Eagle Eye; a study of the technique, early market and business potential

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Preface

This thesis is written in connection to the masters study *Business Creation and Entrepreneurship (BCE)* were the students in parallel to writing their master's thesis are running a start-up project. The thesis will therefore act as help for the project and be implemented in the start-up. The idea provider, Northern Research Institute (Norut) Tromsø has been of significant help during the thesis process and we would therefore like to thank research director Kjell-Aril Høgda, scholarship holder Tom-Rune Lauknes and senior scientist Yngvar Larsen who have helped us during our investigation of the technological idea they have developed at Norut. We would also like to thank Boo Edgar, associate professor at the University of Gothenburg, who has as our tutor provided us with feedback, interesting suggestions and discussions throughout the process. Lastly we thank Sven Arne Rokvam Pedersen, assistant professor at the University of Tromsø, for his help as co-tutor and his contribution to the thesis work.

Summary

In 2009 the Norwegian Water and Resources and Energy Directorate (NVE) received 108 million NOK from the Norwegian Government to map land areas in risk for potential landslides. Norway, due to its geographical structure, is to a large extent exposed to geological hazards such as landslides. These arise due to that the strength in the ground deteriorate so far that the ground is no longer in equilibrium, but begins to move. Ground movement is due to natural processes but can also occur to underground construction work or extraction of oil and gas.

Geologist can today by manual measurements detect ground movement over time and announce when an area is exposed for potential landslides. Manual measurements of ground movement monitoring is efficient considering small land areas, however when one wants to monitor large areas (above 1km^2) these methods can quickly become extremely time consuming and expensive. In addition, manual measurements do not enable monitoring in unreachable terrain and cannot provide historical ground movement data.

Generic Synthetic Aperture Radar (GSAR) is a software platform developed by the Norwegian research institute Norut. This software can based on satellite data detect, monitor and measure ground movement and help geologist to risk assess areas exposed for landslides. Norut believes that there is a commercial potential in GSAR however they do not possess any business competence. Therefore they contacted Technology Transfer Office Nord (TTO) AS to find entrepreneurs that possess competence to commercialize GSAR. Consequently TTO contacted us the three students at the master's program Business Creation and Entrepreneurship to initiate the commercialization process as part of their master thesis. The project is today named Eagle Eye.

We have used both, primary and secondary data to evaluate the GSAR technology. By understanding its functions and possibilities in satellite surveillance we could discover that large scale monitoring was an application area where GSAR would provide most value to the customer. This knowledge was later used in a comprehensive market research to confirm the need for large scale monitoring and which customer groups Eagle Eye should target. We have made 20 qualitative interviews with potential customers to Eagle Eye and retrieved valuable customer information regarding their values, purchasing powers and their needs. The 20

different companies were later divided into seven different segments. After evaluating these segments we ended up with two most attractive segments named, Resource Extraction and Geo-Hazards.

By studying the business potential in GSAR, Eagle Eye should primarily sell ground movement images. Further we have worked out a plan and concluded that Eagle Eye will provide extensive societal, economic and business value by targeting the Geo-Hazards and Resource Extraction segment. In addition GSAR enables Eagle Eye to operate in several markets which opens up for high profitability and long-term sustainability.

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1 Thesis Introduction

Countries that have mountainous areas, such as Norway, have historically and to present day experienced several small and big landslides. Unexpected landslides can jeopardize people's safety and there is a big risk that landslides will occur again. Research on climate change has also indicated that due to the globally increasing temperature countries such as Norway can expect more frequent landslides in the future. Therefore the Norwegian Water and Resources and Energy Directorate (NVE) have invested 108 million NOK to map potential ground movements in Norway. Land subsidence and surface deformation, such as landslides, are part of the natural process but can also occur due to extraction of ground water, oil, gas and minerals or by underground construction work. Consequently ground movement is a problem that for instance hydropower stations, oil – and mine companies and not to mention organizations controlling and maintaining roads and railroads encounter on a daily basis. Today the way of determining ground movement at specific locations is typically made manually by ground measurements. When facing areas which are hard to reach by foot manual measurements can be a problem in terms of high costs and time-consuming measurements. In addition it is very difficult to identify and analyze deformations that have occurred several years back in time, which therefore results in a lot of guesswork. Techniques used in manual measurements are addressed to cover smaller areas and single objects, however when facing larger land areas these techniques are expensive and time consuming!

1.1 Background

Norut has after years of research developed software, named Generic Synthetic Aperture Radar (GSAR), which can be used to monitor deformation of large-scale areas. They saw a large potential in their software since it could be used as a solution for the issue rose in the section above. Since Norut is a research institute they have no competence or resources to commercialize their invented technology. Therefore they provided the idea to Technology Transfer Office Nord AS (TTO), a government-funded organization that actively contributes to that research from northern Norway is commercialized. TTO contacted us, the three master students at the BCE-program to help them with the commercialization process and to develop a Technical Study, Market Study and a Business Plan based on GSAR.

1.2 Thesis Composition

The thesis is constructed in three parts; Technical Study, Market Study and Business Study. The main purpose of the thesis is to provide our start-up project with best possible starting point, a carefully prepared Business Plan.

To receive a better understanding of the technology we are commercializing and more knowledge regarding the target market we have chosen to enter we have decided to write a Technical Study and a Market Study before getting to the last part; the Business Plan.

The first part, the Technical Study, has the purpose to present a better view the technological possibilities and limitations with GSAR. By understanding the technology of GSAR we are able to segment the market based on the different customer needs which is the focus in the second part, the Market Study. In this study our goal is to find the right customer segment to put initial focus on in the commercialization process. The information collected in these two parts will be used as groundwork in the third part, the Business Plan. This document will be used as a tool in the commercialization process, with the purpose to document and facilitate better management of the company. Further, it may also work as a selling document when presenting the project when raising money in different occasions.

We have structured the different parts of the thesis with relevant method and delimitations under each specific title (Technical Study and Market Study) to provide reader with an easier reading and a better understanding of the process. Below we will describe the content in the different parts.

1.2.1 Technical Study

Since our technology is complex, we have chosen to investigate the technology thoroughly to discover and understand the strictly technical limitations and possibilities considering the use of the software our start-up project is based upon. Consequently, the main objective with the technical part is to explain the underlying technologies and illumination concepts. Moreover the study is performed in order to identify which internal and/or external technologies can be improved in order to optimize output data on ground movement mapping. Finally, the Technical Study is concluding what applications the technology is most suited for.

1.2.2 Market Study

The technical understanding gained in Technical Study will perform as base of what applications the technology is most suited for. Representative users connected to the theoretical utility the application provides will be presented for further research and analysis in the empirical Market Study. Therefore this part was performed to gain a comprehensive market and customer understanding based upon the product utility connected to the applications suggested in the Technical Study. We want to analyze what corresponding needs our potential customer groups have today and what needs that we can create with this innovative solution. Hence, we will be able to arrange the potential customers into segments based on their demands. Moreover, the objective with the Market Study is to come to a strategic choice of segment(s) to apply initial focus on during commercialization.

1.2.3 Business Plan

The knowledge gathered in the Technical Study will create a better understanding of how to describe the complicated technology in general. The Market Study will determine which market segment we should focus on in the Business Plan. The Business Plan will in turn describe the project Eagle Eye's objective and how they will be reached.

The intention with this part is to separate it from the complete thesis and to use it in a professional context. This may result in that some of the text will occur repetedly times due to that the Business Plan in many ways concludes the first two parts.

Part One – The Technical Study

2 Introduction

The first part will introduce you to the technical study, its content and methodology used.

GSAR is a software technology that can by use of satellite images determine historical ground movement that has occurred on earth's surface. Continuous ground movement on earth's surface can lead to geological hazards (geo-hazards) such as landslides that can have large negative economic and environmental impact on today's society. Today geologists use historical ground movement information in order to evaluate land areas that could lead to potential geo-hazards. However the methods they use today to determine ground movement can be extremely expensive, time consuming and impractical when one wants to analyze unreachable terrain. Our software is therefore a very time and cost efficient tool to survey historical ground movement on earth's surface since we (by using satellite images) can analyze much larger areas than existing technologies.

It is indeed the satellite images that enable the use of our software. Therefore the objective with the Technical Study is to understand the underlying technologies that enable satellite surveillance but also its limitations. By understanding these, together with the functionality of GSAR, we will by using a techno-economic analysis gain comprehensive knowledge of where our technology can be applied.

2.1 Content in the Technical Study

The content in the technical part has the following structure. Chapter 3 will describe the theory which we will base our technology analysis on. The theory described in chapter two will also constitute the basis for conclusion (Chapter 7) related to the outcome of our Technology Study.

Chapters 4 and 5 will describe the underlying technologies in detail. By understanding our technology we will be able to perform a technology analysis in Chapter 6. The outcome in the technology analysis and suggestions of focus in the Market Study will then be concluded in Chapter 7.

2.2 Methodology

The technical report will serve its purpose by collecting data from discussions with researchers, reports, books and information from internet during the months February and March in 2010. The use of books, reports and internet are seen as credible information sources since the information is published by well-known organizations and authorities that mainly work with satellite surveillance technologies. We have had continuous interviews and discussions with the developers of GSAR in order to gain thorough understanding of the technology (Interviews with Høgda and Larsen 2010, see Bibliography).

3 Theoretical Framework and Assessment Model

This chapter will describe the theoretical framework we have based our technical analysis on.

To assess our technology in relation to the existing industry we want to put our technology into perspective of competing technologies. We believe that our technology could outperform existing technologies in various ways. As a starting point for our technical analysis we will use the theory of disruptive technology (Christensen, 2002). Furthermore we will also assess *how* our technology could fit into the existing market or possibly create a new non-existing market. In addition we want to, in detail, understand our technology in order to assess how our technology could be further developed in order to maximize technology performance and thereof become superior against existing and competing technologies. For this assessment we will use the Techno-Economic Analysis (TEA) (Lindmark, 2006).

The theory of disruptive technology will be used as a basis for discussion as regards to technological position among alternative technologies on the existing market. However since this is a technical part of our master thesis we will mainly discuss our technology from a technical perspective. Other factors such as market potential, segment focus, management of technology, external networks and resource allocations will in detail be considered in Part two – Market Study and Part three – Business Plan.

According to Lindmark (2006) a TEA can be performed on several levels; national level, industry level, company level, technology level and product level. To correspond to the size and extent of this master thesis the TEA will only consider the interaction between technical and economic variables on a technology level. Therefore the technical variables will be considered and evaluated in the technical analysis, and these will later be tied to customer utility in the Market Study to reach the economic variables in the Business Plan.

3.1 Disruptive technology

Eastwood (2009) defines a disruptive technology as "*A new technology or innovation that evolves to challenge and eventually replace an existing technology"*.

Throughout history disruptive technology has occurred time after time where existing technology that has become obsolete has been replaced by new disruptive technologies. Disruptive technologies is not a new phenomenon and can be identified with innovation and technologies such as airplanes, steam ships, motor cars and more modern technologies such as mobile phones and disk technology (to see examples of disruptive technology see Appendices I). A disruptive technology does not only replace existing technologies but they also shift power in entire industries and can extinguish incumbent market players. Therefore established companies need today a specific strategy in order to monitor and predict disruptive technologies in order to manage a next attack of disruptive technologies (Eastwood, 2009).

3.1.1 Sustaining Versus Disruptive Technology

Today most technological advances that occur in industries today are of sustaining character. Sustaining technologies are those that improve performance of existing products in the mainstream markets (Christensen, 2002). The development of sustaining technologies can be radical in character while others are more of an incremental nature.

Disruptive technologies instead provide worse product performance in the short-term since they bring a different value to mainstream markets than what has been available before, facilitating for disruptive success story, illustrated in Figure 3-1. This means that initially, disruptive technologies underperform or bring "low-value" to the mainstream markets since they provide different customer value. Usually, disruptive technology adds an additional functionality to existing technology and provides products that are typically cheaper, simpler, smaller, and frequently more convenient to use but which obviously have to address a customer need (for disruptive characteristics see Appendices II) (Christensen, 2002).

Christensen (2002) further, distinguished between two different technology disruptions. The first is the "low-end" disruption which targets customers that does not need the full functionality of products aimed to high-end customers. The second disruption addresses a customer need that was previously unrecognized.

Since disruptive technologies to a start do not meet the performance parameters of existing sustaining technology, established market players often ignore these disruptive technologies. As Eastwood (2009) states in his report, the previous provider of photographic film products, Kodak once described digital photography as “a fad”. This is a well-known historical example where the established player did not see the value in chasing disruptive technology. So they ignored it, which then eventually lead to that disruptive technology extinguished their market. Therefore and in order to prevent being “disrupted”, companies need to focus their resources to identify relevant technologies that have disruptive characteristics in order to identify where disruption is likely to occur.

3.1.2 Development of Disruptive Technology

The scenario in Figure 3-1 illustrates the development of disruptive technologies. Today research departments, universities, start-up companies deal with various innovation processes, represented by the bottom line in Figure 3-1. Simultaneously, established market players regularly invest in sustaining technology that gained them market position in first place, represented by the top line in Figure 3-1. They do this in order to increase product performance and meet customer demand.

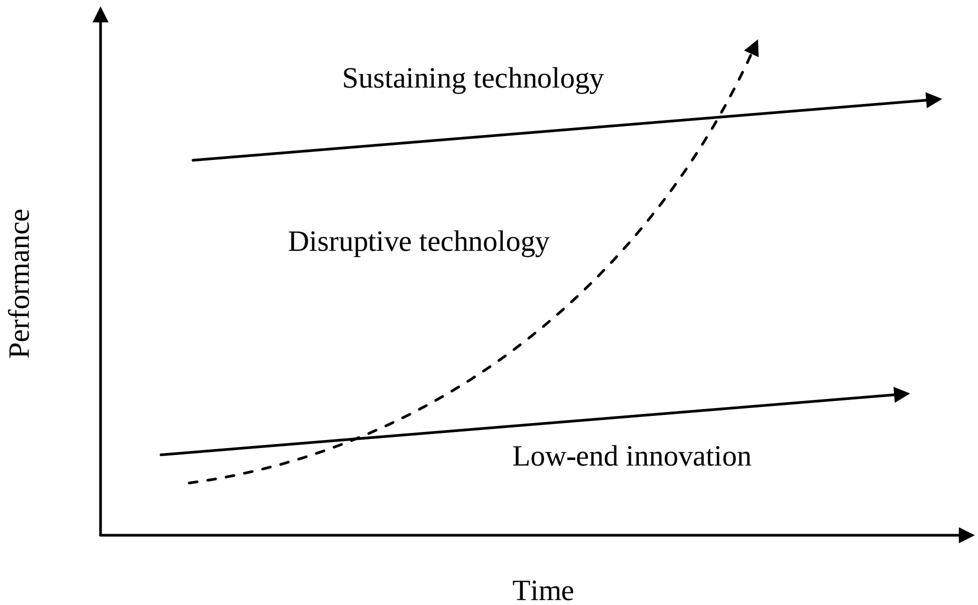


Figure 3-3 Development of disruptive technologies. Adopted from (Christensen, 2002).

The majority of low-end innovation will probably not become mainstream technologies due to various reasons. However some technologies that emerges from these innovation processes will target a small market first and offer something of greater value than the sustaining technology (Eastwood, 2009). As Eastwood (2009) further states, these disruptive technologies that emerges will perhaps create a cluster of start-up companies that specialize in that technology until product performance exceed that of established technology.

In most social systems there are innovators, early adopters, early majority adopters, late majority adopters and "laggards" (Rogers, 2003). Figure 3-2 represents the normal distribution of adopters from innovators to laggards.

