthermore in 2015, there were around 3700 cases of SUID deaths reported in the US with no definite cause. (Anon, 2019) Though new parents may adopt the recommended preventive measures, the fact that a definite cause cannot be traced makes it even more challenging.

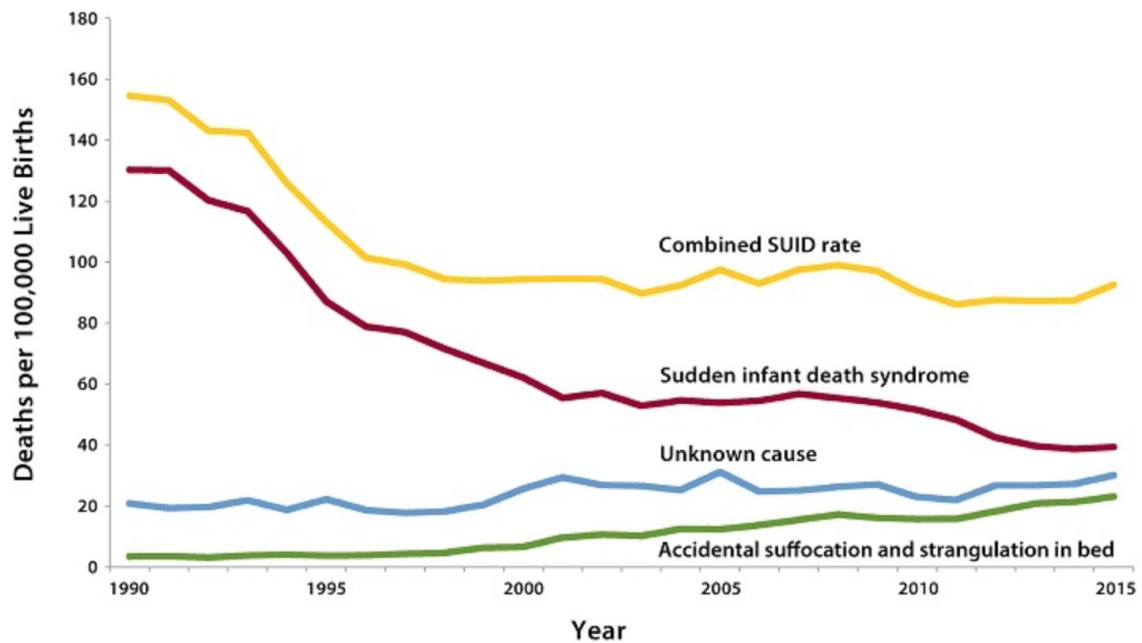


Figure 2. Trends in SUID rates in US between 1990 to 2015. (Source: Anon, 2019)

From the figure above, in the 1990's the SUID rate was about 154.6 deaths per 100,000 lives. It declined significantly between 1992-1994 due to safe sleep campaigns. It further decreased at the beginning of 2009. However, from 2014 to 2015, there has been a slight increase in the SUID rate, notably increasing from 87.5 deaths to 92.6 deaths per 100,000 lives. Out of which, SIDS rate has significantly decreased from 130.3 deaths in 1990 to 39.4 deaths per 100,000 in 2015. Unknown cause of infant deaths at 2015 stand at 30.1 deaths per 100,000 lives and accidental suffocation and strangulation in bed is on the rise with highest rates recorded in 2015 being 23.1 death per 100,000 lives. (Anon, 2019)

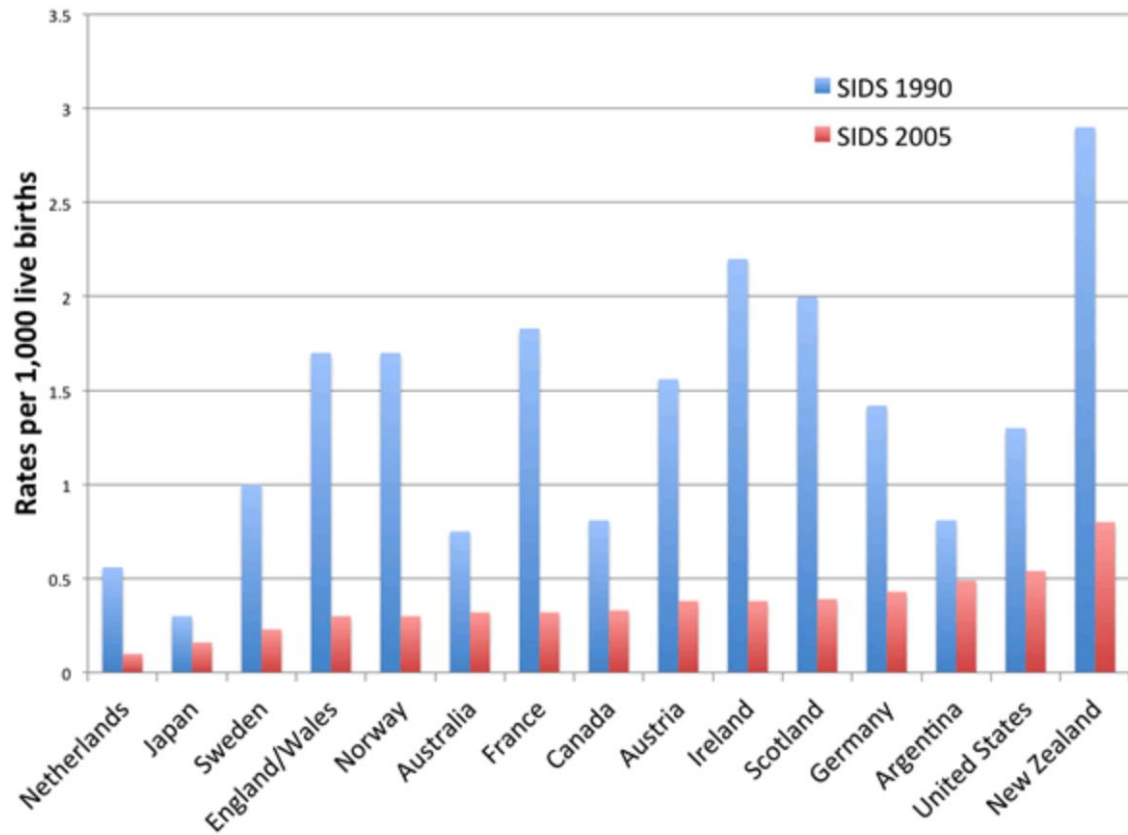


Figure 3. International SIDS rates. (Source: R. Hauck and O. Tanabe, 2010)

The above figure 3 indicates the SIDS rates across the world. However, according to the authors (R. Hauck and O. Tanabe, 2010), it is important to note that different countries have different age inclusions to be considered as SIDS. Furthermore, the SUID rates could not be determined hence it is unclear if they had an impact on the findings.

## 2 Technology

### 2.1 Respiration monitoring methods and its importance

Respiration has always been an important indicator of personal health. The process covering inhalation and exhalation results in one respiration cycle/rate. (AL-Khalidi et al., 2011) Research also shows that changes in respiration cycle could predict certain illnesses such as cardiac arrests. (Fieselmann et al., 1993) Furthermore, monitoring respiration rates are better than pulse and blood pressure monitoring to gauge healthy patients and patients at risk. (Subbe et al., 2003) These changes in respiration patterns can help identify high risk individuals as far as 24 hours in advance 95% of the times. (Cretikos et al., 2007)

Over the years, the methods of monitoring respiration rates have significantly increased. They now can broadly be classified into two categories — contact and non-contact respiration monitoring devices. They are shown in the table below.

Table 1. Methods for Respiration Monitoring. (Based on AL-Khalidi et al., 2011)

<b>Respiration Monitors</b>	
<b>Contact Based</b>	<b>Contactless</b>
Acoustic Monitoring	Radar Based Respiration Monitoring
Airflow Monitoring	Optical Based Monitoring
Chest and Abdominal Movement Detection	Thermal Sensor and Imaging Based
Oximetry Probe (SpO2)	
ECG derived respiration rate	

A brief description of the methods mentioned in Table 1 is provided below.

### **Acoustic Based Monitoring**

Acoustic methods involve detection of sound waves by devices that are kept in close proximity to breathing channels such as chest, nose or throat. (Shneerson, 2005)

### **Airflow Monitoring**

Airflow monitoring involves a number of parameters such as temperature of exhaled gases, pressure and volume in the nasal passage, humidity and CO<sub>2</sub> content. (Folke et al., 2003) (Lee-Chiong, 2006) (Folke, 2002) As is the problem with most contact based devices they not only cause discomfort but interfere with breathing and provide inaccurate estimates because of the space taken up by sensor in the airway. (Tobin, 1988)

### **Chest and Abdominal Movement Detection**

Chest Movement sensors use the principle of strain gauges placed inside a flexible band worn on the chest or abdomen which changes its conductivity while stretching or contracting according to the respiration pattern. (N.A. 2018) This method employs two bands, one of which is placed on thoracic cavity while the other is placed on the abdomen and a system algorithm checks for synchronicity and may even be able to differentiate between distinct modes of respiration. (Nepal et al., 2002)

### **Oximetry Probe (SpO<sub>2</sub>)**

Respiration rates can also be detected from the oxygen content in the bloodstream. Red and infrared frequencies are used to determine the saturation of hemoglobin in blood and can simultaneously provide information about pulse rate. (Meddeviceonline.com, 2018) Again this does not seem to be a convenient option for long term monitoring as the light from the probe heats up the area of the skin it is contact with.

## **ECG (electrocardiogram) Derived Respiration Rate**

Electrocardiogram Derived Respiration (EDR) is a method that detects changes in morphology during the respiratory cycle which is caused by the activity of the heart relative to the electrodes and the change in lung volume. (Mazzanti et al, 2003) The EDR can also be performed with a photoplethysmogram, a method similar to the pulse oximeter which generates ECG output based on light absorption in the skin. (O'Brien and Heneghan, 2007)

## **Optical Based Monitoring**

Optical based monitoring is an area that has seen increased interest and development over the last decade. With the advancement of camera sensor and microprocessor technology, it is becoming possible to detect minute variations on a test subject to obtain vital monitoring signs such as heart rate and respiration rate. A typical setup consists of a Charge Coupled Device (CCD) camera and an infrared light emitter which projects a series of bright spots. Measurement of the intensity of a group of pixels over time yields the respiration rate. (Nakajima, et al. 2001)

## **Thermal Sensor and Imaging Based**

Thermal Imaging based respiration monitoring is performed by measuring changes in skin temperature around the nasal region, throat and thoracic cavity. Since all measurements here are based on skin temperature, tracking a particular region of the skin, movement and covering are major challenges to this method.

## **2.2 Doppler Radar technology and applications**

### **2.2.1 Doppler Effect**

The Doppler effect is also known as the Doppler shift was first proposed in 1842 by Christian Doppler. It is described as follows:

“The change in frequency of a wave for an observer moving relative to the source of the wave”



This is a common phenomenon often experienced when an observer notices the change in pitch of a siren of an emergency vehicle as it approaches, passes and then recedes from the observer. When the source of the sound or light moves towards the observer, the successive wave crest is emitted from a position closer to the observer. Hence, it takes a shorter time to reach the observer. Therefore, the time interval between the arrival of two successive crests at the observer is reduced, therefore increasing its frequency. Similarly, when the source of sound or light moves away from the observer, each successive wave crest is emitted from a position farther away from the observer. Hence, the time taken in the arrival of each successive wave is longer, reducing its frequency. (Petrescu, 2012)

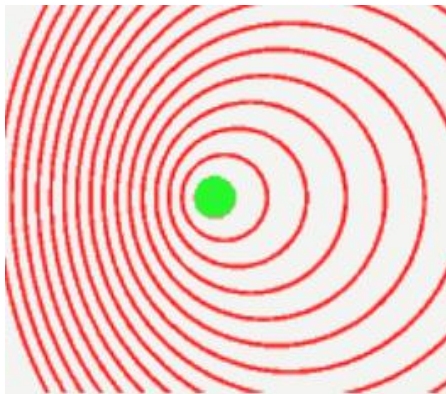


Figure 4. Schematic representation of Doppler Effect. (Anon, 2018)

### 2.2.2 Doppler Radar

A Doppler radar is one of the many applications of the Doppler Effect. A doppler radar can further be used in many applications ranging from determining the velocity of an object to the range of objects. A common application is its use in the radar gun used by the police services in determining the velocity of vehicles. It works by emitting waves at certain intervals of time. The waves return to the radar gun in different intervals of time since the vehicle is in motion. Narrow band receiving filters can be used to segregate signals from slow moving and stationary objects. Here the radar gun acts as both the emitting and receiving device. By applying the principles of Doppler Effect, police services can accurately determine the velocity of the vehicle they are monitoring. Radar guns can also be used in sporting events such as baseball to determine the speed at which the ball is travelling. (Sawicki, 2018)

Furthermore, the Doppler Effect can be produced in three ways to be used in radar technology.

1. Coherent Pulsed Radar
2. Pulse-Doppler Radar
3. Continuous Wave or Frequency modulation

Continuous Wave Doppler Radar is a system where a known radio wave of a known frequency is transmitted and received to gauge object distances. The advantages of such a setup is that they are simple and inexpensive to manufacture and use. The broadcasting power of the wave is of vital importance in determining the range of this radar. (Federation Of American Scientists, 2018) Frequency modulated radar is an extension of the continuous wave radar. The main difference being the ability to change its operating frequency during transmission. (Radartutorial.eu, 2019) Pulse Doppler Radar on the other hand are lightweight alternatives for continuous wave radars. The combination of pulse radars along with Doppler processing leads to accurate velocity information.

## 2.3 Sensor Radiation Emissions

Any electronic device which is wireless or emits any sort of radiation must comply with certain regulations ensuring it is safe for the environment as well as human use. The International Commission of Non-Ionizing Radiation Protection (ICNIRP) is one such internationally recognized independent organization that provides scientific information as well guidelines for various organizations to comply. It consists of a 14-member commission and is supported by a 25-member Scientific Expert Group (SEG) consisting of scientists from around the world and having various expertise. ICNIRP covers all radiation from ultraviolet, infrared and radio waves to radiation emitted by household devices such as microwaves, mobile phones and WIFI routers. (ICNIRP, 2018) Furthermore, the Federal Communications Commission (FCC) in the USA and the European Telecommunications Standards Institute (ETSI) in Europe provide guidelines for Ultra-wideband radar devices. The maximum permitted equivalent isotropically radiated power (EIRP) is -41.3 dBm/MHz in the range of 6 - 8.5 GHz for ETSI (ETSI, 2018) and 3.1 - 10.6 GHz for FCC. (Efr.gov, 2018)

Table 2. Comparison of various devices according to ICNIRP. (Based on Xethru Blog, 2018)

<b>Technology</b>	<b>Transmitted Power, EIRP (Watt)</b>	<b>E-field strength @ 0.4m (V/m)</b>	<b>Times less than ICNIRP reference level</b>
5 GHz Wifi	1.0 W	13.69	4.5
3G mobile phone (Class 2)	0.5W	9.68	6.3
2.4 GHz Wifi	0.1W	4.33	14.1
Typical laptop WLAN	32mW	2.45	24.9
Bluetooth 10m range (Class 2)	2.5mW	0.68	89.1
Theoretical UWB FCC mask device	556 $\mu$ W	0.32	189
Theoretical UWB ETSI mask device	185.3 $\mu$ W	0.19	327.2
Sensor in discussion	84 $\mu$ W	0.126	486.0

As shown in the table 2 above, various household devices ranging from mobile phones to laptops are compared against each other for transmitted power and electromagnetic field strength. The sensor to be utilised in the discussed solution is approximately 500 times lesser than the levels recommended by ICNIRP for a device in its class, demonstrating it is well under prescribed limits and safe to the environment as well as human use.

## 2.4 Sensor setup

Since the sensor is non-contact, certain precautions must be adhered to ensure accurate monitoring. The sensor can be positioned by bedside or mounted on a ceiling/wall above the targeted user keeping the 'TX' antenna in the upward direction. Due to the capabilities of the sensor, it can be placed at a range of 0.4m to 2.5m away from the user whilst being perpendicular to the user's chest and abdomen. Below are a few terms associated with the sensor setup -

**Detection Zone:** Detection zone refers to the area in which the sensor can measure the expansion and compression of the chest. For this sensor the detection zone is until 2.5m. The detection zone must be large enough to focus on the user yet small enough to negate the influence of other moving objects to maintain accuracy of the sensor.