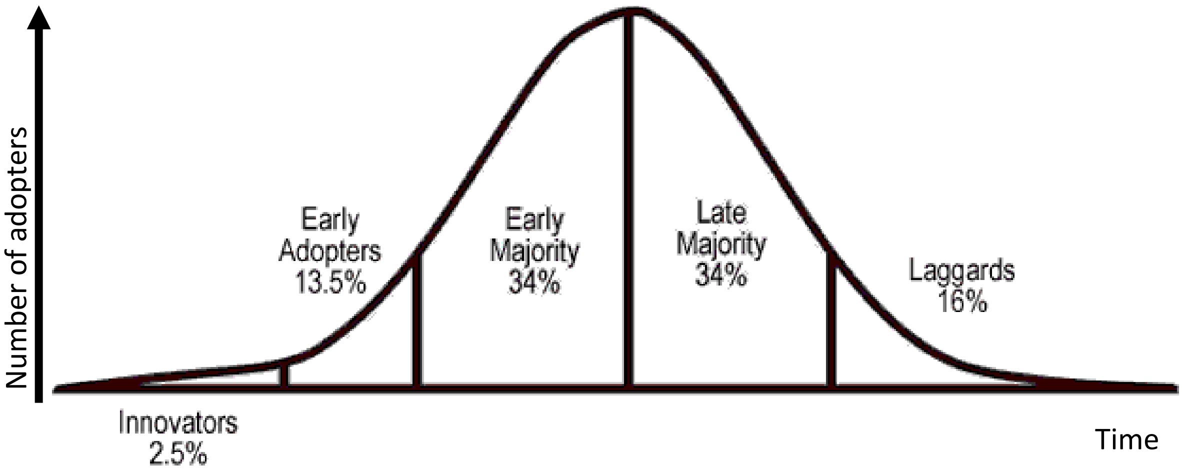


Figure 3-2 Categories of innovativeness; A bell-shaped curve represents the level of adopters. Source Rogers (2003).

As the benefits of disruptive technology become clearer, these will be absorbed by early adopters (Eastwood, 2009). Moreover, Rogers (2003) states that there are relatively few adopters at first but as the technology is taken in by innovators and early adopters their influence will have impact on the majority of other potential adopters. When disruptive technology is absorbed by early adopters the new companies will have developed new markets and receive specialist competence around this new technology which consequently will leave existing and incumbent market players behind. However it should be noted that over time the disruptive technology will become a sustainable technology. This means that it could in the future be surpassed by new disruptive technologies (Eastwood, 2009).

The reasons why we have described the theory of disruptive technology is because we believe that GSAR could potentially become a disruptive technology. After we have received more knowledge about our technology, its possibilities and position towards other technologies we want to conclude our technological position in relation to existing and alternative technologies. If possible we would also like to identify signs that indicates whether GSAR could potential become a disruptive technology.

3.2 Techno-Economic Analysis

Technology and innovation is today a very important part of economic and industrial growth of nations. Research and development made in various firms and organizations today often involve economic considerations and analyses. There are today various methods to perform economic analysis such as industry analysis, market analysis, investment and financial analysis etc. However Lindmark (2006) states that these economic analyses have often weak ties to the dynamics in technological research and development. There is therefore at many levels in society a need for more integrated TEA.

The purpose of a TEA is to map and analyze the relations and interactions between technological and economic variables. A TEA is often divided into a static and dynamic part. In the static part one usually identifies and maps the various concepts and of a technology. The dynamic part then considers technology development over time. Lindmark (2006) further states that performing a TEA and considering both the static and dynamic part is usually a very complicated process since it includes numerous variables in uncertain contexts that changes over time. Further there is no unique or optimal method for TEA but instead several approaches and intermediate variables should therefore be used (Granstrand 2000). We will in this master thesis only consider the static part of the TEA. This because the timeframe of this master thesis does not allow us to follow and understand technological development over time. Even if using only the statical part it will not underemphasise the purpose of TEA since we will still be able to map, analyze and link technological and economical variables.

3.3 Techno-Economic Analysis Framework

Figure 3-3 illustrates the general framwork that can be used to link various technological and economical variables (Lindmark, 2006).

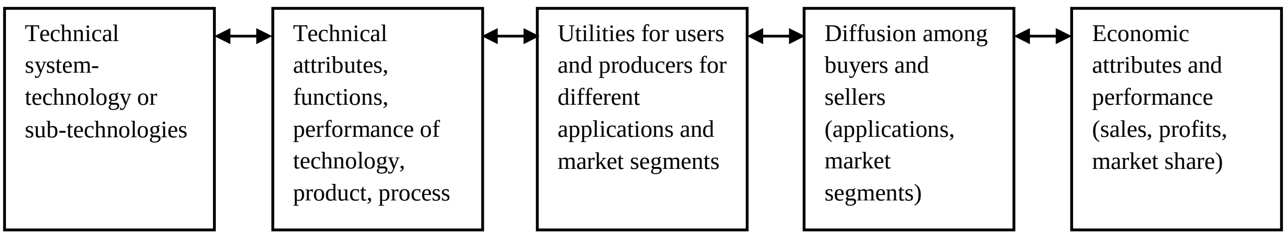


Figure 3-3 Framework for techno-economic analysis at a technology level. Adopted from Lindmark (2006).

Based on the Lindmark's (2006) general framework the following variables will be used in the TEA throughout this master thesis.

1. Technologies and sub-technologies
2. Complementary technologies
3. Function(s) that the technology performs
4. Technical performance parametres
5. Applications

Technical Varibles

---

6. Utility
7. Market segments
8. Economic attributes and performance (Sales, profits, market shares)

Economic Varibles

Lindmark (2006) states that the base for a technology system comprises a set of distinguishable sub-technologies required to produce a technology (product). The technology is then characterized by a set of functions it delivers. These functions can further be specified by different *performance* attributes. Different set of technologies commonly allows for different levels of performance (Lindmark, 2006). If technology developments are made these are linked to improvements in performance attributes. Therefore a technology can be used in different applications areas and contexts. Since a technology could have different functions and performance attributes a technology offers different values (utilities) to various users in terms of need and user economy. Hence if various users have similar utility functions they can be grouped into market segments with respect to for instance performance attributes (Lindmark, 2006). The sales of a product/technology will perform differently depending on target segment. This will in turn impact revenues, market shares and other economic attributes. An example of how these different concepts and variables can be linked for one product area is illustrated in Appendices III.

Moreover, we will use the TEA in order to map and investigate how the performance of our technology can be increased but also to investigate in what commercial context it could be applied. By understanding our technology we will map and understand the interaction between the variables 1-5 stated in the previous section. Variable 5 will connect our Technical Study with the Market Study and act as input for further studies to identify customers utility (Variable 6) and market segment (Variable 7). By concluding which segment to target in the market part we will be able to construct a Business plan and estimate Variable 8. The outcome of the complete TEA will be concluded in the final conclusion of this master thesis.

4 Understanding Radar Satellite Systems and its Characteristics

Before going into detail of the underlying technologies of satellite surveillance we want to provide the reader with an overview of the earth surveillance value chain, how radar system serves its functionality in earth surveillance.

4.1 Value Chain

There are nine satellites that orbit the earth at an altitude of 500-700 km (see Appendices IV for operating satellites) and that captures images related to ground movement mapping. These satellites carry a specific type of technology named Synthetic Aperture Radar (SAR. Detailed explanations are in Chapter 5) instruments which are based on radar technology. What a radar system is and how it works is further explained in Chapter 4.2. When a satellite carrying SAR instrument scans the earth (Figure 4-1 **a**) the recorded data is stored inside the satellite until a downloading station is in reach (Figure 4-1 **b**).There are today around 40 downloading stations worldwide that can receive data from these nine satellites. Downloading of data takes under a minute and is necessary in order to liberate storage space in the orbiting satellite. The satellite providers are owned by various government funded organizations such as the European Space Agency (ESA). The ground stations do not have to be government owned but can for instance be companies that have co-joint agreements with the satellite providers to distribute satellite data.

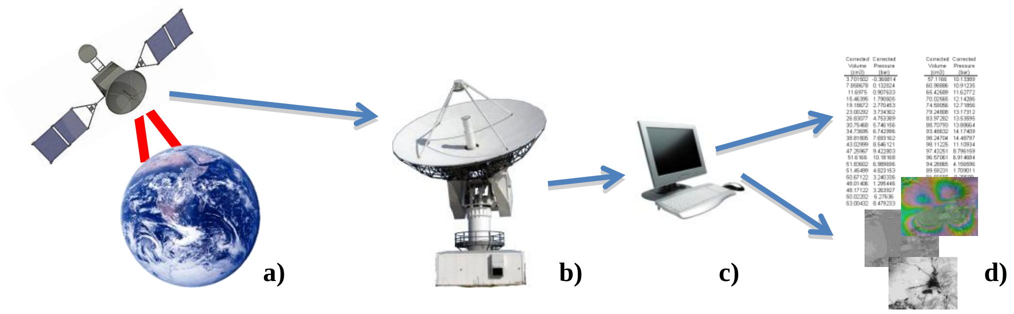


Figure 4-1 Different steps in the production process of ground movement images.

Software such as GSAR then processes and analyzes SAR data and turns it into manageable and useful information (Figure 4-1 **c**). The processing is either done by the ground stations themselves, research organizations or companies having the necessary technical knowledge and resources. The outcome of processed SAR data can be in form of illustrative images and numerical data (Figure 4-1 **d**).

The rest of Chapter 4 will describe the technology onboard satellites, namely radar systems which enables surveillance of earth. The chapter will also describe the limitations using radar systems onboard satellites but also how these limitations can be overcome by using the satellites motion.

4.2 Radar System

The word RADAR is an acronym for RAdio Detection And Ranging (Borden, 2009). It is a microwave radar system who transmits and receives electromagnetic energy (see Appendices V and VI for explanations of microwave radar system, respectively electromagnetic energy). A radar system (such as from a satellite) emits signals that are scattered in all different directions when hitting a target for example a house, a bridge, mountains. Some of the emitted signals are reflected back (backscattered) to the radar system once they hit a target. By analyzing the characteristics in the backscattered signals it is possible to determine distance, altitude, direction or speed of both fixed and moving targets. Whether a radar is mounted on an airplane, satellite or is ground based the principle is the same. Moreover, the signals emitted from a radar system can penetrate clouds (Jensen, 2007).This mean that satellites can provide images over the earth during both day – and night and during extreme weather.

To emphasize the section above, a radar system mounted on a satellite only measures distance between the satellite and the earth (targets on earth). So the actual data that a satellite captures when scanning the earth is truly distance data. However for the sake of simplicity we will use the expression that "a satellite captures images" over the earth's surface.

4.3 Radar Geometry Characteristics

Some additional parameters must be known in order to understand the nature of a radar system and its functionality in relation to satellite surveillance.

There are two different scanning mechanisms used when capturing an image of the earth by satellite. **Across-track** refers to when an image is captured perpendicular to the flight direction (Figure 4-2) while **along-track** refers to when an image is captured along and parallel to the flight direction. Across-track is the most commonly used scanning mechanism [1], [2].

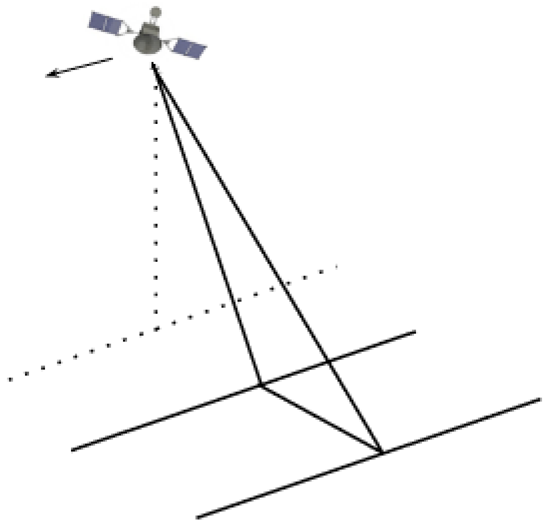


Figure 4-4Earth is scanned perpendicular to the flight direction.

As seen in figure 4-2 the width of the radar signals emitted is coarser with increasing distance from the radar system. This scanning characteristic constitutes the radars *line-of-sight (LOS)* which is a subject of one-dimensional measurements. The LOS has big impact on what type of information can be received in the resulting satellite images, and will further be discussed in Chapter 5.2.

4.4 Radar Image Resolution

Range – and azimuth resolution of a radar system determines the spatial resolution of different scanned targets. Range resolution refers to targets that can be resolved perpendicular to the flight direction. Azimuth resolution refers to different targets that can be resolved in the flight direction.

4.4.1 Range Resolution

Figure 4-3 illustrates how targets can be illuminated in the range direction, perpendicular to the flight direction. A radar system could be seen as a device that can measure distances to a target by sending out and receiving pulses of radar signals (Figure 4-3). To differ between targets on a radar image they must be separated by more than half the pulse length (P) of the emitted radar signals. In Figure 4-3 targets 3 and 4 can be resolved. Objects 1 and 2 are enclosed in the same pulse and cannot be resolved and will therefore appear as one single target in the radar image.

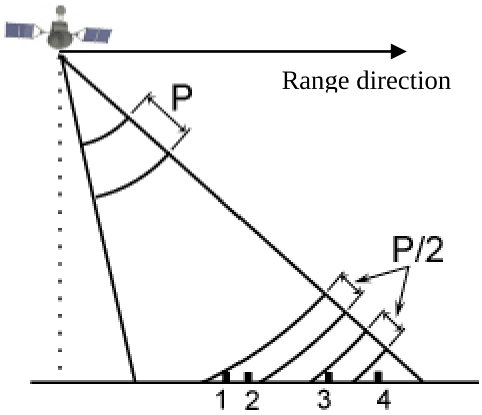


Figure 4-3 Concept of range resolution. Satellite is moving towards the reader.

However, today most satellite borne radar systems can overcome this problem by using a "pulse compression technique", named chirp generators (Kramer, 2002). These generators can modulate the emitted pulses to improve range resolution and thereof identify different targets that are located very close to each other [3].

4.4.2 Azimuth Resolution

In Figure 4-4, A represents the width of a radar beam. The width of the radar beam is coarser with increasing distance from the radar sensor. As the radar moves in the flight direction targets 1 and 2 that are closer to the sensor can be resolved but targets 3 and 4 cannot and will instead appear as one single target in the radar image.

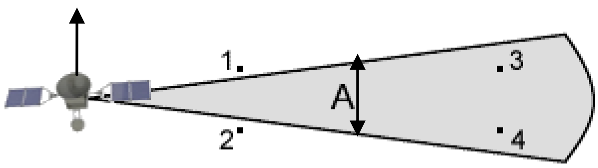


Figure 4-4 Concept of azimuth resolution. Satellite is moving perpendicular to radar beam.

In the case of range resolution satellite systems uses pulse generators to receive higher resolution. However it is not possible to use such technology when one wants to increase azimuth resolution. In order to receive a high *azimuth resolution* one could build a very large radar antenna to minimize the width of the radar beam. This is however in practice not possible where the limit of satellite radar antennas is approximately two meters. Instead by applying the SAR technology it is possible to synthesize a longer antenna and thereby receive higher azimuth resolution [4].

5 Synthetic Aperture Radar and its Limitations

In this chapter we will in a simplified way describe SAR technology and its limitations. We will also describe how topographic and ground movement data can be retrieved.

5.1 Synthetic Aperture Radar

The principal of SAR builds on a conventional radar system where one uses the satellites motion in order to synthesize a longer antenna and thereof improve azimuth resolution. The longer antenna is synthesized by taking advantage of the satellites motion and the Doppler principle (Figure 5-1) [5]. The Doppler principle can be recognized when the sound from an ambulance siren approaches, passes and recedes from the observer (Doppler Effect is described in Appendices VII). As the satellites moves the radar emits a great number of pulses towards the target as the satellite passes the target. The distance to the target varies with every pulse that the radar emits as the satellite is moving (Figure 5-1). These pulses are then backscattered to the antenna and vary due to the relative movement to the target (Doppler principle).

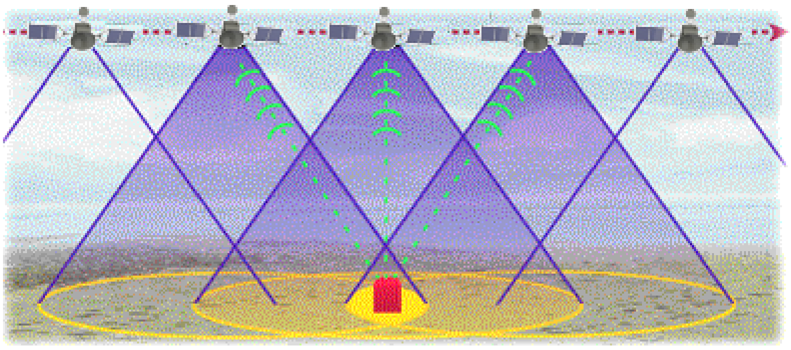


Figure 5-1Showing how a long radar antenna is synthesized by a SAR system.

A SAR system then takes advantage of the radar signals propagation characteristic and together with complex processing of the radar signals using software such as GSAR it is possible to retrieve high resolution images. By processing the combinations of the many backscattered pulses in both azimuth and range direction using software such as GSAR it is possible to receive a well-focused, two-dimensional (2-D), high resolution images.

The size of a SAR satellite image is 10 000 km^2 and these images have various resolution. Best resolution of 1m^2 can be received from the satellite TerraSAR-X at a distance of above 500 km from earth!

5.2 Interferometric Synthetic Aperture Radar

Images resulting from SAR processing can provide information in two dimensions (2-D). Interferometric SAR (InSAR) is a technique used as next step in the processing chain of satellite images to retrieve three dimensional (3-D) information as well as potential deformation/movement of the corresponding target area (Ding 2008). It is a powerful tool that can be used in application areas such as earthquake displacement, landslide monitoring and to detect movement in man-made buildings and infrastructure.

When acquiring topographic data by use of InSAR, two different images of exact same area (from two different positions) (Figure 5-2) must be acquired (Jensen, 2007). As there is difference in satellite position between the two radar-image acquisitions, it will also be a difference in the corresponding radar signals. Combining this information with the two satellite positions it is possible to retrieve 3-D ground information. The result is named a Digital Elevation Model (DEM) or a topographical/reference interferogram [6].

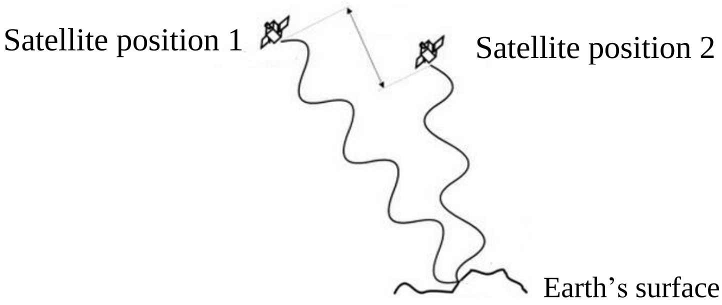


Figure 5-2 Concept behind interferometric SAR deformation mapping.

5.2.1 Differential Interferometric Satellite Aperture Radar

To determine deformation/movement of a target (target area) a technique named Differential Interferometric Satellite Aperture Radar (D-InSAR) is used which is an additional step in the InSAR processing technique. By capturing an additional (third) satellite image an interferogram containing topography and movement information is created. By subtracting the latter from the reference interferogram (thereof the name differential) it is possible to reveal data which can indicate potential movement in the target area.

SAR and InSAR is a common software technology used by different SAR software including GSAR. However InSAR can be applied to either measure movement of single targets such as building and houses or to measure movement of large natural areas such as mountains or desert. GSAR's main functionality is to determine movement of large areas. How GSAR's technology system differs from similar technologies is discussed in chapter 6.

5.3 Limitations in Synthetic Aperture Radar Image Resolution

A radar system is only able to measure targets in its *LOS* which is a subject of one-dimensional measurements. A SAR system is measuring distances to targets rather, rather than the horizontal distance along the ground. The resulting images are therefore strongly dependent on the topographical variations in the terrain. There are two different terrain relief displacements named, *foreshortening and layover*, which will strongly affect the outcome of a SAR images [1].

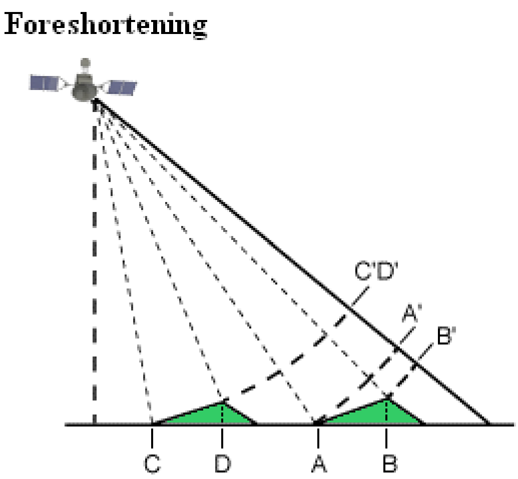


Figure 5-3 Foreshortening relief displacement.

Figure 5-3 illustrates that there is a height difference between C and D but that since radar measures distances in the *LOS* the slope C-D will not be registered in the resulting satellite image (C'D'). The slope A-B appears less compressed (A'B') in the resulting image.

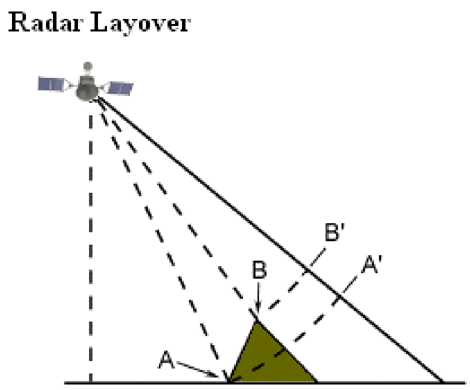


Figure 5-4 Layover relief displacement.

The illustration to the left in Figure 5-4 illustrates that a radar beam reaches the top of an object (B) before it reaches the base (A). It is said that the top position “lays-over” the base (B’ over A’). Therefore in the resulting image the top of a target is displaced towards the radar from its true position.

The two relief displacements are results of an increasing terrain slope with respect to the flat reference surface. Conversely, when the terrain slope decreases with respect towards the flat surface it is not possible to illuminate and receive signals from a decreasing surface. This effect is named radar shadow (Figure 5-5) [1].

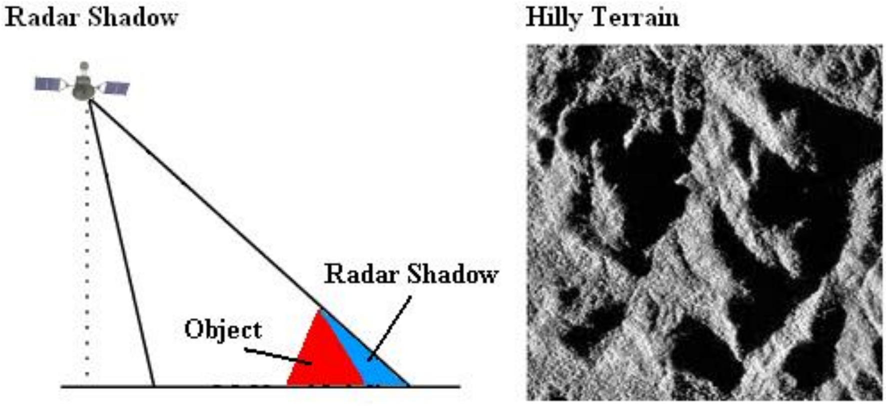


Figure 5-5 The dark areas in the image to the right illustrate radar shadow and are indistinguishable and it is therefore not possible to retrieve information of these areas.

5.3.1 Ascending/Descending

As one might comprehend from the section above the LOS has often a significant impact on the interpretation of the scanned target area. The extent to which signals (and thereof useful information) can be retrieved from a specific target in the target area depends considerably on their surface orientation relatively to the LOS. Therefore, targets that are indistinguishable using one LOS might be distinguishable using a different LOS (Jensen, 2007).

This phenomenon is in many cases a problem but considers all radar satellites. However by combining the orbital satellite motion along the meridians and the earth’s rotation in the equatorial plane (Figure 5-6) it is possible to observe almost the whole surface of the earth from various angles (Ferretti, 2007). By observing the same target (target area) from different angles it is thereof possible to a large extent overcome the difficulties with relief displacements and radar shadow. It should be noted that this problem cannot be overcome fully since some targets are not in reach of radar signal no matter which angle one uses.

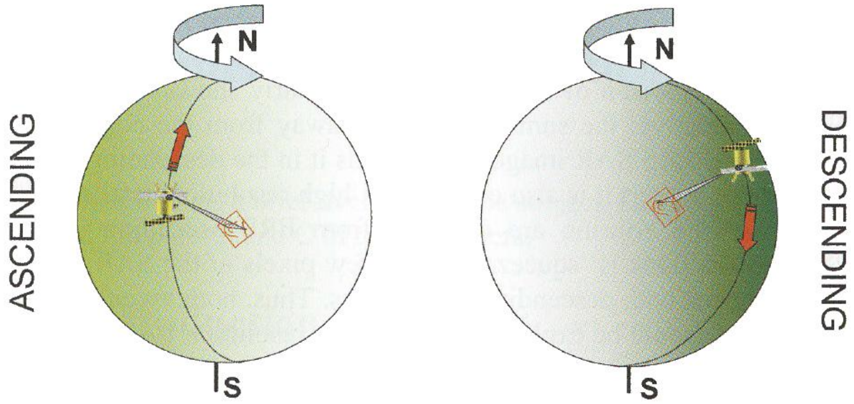
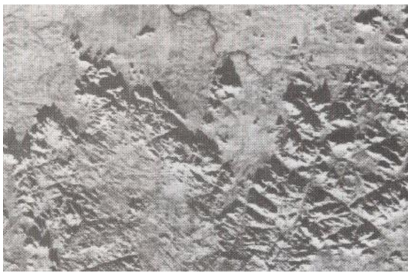


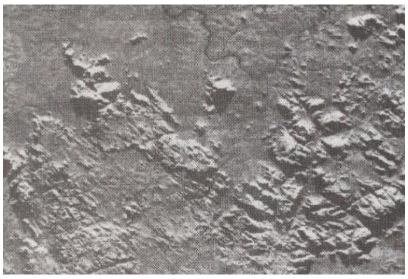
Figure 5-6 Ascending and Descending passes.

Figure 5-6 illustrates when a satellite orbits from south to north (ascending passes) and north to south (descending passes). As the satellite antenna is usually fixed and points perpendicularly to the orbit track the radar beam will always point (in this case) to the right side of the orbit track. Thus a scene on the ground can always be observed from the east (descending passes) and from the west (ascending passes) (Ferretti 2007).

Figure 5-7 illustrates another example of radar images captured with different LOS. In reality one always uses several images from different views in order to get an idea of how the actual target (target area) on earth looks like. This comparison of satellite images is nowadays a standard procedure and is made by SAR software such as GSAR.



a.↑ north look direction



b.↓ South look direction

Figure 5-7 Both images show the Kaduna State in Nigeria. Dark areas are indistinguishable. a) Image is captured when flying east-west and having the radar LOS pointing to the north. b) Image is captured when flying east-west with the radar LOS pointing to the south. Adopted from Jensen(2007).

5.4 The Main Limitations in Processing Satellite Images

5.4.1 Coherence

To determine potential displacement of a target at least two SAR images are needed that covers the exact same target area. However, before starting to investigate potential displacements it is necessary to investigate whether there is some degree of coherence in the two SAR images. If the backscattered signals in the two images show some degree of consistency it means that there is coherence in the pixels (and correlation between the pixels) in the corresponding images. By determining that data from the two images can be assimilated, one can by use of InSAR processing determine potential deformation in the target area. Consequently if there is no consistency in the signals between two different SAR images there are no possibilities to retrieve displacement data (Interview, Høgda 2010).

5.4.2 Atmosphere

When capturing images by use of satellite the radar signals can be affected differently by the atmosphere. The atmospheric pressure, temperature and humidity tend to either slow down or accelerate the speed of the radar signals (Ding, 2008). The various atmospheric conditions can modify the emitted and received signals and thus have a substantial impact on both altitude and terrain deformation analysis (Figure 5-8).

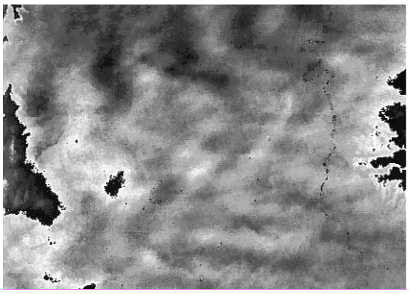


Figure 5-8 A SAR image generated over the Pianara Panada valley in northern Italy. Here almost a flat surface was expected from the known topography, but due to atmospheric distortion the altitude of the ambiguity in the SAR image (black to white in the grey scale) is about 300 meters (Jensen, 2007)

Various methods have been developed to mitigate the atmospheric effect on SAR/InSAR measurements. Some methods are based on external data such as ground metrological observations and satellite observations and that have been used to map for instance water vapor in atmosphere. Other methods used are based on simple data analysis or numerical solutions in order to mitigate the atmospheric effects (Ding, 2008).

GSAR take use of external data in order to mitigate the atmospheric affects. Researcher at Norut has also developed (and is constantly developing) own algorithms that mitigate the atmospheric impact further. This enables GSAR to provide ground movement with very high accuracy that corresponds to the actual ground movements in nature.

5.4.3 Data Accessibility

Nine satellites can today provide radar (SAR) images. These satellites have a global coverage of the earth with various repeating cycles (Ward, 2008). However the satellites are programmed to capture images at specific location on earth. This means that although satellites have a global coverage it does not imply that there are stored SAR images covering all areas of the earth [7]. Especially in the case when the need is to retrieve displacements information, lack of data might be a problem. This since deformation occurring at the earth surface is usually a slow process where a millimeter deformation can sometime take years to discover. Hence, a displacement mapping requires several images over time and if no images are available one might need to initiate an analysis today by ordering satellite images. This analysis can then take months or even years to discover if any ground movement has occurred. Nevertheless, satellites such as ERS-1 (mission ended 2000), ERS-2and RADARSAT-1 and RADARSAT-2 have been providing images of the earth since early 1990s, which are stored in databases by each satellite provider (see Appendices IV for satellite providers) (Ward, 2008). In addition, it is not possible to use data from different satellites since every satellite operates with a unique combination of wavelength, frequency, polarization, orbital path etc. However, in the case of ERS and RADARSAT satellites, their data can be used together since their SAR sensors are compatible [8].

When one wants to discover ground movement SAR software usually needs 20-30 images to be absolutely sure where and how much ground movement there has occurred on earth’s surface. So in relation to satellite images available this could potentially become a problem if there are less than 20 images over an area of interest. In the case of GSAR this is seen as a minor problem. This because GSAR software only requires eight satellite images in order to provide accurate ground movement information. Consequently this is an advantage for GSAR comparing to other SAR software when one wants to determine ground movement on earth where only eight satellite images are available (Interview, Høgda 2010).