**Sensitivity:** Sensitivity refers to the accuracy of the sensor. A higher sensitivity setting leads to better detection of small movements while a lower sensitivity prevents false detection.

**LED control:** LED control is a switch to toggle between ON/OFF. The LED can be turned off for instances for recording the respiration patterns during the night.

**UI Settings:** UI setting is to determine the x-axis of the live plot of the sensor output. This can be specified depending on user and their characteristics.

**Log Settings:** Log setting specifies the location for the sensor to save the data.

Below are few terms explaining the various states of the sensor.

**No Movement:** This term is displayed when no presence is detected by the sensor or if the user is outside the detection zone.

**Movement:** This term is displayed when presence is detected but the breathing is unidentifiable.

**Movement Tracking:** This is visible when user presence and breathing movement is detected.

**Breathing:** This is visible when a precise breathing movement is detected.

**Initializing:** This term is displayed post the sensor setup.

**RPM:** Refers to respiration per minute

**Object Distance:** This term refers to the distance to where the breathing is detected. This is measured in meters.

**Object Movement:** This term refers to the movement of the breathing motion. This is measured in millimeters.

**Signal Quality:** This refers to the signal being relayed to and from the sensor. It is designated a score of 1-10, with 1 indicating low and 10 indicating high signal quality.

## 2.5 Analysis of output data from sensor

Radar Vital Signs Monitoring (RVSM) detects respiration induced chest movements with Doppler phenomenon. In the proposed solution, the sensor will be equipped with a Ultra Wide Band (UWB) radar which not only consumes less power, but is also able to detect through bedding and linen.

During the processing of the signal emitted by the radar system, the received signal is at a frequency shift proportional to that of the target speed. This is the Doppler Effect. If the intended target is the chest, as in this case, the echo signal returning to the radar system includes heartbeat and respiration information due to the chest movement.

$$s(t) = \cos(2\pi f t + \varphi(t))$$

If ' $\varphi(t)$ ' is the phase noise of the oscillator, the signal reflected from the human is at a distance 'd' and the time-varying displacement is given by ' $x(t)$ '. The reflected signal's amplitude and frequency is modulated by the motion of the object, and  $x(t) \ll d$ . Neglecting amplitude variations, initial phase offset and noise, the received signal  $R(t)$  can be obtained as

$$R(t) = \cos[2\pi f t - (4\pi d / \lambda) - (4\pi x(t) / \lambda) + \varphi(t - (2d / c))] ]$$

where  $\lambda$  is wavelength,  $c$  is the velocity of light. According to Doppler Effect, the received signal is modulated by the periodic motion of the target. The periodic target motion

information can be demodulated if this signal is multiplied by a local oscillator signal that is derived from the same source as the transmitted signal.

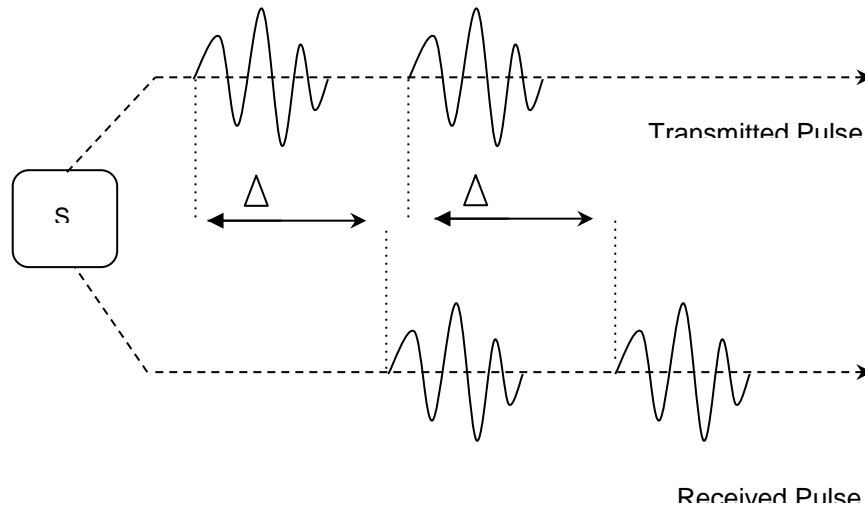


Figure 5. Schematic representation of transmitted and reflected waves (Based on Xethru Community Resources, 2018)

Figure 5 shows a schematic version of the sensor's (XeThru, 2018) working principle where each transmitted pulse is received after  $\Delta t$  period and sampled to identify the corresponding changes after being reflected from the target.

## Early Test

Preliminary tests were carried out to understand the viability of RVSM during sleep monitoring. It was decided to concentrate on breathing cycles during sleep because of convenience factor. The following figures represent data taken during an 8-hour sleep by one of the test subjects.

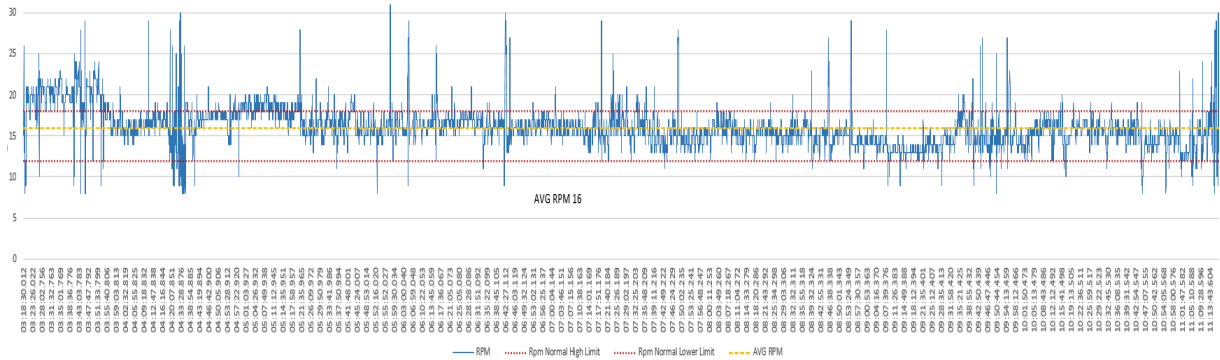


Figure 6. Respiration pattern at test 1 (T1)

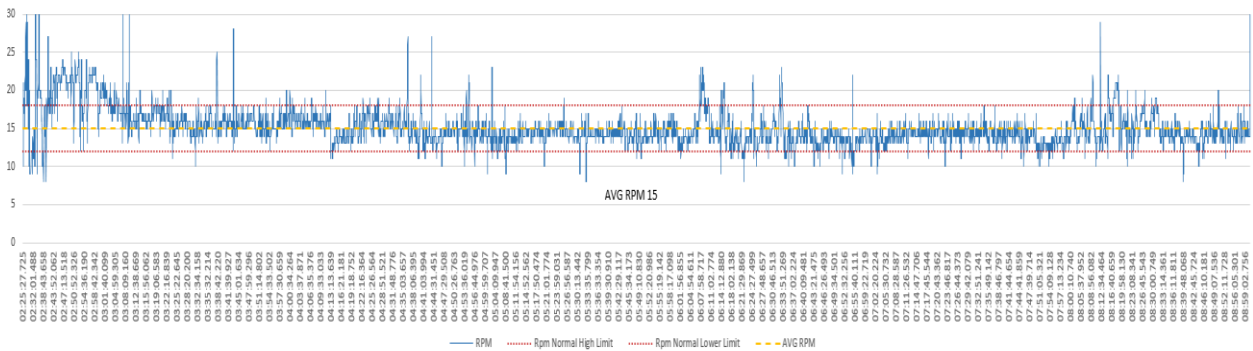


Figure 7. Respiration pattern at test 2 (T2)

The test (T1) was performed after the subject was diagnosed with asthma and had not undertaken any medication. The subject's condition was being monitored with a flowmeter as prescribed by the health practitioner to determine improvement in lung capacity and monitor the variations in peak flow as well.

Follow-up monitoring at test (T2) was performed after 40 days of medication to determine whether the sensor was able to generate information on the subject's improvement in respiration.

Both graphs were compiled after the raw data was filtered to exclude noise and erroneous measurements. The dotted red lines correspond the upper average respiration rate of 18 and lower average respiration rate of 12 in healthy adults. Upon close inspection, the differences in both graphs reflect an improvement in the subject's respiration rate, especially in the

reduction of high variability during breathing. The spikes in T1 test are more frequently outside the healthy range than in T2 after the subject started taking the asthma medication. This was also confirmed by the subject's self-assessment of "gasping for breath" during sleeping before the medication was prescribed. The test and conclusions derived were reactive but the intention is to develop an active solution. Research on variations in respiration rate in normal healthy adults during sleep cycles, as shown in figure 8, can help us identify the quality of sleep or any abnormalities in respiration by identifying a respiration pattern. The same principle is intended to be utilised for the baby monitoring device.

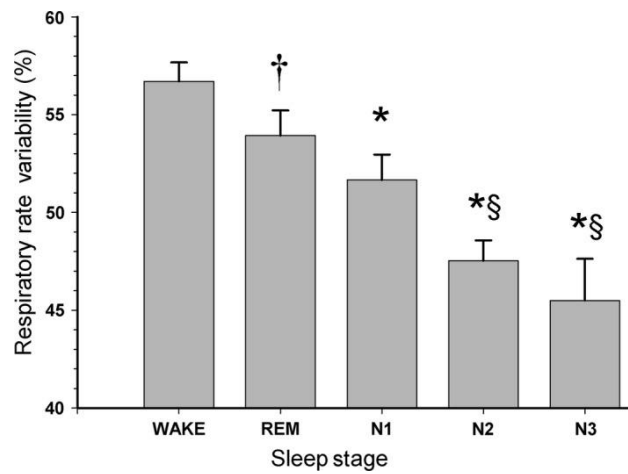


Figure 8. Variability in respiration during sleep cycles (Source: Breathing During Sleep in Normal Middle-Aged Subjects, 1990)



### 3 Patent Analysis

World Intellectual Property Organization (WIPO) is an international organization that was established in 1970 to protect and promote original work of creators all around the world. WIPO currently consists of 191 member countries across the globe. (Wipo.int, 2018) It is also a part of the special agencies of the United Nations to protect intellectual property rights. It acts as a one-stop-shop for the filing of trademarks, industrial designs and patents.

Furthermore, WIPO mainly cites three reasons for promoting and protecting intellectual property. First, the development of mankind depends on its ability to create new ideas in areas of culture and technology. Secondly, new creations encourages more resources to be directed towards new innovations and thirdly, promotion of intellectual rights also acts as a benchmark for economic growth of a particular nation by creating new jobs which eventually leads to higher standards of living. (Anon, 2018)

WIPO defines Intellectual property (Wipo.int, 2018) as -

“creations of the mind, such as inventions; literary and artistic works; designs; and symbols, names and images used in commerce”

It can further be classified into five types -

1. Copyrights
2. Patents
3. Trademarks
4. Industrial designs
5. Geographical indications

**Copyrights** is a legal term used by creators to cover their literary or artistic content. The contents that can be classified as a copyright include books, scripts, movies, paintings and sculptures to name a few. Copyright holders can limit the reproduction of their work in any form. They could also authorise organizations better capable of reproducing their work in

exchange for remuneration or royalty. Copyrights can last for as long as 50 years after the creator's death ensuring their successor continues to benefit from their work. (Wipo Int, 2018)

A **patent** is a publicly available document that grants an individual the right to use their invention. This right is given for a maximum period for 20 years. The general idea of a patent is that the particular invention cannot be commercially utilised without the patent owner's permission. The patent owner can then decide whether they want their invention to be utilised by others. They can do so by either licensing, giving consent or selling the patent. Once the patent expires, the patent owner no longer has exclusive access to utilise the patent.

Furthermore, a patent can be granted by initially filing a patent application. Information regarding the innovation such as description, background as well as diagrams pertaining to the inventions must be specified in simple language. Once the patent application is made, the patent is granted by the national patent office or regional patent office subject to its approval. Some examples of such patent offices are European Patent Office (EPO) and African Intellectual Property Organization (OAPI). The patent applicant can then specify the countries in which the patent is to be valid. There is also a possibility for the patent applicant to file a single international patent valid among countries within the Patent Cooperation Treaty (PCT) which consists of 152 countries.

A **trademark** can be described as a sign or a symbol consisting of letters, numerals or drawings that helps differentiate one company or service from another. The general idea of the trademark is to help the consumer buy the specified product or service. A trademark ensures that the applicant is the sole user of the specified sign or symbol and is valid for an infinite period of time subject to payment of the trademark fees. Moreover, trademarks could also represent associations or standards. Furthermore, a trademark can be filed by filling an application to the national or regional office. Details such as size, shape, colour and description stating the goods or services that encompass the trademark must be specified during the patent application. (Anon, 2018)

An **industrial design** can be three dimensional or two dimensional design purely aesthetic in nature. Three dimensional industrial designs constitute shapes or figures while two dimensional industrial designs can constitute lines or patterns. The functionality of this device

is not protected in an industrial design registration. However, these claims can be mentioned in the form of a patent. Furthermore, industrial designs covers a wide variety of industrial products ranging from medical instruments to jewellery as well as electrical appliances to architectural designs. In order for an industrial design to be protected, no similar design must previously exist. Once the industrial design is registered it is valid for upto 5 years and upto 15 years in entirety. There is also a possibility to file for a universal design registration under the WIPO's regulations.

**Geographical indication** represents the origin and unique characteristic of the particular product. The use of geographical indications cover a variety of products ranging from agricultural produce to watches. It could also be used to indicate the particular qualities of the manufactured product due to human factors. A few examples are - 'Tuscany' for olive oil made from a particular area in Italy, 'Roquefort' for cheese produced in that area of France and Swiss watches for watches made in Switzerland. The general idea surrounding geographical indication is to prevent unauthorised third parties from misleading consumers into buying products which have reputation associated with that particular country of origin. (Anon, 2018)

Table 3. Summary of Intellectual Property

<b>Intellectual Property</b>	<b>Protects</b>	<b>Tenure</b>
Copyright	Literary and artistic works	Upto 50 years post creator's death
Patent	Inventions and their functionality	20 years
Trademark	Signs and symbols	Infinite
Industrial Design	Aesthetic shapes and figures	15 years
Geographical Indication	Origin of product	Infinite

### 3.1 Freedom to operate and limiting risks

A freedom to operate search is of vital importance for any company in the technological sector aiming to launch a new product on the market, as infringing patents could lead to lengthy patent litigations which could potentially lead to expensive and uncertain outcomes. The general idea surrounding the freedom to operate as summarised by WIPO is,

*“to ensure that the commercial production, marketing and use of their (a company/organization) new product, process or service does not infringe the IP rights of others.”*

WIPO also argues that conducting a FTO search does not guarantee an absolute freedom but it certainly is detrimental in minimising risks as well as serves as a good source of business intelligence. WIPO recommends the following ways to minimise risks whilst efficiently utilising company resources -

#### 1. Searching patent documents

An FTO search begins by analysing various patents available in online libraries to determine the status of the patents (i.e pending or granted). A legal opinion is also sought to evaluate if the potential product or service is infringing existing patents. Depending on the country there are many organizations that offer such services.

#### **Spotting Opportunities in Patent Limitations**

In conducting an FTO search and analysis, it is worth bearing in mind that some of the limitations on patents also offer potential opportunities. For example:

Patent protection is territorial. While a certain technology may be protected in a company's main markets, it may be in the public domain in other countries. In the latter, no permission (or license) is needed from the patent owner in order to commercialize the product.

Patents have a limited duration. Patent protection lasts for a maximum period of 20 years. Thereafter, a patent is considered to be in the public domain and may be freely used by anyone. Moreover, the European Patent Office (EPO) estimates that fewer than 25 percent of all patents granted through the EPO are maintained for the maximum 20 year term. Many patents are allowed to lapse through non-payment of maintenance fees by the patent holders before the 20 years are up.

Patents have limits of scope. The claims section in a patent document determines the scope of the patent. Any aspect of an invention not covered by the claims is not considered to be protected. That said, it is not always easy to determine the scope of a patent. It requires considerable experience in interpreting the claims, the written specification and the history of the application process.

Figure 9. Opportunities in Patent Limitations. (Source: Anon, 2018)

## 2. Clearing obstacles

On the assumption that a company identifies potential IPs that affect its operational hindrance in the previous step, it can address these concerns in the following ways -

- a) Purchasing or licensing the patent: Licensing involves obtaining permission from the patent holder to use the patent for a particular period of time. This is usually carried out in exchange for a lump sum payment or periodic royalties.
- b) Cross-licensing: Cross-licensing is one where two companies use each other's patent to mutually benefit each other. Generally, a company should have a patent portfolio which could be of subsequent interest to the other company for a cross-licensing to take place.
- c) Inventing around: As the name suggests, inventing around requires companies to further research, innovate or improvise around the existing patent so as to not infringe that particular patent.
- d) Patent pools: Patent pool is one where two or more organizations having similar technological expertise collaborate by putting together their patents to address a particular challenge.

## 3. Protecting Technology

If searching patent documents yields no patents hindering freedom to operate, the searching organization can now file for a patent themselves provided their product or service meets the patent criteria hence increasing their freedom to operate. WIPO further states,

*“A patent in itself does not provide the right to commercialize the protected technology, but only to prevent others from commercializing it.”*

#### 4. Defensive publishing or technical disclosure

There are some situations when a company may not find it necessary to file for a patent. Under such circumstances they could opt for defensive publishing enabling some extent of freedom to operate for all. Defensive publishing is making an invention public so that no one can patent it. The publishing is usually carried out in a well-recognized technical journal or well recognized technical publication. These journals or publications are utilized by patent examiners when awarding a patent.

Irrespective of the methods chosen, WIPO recommends technological driven companies to perform a basic freedom to operate at an early stage to prevent future disruptions. It not only helps minimise risks but also increases an organization's chance to finding potential business partners or investors. (Anon, 2018)

For the purpose of this research, a basic freedom-to-operate (FTO) search was performed using Google Patents and cross referenced with WIPO's database. The first step and the most important step in the FTO search was identifying the keywords associated with the project. This analysis was carried out with discussions with Juhani Talvela of LUT. Based on these discussions, various keywords along with their synonyms were shortlisted as shown in the table below. These keywords were then used in Google Patents to evaluate the patents related to this research.

Table 4. Search summary of FTO search

Searches	Search Terms	Number of Hits
1	(device or apparatus or meter or gauge) <b>and</b> (monitoring or measuring or evaluating) <b>and</b> (respiration or breathing or inhaling or vital sign) <b>and</b> (contactless or remote or wireless or RF or radio or RADAR)	2
2	(device or apparatus or meter or gauge) <b>and</b> (monitoring or measuring or evaluating) <b>and</b> (respiration or breathing or inhaling or vital sign)	286
3	(device or apparatus or meter or gauge) <b>and</b> (monitoring or measuring or evaluating) <b>and</b> (contactless or remote or wireless or RF or radio or RADAR)	18
4	(device or apparatus or meter or gauge) <b>and</b> (respiration or breathing or inhaling or vital sign) <b>and</b> (contactless or remote or wireless or RF or radio or RADAR)	2
5	(monitoring or measuring or evaluating) <b>and</b> (respiration or breathing or inhaling or vital sign) <b>and</b> (contactless or remote or wireless or RF or radio or RADAR)	5

The following were the outcomes of the FTO search -

1. The inventors whose names repeated the most and their field of operation were understood.
2. The company which filed the patents were also identified.
3. A total of 30 patents were deemed as relevant for further analysis as well as to gather business intelligence.
4. Majority of the 30 patents shortlisted were filed in the USA.

5. Majority of the 30 patents belonged to IPC Class - A61B.

Figures 10 and 11 below show the distribution of these 30 patents as per countries as well as IPC classes

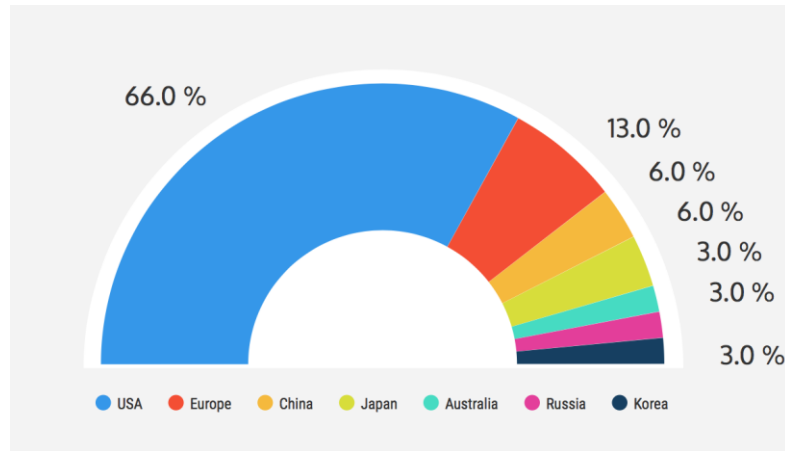


Figure 10. Summary of the shortlisted patents (Countries)

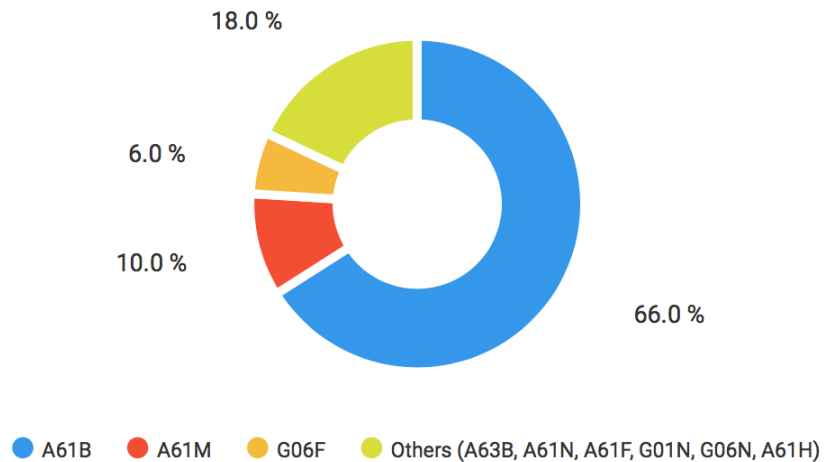


Figure 11. Summary of the shortlisted patents (IPC Classes)



This initial FTO search revealed essential insights which could be used as business intelligence as the project continues. These results give an idea of the technology already existing in the market place and also gives the information of potential partners to collaborate if needed. Hence showing, patent analysis plays a vital role in all organizations. Though some startups differ in their opinions about patents due to its cost and complexity; its benefits outweigh these hindrances. Some presumed benefits include added credibility, higher rate of success as well as increased company valuation.

## 4 Market Research

Marketing is of paramount importance in all organizations. It forms the base through which an organization can efficiently put itself out in the market. According to the American Marketing Association (American Marketing Association, 2017) marketing can be defined as " the activity, set of institutions, and processes for creating, communicating, delivering, and exchanging offerings that have value for customers, clients, partners, and society at large." From this definition we can conclude that marketing not only benefits the organization but also the customers and their surroundings as well. However, with an ever-changing world and borders being minimized with advancing technology, firms attempt to expand to foreign markets. Internationalization not only increases the organizations competitiveness but also exposes them to new and possibly rewarding markets as compared to their local marketplace. (Hollensen, 2017) The revenue generated from sales abroad could significantly aid in R&D. Going global can also cover any shortcomings in the local market such as ageing demographics and fewer sales hence evening the playing field for entrepreneurs or SME's. (Hisrich, 2013)

### 4.1 Baby monitoring device market

According to the Technavio report of Global Advanced Baby Monitor Market 2017 - 2021, (Technavio, 2018) the market will grow at a CAGR of about 11% with majority of the demand transpiring from working parents. In terms of geography, countries corresponding to Europe, Middle East and Africa amount to the highest market share due to increasing awareness of infant related diseases like SIDS and rising fertility rates among African countries. There is also an indication of increased spending capacity of the people corresponding to these countries. Also from this report, the market can be described as -

*“ Moderately fragmented due to the presence few large and small players. The vendors in the market are focusing on developing new products for the consumers by adopting advanced sensor-driven technologies. In addition to developing innovative products, the vendors are also focusing on strategies such as partnering with doctors, expanding target customer, and offering discount codes, to increase sales and improve their market position. “*

Moreover, the segment leaders of advanced baby monitoring devices can be classified into three categories. Firstly, the under-the-mattress format. AngelCare is one of the leading baby monitoring device companies that provides such a format. Secondly, Diaper attachment format and thirdly, a smart wearable format. Smart wearables is addressed by devices such as Owlet and Monbaby. Owlet is a smart sock that can be put on the baby's leg while Monbaby is a Bluetooth enabled device that can be attached to the baby's clothing. Currently, the under-the-mattress format amounts to the highest revenue generation among these three market segments. As seen above, the market is clearly dominated by contact devices leaving tremendous opportunity for a contactless solution. To further validate the prospects of a contactless solution, various trends pertaining to the life sciences industry, the high-tech industry and the consumer goods and retail industry is discussed below.

### **Life Sciences**

It is understood that personalized and holistic healthcare is set to become a standard in the life sciences industry. Life science companies are also determined to reduce the time required in bringing their products to the market since it is highly regulated where on average it takes about ten years and about \$2.6 billion to bring a new drug to the market. Hence, anything that can reduce the time to market is highly important to manufacturers, physicians and patients. Patients are also increasingly leaning towards predictive and preventative treatments as a significant percentage of them wear or are willing to wear technology to track their lifestyle and vitals. Furthermore, the American Medical Informatics Association predict a 50% increase in the volume of health data between 2012 and 2050 hence, the opportunity to utilize this data is immense. (Expectations in Life Sciences, 2018)

### **High Tech Industry**

In today's, fast paced world one of the biggest challenges faced by the high-tech industry is the rate at which consumer electronic goods can become outdated. Taking this into consideration, 71 percent of the CEO's surveyed by PwC concluded that their customers are the most detrimental factor in the subsistence of their business. A separate Genpact research highlighted the above fact by stating a reduction of 5-15 percent in customer satisfaction could prevent as much as 35 percent of regular customers from making repeat purchases. Hence, early detection of product trends as well as incorporating customer feedback into the product life cycle is crucial. Furthermore, 73 percent of High-Tech industry are now using

data from IoT devices to improve their business. Moreover, as noticed in most industries, providing quality service is as essential as producing high quality softwares and hardwares. (Expectations in High Tech, 2018)

### **Consumer Goods and Retail**

Consumer behaviour has completely transformed in the 21st century with a recent report from GlobalData predicting a 112 percent rise in spending via mobile devices in the next five years. This is due to the increasing number of consumers spending time on social media enabling them to explore and purchase products at their convenience. Due to the online nature of this behaviour, consumers are also engaged in receiving relevant data concerned to their experience such as tracking delivery and being able to efficiently return unwanted products among others. To validate this, every organization concerned in this sphere prioritises on delivering personalized customer experience. Furthermore, by utilizing disruptive technologies such as additive manufacturing and augmented reality companies aim to adopt mass customization as a part of their core competency. Furthermore, as also mentioned in the high tech industry, the quality of service is as important as the quality of the product. (Expectations in Consumer Goods and Retail, 2018)

## **4.2 Marketing Plan**

Peter Thiel encourages entrepreneurs to create monopolies. (Thiel and Masters, 2014) He explains this further by describing 'perfect competition'. A 'perfect competition' market is one where producer supply meets consumer demand. Any firm in such a market that is like its competitors and sells similar products. Since the competition is high, no firm has market power and hence must sell products at a price at which the market determines. Assuming there is money to be made, new firms entering such a market, increase supply further bringing down prices and gradually eliminating profits, that brought them to these markets in the first place. The author cautions entrepreneurs that under perfect competition no company makes a profit hence explains monopoly by stating that it is the opposite of perfect competition. A firm creating a monopolistic market, owns the market and determines its price. In this way, a new company produces its goods in a perfect combination of price and quantity to maximize its profits.

Though monopoly has a negative connotation to it, its importance in progress cannot be undermined. New firms with new ideas intending to create monopolies give customers more options. Such new firms are not only great for customers but also significantly improve the current conditions. Monopolies are powerful incentives for companies because it promises years of profits. These profits enable them to keep innovating, create long term plans and fund next-generation research projects that eventually give them an edge over their competitors.

Dominating a market is the end goal of every company. However, every start up initially addresses a small market. Like previously mentioned academicians, established entrepreneurs encourage newcomers to start small since it is easier to capture a small market than a large market. The reason behind this thought lies with the fact that it is easier to reach out to a few people who really need a product than to reach out to a large number of people at different locations. Entrepreneurs go on to argue that, the perfect target market for an upcoming firm is a small group of likeminded individuals in one geographical location with little or no competition. They further warn that a large market could possess market penetration challenges or could have many competitors in the same space.

On successfully penetrating and dominating a market the next progression would be to scale up. Scaling up can take forms. Internationalization is also an aspect of scaling up. However, a very important but less looked at option is expanding to similar or broader markets. (Thiel and Masters, 2014) A good example of scaling up with regards to expanding to broader or similar markets is Amazon. Amazon began with selling books. Due to their platform, even the least sold books in bookstores gathered enough attention to be sold online. Amazon dramatically helped local bookstore owners reach a bigger and wider audience. Once they established their credibility with books, they ventured into CDs, videos and software. They continued to scale and added a wide range product to eventually become the world's general store. Hence, creating a company culture where dominating a specific market and then scaling to adjacent markets is of paramount importance to young entrepreneurs.

Contradicting first mover advantages discussed earlier, the author encourages entrepreneurs to not pay attention to 'disruption' and 'first mover advantages'. He argues that disruption attracts attention and eventually competition. Hence, circumventing competition is key in the

initial stages of a company. Moreover, since disruption is used to describe a company with respect to its competitors, the act of creating something new is more important than creating a 'disruption' in the industry. Similarly, being a 'first mover' should not be a priority. The priority should be on generating cash flows and to make the last great development in a specific field to create a monopoly and years of profit.

### 4.3 Market Growth

Market growth is of vital importance for a young startup as marketing improves sales and sales eventually generate profits. Sales and customer satisfaction play a huge role in building a brand hence it is important to address market growth. The authors (McGrath and Macmillan, 2005) recommend the following ways because these are internal changes that a startup can adopt to better align themselves with their customers. They are complex to replicate by competitors since the changes made are internal and cost little to no money to implement. Moreover, the authors even claim that easy to imitate banking products were only replicated after 12 to 18 months after detection even though it depicted a clear competitive advantage. The following are eight methods advocated by academicians for exponential market growth -

#### I. Changing unit of business

Unit of business corresponds to line of work. Present day organizations are either product based, service based or a mixture of both. Clients are usually billed based on the above unit of business. Changing unit of business implies to modifying the product (or service) offering to customers to better suit their needs. In other words to improve their value to customers. A good example of changing unit of business would be Madden Communications, a privately-owned printing company. They mainly printed promotional material for companies. Due to dwindling profits, Madden Communications soon changed their unit of business and offered to print, distribute and install the materials; thereby improving revenues from \$10 million in 1990 to \$133 million in 2004.

## II. Improving productivity

Productivity is a vital parameter in any industry as companies look to limit the time taken from order placement to order shipment. Reducing these time frames is one of the many methods through which organizations can have a significant edge over their competitors. Lamons Gasket is one such company which produced static sealing solutions. A typical order from customers took about 30-60 minutes to process. Noticing the possibility to improve productivity, Lamons Gasket created an online website where customers could place an order online. This not only improved the company's productivity but also improved their customer's own productivity leading to better customer retention rates and higher market share. <sup>[55]</sup>

## III. Improving cash flow frequency

Cash flow can be briefly described as the amount of money entering and leaving a company in a particular period of time. A positive cash flow is when money entering the company is more than the money leaving the company. The contrary of this is a negative cash flow. The authors argue that a higher cash flow frequency implies lesser working capital and more efficient asset utilization. The American Home Mortgage Holdings (AHMH) decided to address homeowners refinancing their mortgage plans as interest rates dropped and property value increased. They closely partnered with large refinancing companies and completely digitalized their documentation process, enabling them to briskly execute deals. This in turn increased their cash flow frequencies with the company estimating a growth of 28% that respective year.

## IV. Improving asset utilization

Asset utilization is another key measure that companies can consider improving their performance. Reducing assets tied in operations could drastically improve asset utilization. Improving customer's asset utilization would also be highly beneficial for both parties involved. Quanta Computers reduced asset utilization for both itself and its customers by initially, partnering up with many customers as a contract manufacturer, hence improving its asset utilization. It benefited its customers as they reduced their asset intensity by

outsourcing some (or all) manufacturing of components to Quanta. As a result, Quanta's sales were estimated to be \$4 billion by 2002.