6 Generic Synthetic Aperture Radar Technology Analysis

In this chapter we will perform the first step of the TEA according to Lindmark (2006) where we will identify variables 1-5. The TEA will consider the GSAR technology system, performance of its functions and its preferred application areas. We will also identify the key technologies of GSAR and analyze how these can optimize technology performance and link to feasible applications.

6.1 Mapping of Technology Variables

By applying Lindmark's (2006) general TEA framework we have according to variable 1 identified sub-technologies to GSAR. Figure 6-1 illustrates the GSAR *technology system* and its different levels of *sub-technologies*; SAR, InSAR and Small Baseline Subset (SBAS).SBAS is a software algorithm and an expansion of InSAR which separates GSAR from similar software since it enables ground movement monitoring of large areas. This is further discussed in chapter 6.2.1.

The word "Generic" in the name GSAR refers to the modular structure the software platform is built upon. All input data to the software must experience SAR processing in the main module. The combination of SBAS and InSAR is then used to enable ground movement monitoring of large areas (Interview Larsen, 2010). The generic platform construction enables flexible development of only new additional technologies from SAR (main module) which then saves development time and corresponding development costs. Other existing SAR software (Figure 6-2) is much more integrated and requires that the complete development process is repeated in order to develop new functionalities.

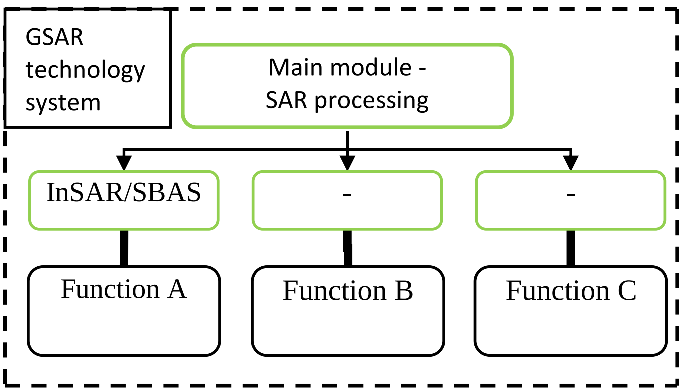


Figure 6-1 The flexibility in GSAR illustrates that only new sub-technologies, and not the complete system, needs to be developed in order to develop a new functionality.

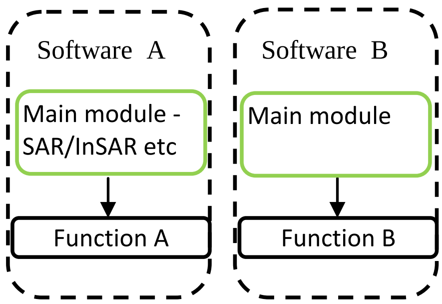


Figure 6-2 In other SAR software the complete software development process must be repeated to develop a new functionality.

Further we have identified the second variable; complementary technologies to GSAR. These are satellite images and a conventional computer (hardware). Variable 1 and 2 are illustrated in Technology column in Figure 6-3.

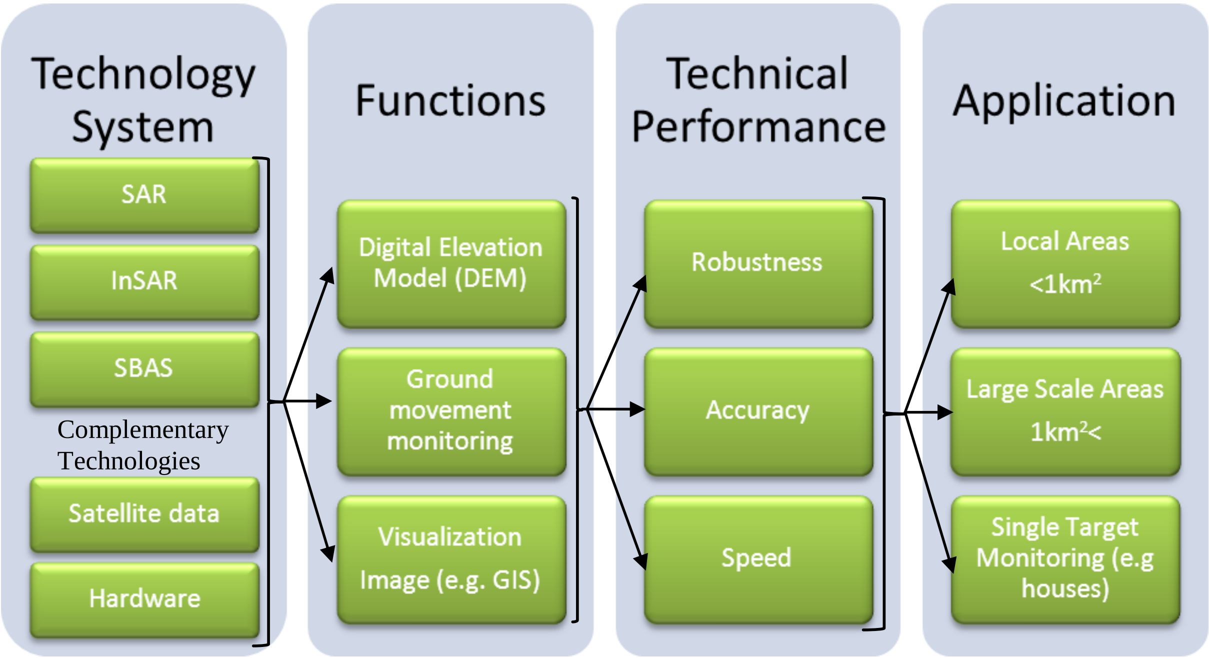


Figure 6-3 The different technologies needed to perform the different functions. The quality in the different functions is measured in terms of technical performance.

The *functions* (third variable) that the various technologies convey are topographic information (DEM) and ground movement monitoring. The functions can be visualized by 2-D or 3-D images or as input data in various information programs such as Geographical Information Systems (GIS).

The fourth variable *Technical performance* relates to the quality when executing the function. The level of technical performance is in this case measured in terms of *Robustness* and *Accuracy*. Robustness refers to how well the calculated displacement data match the true displacement in nature. Accuracy refers to how detailed the information is regarding ground elevation and potential displacement. The level of accuracy is to a large extent determined by the technical limitations of the SAR instruments onboard satellites but is also influenced by the GSAR system processing. Today it is possible to determine deformations on a millimeter level but with increasing developments of SAR sensors onboard satellites it would be possible to increase the level of accuracy even more. The InSAR technique could as described above also be used for elevation (topographic) measurements. However there are technologies based on optical data that can deliver more detailed topographic information than the InSAR technology. Therefore the InSAR technology used for elevation modeling is primarily used in combination with the SBAS technology to determine ground movement of large areas.

By utilizing the fourth variable (applications) according to Lindmark (2006) we have based on our technical performance identified three applications in where GSAR could operate in theory. We have differed between large scale (>1 km^2) and local areas (<1km^2). Large scale areas refer to screening made in order to identify areas exposed to ground movement. Local areas refer to areas where ground movement has been identified and that require further monitoring. If the area is relatively small geologist could in a cost efficient way monitor these areas. The application area is named single target where one is monitoring single objects such as houses.

6.2 Optimizing the Technical Performance

We have defined the SAR processor as a *base* technology since its main purpose is to convert satellite raw data into manageable data and it has no impact on the function or technical performance. The same applies to computer hardware, since a faster computer can only accelerate the image processing (Interview Larsen, 2010).

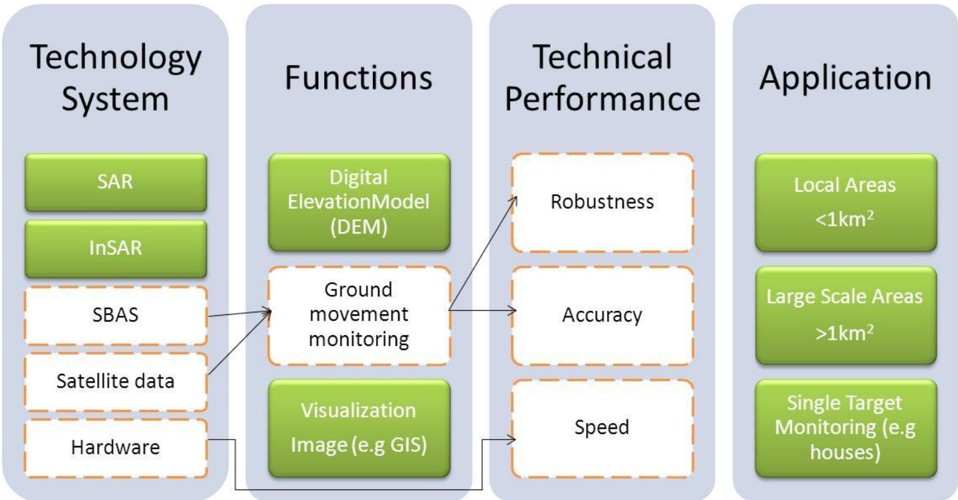


Figure 6-4 Base and key technologies (crosshatched box) are illustrated to the left in figure. Two key technologies eminently affect the quality in displacements mapping.

Satellite data and the SBAS algorithms are defined as *key* technologies (Figure 6-4) since these are eminently affecting the level of robustness and accuracy of ground movement mapping. However the quality in satellite data depends on the SAR instruments onboard the satellites. So from a processing perspective the only way to improve the technical performance is to interpret the satellite data as good as possible by use of the SBAS technology.

Interpretation of SAR (radar) signals in relation to ground movement mapping is very much dependent on the construction and design of the SBAS algorithms. When measuring ground movement the SBAS algorithm considers all of the backscattered radar signals in an area (Figure 6-5).

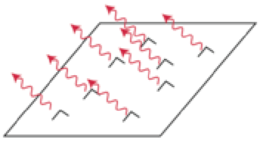


Figure 6-5 Showing the many backscattered signals of an illuminated target area.

Hence, by analyzing the many backscattered signals it is possible to conclude that the complete area is deforming – if that happens to be the case.

6.2.1 Further Technical Improvements

Sometimes one might want to identify if there is movement in only one specific target on the ground such as a building. Competing technologies are today using a different method to SBAS, named Persistent Scatterers (PS), where they identify the strongest backscattered signal of an illuminated area (Figure 6-6) [3]. Strong signals are often related to buildings and houses. By analyzing only one strong signal it is possible to identify deformation of one single target.

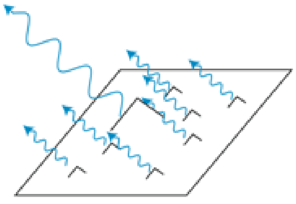


Figure 6-6 Figure illustrates one strong signal among the many backscattered radar signals.

In practice the existing SBAS algorithms could also be used to measure displacement of single targets (Figure 6-6). However to match competing technologies, in relations to accuracy and robustness, further development is needed with the main goal of identifying single backscattered signals as good as possible.

A final step in the development process and further technical improvements is to combine algorithms such as SBAS and PS that are applicable for both single target and large area displacement mapping. This development step would consequently be the optimal level considering robustness and accuracy of displacement mapping of large areas and single targets using GSAR (Interview Larsen, 2010).

7 Discussion

In this chapter we will discuss the most important information we have encountered in the Technical Study.

Ground movement mapping by use GSAR is a relatively cheap method that can provide very high accuracy and robustness in ground movement measurements. Conventional methods used in Local Areas can for certain provide even more detailed information and measure angles not in reach for the satellites, however when there is need to cover larger areas the conventional methods will quickly become expensive. Therefore surveillance by satellite should primarily be used as a tool to identify and keep historical records of Large Areas in risk for potential ground displacement whereas conventional methods should be used as a supplement to further more accurately investigate and survey deformation exposed areas.

In terms of technical limitations, lack in correlation between two captured satellite images reduces the possibility to identify potential deformation on the ground. Therefore the GSAR cannot perform measurements on areas where there is a lot of movement on the ground. This limitation refers to areas having loads of vegetation such as forests and high grass. Other application areas where deformation cannot be measured are snow and water. This limitation is due to the fact that no radar signals are backscattered to the radar (when hitting snow/water) hence it is impossible to analyze the characteristics of the emitted and received radar signals. Limitations considering the atmospheric characteristics do not directly prevent deformation mapping but could distort the results in the final product. However several rectification methods are used to limit the atmospheric fault measurements. There may also be other errors that lead to incorrect measurements, such as programming faults. Moreover since Norut has developed the SAR, InSAR and SBAS technology in-house it implies that one has complete control of the entire production process. This in turn facilitates the error diagnosis whether there are internal or external causes to the error measurements.

GSAR could potentially become a disruptive technology as the obvious benefit towards existing technologies is the flexibility in the construction of the software platform. It is possible to develop new functionalities based on the same software core. This enables GSAR to operate in several application areas and reach a larger market than existing technologies. As demonstrated in the Technical Study, GSAR is more suited to monitor ground movement of Large Areas and not of single targets. Hence, from a commercialization perspective the

GSAR software should target customers that need to detect, monitor and measure ground movements of large areas where there is very little or preferably no vegetation. The GSAR then becomes a very powerful tool to measure movement in areas where there is risks of fatal ground movement that could have large negative environmental and economic impacts.

The PS method on the other hand becomes very useful where there is no interest to measure deformation of large areas but instead of single targets, such as buildings. However, concluding that a single target such as a building is moving does not necessarily imply that only the building is moving. Movement of the complete surrounding areas could be the actual cause to building displacement. Furthermore, one should be aware that more satellite data is necessary for single target analysis which eventually leads to higher cost for the customer. In addition, where there are only eight to 20 satellite images available competing technologies would not be able to perform a ground movement analysis, hence GSAR would be the only option for the customer. Therefore thorough deliberation is necessary when considering choosing either the GSAR technology or SAR technologies focusing on the PS technology. The decision is very much dependent on application area, customer need and the willingness to pay for retrieving necessary satellite data. Choosing GSAR would naturally result in a lower cost per each m^2 analyzed with the disadvantage of retrieving less displacement information of specific targets.

In addition one might argue that it should be in countries and businesses interest to survey its natural land areas in order to prevent geological hazards that could have large negative impact on societies and its surrounding environment. Consequently by conveying the benefits and value of GSAR it should be possible to address an unmet need among world's nations and businesses.

8 Conclusion –Technical Study

The focus of the Technical Study was to understand the underlying technologies to satellites surveillance and its possibilities and limitations. Having understood these together with the functionality of our software we wanted to understand where GSAR would be best applied.

Having received comprehensive understanding in satellite surveillance one could argue that the limitations connected to GSAR are related to the instruments the satellites carry and how a satellite captures images of the earth's surface. The possibilities related to GSAR and what type of information one receives from downloaded satellite images is on the other hand powered by software development.

Through the Technical Study we have concluded that our technology can be applied in three different application areas, namely local areas, large areas and single target monitoring. From the TEA made we believe that it is within large scale areas we can deliver highest value to customer (see Figure 8-1 for TEA conclusion). Since GSAR is the first of its kind in offering ground movement monitoring of large areas, together with its flexibility it should from a technology point of view have a good starting-point to develop into a disruptive technology. However one must still remember that it is how the technology is managed in a commercial perspective and thereof meets customer needs that will finally decide if GSAR can evolve and replace existing technology. To be able and convey the value of GSAR we must first initiate a market research in order to target potential early adopters who could absorb our technology and facilitate disruptive innovation. This is made in the following Market Study (Part Two).