#### V. Improving customers' performance

Collaboration between unlikely of partners is very rare in modern businesses. However, such collaboration could yield to improving each other's performance leading to a loyal customer base. This is demonstrated when certified technicians from UPS were authorised to conduct repairs on Toshiba laptops. This drastically reduced the down time of laptops as UPS took over Toshiba's repair and shipping activities as well as it eliminated the PC maker to employee maintenance staff.

#### VI. Improving customers' productivity

Asset productivity revolves around a commercial customer while simple terms as convenience and time saving techniques revolve around a consumer. A great example of this is the AHMH move to digitalise consumer's paperwork to hasten their refinancing process. This enabled their consumers to upload the necessary documents at their own convenience anytime of the day.

#### VII. Improving customers' cash flow frequency

As described in the factors above, any factor that increases the customers value or makes things more convenient, leads to happier stakeholders interactions. Improving customers' cash flow is one of the other factors as well as demonstrated by software company SAS. It only grew as dramatically as it did as it helped its customers make better decisions faster hence improving their cash flow frequency.

#### VIII. Reducing customers' asset intensity

This factor is synchronous with factor four mentioned above. As the authors state (McGrath and Macmillan, 2005),



*“ If you can find ways to reduce or improve customers’ utilization of their assets, you may profit from their increased loyalty to your firm.”*

This is demonstrated by GE’s locomotive decision. They decided to sell haulage contracts to railroads rather than locomotives. This not only increased the railroads utilization but also enabled them to remove expensive locomotives off their balance sheets. <sup>[55]</sup> Such aspects can be seen in many industries such as the one employed by Rolls Royce. Rolls Royce decided to charge airlines for the amount of time the aircraft was in the air rather than for the engine itself. For the aircraft companies, this not only reduced the cost in procuring the engine, but also enabled Rolls Royce to sell more contracts.

#### 4.4 Marketing tool recommended by entrepreneurs

Andrus Purde, is an Estonian serial entrepreneur and currently is the founder of Outfunnel. He was the head of marketing at Pipedrive in 2014 and has handled various marketing roles in Skype between 2006 and 2010. He recommends a 6-step approach in marketing planning for early stage startups. (Purde, 2018) There are as follows -

##### 1. Understanding your category awareness and category urgency -

Category awareness refers to the knowledge the customer base has about a particular product. It varies between low category awareness (industries such as Security drones, App for renting an unused parking lot etc.) to high category awareness (industries such as Smartphones, CRM softwares etc.) Category urgency on the other hand refers to the demand for a certain item in a particular period of time. DVD players are a good example of low category urgency in current times. Hence, Andrus recommends that the early stage startup understands its capacity with respect to the above-mentioned parameters as a first step.

##### 2. Variety of marketing channels -

Once step one is determined, step two relies on using a variety of marketing channels to lead the product offering into a high category awareness area. If a product offering currently lies in a low category awareness (LCA) zone then one could employ methods like displaying ads,

public relations campaign or “viral” marketing in order to transit to a high awareness zone. However, if a product offering lies in a high awareness category (HCA) zone or in the intermediary, then one could employ methods like Search Engine Optimization (SEO) Marketing, Paid searches as well as review sights to improve visibility. Referrals can be utilised on both ends of the spectrum.

Table 5. Channel Prioritization Recommendations (Source: Andrus 2018)

<b>High Category Awareness</b>	<b>Low Category Awareness</b>
SEO	Social (Organic + Paid)
Paid search	Display ads
Bottom of Funnel Content	Top of Funnel content
Review sites	PR
Direct response paid channels	Viral
Marketplace, catalogues	
Referrals	

### 3. Keyword Analysis -

The third vital step was to perform a keyword analysis or keyword research. Here, Andrus recommends an early stage startup to determine 10 - 20 keywords relevant to their product offering and rate them in terms of volume and difficulty in obtaining them. Tools such as Google Adwords and Moz can be utilised to determine search volume and difficulty ratings.

### 4. Preparing a channel opportunity matrix -

The fourth step is to prepare a channel opportunity matrix. Using the keywords determined in step 3 in a search engine, the first 10 findings are to be noted. It is important to note the different types of search results that are obtained. The search results could be of a competitor, comparison site, media site, user generated content site among others. On creating a list of these search results with the keywords used in obtaining them, one can

construct a channel opportunity matrix. The goal of the matrix is to transfer the product offering in as many cells of the matrix as possible. Depending on the type of search result, appropriate measures like media outreach, publishing own content to name a few can be adopted.

#### 5. Maximise referrals -

Andrus observes that referrals are the most profitable channels. Based on the findings from a customer survey conducted by Pipedrive in 2014, he argued that majority of the referrals were from moral origins like helping a friend/colleague and genuine interest in the product rather than other benefits. Hence, he recommends early stage startups to create referrals based on the below guidelines -

1. Limiting rewards of referrals to a minimum.
2. Implementing referrals at the beginning of the venture.

#### 6. Execute, measure, repeat, patience and ICE -

The sixth and the final step in generating a marketing plan for an early stage startup is execution of the plan. Andrus reaffirms step 3 and 4 as being the most important steps in creating a marketing plan and also confirms that generating keywords is the most time consuming process. He recommends such a plan to be reevaluated bi-annually. As a concluding and pro-tip he also recommends using ICE as a method to prioritising the ideas for execution. <sup>[56]</sup>

I → Impact

C → Confidence

E → Effort

'I' represents impact. The potential impact generated by the proposed idea. 'C' represents confidence. The confidence with which the proposed idea will bring about the necessary impact. 'E' represents effort. The effort required to execute the proposed idea. Below is an example of the same -

Table 6. Demonstration of prioritising using ICE table. (Based on (Purde, 2018))

<b>Idea</b>	<b>Hypothesis</b>	<b>Impact</b>	<b>Confidence</b>	<b>Effort</b>	<b>ICE (I*C*E)</b>
Update signup form	Removing username will increase completion rate	4	5	4	80
Promote referral program in signup form	Increasing awareness of program will drive usage	4	3	4	48
Build connector to Microsoft Office	Visibility in Office Store will drive new signups	3	2	2	12

**Appendix 1** shows the tools recommended by Andrus for the startup idea. For the purpose of this research, it is important to note that the keywords and the channel opportunity matrix were limited to 5. Andrus recommends 10-20 keywords to be utilised whilst taking into account all 10 positions in the channel opportunity matrix. Furthermore, markets were also restricted to Nordic countries as well as EU countries appearing in the top 10 on Google's market finder tool under categories baby monitors, maternity and new parent, baby health, respiratory conditions and cribs.

### Advice on keyword research

For the context of this thesis, a keyword will be defined on the basis of an internet research. A keyword is a word used to retrieve a specific piece of information. It can be a single word or a combination of words used to retrieve certain specific information. Keyword research is of vital importance to all organizations. It can be utilised by large scale multinational corporations as well as small to medium scale enterprises in promoting their product offerings. The difference however, lies in the dept of volume of keywords searched and the resources allocated to keyword research. (Purde 2018)

The ideal keyword should consist of the following three parameters -

1. Monthly searches - It should have a high number of monthly searches.
2. Competition - It should have low competition with regards to content in the form of blog posts, pages of similar content among other parameters.
3. Relevancy - Be as relevant as possible to the content one wants to promote.

When the above parameters are used in tandem, the search yields valuable insights to the marketer. For instance, from the table 11 below, the keyword 'baby camera' has 49500 searches per month whereas keyword 'wireless baby monitor' consists of only 8100 searches per month. At first glance, 'baby camera' is the obvious choice. However, when competition and relevancy are considered, the choice is less obvious. Search engine users considering 'baby camera' could vary from users conducting research on baby cameras to grandparents learning how to use baby cameras. On the other hand, users searching for 'wireless baby monitor' are more focused and more precise. Furthermore, 'wireless baby monitor' represents the product offering better than 'baby camera', hence giving it higher points for relevancy in the table below.

Table 7. Keyword search analysis

<b>Keyword</b>	<b>Monthly Search Volume (SV)</b>	<b>Competition (C)</b>	<b>Opportunity Score [OS = SV*[1-C]]</b>	<b>Relevancy (R) (Subjective)</b>	<b>Total Opportunity Score (OS*R)</b>
Baby camera	49500	0.53	23265	20%	4653
Wireless baby monitor	8100	0.52	3888	100%	3888

Andrus also argues that often, startups should focus on less generic and more specific keywords rather than high volume ones. He also recommends the usage of 'Long Tail' keywords rather than shorter ones. This is because 'Long tail' keywords cost less per click since the competition is low. Though the usage of long tail keywords could drive less traffic

through the website, the visitors visiting it as well as the eventual conversion rates are higher since these people are more focused and aware of their search. (Purde 2018)

## **5 Business Model**

With regards to a startup, a business model can be defined as a system of unique choices made by a new venture that identifies its customer value proposition and states methods through which it will address aspects pertaining to customer value, technology and operations management, go-to market plan and revenue model. (Eisenmann, 2014) A well-made business model depicts a firm's ability to handle a crisis such as a new competitor or change in regulations. However, the author is also quick to argue that one must frequently adapt their business model based on the ever-evolving state of the business.

### **5.1 Customer Value Proposition**

Creating value to the customer is the basis of any business model. Some of the questions that could clarify customer value is mentioned in the table below. The biggest challenge is overcoming customer skepticism due to new nature of a startup. However, there are a few important factors that are detrimental for a new business.

#### **Partnerships**

Due to their limited budgets, startups often are unable to fund their product development. This is where partnerships with well-established partners could enormously help startups. In order to do so, startups must demonstrate that they can bring enough value for both themselves and their partners. This is usually done from a weak bargaining position in exchange of significant equity in the company or monetary concessions. Within the baby monitoring market, a good example of such partnership is between Raybaby and Johnson and Johnson. Raybaby provides the possibility of a new, market leading device on the market while Johnson and Johnson provides the necessary recognition required to bring such a product to market among other aspects.

#### **Customer Switching Costs**

Switching costs can be described as other expenses, inconveniences or risks adopted when a customer switches from one supplier to another. Switching costs is important to consider in

a business model since, one, if a venture addresses an existing market, it must deliver a product of greater value than the products already existing in the market as well as the costs incurred by its customers to switch over to its services. Two, if a new firm already has customers, it could create more value if its customers confront higher switching costs. A good example of relating to switching costs is when one switches from a Windows PC to an Apple PC and iTunes.

### **Network Effects**

According to the author, network effect can be defined as follows -

*“A platform-mediated networks, which include networks of customers—often called users—who wish to interact with each other, along with one or more intermediaries who provide a platform, encompassing infrastructure and rules to facilitate users’ interactions”*

A modern example of network effects is Facebook while a classic example of this is the fax machine. A single fax machine has no value unless someone else also bought one. Furthermore, 60 out of 100 of the world’s most valued companies generated most of their revenue from platform-mediated networks.

Table 8. Customer Value Proposition Questions (Based on Eisenmann, 2014)

<b>Customer Value Proposition Questions</b>
What are the unmet needs of the customer?
What is the differentiation factor?
What are the customer segments?
What type of market will the venture serve? (new, existing, or re-segmented)
What will be the MVP?

With respect to the business idea discussed in this thesis, partnerships will be key in gaining initial market traction. The new venture established will cater to a new segment of the market



emphasizing on high product quality. Moreover, it will also provide a new method of addressing baby/infant monitoring.

## 5.2 Technology and Operations Management

After creating a framework for customer, the next area to focus on is technology and operations management. A list of questions to better understand this is mentioned in the table below. A few factors to be considered under this section are vertical integration and first and late mover advantages.

### **Vertical Integration**

Due to the uncertain nature of startups, in many situations utilising resources or services from another firm to compliment in house capabilities can be extremely useful to a new company. This not only creates a valuable partner but enables the new venture to allocate its resources on other essential tasks. Cake Financial is a good example of such a scenario. Cake Financial was an online service that rendered investment advice to it's clients based on their trading data. Cake could either develop the software from scratch or license the data from companies with similar software. Cake took the former decision and in doing so utilised a significant amount of its \$ 9 million raised in venture capital putting it in a tricky situation as it's customer were slow to adopt such an offering due the global economic crisis of 2008. Though Cake's case study should only be considered as an example, vertical integration is something every startup should consider.

### **First Mover Advantage**

Firstly, when entering as a first mover the possibility to address the economies of scale is large and there is huge potential to build lasting customer relations. This not only builds customer relationships but also spreads the manufacturing costs over more customers. Secondly, securing necessary limited assets such as skilled personnel, locations for retail outlets, factories is also a promising possibility. Thirdly, if the startup is more R&D oriented, filing patents could potentially make it more difficult for competitors to enter the market.

Lastly, if in an industry the scale of production has to be high and the size of the market is relatively limited, setting up first could deter other competitors from entering into the market. Teledesic and SkyBridge are good examples where both intended to launch low orbiting satellites (by spending billions of dollars) to provide high speed internet anywhere across the world. Their main concern was in the size of the market and its ability to cater to both service providers. (Eisenmann, 2014)

### **Late Mover Advantage**

First, is the possibility of reduced R&D costs. This is done by reverse engineering. Reverse engineering is lot more economically efficient when compared to developing something totally new. Lastly, there is a possibility that late movers could analyse potential early movers and produce a product that technologically more superior than early movers. This is possible by utilising technology that was once not available to the early movers. Information relating to early and late movers from an entrepreneurs' perspective is described in section 5.5 below.

Table 9. Technology & Operations Management Questions (Based on Eisenmann, 2014)

<b>Technology and Operations Management Questions</b>
What tasks are to be performed to bring the product to market?
What tasks are performed in-house and what will be outsourced?
What are the terms of outsourced tasks?
To what extent can economies of scale be used to drive down costs?
How will any IP generated be protected?

With regards to the business idea discussed in this thesis, late mover advantages are key for initial market penetration. As mentioned in chapter 4.1, the baby monitoring device market is moderately fragmented and has only three segments within the industry. Hence, there is tremendous potential being the late mover. The main activities required in this business is product integration and testing. Activities identified to be performed inhouse is data analysis

while manufacturing of major parts/components can be outsourced. Economies of scale can definitely be utilised to further drive down costs once initial market traction is gained.

### 5.3 Go-to market Plan

A go-market plan identifies the methods through which a new firm brings its product out into the market. Some of the questions to better understand this is mentioned in the table below. Irrespective of whether a new firm introduces a radically new product into the market or if it just caters to an already existing market, it must effectively acquire initial customers. These initial customers are crucial in gaining initial traction. (Eisenmann, 2014)

Other than conventional marketing techniques, startups can also harness the power of network effects as mentioned in generating customer value proposition mentioned above. Other common methods are word-of-mouth marketing and providing incentives. If a startup relies heavily on viral growth (such as word-of-mouth and referrals) it should monitor its viral coefficient. A firm's viral coefficient can be defined as the number of customers acquired through viral methods for every customer initially acquired. For example, if a startup has acquired 1000 customers in year 1, with a viral coefficient of 0.3, it will acquired 300, 90, 27 new customers in year 2,3 and 4 respectively. For same initial 1000 customers if the viral coefficient is 1.3, it will acquire 1300, 1690, 2197 in year 2,3 and 4 respectively.

Table 10. Go-to market questions (Based on Eisenmann, 2014)

<b>Go-to Market Questions</b>
What methods will the venture employ to reach market? (Direct, indirect or mix)
Any exclusive channel to be utilised?

Creating a promising crowdfunding campaign will be a vital first step in generating and validating market interest for the business idea mentioned in this thesis. More traditional means such as social media marketing techniques could be used to further promote the

crowdfunding campaign. Post the crowdfunding campaign, search engine optimisation techniques along with paid advertisements can be used to further penetrate the market.

## 5.4 Revenue Model

The revenue model describes the economic feasibility of the new venture by considering the above three mentioned parameters. Questions essential to the revenue model are mentioned in table 8 below. The author agrees that managing cash flow is of paramount importance for cash constrained startups. Two of the most important factors when creating a revenue model is the magnitude of negative cash flow and the time at which it occurs. (Eisenmann, 2014) Information relating to revenue model from an entrepreneurs' perspective is described in section 4.5 below.

Table 11. Revenue model questions (Based on Eisenmann, 2014)

<b>Revenue Model Questions</b>
What are the profit margins of the venture?
What are the recurring fixed costs?
What is the negative cash flow or breakeven point?
What is the working capital required?

With regards to the business idea discussed in the thesis, there will be two revenue streams. First will be from the sale of the product and second will be the sale of the service component of the business. The margins of the venture due to the sale of the product will increase in the later years of the business as economies of scale can be utilised. However, the sale of the service component of the business idea will aid the revenue model from day one. A breakeven analysis is performed and is discussed in chapter 5.8 below.

## 5.5 Factors to be considered in business model by entrepreneur

Peter Thiel is an American entrepreneur, venture capitalist and philanthropist, most commonly known as the co-founder of PayPal, Palantir Technologies and founders fund and the founder of the Peter Thiel Foundation. He explains that there are four characteristics for a company to be successful or for it to turn into a monopoly. (Thiel and Masters, 2014) The four characteristics are proprietary technology, network effects, economies of scale and branding.

### **Proprietary Technology**

With imitations of new technologies occurring in record breaking times, proprietary technology becomes even more important to prevent replicas from legally entering the market. Patents enable this to some extent by offering protection upto a period of 20 years. Though patents are initially restricted to their region of filing, they can easily be extended to regions around the world subject to availability of funds. Proprietary technology must be at least 10 times better than its closest competitor to have a real monopoly in the market. Peter continues to explain that the direct way to create such a difference is by creating something totally new. Good examples of approximately 10 times improvement across various sectors are Paypal, by easing buyer-seller transactions, Amazon, by initially offering 10 times as many books as any other book store in the world and Apple, by drastically improving its Ipad's designs to make tablets useful for all.

### **Network effects**

As discussed in section 5.1, network effect refers to making a product more useful by increasing the number of users. The advantages of harnessing network effects is word-of-mouth marketing and in some cases even viral marketing by the users of the product. However, the challenges with addressing network effects is making the initial product useful to the first set of users. An important aspect to also note is, it must start with smaller markets.

## **Economies of Scale**

Economies of scale are of vital importance for any company. It helps distribute the fixed cost of producing a product over large quantities of sales. Software companies have an added advantage as the cost of replicating the product is zero. The author advises young entrepreneurs to consider economies of scale in initial designs of final product development.

## **Branding**

Branding defines the image of the company with the rest of the world. People's perception of a product is associated with its branding. Apple is one of the best examples when it comes to branding. It has a list of proprietary technologies, manufacturers products at a large scale to dictate pricing of the materials for its products and harnesses network effects to its maximum. Despite stating the obvious, The author (Thiel and Masters, 2014) warns that building a brand without a product is disastrous and branding alone is not sufficient to build a technology company.

## **5.6 Pricing strategies**

The detrimental factor in determining the value of a company lies in its cash flows. The value of a business in present times is gauged by the amount of money it can make in the future. Moreover, correction on the valuation should also be considered due to inflation. It is important to note the difference between low and high growth companies when cash flows are determined. The value of low growth companies lies in the immediate future. An example of a low growth company is newspapers. According to the author, low growth companies such as newspaper companies could sustain their current cash flows for the foreseeable future. However, any competition will eventually lead to depreciating profits.

The author further argues that technology companies are high growth companies where they often make little or no money in the first few years and it's true value can only be determined 10 to 15 years in the future. In 2001, PayPal were yet to make profit but their revenues were growing at a rate of 100% every year. It's then value was estimated to arise from profits

generated beyond 2011. On closer inspection, as of 2014, PayPal continued to grow at 14% per year where the company's current value would only be from beyond 2020.

Future cash flows are essential as long as the company exists. For a company to be valuable it must grow and sustain itself. The mistakes most entrepreneurs make, is that they focus only on short term growth. Since growth is easier to measure, robustness of a new company is often neglected. Zynga and Groupon are examples of such scenarios where entrepreneurs focused on short term growth and failed to address issues concerned with sustainability and robustness. Though Zynga created games like Farmville they soon ran into trouble associated to catering to a fickle audience. Groupon initially grew at an exceptional rate however challenges of converting the small businesses to repeat customers was harder than initially imagined. A balance of numbers as well as long term plan is key in establishing a monopoly for any new company.

An effective price of €349 was decided for the initial purchase of this device after market analysis, supplier negotiations and cashflow analysis. Furthermore, €9 per month would also be charged as the service component of this device if the customer decided to opt for the service after purchasing the device.

## 5.7 Financial Planning

Financial planning lay a concrete foundation of all the incoming and outgoing transactions of the company. It helps keep track of the costs and revenue projections of the project. Another important aspect of financial planning is it demonstrates the amount of debt a company could incur and the time it could possible take to repay the debt. (Triantis, n.d.) Furthermore, the author also encourages the users to take into account the following factors when deciding quantity and price forecasts. First, host country's growth rate, inflation rate. Second, the industry structure/competition. Third, market analysis tool such as PESTEL (Political, Economic, Social, Technological, Environmental, Legal). Fourth, changes of growth rate with respect to market changes. Fifth, price adjustments with respect to regulated and unregulated markets. For the purpose of this research, financial planning was conducted using a 3-year financial calculation model. This was carried out after multiple consultations with representatives of Wirma utilising it's financial planning guide.

**Appendix 3** shows a screenshot of the financial calculation model as recommended by Wirma.

## 5.8 Breakeven Analysis

The breakeven concept, also known as cost-volume-profit analysis, first originated in the 19th century. It has been revised several times to reduce its limitations and make it more applicable in business scenarios. The author describes breakeven thinking as, *“A way of comparing the amount of incoming value that an organization needs in order to serve its customers by delivering outgoing value of an equal amount.”* Breakeven thinking and breakeven analysis could be detrimental in deciding whether to quit a job and start a business, whether to outsource, whether to sell products on the internet, whether to change production capacity and determining the impact of change in final price and cost price among other promising scenarios. (Wentworth. and Cafferky., n.d.) Below, we describe the first 3 years with respect to this project.

### **Year 1**

Year 1 is shown in the figure 12 below. It describes the first year of running the business. As mentioned earlier, the true value of a technology company is only realised in its later years. This statement validates our initial findings. Since the cost of setting a business is initially high, production volume must be kept at an optimum level. This significantly reduces the ability to negotiate on an economy of scale. Based on these facts, in the first year of running the business, if the estimated fixed costs amounts to €17367 per month, variable cost per unit is €200 and unit price is €349; it takes about 117 units to be sold every month to breakeven.



<b>Fixed Costs</b>	€ 17,367
<b>Variable Cost per Unit</b>	€ 200
<b>Unit Price</b>	€ 349
<b>Unit Increments</b>	15
<b>BREAK-EVEN POINT</b>	<b>117</b>

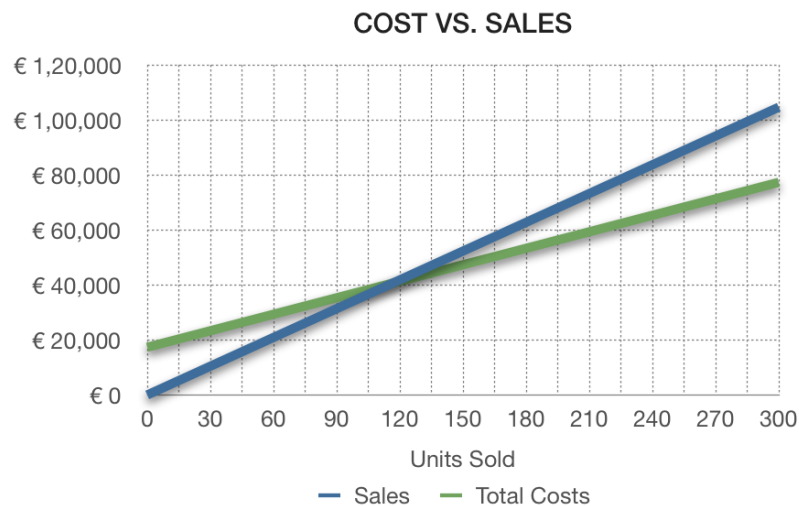


Figure 12. Breakeven Year 1

## Year 2

Year 2 is depicted in figure 13 below. It shows the second year of running the business. In the second year, certain one-time costs relating to setting up the business have been reduced, bringing down the fixed costs to €12311 per month. However, the production volume is increased by 500 units. This leads to a slight reduction in variable cost per unit, bringing it down to €180. Retaining the same unit price of €349, the break even in the figure depreciates to 73 units.

<b>Fixed Costs</b>	€ 12,311
<b>Variable Cost per Unit</b>	€ 180
<b>Unit Price</b>	€ 349
<b>Unit Increments</b>	15
<b>BREAK-EVEN POINT</b>	<b>73</b>

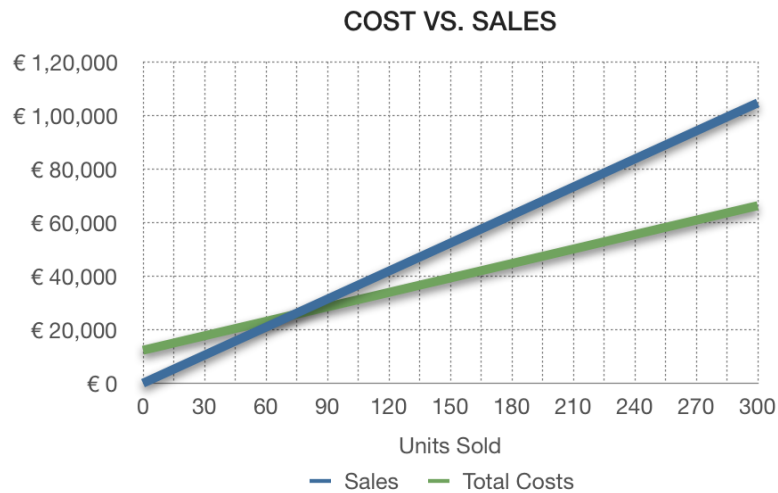


Figure 13. Breakeven Year 2

### Year 3

Year 3 depicts the third year of running the business. It is shown in the figure 14 below. In the third year of running the business, aggressive production tactics have been adopted to further bring down the cost per unit. Economies of scale have been taken advantage of by increasing the production volume to 1000 units. An increase of 500 units since the previous year. This has led to the reduction of cost per unit, bringing it down to €150. Retaining the unit price of €349 and with a production cost of €15739 per month, the breakeven point is identified to be at 79 units.

<b>Fixed Costs</b>	€ 15,739
<b>Variable Cost per Unit</b>	€ 150
<b>Unit Price</b>	€ 349
<b>Unit Increments</b>	15
<b>BREAK-EVEN POINT</b>	<b>79</b>

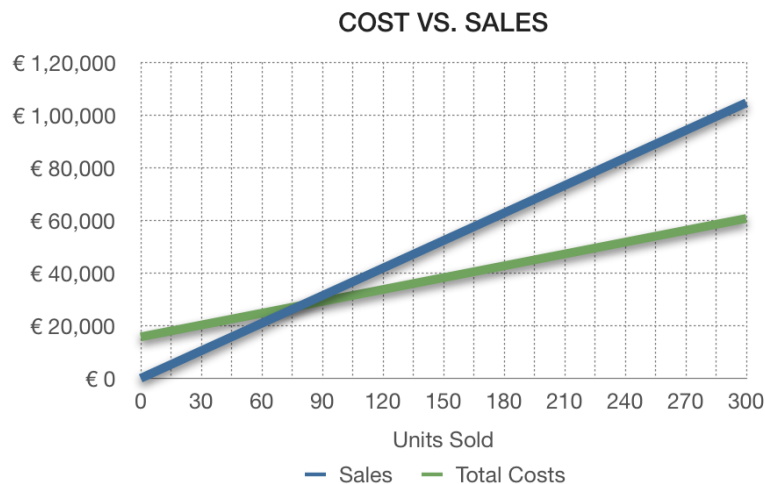


Figure 14. Breakeven year 3

Based on the numbers mentioned above, the company is estimated to make a loss during the first year but recovers in the year 2 and year 3. It is also important to note that the service component of the business has not been taken account in this breakeven calculation. Including the service component in breakeven could potentially reduce the number of units required to break even. Furthermore, the first year of business is the most difficult time for the business owing to its initial startup costs.

## 5.9 Predicting the revenue of a product

Tim Ferriss is an American entrepreneur and author. In his book the 4 Hour Work Week, he recommends entrepreneurs using a simple process to determine the revenue of a product before beginning the manufacturing process. (Ferris, 2007) Such an analysis could also help predicting the volume of traffic to a website as well as gauge return on investment.

1. Determining the size of potential customers: Tim recommends this to be done by using keyword analysing tools such as Overture, Moz, Google keyword planner among others. By using these tools one can determine the amount of people searching for terms related to the particular product or service per month.
2. Once the size of the market is determined, the second step is to determine a click-through rate (CTR). Tim cautions that with a decent paid ad design one can expect a conversion rate of 0.5-1.5%. However, if the search term is more specific the CTR can be 3-5%. Furthermore, if the competition is limited and one uses brand names then the CTR could vary between 50-100%.
3. The third step and final step in determining the revenue of a product is assuming the conversion rate. Conversion rate is the ratio of the number of people visiting the website to the number of people buying the product. Tim argues that if the website of the product significantly differentiates itself from its competitors, one can assume a conversion rate of 1-2%. Moreover, it is also important to consider the cost per click in this step in determining the final revenue of the product.

**Appendix 2** shows the predicted revenue for the product as recommended by Tim. He further argues that many such keywords can be analysed to understand the various return on investment for the same product. For the purpose of this research, one keyword was selected for analysis to demonstrate the working of the model as advised by Tim.

## 6 Fundraising and investors

### 6.1 Investors and its types

Raising money is of vital importance for the operations of a startup. It is all the more important when it is an early stage startup. Startups use this money to scale and expand their business. However depending on the stage of the startup as well as the country in which it is located in the type of investment significantly varies. Jeremy Liddle is the Co-founder and Executive Director of CapitalPitch, a digital investment firm that helps such founders with funding. (Liddle 2018) Based on the companies research in US, UK, Australia and China, funding can be broken down into three stages -

#### 1. Pre-seed

A pre-seed stage startup is one where it is in product development phase of a minimum viable product (MVP). The objective of this funding is to utilise the money raised for testing, prototyping and building a core team. The money raised in this phase is relatively small compared to the other phases due to the conceptual stage of the startup. Money during this phase is usually raised by Friends, Family and Fans (3 F's). The money raised in this stage is usually between \$50000 - \$250000 while the company has a pre-money valuation of less than \$2million.

#### 2. Seed

A seed stage startup is one where it has already proved its product or service and is receiving monthly revenue. It requires further funding to develop as an organization as well become a competitor in the marketplace. The money raised in this stage is significantly higher than compared to the pre-seed stage as ranges between \$500000 - \$2million while the company has a pre-money valuation of \$2million - \$5million.

#### 3. Series A (B, C and D)

A Series A stage startup is one where it generates enough revenue from its business however not significant profits. The types of investors are usually venture capitalists or angel investors since a significant amount of risk is involved in such a scenario. The money raised in this stage is usually to scale production as well as boost sales nationally and potentially

internationally. The money raised ranges between \$2million - \$10million while the pre-money valuation of the startup is between \$5million - \$20million.

Table 12. Summary of different types of investors. (Based on Liddle 2018)

<b>Category</b>	<b>Pre-seed</b>	<b>Seed</b>	<b>Series A</b>
Revenue	\$0	> \$5k/month	> \$100k/month
Product	No MVP	MVP/Beta	Final product exists
Customer/Revenue Growth	Customer Validation / Pilot Complete	Beginning	10%/month for 6+ months
Team	1-4 co-founders	2-4 full time co-founders	2-4 full time co-founders
Executive Team	Founders	Founders + 1-5	Founders + 5-20
Board of advisors	1-2 advisors of industrial experience	3-6 serial entrepreneurs and/or industry experts	6+ serial entrepreneurs, and/or investors , industry experts
Board of directors	None	1-2 co-founders	2 co-founders and 1 serial entrepreneur, investor or industry expert
Cash burnout	Running on personal cash flow	6-18 months	6-18 months
Intellectual Property	No owned	Owned	Protected
Amount raised	\$50k - \$250k	\$500k-\$2m	\$2m - \$10m

Furthermore, Jeremy also argues that the above table should only be used as a guide as the home location of the startup as well as the investor could significantly influence the parameters.

## 6.2 Difference between business angel and venture capitalist

Venture capitalists and business angels are well known components in the startup ecosystem. According to Will Jiang, one of the Top 30 Early-Stage VC Investors of 2016 and founding partner of Chinese Venture Capitalist firm: N5Capital, (Jiang, 2018) the services offered by these two firms may seem similar which often leads to a dilemma amongst founders. However, there are a few key differences between the two and hence, the founders can decide which route to take based on these factors.