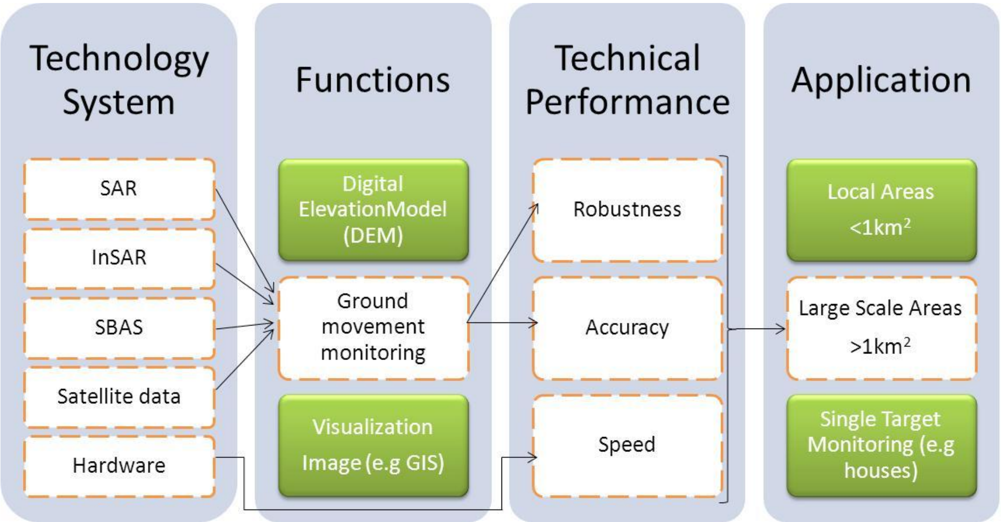


Figure 8-3 Concluding TEA of the Technical Study. GSAR should be applied to Large Scale Areas.

Part Two – The Market Study

9 Introduction

This introduction chapter will introduce you to our market research and describe how this study has been performed.

The outcome of the Technical Study will act as a starting point for this chapter, the technical application; detection, measuring and monitoring of ground movement of **large** areas. Our objectives will be based on the technology investigated in the Technical Study commercialize large-scale area deformation images. To do this successfully the start up need to acknowledge the most prevailing customer segments to offer products to. We will therefore follow up on Lindmark's (2006) TEA framework, variable 7, starting with compiling the feasible theoretical utilities connected to the applications accumulated in the Technical Study, illustrated in Figure 9-1. To gain a better understanding of the potential customer demands and how we can connect the most decisive theoretical utility to the most lucrative customers' practical requirements, we have performed further market research of correlated potential customer to the application and theoretical utilities. Depending on the acknowledged customer requirements segments will be established and strategically selected in the Analysis and Conclusion performing Lindmark's variable six and seven. We will also strive to acknowledge customer needs related to the alternative applications to facilitate a sustainable business development.

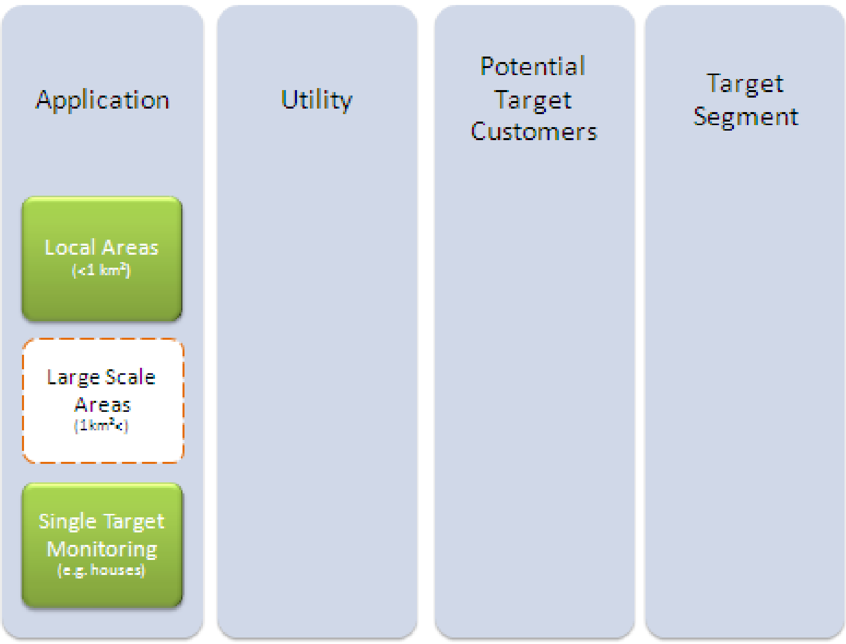


Figure 9-1 Continuance of the TEA; Utility, Potential Target Customers, and Target Segments

9.1 Content in the Market Study

This study is orderly arranged with stating the objectives below before we describe our chosen theoretical framework, methodology, discussion and finally sum up with conclusion of what determined segment(s) to target. The study will build upon the TEA and add relevant utilities and focus segments to the model that will be further elaborated on and perform as increased knowledge and understanding of our technology and market in the third part, the Business Plan, with the purpose to reach an economical perspective of the technology fulfilling the TEA described in Chapter 3.2.

9.2 Research Objectives

We aimed through this market research, to gain understanding of customer requirements to be able to, based on the technology, target the most lucrative customer segments. Hence, based on the TEA initiated in the Technical Study we will continue to link application and utility to strategic short- and long-term customers and related segment(s).

10 Theoretical Framework for the Market Study

This section describes the theoretical framework we have based our research and analysis on to reach conclusions of this chapters set purpose.

We have chosen the Segmenting, Targeting and Positioning (STP) framework, based on the three steps; Segmentation of market, Targeting market(s) and Positioning your company. Moreover, to reach credible and thorough results during our limited amounts of time we choose to focus on the first two steps; Segmenting of markets and Targeting market(s). These two parts will be used to approach a final conclusion on what segments and associated customer(s) to focus on in the commercialization process. Consequently, we will leave the positioning for upcoming initiatives based on the information gathered, discussed and concluded in this work.

10.1 Segmenting, Targeting and Positioning Framework

When commercializing products to various customers with different requirements, different market approaches are required, underlining the importance of the right market strategy [9]. Market segmentation is a strategic approach used to identify different customer requirements and group those potential customers into segments based on this information (Blocker & Flint, 2006). Hague confirms that identifying various needs and group customers with similar requirements into different groups are at the heart of business marketing [9]. As we are aiming to initiate a start-up we will have restricted resources and therefore a need to target the most profitable and less risky customers. Hence, we will segment the market and cleverly choose the most strategic segment to focus on. According to Hague the difference between selling and marketing is that by only selling products, the company might leave the customer with product they are not satisfied with or do not require [9]. Therefore we will by implementing the STP framework, match offering and resources with customer's requirements. By doing this already before initial sales, we will be able to target the customers who will gain most value from the products and facilitate their loyalty towards us [9].

Moreover, Wedel and Kamakura (2000) are considering the heterogeneity of customer needs and emphasizes segmenting as an essential element especially in the industrial market that we will operate in; the business-to-business market. This market is more complex than the business to consumer markets (meaning individuals and households who purchase goods and services for personal use) since the business buyer often represents an organization rather than themselves. Eagle Eye will encounter a whole range of persons to make our sale and for them to make the purchase decisions. Described by Hague it is not unusual to meet the user who are to test and approve the product, the product manager who will run the product through trials, the board of directors may inflict the overruling structure of source of supply and the buyer will most certainly negotiate and require a better price [9]. This is most certainly more complex than selling an item of clothing or food where purchaser will have most influence, occasionally swayed by partner or family, underlining the importance of getting to know your customers in the business-to-business market.

The first two first steps, we are focusing of the STP framework, is illustrated in the left box in Figure 10-1 below. We will in the next chapter describe the principles and process of segmentation and how one can target the established segment(s).

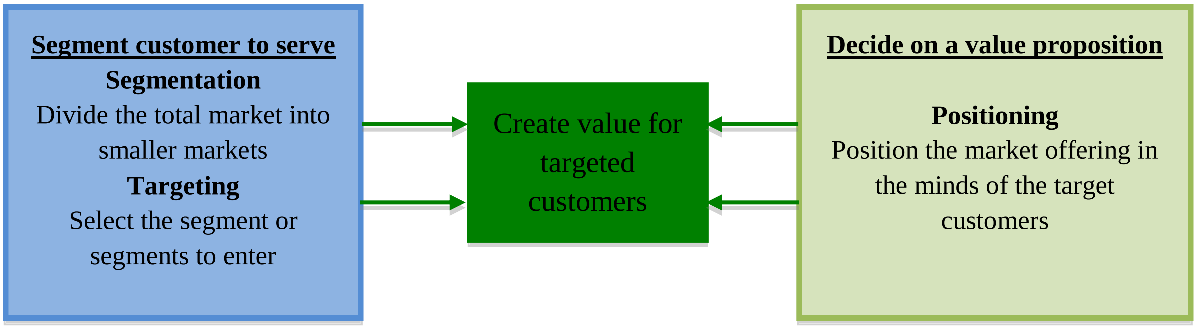


Figure 10-1 STP framework, Adopted from Kotler (2003)

10.1.1 Segmenting

Segments are defined by Smith (1956) as the groups directly derived from the heterogeneity of customer demands. Consequently, segment consists of a group of buyers with similar sets of demands. Segments are not created but identified based on their different needs. Figure 10-2 illustrates identification of four different segments each with similar demands derived from the market, visualized by the large circle to the left (Kotler, 2003).

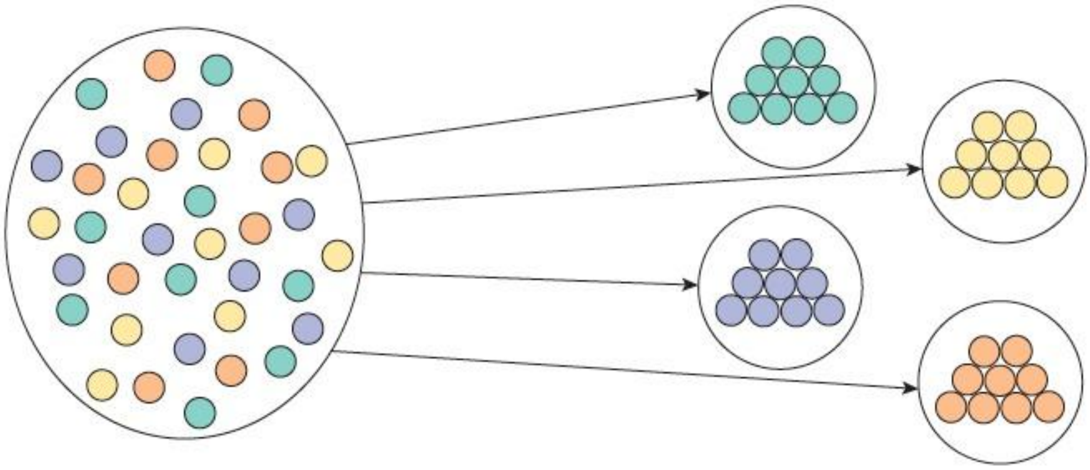


Figure 10-2 Sector Heterogeneity - Segment Homogeneity

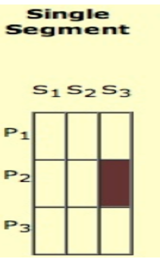
Smith (1956) emphasize that the market segments by his time did not arise from empirically partitioning of the market due to collected data and consumer statistics but based on the managers conceptualization of the structured and partitioned market. However, many of today’s marketing experts (Kolb 2008, Kotler 2003, Malhotra & Birks 2007) claim to commit to an empirical segmentation based on the empirical data and conclusions of what customers different need are. It is also important to align and derive the segmentation from the vision and objectives as well as current position, strengths and weaknesses of the company to provide a solution for the customer problem in the best way.

The buyer segmentation is normally divided into potential customer groups depending on appropriate criteria’s relating to Behavioural, Psychographic, Geographic and Demographic factors. These are used combined or alone to in a structured way divide the market into defined customer groups that is fairly equable and sufficiently large to serve efficiently (Bengtsson et al. 2005, Solomon et al 2008). For business marketers these factors are accompanied with economic criteria as well as operating variables, purchasing approach, and situational factors that are relevant when segmenting business markets (Kotler, 2003). (Examples of segment criteria’s is illustrated in Appendices VIII)

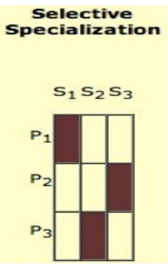
10.1.2 Targeting Market/Customer

The second step of the STP process and our objective of the market study are to determine which, if any, of the segments revealed to target and initiate focus on in the commercialisation process. Based on the segmentation companies need to decide which of the proposed segments they can target efficiently and most profitably. If this process is done correctly it offers growth and profit opportunities with minimized risk of investment for the company (Doyle, 1994). This is emphasized by Bengtsson et al. (2005) who claim that the point is not to target every segment at the same time but focus on the segment(s) you believe will provide the company the with the largest profits, today and in the future. This is important as some attractive segments might not mesh with the companies' long-term objectives or require additional competence to be targeted. Concentrating marketing efforts on the key segment(s), can be the key to small business success. Therefore segments are preferably evaluated according to an appropriate model. One model originally suggested by McDonald and Dunbar (2004) facilitating you to take the company objectives and resources into consideration when evaluating the segment's attractiveness. This is done by rating the different segments based on appropriate factors. The factors compiled for our case based on McDonald and Dunbar's model are; potential growth, geography, competitive intensity, quantity demanded, purchase power, demand corresponding to product offering, potential collaboration, attitude and purchase procedures. Each factor shall be weighted in relation to each other and then be rated on a scale from 0-10 corresponding to the different segment properties. Consequently every segment shall based on the criteria rating and weighs be summarized, providing an order of attractiveness (see Appendices IX for Evaluation model). Hence, this model facilitates the choice of what Kotler (2003) describes as selection strategies. There are five general patterns of these selections strategies suggested, presented in Table 10-1 below (Kotler 2003, Solomon, Marshall and Stuart, 2008).

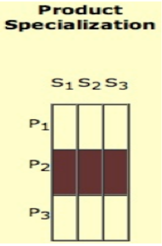
Table 30-1 - Selection Strategies, Adopted from Kotler (2003)



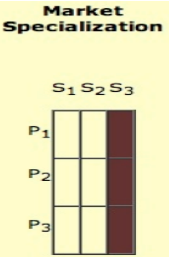
Single Segment concentration
Focus on single segment facilitates concentrating marketing gaining strong knowledge of customers needs. However risky if specific segments change behaviour.



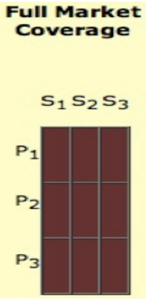
Selective Specialization
Selecting a specific number of products for different segments, diversifying risk. Differentiate marketing through supply product objectively attractive for the specific segment.



Product Specialization
Single product sold to several segments; build different models to the different groups while building strong relationship in the product area.



Market Specialization
Focus on satisfying several needs within a certain customer group, gaining strong relation and brand in the certain customer group and becomes a channel for further additional products.



Full Market Coverage
Only very large firms can undertake this undifferentiated strategy of supplying all customers' needs within all customer groups and with all products they might need.

Kotler (2003) further claims that a company shall, based upon the segments' attractiveness, the company objectives, competencies and resources chose a selection strategy correlating to these factors. Hence, facilitate minimized risk of investment for the company.

10.1.3 Utilizing the frameworks

This part describes how we will utilized the first two steps in the STP framework and how we integrated it into the TEA used in part one, the Technical Study. Both frameworks is somewhat interrelated since they both build on customers' needs. The analysis on the gathered data will combine the two frameworks to serve the objectives of this study. By segmenting and targeting customers corresponding to the STP framework we will build upon the TEA model linking our technology to most suitable customer and market segment(s).

10.1.4 Utilizing Segmentation Theory

To gain a better understanding of our buyer requirements and importance of the different criteria's used to divide market into segments based on different needs, we have combined relevant criteria's from both buyer and organizational aspects. We have done this based upon inspiration from various theories (Bengtsson et al. 2005, Kotler 2003, Solomon et al 2008).

This enables us to get a better chance of finding different requirements decisive to customer. Our adopted segmentation criteria are illustrated in Figure 10-3.

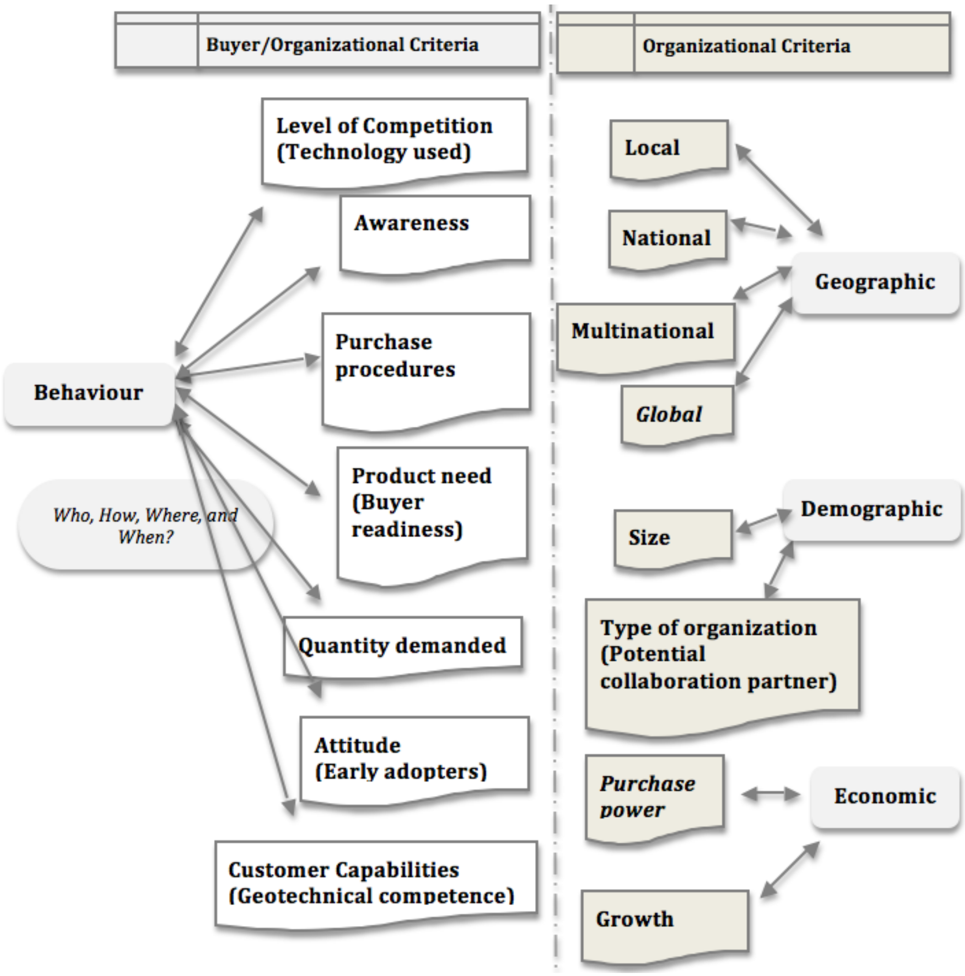


Figure 10-3 Our Buyer & Organizational segmentation criteria.

The criteria are further supplemented with questions organized into the Interview Guide that have been used to collect data from potential customers compiled with a sociological standpoint according to Mordal (1989) (see Appendices IX for Interview Guide).

10.1.5 Utilizing the Selection Theory (Targeting)

By breaking down the market into different segments we have used the combined list of criteria described above to evaluate segment(s) overall attractiveness in relations to our technology. This is done by using McDonald and Dunbar's (2004) model (described in Chapter 10.1.2) and enabling an alignment of the derived segments and our offer, facilitating a successful commercialisation. This facilitates us to use our strengths to provide best solution for the customer. We used the list of the most suitable segment attractiveness factors for our project, illustrated in Table 10-2 (see full calculations in Appendices XI)

Table 10-4 – This model is developed based on the market research done , used to illustrates our various segment attractiveness. Source: Modified by McDonald & Dunbar (2004)

SEGMENT ATTRACTIVENESS FACTORS	RATING		
	HIGH (10-7)	MEDIUM (6-4)	LOW (3-0)
POTENTIAL GROWTH	Expressed expansion	Maybe	No intention to increase
GEOGRAPHICAL	Multinational	National	Regional
TECHNOLOGY USAGE/COMPETITIVE INTENSITY	Low similar technology usage	Medium similar technology usage	High similar technology usage
QUANTITY DEMANDED	>5 Products/year	3-5 Products/year	1-3 Products/year
PURCHASE POWER	>1000' NOK/year	500'-1000' NOK/year	0-500' NOK/year
CONFORMATION PRODUCT-CUSTOMER NEED	Precise	Ok	Inadequate
POTENTIAL COLLABORATION	Expressed interest	Can be negotiated	Not an option
ATTITUDE/EARLY ADOPTERS	Ready to adopt and purchase continuously	Will purchase occasionally	Only interested in single projects
PURCHASE PROCEDURES	Ordinary purchase	Procurement in certain occasions	Procurement

Moreover, this model will be used to value the factors that correspond to our objectives; to enter the market efficiently with minimized levels of risks. Then segment evaluation will further facilitate choice of Kotler's (2003) selection strategies as described in Chapter 10.1.2 above.

11 Methodology

Based on the objective of the study and the theoretical framework suited for the purpose the following methodology is chosen for this intent.

11.1 Survey Design

To gain the information required to implement the framework described we have selected an intense and qualitative form of primary research that will provide us with the possibility to obtain detailed information, an overall understanding of customers, their situations, requirements, and purchase procedures (Malhotra and Birks, 2007).

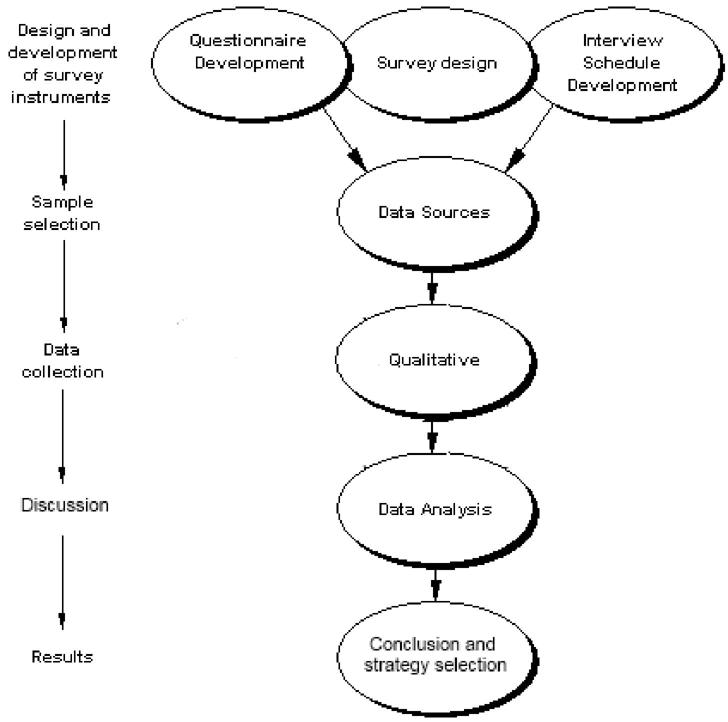


Figure 11-1 - Research Design

The Interview Guide has been developed constituting questions whose answers will create a good base for further implementation of the theoretical framework. Figure 11-1 illustrates our steps in the research process (see Appendices IX for Interview Guide)

11.1.1 Sample Selection of Data Sources

Due to the fact that our technology is novel and requires early adopters to be commercialized successfully we have chosen to analyze the unexploited Norwegian market and gain a foothold in our home market before going internationally. We see it as a natural step to go through national actors as the Norwegian market has due to its geographical location, an increasing demand of monitoring ground movement corresponding to potential landslides. Hence we have through Norut's experience in combination with Lindmark's (2006) sixth variable compiled theoretical utilities based upon the application accumulated in the Technical Study, illustrated in Figure 11-2. Furthermore, potential target customers, the seventh variable, have been assembled corresponding to the feasible theoretical utilities, the sample selection for our market research. Some of the potential target customers have been in contact with the technology before, while others were chosen due to feasible technical applicability.

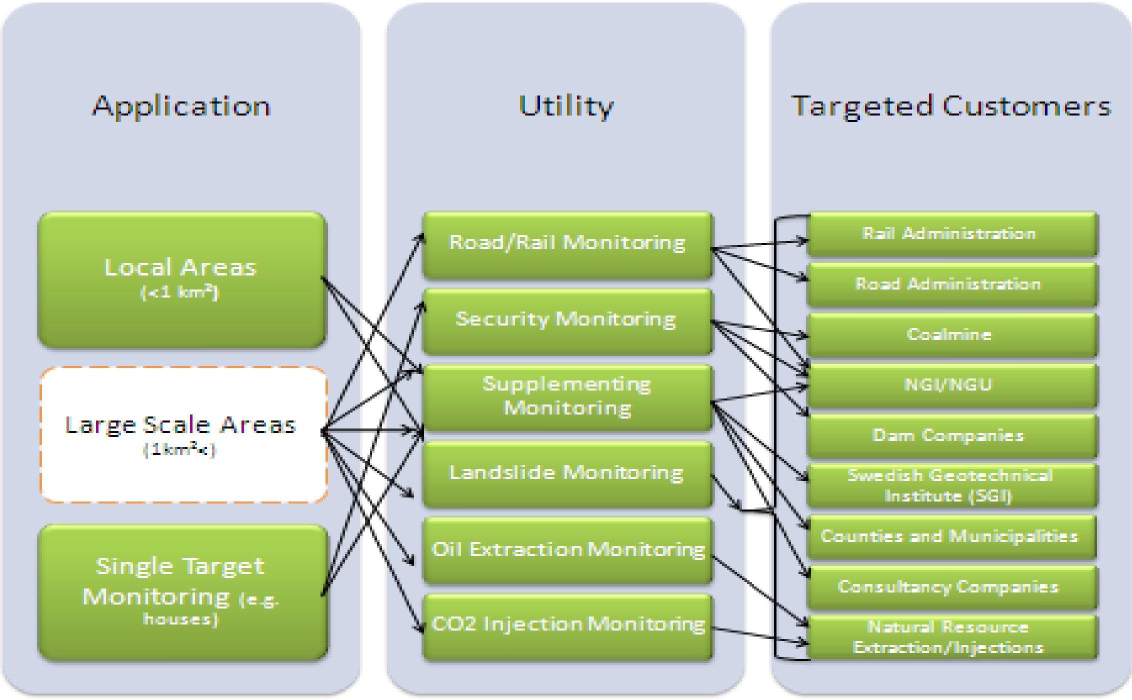


Figure 11-4 Continuance of the TEA; Utility and Potential Target Customers.

Therefore we have constrained our market research both geographically and demographically to a number of interesting customers to get sufficient depth of our empirical data (one geographical exception, SGI, further described in the Analysis). Interviewed potential customers are listed in TEA (Figure 11-2) and specific information of interviewed persons is found in the Bibliography.

11.1.2 Data Collection and Discussion

Our sample selection has composed our base for data collection. We have initiated contact with multiple customers chosen to match the characteristics of our utilities illustrated in Figure 11-2. However, before reducing the list to the most appropriate respondents we also contacted companies' listen in Appendices X, later expurgated due to lack of time. The listed customers have initially been contacted via telephone and subsequently received interview guide and product information via e-mail before meeting to create best starting point for the interviews. Henceforth we have developed good situations with representative persons to obtain inspiring and credible information from respondents through an average of two hours interviews. We were able to meet seven out of 20 potential customers for face-to-face interviews and the remaining 13 have been done through telephone interviews due to our remote location. To increase the possible specificity the interviews have been recorded in addition to documented in writing. Due to the fact that the products and services we offer is today relatively novel and unknown, the qualitative designs is used and based on thorough interviews of fewer units providing us with a better possibility to gain relevant data collected with sufficient depth. Further we have, according to Figure 11-1, analyzed the data by applying the theoretical framework to reach our objectives and suggest a selection of how to select segment(s) to target.

11.2 Validity

When pursuing this field study we have illuminated the sources of error that might affect our result and for us to be aware of during the process. Due to the fact that we are three students writing this thesis together, with diverse interpretation of the empirical data, we have performed recorded interviews with a minimum of two students present at every interview. We have also, due to limited amount of time, interviewed a concentrated amount of the potential customers and therefore gained a particular insight in the chosen part of the market to enter. Further market research is required for expansion with additional product offerings and international approach. Moreover, to minimize interpretational errors in the steps of market research we have chosen the qualitative and inductive approach that brings us close to customers and market requiring fewer levels of market interpretations.

12 Analysis

This chapter will describe the most relevant information that we have encountered during our market research interviewing companies within the various industries (see Bibliography)

The general impression from all of the companies interviewed is that they perceive our products as very attractive and want to hear more about how it could be implemented into their businesses. Hence, the data collection has provided us with important information describing customers' aspects and requirements in relation to our products and utilities. We will here describe how we have divided the market into segments and go through the most relevant information from every industry contacted that has acted as a base for the segmentation to facilitate targeting of the right customers. It will all be summarized in segmentation where we illustrate the segments' different requirements and further conclusions on what selection strategy we will use.

12.1 Dividing the Market

We have divided the customer list into segments each having equal requirements. The listed segmentation criteria (described in Chapter 10.1.4) has been broken down into eight criteria's that has been recognized as most relevant through the interview. However, the first four criteria did not distinguish the customers and has therefore not been used in the initial breakdown of market but instead applied in the final evaluation and ranking of the established segments' attractiveness. These four criteria will be listed and described briefly below; (1) Attitude for trying our products, (2) Competitive technology used, (3) Growth (money spent on improvements and new technologies) and (4) Possession of geotechnical competences. The common Attitude (1) from all of the companies was that they perceive our products as very attractive. When it comes to the Competitive technology used (2) by customer the different segments did not differ decisively. There are not many competitors in Norway and the potential customer that has tried competitor's products was not satisfied with the results and was more positive when it came to our solution, superior in the Norwegian terrains. The customers also described trends indicating Growth (3) due to more money spent each year on improvements and new technologies for more efficient results and/or lower costs. All the companies we have been talking to are in possession of Geo-technical competence (4), meaning that they are able to understand our products and use them for further analysis. Even though every customer were positive to the initial factors they did differ somewhat, therefore we have utilized McDonald and Dunbar’s (2004) evaluation model described further down to implement the different levels of optimism into our final elaborations.

Nevertheless, there were also decisive criteria that differentiated the companies from one and other. The vital criteria’s used in the breakdown characterizing our potential customers has shown to be; (5) Product Needed, (6) Level of purchasing power, (7) Numbers of project needed every year and If they have expressed interest in establishing (8) Potential collaboration.