### 6.2.1 Business Angel

1. Structure - A business angel or an angel investor is often a wealthy individual investing their own personal finances in exchange for equity in the startup. Such investors usually work by themselves and are often well-connected influential individuals.
2. Investing amounts - Since business angels often invest from their own finances, the amount of money they invest is limited compared to a venture capitalist. Though contacting business angles could lead to quick solutions, they will only be able to finance parts of the project. Angels usually invest between \$25000 - \$ 100000, however there could be instances when angels group together and collectively invest up to \$750000 on average on a startup. (Adams, 2018)
3. Responsibilities and motivations - The primary role of angels is that of financial support. Though angels could advice founders or introduce them to important connections, their role is often limited.
4. Stage of the startup - Business angels are more focused on early stage startups compared to venture capitalists. Their expertise lies in product development as well was early market entry.

5. Due diligence - Due to the private nature of financing there is little to no due diligence performed by business angels. Hence, the investment could be quicker to receive as compared to a venture capitalist firm.

## 6.2.2 Venture Capitalists

1. Structure - Venture capitalists on the other hand are a group of individuals either investing their own finances or finances of other corporations or foundations. They often work together with founders to ensure their investment is being utilised appropriately and the company is growing in a mutually beneficial manner.
2. Investing amounts - Due to the collective nature of venture capitalists, they invest around \$7 million on average on startups. (Basta, 2018)
3. Responsibilities and motivations - As mentioned earlier, venture capitalists act as mentors for the founders. Other than financial support, venture capitalists are determined to build a fruitful startup and are often involved in the company's long-term goal. They assume an advisory role for the CEO and the core team of the startup.
4. Stage of the startup - Different venture capitalist firms have different areas expertise. They focus on early stage startups, more developed startups and startups showing immense growth potential. The combination of potential as well as the expertise of the venture capitalist rapidly increases the development and growth of the startup involved.
5. Due diligence - Since the origin of funds of venture capitalists is derived from various sources a due diligence is performed thoroughly. They could spend as much as \$50000 of their resources to conduct due diligence hence increasing the time in investing in the company.

Will further states that the decision of which investor to approach lies solely on the founders and their needs and necessities. However, these parameters could be of vital importance in determining the path taking into consideration the main goals and objectives of the startup.



## 6.3 Crowdfunding

Crowdfunding is one of the many means available for entrepreneurs to raise funding for their projects. According to the author (Mollick, 2014), crowdfunding can be defined as -

*“the efforts by entrepreneurial individuals and groups – cultural, social, and for-profit – to fund their ventures by drawing on relatively small contributions from a relatively large number of individuals using the internet, without standard financial intermediaries”*

Crowdfunding is a very viable option for young entrepreneurs, however, sufficient preparation is required for a successful crowdfunding campaign. Studies (Mollick, 2014) validate the above claim as crowdfunding campaigns either narrowly succeed or fail drastically. 45 of the 50 highest funded projects in Kickstarter converted into established organizations in 2012.

### 6.3.1 Reasons to crowdfund

There are many reasons for entrepreneurs to choose crowdfunding. Raising funds need not necessarily be the only goal of crowdfunding. It can be used to demonstrate the existence of a market even before final product is made eventually demonstrating market validation for traditional investors. Similarly, a lack of market interest enables the entrepreneur to ‘fail quickly’ reducing the need to dedicate further resources or effort to the doomed project. Moreover, it can also be used for marketing during the early stages of product development. A successful crowdfunding campaign could also potentially lead to press coverage which is eventually beneficial to the entrepreneur.

### 6.3.2 Detrimental facts for successful crowdfunding campaign

Factors that lead to a successful crowdfunding campaign can vary on a case to case basis. However, there are a few traits that are common with successful crowdfunding campaigns. They can broadly be classified into two categories - one, quality of the project/preparedness of the founder and two, social media presence.

In most scenarios, the quality of the project plays a very important role. Quality of the project is determined by a well-rehearsed pitch. Furthermore, creating a video of the project further enhances its quality. Another factor that is usually neglected by entrepreneurs is the provision of sufficient updates regarding the project. Kickstarter recommends providing updates as soon as the project is launched. These in turn adds to the quality of the project, affirming that the entrepreneur is well prepared. This further reassures the funders that the project is being addressed whilst they are making an investing decision. The above-mentioned factors are closely followed by spelling errors which reduces the quality of the project.

Other than the quality of the project and the preparedness of the entrepreneur, his/her network and the social presence is also closely associated with the success of a crowdfunding project. (Shane and Cable, 2002) The general trend being the larger the number of 'followers' or 'friends' on social media the better the chances of a successful crowdfunding campaign. However, having no social media presence is better than having a social media account with few connections.

### 6.3.3 Concerns with crowdfunding

In crowdfunding campaigns, funds are raised well before a final product exists, the possibility of deceit is the obvious threat to crowdfunding. However, research shows that this is often not the case. Since, the budget is created well in advance, any new knowledge obtained after the initial budget creation cannot be considered; leading to delays in the delivery of the project. Delays account to the biggest concerns in project deliverables in crowdfunding campaigns. Complex projects and projects that unexpectedly succeed suffer the most from delays. Furthermore, larger projects suffer from longer delays than smaller projects. The factors leading to the delay were largely attributed to manufacturing problems, complexities in shipping, changes in scale and unforeseen certification issues. (Cowley et al., 2012)

## **7 Discussion**

To reinforce the possibilities of establishing a business, the findings of the business stated in chapter in 2 had to be verified and market research to determine the need of such a product had to be investigated. To address both these challenges, 2 survey links via Google Forms were dispatched. First, to identify the market need and second, to get a doctor's perspective on the importance of respiration data. Though the changes in respiration pattern were clear to the naked eye, a strong medical opinion was deemed necessary. Furthermore, the importance of respiration patterns and it's is use in the medical community was of pivotal importance for the continuation of the project. A short, whiteboard explainer video was also made for the recipients to better understand the concept.

### **7.1 Survey 1 - Questions to determine market interest in the product**

Survey 1 consisted of 12 questions covering various aspects to better understand the customer and the amount they are willing to pay if there were to exist such a device in the market. A total of 15 responses were obtained and their characteristics are described below.

#### **Question 1**

Question 1 identified who the customer taking the survey were. As shown in the figure approximately 47% of the respondents identified themselves as 'soon to be parent or someone planning on having a baby'. Approximately 27% identified themselves as 'parent with children' and 27% identified themselves as 'none of the above' mentioned parameters.

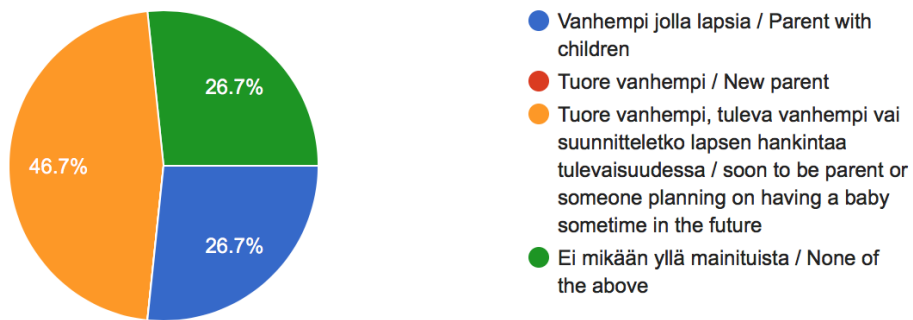


Figure 15. Question 1 distribution

### Question 2

Question 2 identified the region corresponding to the survey responders. The objective of this question was to determine if there was any bias from respondents staying in bigger cities to desire the product or in determining the cost of the product. Most of the the survey respondents were concentrated to the south of Finland and around the bigger cities. The respondents identified themselves as located in cities such as Helsinki, Turku, Vaasa, Lappeenranta and surrounding areas.

### Question 3

Question 3 was identify the age group of the respondents. Approximately 47% of respondents identified themselves as aged between 26-30, 40% identified themselves as aged between 21-25 and approximately 13 % identified themselves as aged between 31-35.

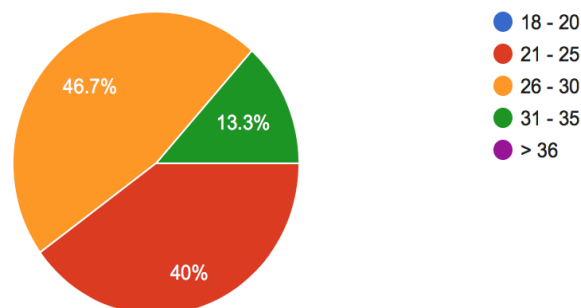


Figure 16. Question 3 distribution

#### Question 4

Question 4 was created to identify the monthly income of the respondent. The aim of this question was to determine if respondents with higher salaries were willing to pay more for the device compared to respondents with comparatively lower salaries. Approximately 7% of the respondents earned between 4000 and 6000 euros a month, 47% earned between 2000 and 4000 euros a month and 20% earned less than 2000 euros a month. Figure below shows the the distribution of the answers.

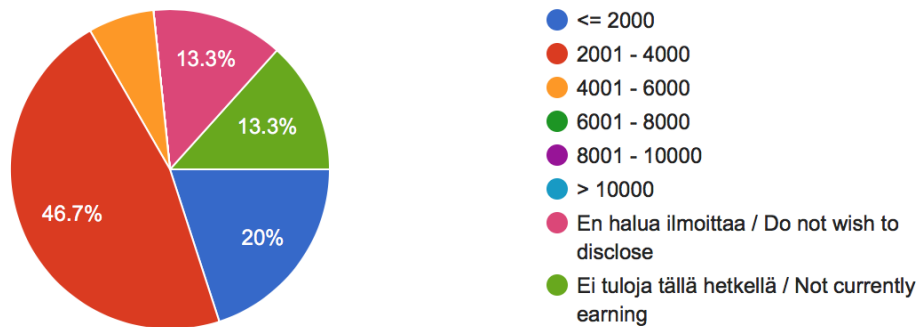


Figure 17. Question 4 distribution

#### Question 5

The objective of this question was to estimate a baseline for the succeeding question and gain potential insight on possible marketing angles for the product. The question was to determine the importance of balancing home and work commitments. Respondents were asked to rate the importance on a scale of 1 to 5 with 1 being the low and 5 being high. Approximately 94% of survey respondents rated that home and work balance was extremely important to them.

#### Question 6

The objective of this question was to understand how having a baby could potentially impact the respondents home or work commitments. This would be a follow-up question to question 5 and the objective was to also identify potential content marketing insights. Respondents

were asked to rate the impact on a scale of 1 to 5 with 1 being low impact and 5 being high impact. An estimated 94% of the respondents claimed that having a baby did or could have a significant impact on their home and life commitments.

### Question 7

This question was more important from a business perspective. The idea was to understand if the respondents would be interested in purchasing this product, purely based on the information they received. An estimated 40% of the respondents were likely to purchase this product and an estimated 33% could potentially purchase the product based on the information they received.

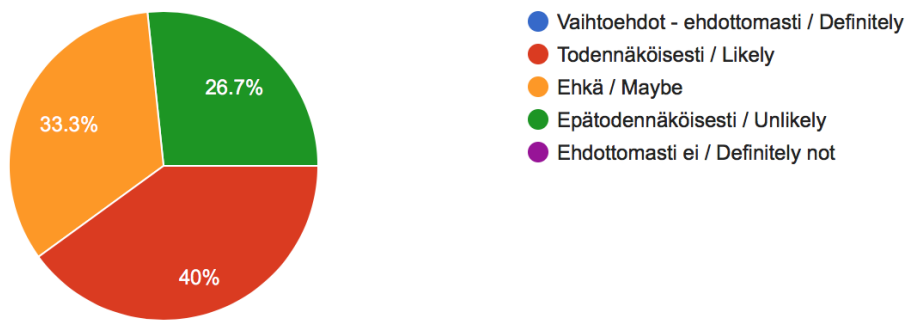


Figure 18. Question 7 distribution

### Question 8

This question was also aimed from a business perspective to get an estimate of the amount of money that the respondents were willing to pay to purchase such a device. Though the answers varied across 30 euros and 5000 euros, approximately 42% of the answers were between 150 and 500 euros.

### Question 9

This was an interesting question to include and gauge the interest of the respondents in determining the importance of a 'Made in Finland' tag of the product. This question was included to see if the respondents held the tag important while making a buying decision. Respondents were asked to rate the importance of the tag on a scale of 1 to 5 with 1 being

low and 5 being of high importance. An estimated 72% of the respondents claimed that a made in Finland tag was important to them.

### Question 10

As the device was intended to be both a product and a service. This question was a continuation of question 8 and was created to understand how much the respondents were willing to pay on a monthly basis after purchasing the device, as a service. An estimated 40% of the respondents replied that they were comfortable paying between 5 - 15 euros a month while 26% wanted it as a complimentary service.

### Question 11

This question was created to determine the viral nature of the product. This is not only important from a business perspective but also important from a marketing perspective in determining efficient marketing channels. An estimated 53% of the respondents indicated that they would likely recommend this product to someone and an estimated 33% indicated that they would maybe recommend this product to someone.

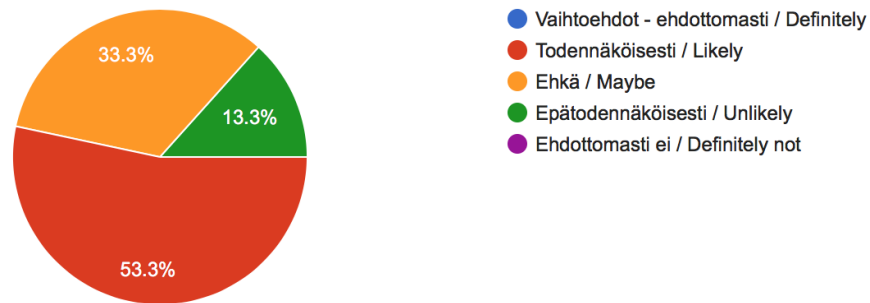


Figure 19. Question 11 distribution

Though the data was not extensive enough to concretely prove certainty, closer examination did reveal a few indicators of possible market conditions. Firstly, potential buyers are willing to pay more for subscription rather than high one-time buying costs. A pricing strategy that consists of lower initial buying cost and slightly higher subscription costs could benefit such a product. Secondly, the 'Made in Finland' tag on the product does infuse a sense of patriotism and subtly influences the buying decision. This could be something to consider if the product

is to be initially sold in Finland. Thirdly, the virality factor of such a device could be efficiently used in the marketing of such a device. Furthermore, as a part of the survey an open-ended question was also mentioned if the respondents wanted to add anything in particular. Some of the important things that were mentioned are the possibility to have more features to bring additional value, the possibility to be used alongside existing monitoring devices and the possibility to notify parents about dangers to their child.

**Appendix 4** provides a screenshot of the survey used to determine market interest in the product

## 7.2 Survey 2 - Questions to understand doctors' perspective

Survey 2 consisted of 7 open ended questions from medical professionals across India, Pakistan, Indonesia and Australia. The objective of this survey was to understand the doctor's perspective on such a device and determining the importance it could have in the medical field. A whiteboard video was also provided to get a better understanding of the device. The questions were structured on the relevance and importance of the data as well as the device itself. A total of 14 medical professionals were able to provide their opinions on the project with a combined average experience of approximately 8 years. The medical professional with the least experience had been practicing for 1 year while the most experienced practitioner had been practicing for 26 years. Their expertise varied from general physicians to pediatric specialists.

### **Question 1**

The first question was intended to identify the prevalence of non-invasive diagnostic measures. Almost all the professionals agreed that non-invasive methods of measurement is the need of the hour. Many believe that it has great potential as it significantly reduces complications that arise due to using contact devices. A few of them also claim to have used a few non-invasive measuring devices however believe there is huge scope for improvement.

### **Question 2**

The second question was inclined towards understanding how well understood is breathing ailments among infants and toddlers. There were some interesting insights for this question



which were more region specific. Medical professionals in Asian countries were much more aware of such medical ailments as it occurs on a frequent basis. Most of the medical professional have standard protocols that they follow when dealing with such conditions. Though the procedures followed are standard the cause of these ailments is not that understood.