12.1.1 Interviewed Organizations and their Characteristics

Rail Administration

When the national rail administration are securing their rails they are today using a test-train with measuring devices connected to the track providing information of the rail during scanned distances. This information is both telling you how the rails are in relation to each other and if they have moved vertically due to ground movements or tensions in the rails. All rails in Norway are tested two times a year with this test train in addition to situations where drivers have reported problems on certain distances. Their test trains have been providing good results why rail administration will continue to use them. Moreover, the rail administration would like to see how the surrounding areas such as mountains and tunnels are moving. For these requirements they are outsourcing work to NGI and NGU who is delivering full reports for the Rail Administration’s requirements.

Road Administration

Today the national road administration is not doing anything to indentify movements of their roads. However, as public operator the road administration has the responsibility for securing existing and newly constructed infrastructure. Therefore they outsource projects to NGI and NGU to detect, measure and monitor movements of the ground in the surrounding environments. Road administration also commits to, similar to the rail administration, outsourcing of this work and are depending on full reports for these purposes. However, Norut has initiated a project with Statens Vegvesen to analyze the potential to detect movements of specific roads with our software, further verifying of our technology. Hence, this is opening up for a potential long-term utility.

Coalmine Companies

In the mining industry large investments are made on human safety and security every year. Since a major part of their fieldwork is done underground the consequences would be catastrophic if something goes wrong. Moreover, when you are extracting coal from mines you want to have continuous minor landslides of the minerals inside the mine. This is to secure control of the coal extraction process. If you do not have these continuous slides you can expect a bigger landslide to occur unexpectedly which may lead to dangerous situations. Consequently, coalmines are securing their processes by using measuring devices inside the mines for daily measurements in addition to measurements done manually to monitoring the mines surface in a similar way to what the dam companies are doing today. The surface processes are only done once a year to secure the employees work place and reduce risk of geo-hazards.

Dam Companies

The energy companies are acting in an attractive national industry and are today earning large revenues while continuously seeking new ways to lower their costs and secure their energy acquisition. The dam companies are today securing their dams to reduce the risks of a dam breaking; they do this by monitoring movements of the construction due to water pressure from the stored water. If breakage would occur it could lead to catastrophic damages on the underlying environment. Monitoring is today done by placing out bolts on the dam construction and manually measure these one or two times a year with manual measurements systems. This has showed to be an easy job that takes up to a day for two people and is therefore not very costly. Since most dams in Norway are small they just need a few bolts to complete their measurements. However the method is very conservative and not very illustrative and applicable to further presentation and documentation. Hence, their responsible technical managers express their need of new methods of measuring these movements. Moreover, the dam owners are interested to analyze what has happened back in time, meaning what has happened from construction of the dam until present today, also to make sure that their measurements are correct.

NGI and NGU

Today, the Norwegian Water Resources and Energy Directorate (NVE) have the overall responsibility to administer public capital for preventive actions on existing infrastructure and preventions of damages caused by landslides. This involves NVE to provide help to local authorities in the form of expertise and provide resources in risk mapping, spatial planning warning and contingency planning. NVE does not possess geological competence why they are closely working with Norwegian Geological Survey (NGU) and Norwegian Geotechnical Institute (NGI) who perform many projects administrated by NVE. In 2009 NVE received 108 million NOK from the Norwegian government to administrate and securing the local environment in Norway.

NGI and NGU are today working as consultancy companies for such as NVE, Road- and Rail administration, Municipalities and Consultancy companies. They perform most of the projects considering geo hazards in Norway today but do also work internationally. They have in previous years worked closely with Norut developing the technology we possess, illustrating their eagerness to adopt the cutting edge solutions. Hence they see great value in using our products to save both time and money in their projects related to detecting, measuring and monitoring of ground movements of large-scale areas. Both national organizations have expressed great interest of continue using these types of products as they do not have adequate alternative solutions. Both organisations are performing in average three projects per year and increasing.

Swedish Geotechnical Institute

When we received high interest from NGI, we decided to make one exemption from the Norwegian market and investigate the interest in NGI's associated organisation in Sweden, Swedish Geotechnical Institute (SGI). SGI's situation is similar to NGI and NGU's apart from that there is today not as much money spent on these purposes in Sweden. They expressed a need and great interest of integrating our products in a couple of projects per year facilitating increased chance of governmental funding. This is due to the fact that they did not possess any alternative solutions of the large scale monitoring of ground movement, limiting their activities for such projects.

Counties and Municipalities

The County Governor (Fylkesmannen) is the extended arm of the Norwegian government and the head of public relief work in the counties, responsible for securing the risk zones in all the pertaining municipalities. When the County Governor has detected risk zones, the specific municipalities are responsible to monitor the relevant zones. The municipalities' then have a central role and responsibility when it comes to citizen's safety. The municipalities should plan the use of areas so that the danger or damage due to landslides does not occur. Therefore they are participating in the handling of emergency situations and crises. When it comes to planning of land use, there are two sections of the Planning and Building Act that is particularly important concerning to development and risks for landslides. These sections describe areas that are hazardous, due to landslides and flooding, and may not be built upon if not secure. The county administrate monitoring of larger areas and indicate a requirement of at least six products each year but municipalities are financially responsible with low purchase power, depending on NVE and other governmental funding.

Consultancy Companies

There are some consultancy firms in Norway that is providing consultancy service within several fields relating to our product offering, such as infrastructure, project planning and supplement monitoring. Moreover, the consultancy services are paid by their customers who have showed often to be very price sensitive. Moreover, the consultancy firms only pursue zero to two projects within our area of interest per year and are mostly covering small areas. In the case of these projects consultancy companies are today outsourcing these services to NGI who supply reports of the specific areas.

Natural Resource Extraction/Injection

Today international oil companies are using seismic tools to discover oil in the ground. This method is telling you how the structure looks like underneath the ground and where you can expect to find oil. They see our technology as a powerful complement to these methods during onshore oil extraction, often deserts areas (Figure 12-1 (1)). Researchers have realized that when one is extracting oil, subsidence is most likely to occur. When you are extracting mass from underground the ground will sink to fill these holes, hence a subsidence has occurred (Figure 12-1 (2)). Moreover, as you know where the subsidence has occurred you can display were large part of the oil fields is most likely to be located, as illustrated by Figure 12-1. This means that you could reposition your oil well for a more efficient and faster oil extraction (Figure 12-1 (3)).

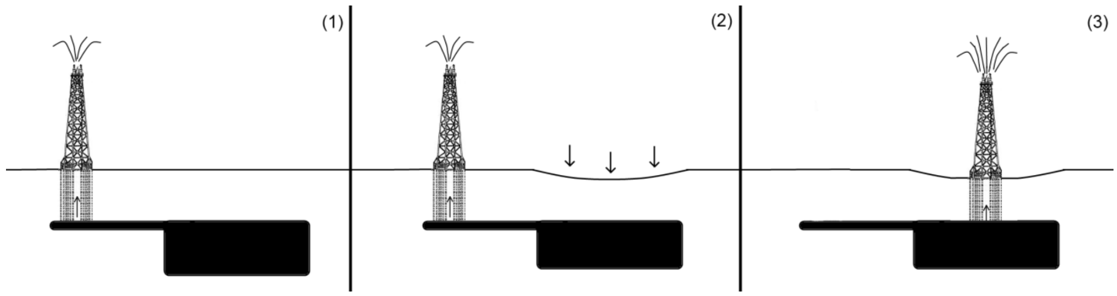


Figure 12-1 More efficient oil extraction

Today, oil companies are often injecting, for example CO_2, in the ground to compensate for what they have extracted in order to do let the ground be unchanged. This injecting could also lead to that the ground moves upwards, which also requires large scale monitoring to secure/measure processes.

An increasing issue for oil companies when extracting/injecting natural resources is that it is not certain that it is only the nearby area that will be affected (Figure 12-2 (1)). There could be a “chain reaction” which leads to that areas hundreds of meters, even kilometres away could be affected too (Figure 12-2 (2)). Today the only thing done is to analyze the ground before starting to extract oil, and then again monitor it once more when they are about to leave that area. The oil companies do not possess any solutions to cover both large scale monitoring of extraction, injection and potentially correlated geo-hazards.

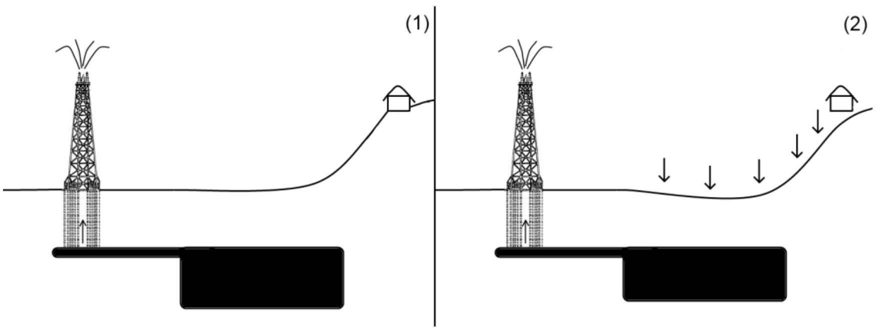


Figure 12-2 Surrounding Environment

Onshore oil companies would like to have updates on the specific areas where extraction/injection occur every third month per oil field. The oil industry is each year spending loads of money on research and development seeking a more efficient oil extraction and was eager to try out our method.

12.2 Segmentation

Segmentation has been performed based on the information gathered and the criteria described above. Criteria (1)-(4) have due to affirmative answers not distinguished the customers. However, Criteria (5)-(8) have divided the companies into seven segments whom will further be elaborated below. Corresponding characteristics will be described before selection strategy is chosen and segments are targeted corresponding to Lindmark's (2006) seventh variable. The seven segments are illustrated in Figure 12-3 (and named innovatively).

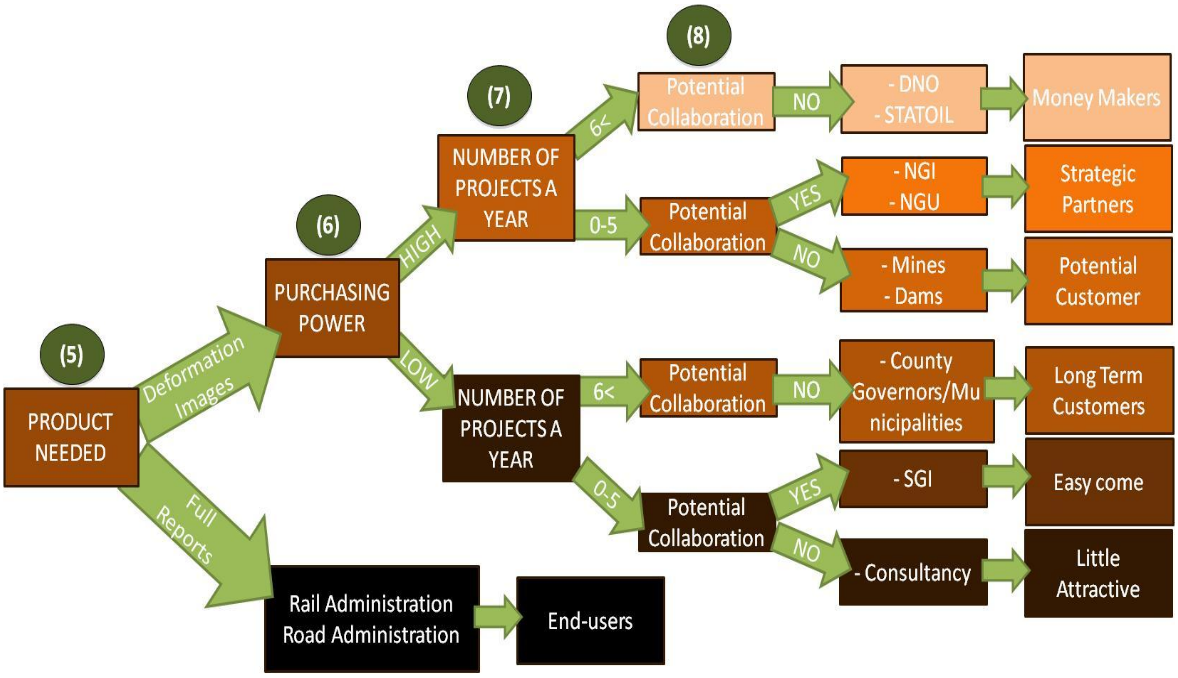


Figure 12-3 Segmentation based on the numbered criteria

Money Makers

Within this segment we find customers with high purchasing power and demand a high quantity of products every year. They are not potential collaboration partners at this stage, but have showed interest in investing money to verify our technology. They see the benefits by using our product on two different areas; firstly for a more efficient oil extraction, but also to be able to see the consequences by extracting/injecting natural resources in the nearby and distant areas.

Strategic Partners

This segment possesses a high purchasing power, and requires an average of three products each year and increasing. NGI and NGU have both participated in earlier research projects and know the value and advantages in using our technology. They are also eager to help us with further market oriented product development to help us to find new application areas that potentially can provide both them and us with new customers. Hence they have also expressed interest in becoming co-owners in the company. They want to use our technology continuously to provide their customers with more accurate reports by including our products in their projects.

Potential Customers

This segment has a high level of purchase power, and demands one to two products each year. They will require our products for safety reasons by monitoring ground movement of smaller areas.

Long Term Customers

This segment wants several products a year, however are not able to pay the prize we have set today.

Easy Come

SGI has the same needs as the strategic partner segment; however the purchasing power is not as high in Sweden as it is in Norway. SGI, as with NGI/NGU, can provide us with projects from their customer base stating that they want to include our product expenses when they are applying for government money.

Little Attractive

The customers within this segment has a low level of purchasing power and do not need many products every year.

End-users

The Rail- and Road administration are outsourcing many services and are requiring full reports concerning our area of interest, which we cannot deliver today.

12.2.1 Evaluation of Segment's Attractiveness

To further align the segment characteristics with our start-up situation we have evaluated the segments attractiveness based on the McDonald and Dunbar (2004) model and the results are illustrated in Figure 12-4 (see calculations in Appendices XI). The model values segment attractiveness from one to ten where ten is the most attractive. Hence, the model underlines the attractiveness of the two segments, "Money Maker" and "Strategic Partner", which stand out on in this evaluation.

Figure 12-4 Segment Evaluation

Both have a distinguished higher value than the others. The highest value is based upon the strategically valuable partnership that we can obtain with the “Strategic Partners” and their characteristics as early adopters already willing to purchase and distribute our products. Further on the “Strategic Partners” have already experienced the value of the product from research and development projects with Norut and expressed their interest of collaboration with us. Therefore they will act as an ideal initial customer and strategic partner ready to start adopting the products in their projects. “Money Makers” are also indicating criteria upon early adopters as they have expressed their interest for investments in our products for their oil fields providing us with multiple continual projects each year and increased revenue streams.

The “Potential Customer” segment represent a high level of purchasing power but will due to low level of products required, each year, involve a large amount of work related to each products sold.

If developing technologies enables lowered cost and the possibility to lower our prices we have the opportunity to reach a lucrative market segment; “Long Term Customers”. They require a large number of products each year but do not have the purchase power to cover our prices today. Low prices will also facilitate “Easy come” as an important strategic partner when going internationally.

The remaining segments “Little Attractive” and “End-users” are today less attractive to us as they do not afford the high-end products and will not require continuous purchases, or offer any other feature to our as a start up. However, we will indirectly reach the “End-users” through the “Strategic Partners” and their consultancy service, based upon our products, towards them.

13 Conclusions – Market Study

The focus of this study has been to map the different requirements and identify if there is any decisive needs that must to be taken into account to reach the most profitable customers segment, short- and long-term.