### **Question 3**

The third question was to understand the importance of analysing respiration patterns to predict diseases such as asthma and dysfunctional breathing among infants and toddlers. Most of the medical professionals highly agreed with this question. They also believed there is huge potential for such a device as in many cases they must rely on what the parents are telling them before proceeding to standard diagnostic practices. Analysis of respiration patterns enables professionals to reinforce the parents claims and provide accurate treatment to the baby. Moreover, they also believe that this could also help parents bring in their children for early treatment incase an abnormality is detected.

### **Question 4**

The fourth question was to identify if any contactless respiration monitoring device was currently being used by medical professionals. This also serves as a method to identify any potential competitors. Approximately 85% of the medical professionals contacted revealed that they were not aware of any such device currently being used either by them or people around them. They were only aware of contact devices like spirometers and respirometers that were being used.

### **Question 5**

The fifth question was to identify the the importance of respiration patterns to the medical community. Most of the medical professionals agreed that it would aid diagnosis. They also agreed that it could be utilised to further researches occuring within the medical community. Some of them also mentioned that this device could be perfect in Neonatal Intensive Care Units (NICU) or Pediatric Intensive Care Units (PICU). Furthermore, they have gone to mention that detecting diseases early could save emergency healthcare resources and could also aid in remote monitoring. This is an interesting insight in this field.

### **Question 6 and 7**

The sixth question was to identify if there were any challenges in actualising such a device from a medical perspective. This question was also created to identify if there were any barriers to entry from a medical perspective. The biggest concern among the medical professionals was creating awareness for such a device. They recommended conducting continuing medical education (CME), presentations in hospitals, colleges and social media as well as conventional marketing to make parents and medical professionals more aware of such a device. Furthermore, cost effectiveness was also something that they mentioned that could be vital for the easy acceptance of such a device. The last question was to investigate if there were any ethical concerns regarding the usage of this device. Privacy was the only ethical concern that was raised.

This survey sent out to doctors was eye opening in many regards. Firstly, a better understanding of the importance of respiration patterns to medical professionals was obtained. Secondly, the possibility to save emergency medical resources and remote monitoring was a very interesting insight. If the end users were B2B market, there is huge potential based on this insight. Thirdly, as mentioned by the doctors there is tremendous scope of improvement for contactless diagnostic monitoring devices. Lastly, the ability to use this device from a hospital setting was also understood.

**Appendix 5** shows a screenshot of the questionnaire that was sent to the doctors.

## 8 Conclusion

This thesis aimed to utilise academic guidelines and recommendations suggested by serial entrepreneurs to demonstrate the necessary skills required to start a business. Various methods such as market research, patent analysis, predicting the revenue of a product, keyword planning, technology validation, breakeven analysis as well as financing was covered in this thesis. Using these methods enabled to convert the business idea from an idea stage to a pre-seed stage. Furthermore, a secondary aim of collating the best practices from the academic and entrepreneurial world was also established on completion of this thesis. It is very interesting to notice the similarities and differences between the methods suggested by academicians and entrepreneurs. However, due to the sensitive nature of the project only certain elements from the final funding application were included in the thesis.

During the course of this thesis, multiple consultations with representatives from Wirma were conducted during October and November 2017 to discuss the business idea and various avenues available for funding. Representatives from Clover Factory Oy were consulted with in January 2018 to discuss the business idea and various possibilities of obtaining funding. Representatives from GE Health Innovation Village were met in Helsinki in March 2018 to discuss manufacturing, office costs and discovering the various benefits of being village inhabitants. An online seminar concerning keyword planning with Andrus Purde was attended via Icebreaker Ventures in May 2018. Finally, representatives from Green Campus Innovation in Lappeenranta were met and an official application for a research to commercialization grant via Business Finland formerly known as TEKES commenced.

As in the case of many pre-seed startups, the more one learns about the country's startup ecosystem and the closer it gets to the market, the more the business idea morphs into the final product. This too was the case in this project. On discussion with relevant authorities regarding the business idea, a few points were raised with the complexities involved in entering such a sensitive market (baby market). These factors enormously increased the time to market; more than that was previously expected. To address this, the relevant authorities and the personnel involved in the project decided to utilise the same underlying technology to a different market. This not only enabled the team to continue to develop the core technology, but it also enabled the team to address the initial concerns raised regarding entering a sensitive market.

To tackle this new-found challenge, personnel from the Applied Electronics Department of Lappeenranta were brought onboard. Discussions with University of Jyväskylä also commenced due to their expertise in the newfound area of interest. During the application phase various consultations with Green Campus Innovation and Business Finland were held. Discussions with the CEO of Aldanella Oy were also held to finetune the business idea. The funding application process began in June 2018 and concluded in the successful submission of the application in September 2018 with intense collaboration between the Applied Electronics of Lappeenranta, personnel from University of Jyväskylä and the project's core team.

## 8.1 Observations

Several observations were made across various fields during the course of the thesis and they are mentioned below -

### **Business Idea**

It is essential to have a concrete business idea. However, enough emphasis cannot be made on its flexibility. As the business idea progresses, it often reaches relevant stakeholders that are essential to bring the product to market. At this point, there is a possibility for the business idea to morph to something that can be more easily accepted in the market. This change is often brought upon by the experience of the stakeholders in the relevant market. Hence, it is of paramount importance to have the ability to make changes to the business idea in order to progress.

### **Funding Application**

Acquiring funding for the business idea is an elaborate and time-consuming process. Relevant planning should be done well in advance. At least, the groundwork of various types of funding available within the region must be identified as applying for funding from a government agency can be a time-consuming affair. Once these avenues are identified, appropriate business plans and other relevant documents can be prepared. Furthermore, there are many institutions or organizations available that help entrepreneurs secure funding.

Services offered by such institutions or organizations are often beneficial and, in some cases can be the difference between receiving and not receiving the funding. Once a funding source is identified, a very important factor to note, is grounds of funding. Many funding institutions have very clear initial guidelines regarding the type of projects they fund. Reading this fine line could also be detrimental in saving time while preparing the relevant documents.

### **Networking**

Another important parameter that cannot be emphasised enough is networking. All aspects from fine-tuning the business idea, finding teammates as well as finding new avenues for funding can be obtained by networking. Networking events organized by the university's entrepreneurship team is a great way to network and get an idea of the local startup ecosystem. Attending seminars conducted by ESTIEM are a great way to gain knowledge and get an idea of the startup ecosystem in Europe. Such events can also be extremely useful for students outside their home countries to start something of their own while being abroad.

### **Cooperation from university**

Cooperation and guidance between the the professors and the departments of the university are crucial for the development of the business idea. Since creating a business is a time consuming process, I cannot emphasis on the importance of the support provided by the professors and the departments. The department deviating from the conventional thesis format and providing the opportunity to demonstrate the various skills attained in the masters program in a real world project was crucial in the development of the business idea and this thesis. Such a project would not be possible during one's academic tenure without the cooperation and coming together of various personnel within the university.

## **8.2 Thesis Limitations**

The various methods suggested in this thesis are limited to a B2C market. The marketing methods would change tremendously if the end user or consumer is in the B2B market. Determining keywords for keyword planning is probably the most important factor if one decides to utilise SEO in their marketing methods. More time can be dedicated to create

better, long tail keywords and get a more elaborate channel opportunity matrix. With regards to the research method, though the market survey had limited response it was targeted to a specific market. However, more responses would lead to a better understanding of the market and the product. This thesis can only provide a framework of the various methods that one could use to get a better understanding of their business and the market. Following the recommended methods will not guarantee success but will definitely give the readers a better understanding of their project or business. Furthermore, learning patience and the importance of having the right mindset and right attitude towards starting a business cannot be emphasised enough.

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## Appendix

### Appendix 1 - Marketing plan tool as recommended by Andrus Purde

Table 13. Keywords selected based on Google and Moz

<b>Keyword</b>	<b>Monthly Search Volume</b>	<b>Difficulty*</b>	<b>Click Through Rate (CTR)*</b>	<b>Priority*</b>
Best baby monitor	49500	41	56%	74
Baby camera	49500	53	90%	59
Baby monitor reviews	12100	40	82%	68
Contactless baby monitor	0	21	94%	31
Wireless baby monitor	8100	52	94%	47

\*Determined via Moz

Difficulty - A score given from 0 to 100. 0 being easy and 100 being difficult. Difficulty score estimates how difficult it is to be placed above competitors on the first page of a search engine.

Click Through Rate (CTR) - Also known as organic CTR, it is an estimate of the percentage of clicks available to links on the search engine results page.

Priority - A score given between 0 to 100. A higher priority number represents more ideal conditions such as high search volume, low difficulty and high click through rates.

## Channel Opportunity Matrix -

The screenshot shows a Google search for "wireless baby monitor" with 1,090,000 results. The results are categorized into various channel opportunities, indicated by yellow callout boxes on the right side of the page.

Search Result	Channel Opportunity
Best Baby Monitor 2018 - Video Monitors With Wi-Fi and Night Vision <a href="https://www.tomsguide.com">https://www.tomsguide.com</a> › Smart Home › Best Picks Apr 24, 2018 - Best Video <b>Baby Monitor</b> ... Project Nursery Smart <b>Baby Monitor</b> with Alexa .... currently among our top-rated wireless home security cameras.	*review site
The Best Wi-Fi Baby Monitors - Parents Magazine <a href="https://www.parents.com">https://www.parents.com</a> › ... › Gear › Baby Monitors › The Best Wi-Fi Baby Monitors Like the Dropcam monitor, WiFi <b>Baby</b> has a video recording function that gives you the option of reviewing past footage, which comes in handy if you end up ...	*review site
Amazon.com: Monitors - Safety: Baby Products <a href="https://www.amazon.com/Baby-Monitors/b?ie=UTF8&amp;node=166870011">https://www.amazon.com/Baby-Monitors/b?ie=UTF8&amp;node=166870011</a> Results 1 - 24 of 903 - VTech DM111 Audio <b>Baby Monitor</b> with up to 1,000... 2,317. \$18.99 Prime .... AnGeer 2.4 inch <b>Wireless Video Baby Monitor</b> ... Safari Garden.	*Online retail
The Best Baby Monitors of 2018   PCMag.com <a href="https://www.pcmag.com/article2/0,2817,2461404,00.asp">https://www.pcmag.com/article2/0,2817,2461404,00.asp</a> Apr 19, 2018 - If you want more functionality than a basic audio-only <b>baby monitor</b> can ... and the 5 Best <b>Wireless Network Baby Monitors</b> at What to Expect. i <b>Baby Monitor</b> M6S · <b>Netgear Arlo Baby 1080p HD</b> ... · <b>Infant Optics DXR-8</b>	*review site
10 best baby monitors   The Independent <a href="https://www.independent.co.uk">https://www.independent.co.uk</a> › Extras › IndyBest › Tech Sep 27, 2016 - When it comes to <b>baby monitors</b> there's an overwhelming number of ... of microwave radiation from <b>wireless</b> technology on the developing ...	*Media/Review site
The Health Hazards of <b>Wireless Baby Monitors</b> <a href="https://www.thehealthyhomeeconomist.com/get-those-wireless-baby-monitors-out-of-t...">https://www.thehealthyhomeeconomist.com/get-those-wireless-baby-monitors-out-of-t...</a> Jan 25, 2018 - Why analog <b>baby monitors</b> are a far safer choice for the nursery than <b>wireless</b> versions.	*User generated content (UGC)
<b>Wireless Baby Monitor</b>   eBay <a href="http://www.ebay.com/bhp/wireless-baby-monitor">www.ebay.com/bhp/wireless-baby-monitor</a> Shop huge inventory of <b>Wireless Baby Video Monitor</b> , <b>Wireless Digital Baby Monitor</b> , <b>Wireless Baby Monitor Night Vision Video</b> and more in <b>Baby Monitors</b> and ...	*Online retail
<b>Baby monitor</b> - Wikipedia <a href="https://en.wikipedia.org/wiki/Baby_monitor">https://en.wikipedia.org/wiki/Baby_monitor</a> Jump to <b>Wired</b> and <b>wireless</b> - <b>Baby monitors</b> generally use <b>wireless</b> systems, but can also use wires or may operate over existing household wiring such ...	*Wikipedia
Best baby monitor: great baby cams and smart camera alternatives ... <a href="https://www.techradar.com/news/best-baby-monitor">https://www.techradar.com/news/best-baby-monitor</a> 4 days ago - Keep an eye on your little ones with these superb <b>baby monitors</b> and smart cams. ... A baby cam with extra <b>wireless</b> functionality. Item Weight: ...	*review site
<b>Baby monitors and listening systems</b>   Argos <a href="http://www.argos.co.uk">www.argos.co.uk</a> › ... › Safety and health › <b>Baby monitors and listening systems</b> › Products 1 - 30 of 82 - <b>Baby monitors</b> and listening systems at Argos. Get it today. Same Day delivery £ 3.95, or fast store collection.	*Online retail

Figure 20. Screenshot of search engine results page

Table 14. Channel Opportunity Matrix

	<b>best baby monitor</b>	<b>baby camera</b>	<b>baby monitor reviews</b>	<b>contactless baby monitor</b>	<b>wireless baby monitor</b>
<b>Position 1</b>	Review site	Review site	Review site	Competitor	Review site
<b>Position 2</b>	Review site	Review site	Review site	Competitor	Review site
<b>Position 3</b>	Online Retail	Online retail	Review site	User generated content	Online retail
<b>Position 4</b>	Competitor	Online retail	Media/Review site	User generated content	Review site
<b>Position 5</b>	Media/Review site	User generated content	Review site	PDF research article	Media/Review site

Using google adwords -

Budget: 20e/day

Locations: Finland, Sweden, Norway, UK, Germany, France, Netherlands, Spain

Daily potential reach: 125+ clicks, 4000+ Impressions\*

\*Impressions: The total number of times the ad has been seen

## Appendix 2 - Determining the revenue of the Product by Tim Ferriss

1. **Keyword** "best baby monitor" results in **49500** searches per month.
2. Assuming a **click-through rate of 1%**, since "best baby monitor" is a broad keyword. It could yield approximately **495 visitors to the website**.
3. Assuming a **1.5% conversion rate**, **7.425 customers will purchase** the product. Resulting in **€742.5 in profit**. (Product price - cost of goods = profit per sale). Assuming 80% of customers subscribe for the services monthly, resulting profit is **€1069.2**.  
Further assuming, "best baby monitor" costs an expensive 50 cents per click, advertising costs would be **€247.5**. Hence, **post advertising profit** would be **€821.7**.



This also implies that for a pre-ad profit of €1069.2 costing €247.5, the **ROI** is an astonishing **432%**. Tim argues that this is just one keyword and if one targets other such with an ROI of 432% the returns could be huge. He also advises targeting highly-specific keywords costing 5-15 cents per click and bidding on as many keywords as possible to drive maximum traffic through the website.

Table 15. Summary of Tool by Tim Ferriss

Keyword "best baby monitor"	CTR @ 1%	Conversion Rate @ 1.5%	Profit inc. 80% customers subscribe	Ad cost @ 50c/ click	Post ad profit	Pre ad ROI
49500	495	7.425	€ 1069.2	€ 247.5	€ 821.7	432%

### Appendix 3 - Screenshot of financial planning as suggested by Wirma

The financial plan is brown down into three parts -

- 1) Fund use and fund resources
- 2) Business Costs in a year
- 3) Sales Estimate



## FINANCIAL CALCULATIONS DEMONSTRATION!

**yritys**  
**TULKKI**  
© Jadelcons Oy



Name of the firm Advertising Agency Ltd. Author \_\_\_\_\_ Date \_\_\_\_\_

FUND USE AND FUNDING RESOURCES			
FINANCIAL REQUIREMENTS (Inc. VAT)	EUROS	FUNDING	EUROS
<b>1. PREMISES ALTOGETHER</b>		<b>6. LONG-TERM LOANS</b>	<b>100 000</b>
- land area		Loan given by	IN ALL
- buildings (duty free)		Finvera	Interest-%
- buildings		Finvera	5,0 %
		Bank	4,0 %
<b>2. EQUIPMENTS ALTOGETHER</b>	<b>122 700</b>		Term (year)
ADP-equipment, machinery	12 500		1 5
Furniture	10 200		5
			4.
		<b>7. LEASING</b>	
		<b>8. PART PAYMENT</b>	5
		<b>9. BUSINESS ALLOWANCES</b>	18 000
- goods storage by business purchases		- ELY-Centres Investments allowances/s	5.
- advanced purchased storage			
- duty free purchases	100 000		
<b>3. MARKETING INVESTMENTS</b>		<b>10. VAT RETURN</b>	4 394
		<b>11. OWN FUNDING IN ALL</b>	17 500
<b>4. DEVELOPING INVESTMENTS</b>		- capital investments by owner	2 500
<b>5. OTHER WORKING CAPITAL</b>	17 194	- shareholder loan from Finvera	15 000
	<b>IN ALL</b>		<b>IN ALL</b>
	<b>130 894</b>		<b>139 894</b>
		Financial Requirements - Funding =	0
		Allowances and VAT -returns in all	4 394

### DEMONSTRATION ADVERTISING AGENCY LTD (OY).

**Situation at the Beginning:**  
One person is going to purchase Advertising Agency's business.  
3 previous employees will continue as old workers having their old employment benefits.

**Financial Requirements:**  
1. New ADP-equipment, 12 500 euros and furniture 10 200 euros.  
2. Agency's old machinery 20 000 euros and Goodwill-value (customers) 80 000 euros, in all 100 000 euros.  
3. Working capital approx. 4000 euros/person.

**Funding:**  
4. Finvera's loan 50 000 euros and bank loan 50 000 euros.  
5. New ADP-equipment, part payment financing 18 000 euros.  
6. Own funding 2500 euros (min. share capital in Ltd/Oy in Finland)  
Finvera's shareholder loan 15 000 euros, which will be invested in share capital of the firm.

BUSINESS COSTS IN A YEAR (VAT 0 %)		1. YEAR 2019	2. YEAR 2020	3. YEAR 2021
<b>12. Instalment of Loans and Accent</b>		14 300	26 088	25 063
- interest in Euros		4 300	3 588	2 963
- capital of loans in the end of the year		90 000	67 500	45 000
<b>13. Annual Costs of Part Payment</b>		4 296	4 296	4 296
<b>14. Wages and Salaries of Employees</b>		77 500	79 825	82 220
- monetary wages in month		6 200	6 366	6 978
- number of months		12,5	12,5	12,5
<b>15. Social costs etc. % of Wages</b>	40 %	31 000	31 930	32 888
<b>16. Entrepreneur's Pension Insurance (YEL), non-mandatory pens</b>		6 750	7 447	7 670
- YEL-wages, basis for the pension (yearly wages)		30 000	30 900	31 827
- YEL-percent in the calculation		24,10 %	24,10 %	24,10 %
- non-mandatory pension insurance premiums				
<b>17. Other Indirect Employee Cost</b>		1 310	1 325	1 341
- YEL-entrepreneurs accident and life insurance fees		1 310	1 325	1 341
- Membership fees of unemployment Funds for Entrepreneurs				
- other non-mandatory insurance premiums for employees				
<b>18. Other Staff Costs</b>		3 500	3 605	3 713
- employee health care		1 000	1 030	1 061
- work clothes and protection instruments				
- other optional staff cost (meal, recreation, schooling, gifts etc.)		2 500	2 575	2 652
<b>19. Costs of Premises</b>		16 600	17 098	17 611
- rents and assessments		9 600	9 888	10 185
- electricity, heating and water		1 580	1 627	1 678
- repair, cleaning, guarding, waste disposal		5 420	5 583	5 750
<b>20. Leasing rents, Final Instalment of the Total F</b>	30 %			
<b>21. Cost of Construction Machines and Vehicles (business use)</b>				
- fuel costs				
- maintenance and repair				
- insurance, inspection, transport, other costs				
<b>22. Costs of ADP-equipment and -programs</b>		4 980	5 129	5 283
- equipment- and program rents, updating and maintenance		3 480	3 584	3 692
- Purchase of ADP-equipment (operating life under 3 years)		1 500	1 545	1 591
<b>23. Costs of Other Machinery and Equipment</b>		1 000	1 030	1 061
- maintenance and repair				
- purchase of machinery/equipment (operating life < 3 years), small-scale acquisition		1 000	1 030	1 061
- other machinery costs				
<b>24. Travelling Expenses (fares, accommodation, meals, other travelling exp)</b>		1 200	1 236	1 273
<b>25. Compensation for Travelling Expenses</b>		2 800	2 884	2 971
<b>26. Marketing Costs</b>		5 800	5 974	6 153
- advertisements, printed matter		1 800	1 854	1 910
- other marketing costs		4 000	4 120	4 244
<b>27. Administrative Services</b>		2 900	2 987	3 077
- hired staff, legal services, consulting service, other administrative costs				
- bookkeeping, financial administration, auditing		2 900	2 987	3 077
<b>28. Knowledge Acquisition (papers, books, membership fees)</b>		1 320	1 360	1 400
<b>29. Costs of Communication and Monetary Transactions</b>		4 580	4 717	4 859
- tele- and data communication		1 860	1 807	1 855
- post and courier fees		2 520	2 596	2 673
- monetary transactions		500	515	530
<b>30. Insurance Premiums (liability-, loss-of-profit-, other insurances)</b>		600	618	637
<b>31. Office Supplies</b>		1 000	1 030	1 061
<b>32. Other Costs (discussion, vehicle costs in private use, other costs)</b>		750	773	796

### Notes:

Cost rise %  
2020 2021

Wages and salaries	Number	Euros/month
- editor	1	1950
- office worker	1	1750
- AD	1	2500
<b>Salaries total</b>		<b>6200</b>

Cost rise %  
2020 2021

We recommend to use full percentage without reduction in calculation!

Cost rise %  
2020 2021

Cost rise %  
2020 2021

Cost rise %  
2020 2021

Cost rise %  
2020 2021

Cost rise %  
2020 2021

Cost rise %  
2020 2021

Cost rise %  
2020 2021

Cost rise %  
2020 2021

Cost rise %  
2020 2021

SALES ESTIMATE (all prices incl. VAT)				1. YEAR 2019	2. YEAR 2020	3. YEAR 2021
<b>Text (Cops, entrepreneur)</b>	24.0%	<b>Net sale</b>		<b>38 306</b>	<b>43 401</b>	<b>49 174</b>
- unit price inclusive VAT				95,00	97,85	100,79
- unit price VAT 0%				76,61	78,91	81,28
- quantity (e.g. euros/hour)				500	550	605
<b>Lay-out (AD)</b>	24.0%	<b>Net sale</b>		<b>63 871</b>	<b>72 366</b>	<b>81 990</b>
- unit price inclusive VAT				88,00	90,64	93,36
- unit price VAT 0%				70,37	73,10	75,29
- quantity (e.g. euros/hour)				900	990	1089
<b>Office work</b>	24.0%	<b>Net sale</b>		<b>35 484</b>	<b>37 645</b>	<b>39 937</b>
- unit price inclusive VAT				50,00	51,50	53,05
- unit price VAT 0%				40,32	41,53	42,78
- quantity (e.g. euros/hour)				880	906	934
<b>Editorial work , local paper</b>	24.0%	<b>Net sale</b>		<b>47 806</b>	<b>50 718</b>	<b>53 807</b>
- sales price/unit inclusive VAT				114,00	114,20	120,43
- sales amount (pieces, quantity)				52,00	53,56	55,17
- purchase cost price per pieces incl. VAT						
- purchase cost price per pieces VAT 0%						
- gross margin %				100,0%	100,0%	100,0%
- gross margin I				47 806	50 718	53 807
<b>Commission of advertisements</b>	24.0%	<b>Net sale</b>		<b>112 258</b>	<b>119 095</b>	<b>126 347</b>
- sales price/unit inclusive VAT				435,00	448,05	461,49
- sales amount (pieces, quantity)				320,00	329,60	339,49
- purchase cost price per pieces incl. VAT				370,00	381,10	392,53
- purchase cost price per pieces VAT 0%				298,39	307,34	316,56
- gross margin %				14,3%	14,3%	14,3%
- gross margin I				16 774	17 796	18 880
<b>Marketing product 3</b>	24.0%	<b>Net sale</b>				
- sales price/unit inclusive VAT						
- sales amount (pieces, quantity)						
- purchase cost price per pieces incl. VAT						
- purchase cost price per pieces VAT 0%						
- gross margin %						
- gross margin I						
<b>INCOMES ACCORDING TO SALES ESTIMATE (GOOD OR SERVICE PRODUCED, GROSS MARGINS OF SOLD</b>				202 242	221 925	243 788
<b>34 - minus BUSINESS COSTS (rows 12 - 32)</b>				-182 186	-199 351	-203 372
<b>35 Business Costs in One Month (x 2 = min. WORKING CAPITAL)</b>				15 182	16 613	16 948
<b>36 ENTREPRENEUR'S EARNINGS (all costs paid excl. personal inc</b>				<b>20 056</b>	<b>22 574</b>	<b>40 416</b>
<b>37 DEPRECIATIONS (25 % of machinery/equipment, 7 % of premises)</b>				-29 536	-22 152	-16 614
<b>38 ENTRAPRENEUR'S TAXABLE INCOME</b>				<b>-9 480</b>	<b>669</b>	<b>24 056</b>
<b>NET SALES / TURNOVER</b>				<b>297 726</b>	<b>323 224</b>	<b>351 255</b>
<b>40 VAT (Euros)</b>				71 454	77 574	84 301
<b>41 TOTAL SALES</b>				<b>369 180</b>	<b>400 798</b>	<b>435 557</b>
<b>BUSINESS WEEKS PER YEAR</b>				47	47	47
<b>BUSINESS DAYS PER WEEK</b>				5	5	5
<b>SALES PER DAY</b>				<b>1 571</b>	<b>1 706</b>	<b>1 853</b>

**Notes:**

Price-quantity change-%		
2020	2021	
3%	3%	Takes care of administration and marketing, no invoicing.
10%	10%	Max. working time without overtime work: 47 weeks * 5 days/week * 7,5 hours/day = 1762 hours.
3%	3%	
10%	10%	
3%	3%	Invoicing basis half of working time.
3%	3%	
3%	3%	
3%	3%	Commission 15%
3%	3%	
3%	3%	
3%	3%	

**Calculate the capacity, what is possible to sell out. Seldom you can charge more than 70% of the capacity.**



Figure 21. Screenshot of demo financial plan as suggested by Wirma

## Appendix 4 - Screenshot of survey to determine market interest

### Market Research - Sol&Mani

Tämän tutkimus on tehty yhteistyössä Lappeenrannan Teknillisen Yliopiston kanssa. Laite on suunniteltu ja valmistettu Suomessa ja on osana vanhemmuuden uudelleen määrittämistä 2000-luvulla.

Tuotekuvaus: Futuristinen, kosketukseton vauvan valvontalaite, joka havaitsee vauvan hengityslikkeet. Tuotteen tavoitteena on analysoida vauvan hengityskuvioita sairauksien ennaltaehkäisemiseksi. (Kuukausittaiset raportit hengityskuvioista liitteenä)

Uskomme vanhemmuuden olevan yksi rikastuttavimmista kokemuksista, jonka ihminen kokee elämänsä aikana. Tuotteemme avulla vanhemmat voivat vaivattomasti tasapainottaa kodin ja työn vaatimia velvoitteita, ja samalla auttaa vauvaansa tottumaan uuteen ympäristöönsä.

Ohessa linkki videoon, josta löydätte lisätietoa konseptistamme.

---

This research is in collaboration with Lappeenranta University of Technology (Finland). The aim is to determine your interest in a premium, contactless baby monitoring device completely designed and manufactured in Finland to help us redefine parenthood in the 21st century.


Product Offering: A futuristic contactless baby monitoring device that detects the baby's breathing and movement with an aim to analyse respiration patterns to predict and prevent diseases. (Monthly reports of respiration patterns provided)

We believe parenthood should be one of the most enriching and fulfilling experiences one can ever have. With this product we believe parents will effortlessly be able to balance home and work commitments whilst helping their baby get accustomed to their new surroundings.

Please find a short video explaining our concept.

\* Required

#### Explainer Video - Sol&Mani



Oletko? / You are? \*

- Vanhempi jolla lapsia / Parent with children
- Tuore vanhempi / New parent
- Tuore vanhempi, tuleva vanhempi vai suunnitteletko lapsen hankintaa tulevaisuudessa / soon to be parent or someone planning on having a baby sometime in the future
- Ei mikään yllä mainituista / None of the above

Asuinkaupunki / City you currently live in ? \*

Your answer \_\_\_\_\_

Ikä / Age ? \*

- 18 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- > 36

Kuukausitulot / Your monthly income ? \*

- <= 2000
- 2001 - 4000
- > 4000

Kuinka tärkeäksi koet kodin ja työn velvoitteiden tasapainon? / How important is balancing home and work commitments to you? \*

	1	2	3	4	5	
Ei merkitystä / Not important	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Erittäin tärkeä / Extremely important

Kuinka lapsi vaikutti/tulee vaikuttamaan kodin ja työn tasapainoon? / How did/could welcoming a baby impact the balance between home and work commitments? \*

	1	2	3	4	5	
Ei vaikutusta / No impact	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Suuri vaikutus / High impact

Olisitko kiinnostunut tällaisen tuotteen ostosta? / Would you be interested in purchasing such a product? \*

- Vaihtoehdot - ehdottomasti / Definitely
- Todennäköisesti / Likely
- Ehkä / Maybe
- Epätodennäköisesti / Unlikely
- Ehdottomasti ei / Definitely not

Kuinka paljon olisit valmis maksamaan premium-laitteesta? / How much would you pay for such a premium device? \*

Kuinka tärkeäksi koet Avainlippu-merkin tuotteessa asteikolla 1-5? / On a scale of 1-5, how important is the "Made in Finland" tag on a product to you? \*

1 2 3 4 5

Ei merkitystä / Not important      Erittäin tärkeä / Extremely important

Kuinka paljon olisit valmis maksamaan tuotteen oston jälkeen kuukausittaista tilausmaksua palveluistamme? / After purchasing this device, how much would you be willing to pay to subscribe for our services monthly? \*

Your answer

Suosittelisitko tätä tuotetta jollekin? / Would you recommend this product to someone? \*

- Vaihtoehdot - ehdottomasti / Definitely
- Todennäköisesti / Likely
- Ehkä / Maybe
- Epätodennäköisesti / Unlikely
- Ehdottomasti ei / Definitely not

Mitä odotat tuotteelta? / Anything in particular you expect from such a device

Kuinka paljon olisit valmis maksamaan tuotteen oston jälkeen kuukausittaista tilausmaksua palveluistamme? / After purchasing this device, how much would you be willing to pay to subscribe for our services monthly? \*

Your answer

Suosittelisitko tätä tuotetta jollekin? / Would you recommend this product to someone? \*

- Vaihtoehdot - ehdottomasti / Definitely
- Todennäköisesti / Likely
- Ehkä / Maybe
- Epätodennäköisesti / Unlikely
- Ehdottomasti ei / Definitely not

Mitä odotat tuotteelta? / Anything in particular you expect from such a device

Your answer

SUBMIT

Page 1 of 1

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## Appendix 5 - Screenshot of survey to gain doctor's perspective

**Doctor's Perspective - Sol&Mani**


Firstly, I would like to thank you for taking time in responding to these questions. This research is carried out in collaboration with Lappeenranta University of Technology (Finland), to understand your perspective on the below mentioned device.

Product Offering: A contactless baby monitoring device that detects the baby's breathing and movement with an aim to analyse respiration patterns to predict and prevent diseases. (Monthly reports of respiration patterns provided)

Please find a short video explaining our concept.

\* Required

**Explainer Video - Sol&Mani**



Name \*

**Email \***

Your answer

**Years of service \***

Your answer

**Hospital/Clinic associated with your practice \***

Your answer

**Would you want to be anonymous in the publication of this research ? \***

Yes

No

**Where does the medical community stand on non-invasive diagnostic medical devices ? \***

Your answer

**As per your experience, how well understood are breathing ailments among new born babies and toddlers? \***

Your answer

**What are your thoughts on analysing respiration patterns to predict diseases (such as Asthma, Dysfunctional breathing etc.) among new born babies and toddlers ? \***

Your answer

**Are you aware of such a medical device currently being used (either by you or other medical professionals) ? \***

Your answer

**In what aspect could respiration patterns of infants be beneficial to the medical community? \***

Your answer

**What could be some of the challenges in actualising such a device? If any, what solutions would you propose? \***

Your answer

**What ethical concerns should be considered in the implementation of such a technology? If any, what solutions would you propose? \***

Your answer

**Would you be keen on receiving updates regarding the progress of this research? \***



device: if any, what solutions would you propose:

Your answer

What ethical concerns should be considered in the implementation of such a technology? If any, what solutions would you propose? \*

Your answer

Would you be keen on receiving updates regarding the progress of this research? \*

Yes

No

Anything else you would like to mention

Your answer

SUBMIT

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