Based on the research findings and concluded segment characteristics we have come to the conclusion that Kotler's (2003) "Product Specialisation" strategy will provide us with the best starting point entering the market. This will reduce cost and risks in the start-up phase and we will build a strong relationship to target customers and the market segments providing the best solutions for target segments. We will with this strategy initially supply the two targeted segments, "Strategic Partners" and "Money Makers", as they have the highest purchase power and simultaneously require a large number of products. In addition the segment's requirements and characteristics correspond to our start-up situation and innovative solutions. Moreover, we will with this strategy indirectly reach the "End-user" through NGI and NGU's consultancy services since they will base their reports on our product. Furthermore, both segments are operating on a multinational market facilitating our improved international recognition.

A long terms strategy will be to develop technology enabling lowered costs enable us to target the segments with lower purchase power with new product packages corresponding to their needs. This will facilitate a lucrative market with customers who require larger volumes of products, providing us with increased revenue streams in multiple segments.

The conclusion of this Market Study will act as input for Part 3, the Business Plan. This input will constitute as a base for selection of strategies leading to economic attributes and performances. Hence, we will elaborate and describe estimated sales, profits, and gained market shares based on the technology analyzed. However, the Business Plan is written with the intention to be separated for professional use. Therefore, the segments will be renamed more descriptively to Geo-hazard ("Strategic Partner") and Resource Extraction/Injection ("Money Makers").

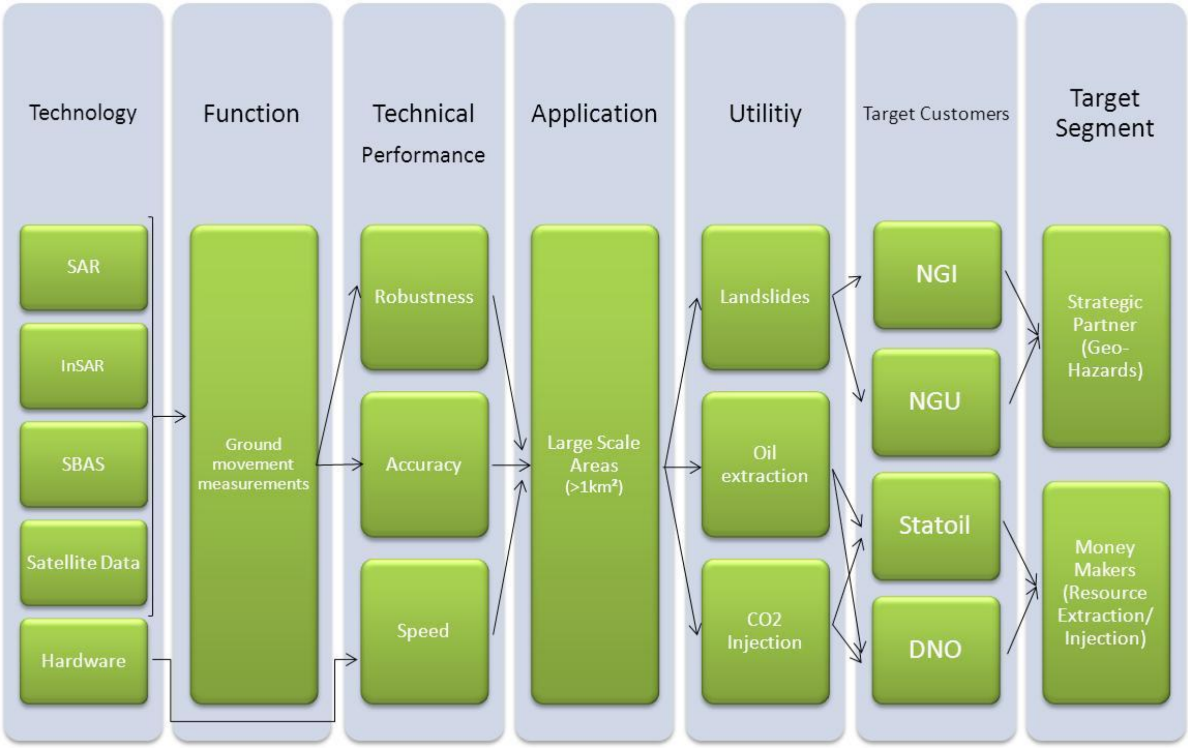


Figure 13-1 Concluding TEA

The economic attributes and performances, described in the Business Plan, will act as the final step (the 9th variable of Lindemark(2006)) in the TEA completing the analyze.

Part Three – Business Plan

14 Eagle Eye - Company under Formation

Executive Summary

Eagle Eye has access to an exclusive software license and to a technology named GSAR. We will, based on the unique software, process satellite images to detect, measure and monitor ground movements of large areas of natural terrain. We can in a time and cost efficient way provide products with comprehensive ground movement data that facilitates important decision-making considering risk assessment of geo-hazards and strategic exploitation of natural resources. Moreover we will initially provide customers with products to rationalize their onshore oil-extraction and monitor potential geo-hazards correlated to on shore natural resource-extraction and/or injection/storage of liquids (H_2O) and gas (CO_2) in the ground. The software construction is based on modules facilitating time and cost efficient product development which enables long-term sustainability by operating in several markets. Our software is developed by the Northern Research Institute (Norut), located in Tromsø, Norway, a world leading within earth surveillance.

The Eagle Eye is initiated as a spin-off from Norut, our idea provider. The Eagle Eye team consists of relevant competences various technology areas, economy, business and experience within business start-up. In addition Eagle Eye’s board possesses the experience and competencies that will help us make this project a commercial success.

Norway will be the initial market of focus due to unique contacts through Norut’s earlier research collaborations with the purpose of developing the software. Moreover, satellite surveillance is today poorly exploited and the risk of landslides (geo-hazards) is high in Norway. Today the Norwegian market turnover is estimated to 20-24 million NOK, and is assumed to be doubled by less than five years. Eagle Eye aims to operate on the European and Canadian market already in 2012 who has estimated turnover of 400-480 million NOK the same year.

Eagle Eye will lower the fixed cost during the start-up phase by hiring resources from Norut when we receive customer orders. Our technology has been developed together with Norwegian Geotechnical Institute who is a leading international center for research and consulting within geosciences. Hence, we will strive to join strategic partnership with them since they can verify proof of concept of our technology. Eagle Eye will start to sell products and services in the second half of 2010 which leads to a positive cash flow in 2013. We will reach breakeven the following year with total sales of 13,2million NOK giving us a net profit of 4, 6 million NOK. The sales are expected to increase rapidly the following years.

15 Introduction

Today's Situation

Today, landslides can unexpectedly jeopardize people's safety. Research on climate change has indicated that due to the globally increasing temperature, we can expect more frequent landslides in the future. Since Norway is a country highly exposed to landslides the Norwegian Government gave the Norwegian Water and Resources and Energy Directorate 108 million NOK in 2009 to map potential ground movement, as an example of increasing fear of geo-hazards [11]. Landslides or more general ground movement or land subsidence are part of the natural process but can also occur due to extraction of ground water, oil, gas, and minerals. Conversely to extraction, resource storage can result in land uplifts as well as subsidence when for instance CO_2 is injected into the ground. Both extraction and injection of earth resources can in a negative sense lead to large economic and social impacts on surrounding environment and societies.

Today the way of determining potential land subsidence is typically made manually by ground measurements. However, when facing areas that are hard to reach by foot, manual measurements can be impractical and a problem in terms of high costs and time consuming projects. Moreover when analyzing potential ground movement, one wants to consider historical deformation trends of the related area of interest. If no measurements have been made on the area of interest historically, using manual measurements, the following decision making will results in a lot of guesswork. The techniques used in manual measurements are addressed to cover smaller areas and single objects. Therefore when facing larger land areas there is from a risk assessment perspective need for a technology that can provide cost – and time efficient data that also can illustrate historical ground movement.

Business idea

Eagle Eye will provide global organization, that utilize our naturally environment, with comprehensive ground movement data in order to increase the knowledge of earth surface and strengthen environmental and public safety.

Eagle Eye's products are based on a worldwide, no time limited exclusive license on unique software developed by Norut, the world leading earth surveillance research institute. By comparing several satellite images of a specific area, at different points in time (preferably 15-20 images), our software will subsequently produce an image illustrating potential ground movement, with millimeter accuracy, during the chosen time period. Eagle Eye's products have proven to provide superior results when facilitating important risk assessment correlated to ground movement.

Our final **product** consists of illustrative images (an example of a product is illustrated in Figure 15-1) over chosen area with pertaining documentation of the image analysis process. Eagle Eye's products will enable a time and cost efficient solution of data acquisition for risk assessment of large areas (>1 km^2). Moreover, Eagle Eye will by use of stored satellite images, have the opportunity to offer analysis of deformational trends since 1992 and onwards. The benefits of our products are;

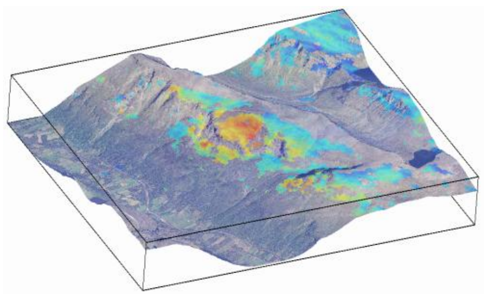


Figure 15-1 Example of Eagle Eye's product where the different colours indicate movements of mm/yr.

- Eagle Eye is based on the only software uniquely developed for monitoring of large areas of natural terrain, providing most coherent and dense monitoring for superior results.
- Ability to use images from <u>all</u> satellites within the area providing the largest archive.
- Require less number of images for each analyze, hence access areas were others are not able to.

Moreover, since the software is module based, it facilitates a cost- and time efficient development of new applications based on the core module. Hence, Eagle Eye will develop new features in a wide range of application areas, see long-term strategy Chapter 18.3.

The unexploited Norwegian market potential of these types of satellite-based products is estimated to 24 million NOK in 2010. The international and more lucrative market has 2,5 billion NOK in product and services sales the same year. The technology behind Eagle Eyes products has performed proof of concept and is ready to be commercially distributed. Initial sales will be made with initial focus on monitoring of landslides, on shore oil-extraction and water or gas injection/storage. Target customers will be public and governmental institutions who will gain important information to perform potential pro-active actions carried out in time to lower risk of geo-hazards and in worst-case, loss of lives. Other target customers are companies operating with onshore oil-extraction and water or gas injection/storage. Eagle Eye's products will monitor deformations that can be correlated to the extractions of oil and facilitate decision-making regarding strategic relocation of the oil wells for improved oil-extraction. Moreover our products will also be able to monitor the grounds movement during oil-extraction and the injection/storage of water or gas into the ground correlated to potentially related geo-hazards in the surrounding areas.

Vision

Eagle Eye will by delivering quality products to target customers strive towards our vision;

"Eagle Eye will be the preferred supplier for products that detect, measure and monitor changes of large areas of natural terrain."

16 Organization

16.1 Organization structure

Eagle Eye's company structure is described in Figure 16-1. Although the company will develop at a high pace during the coming years the organizational structure will in general remain as in Figure 16-1.

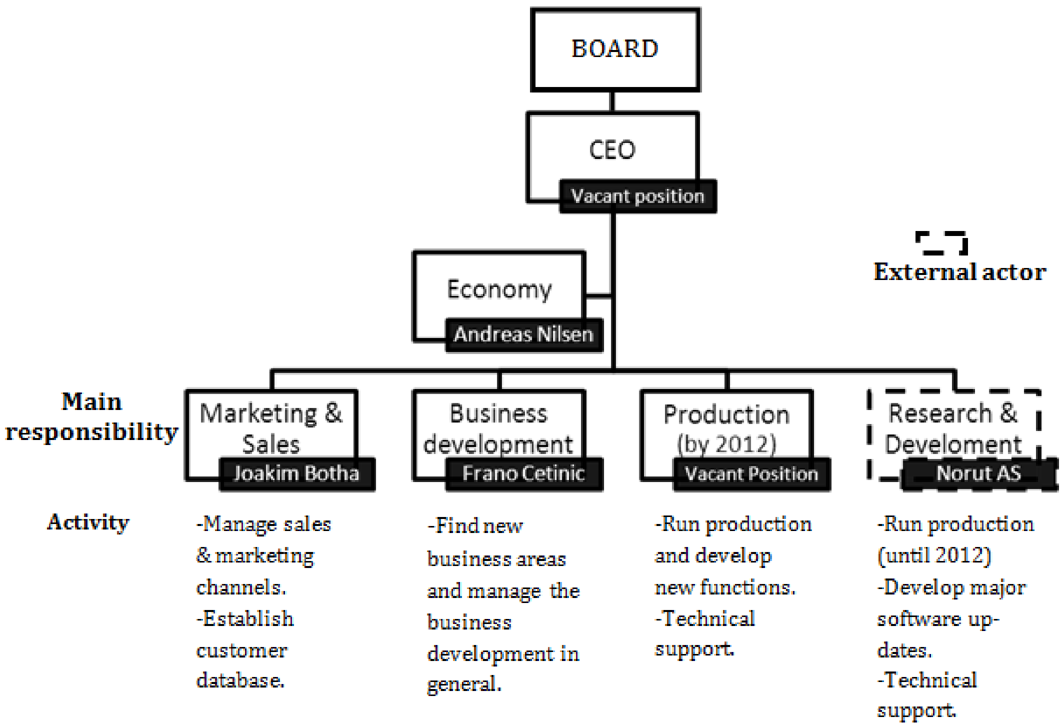


Figure 16-1 Eagle Eye organization structure and responsibility areas.

16.2 Management Team

The Management Team constitute of three highly dedicated entrepreneurs that are working in close contact, on a daily basis, with the project board. They are at the moment finishing their masters in Business Creation and Entrepreneurship at Tromsø University Business School. They share broad competence and experience within various technology areas, law, business and finance. The Management Teams' background and competence is described below.

Andreas Nilsen has a background and BSc in Business Leadership from the Norwegian College of Fishery Science where he followed the Business Development track. He has extensive experience within sales and business development from companies within various industries. Nilsen has also been involved in various start-up projects.

Frano Cetinic has a BSc in Mechanical Engineering from Chalmers University of Technology. He complemented his studies at Chalmers by economic and marketing studies at the Fullerton University Business School, United States. Cetinic has experience in strategy and business development in a start-up (IT-health) project at the Norwegian Center for Integrated Care and Telemedicine. Cetinic has also sales experience from the entertainment industry.

Joakim Botha has a BSc in Mechanical Engineering from Chalmers University of Technology as well as complementing marketing and economic courses from both Gothenburg and Hawaii Pacific University, United States. Botha has experience from strategy and business development in a start-up (IT-health) project at the Norwegian Center for Integrated Care and Telemedicine in addition to sales and service experience from consumer products.

16.3 Preliminary Board

The project board consists of individuals with various backgrounds (see Appendices XII for details).Their highly valuable skills vary from front edge competence within software development to decades of experience within various start-ups projects, IPR, consulting and commercialization. The board will participate in strategic decision making, as well as provide the management team with important networks and business advice.

16.4 Owner Structure

One of the most important agreements is the shareholders agreement, created to ensure harmonious management and control of the company, as well as provide disposition of the common stock. The common stock capital of the company is 400 000 NOK and the owner structure is illustrated in Table 16-1.

Table16- 2 Stock distribution in the company.

Party	Shares
Norinnova AS	28 %
TTO Nord	28%
Norut AS	28%
Eagle Eye management team	16%
Total	100%

17 Market Analysis

Remote sensing is the standoff collection through the use of a variety of devices (e.g. aircraft, satellite, spacecraft etc.) for gathering information on a given object or area. The remote sensing market, and therein Satellite Aperture Radar (SAR) processing where Eagle Eye will operate, meaning the market of products and services based on the satellite radar images named SAR. Is today evolving from a government-led, technology-push enterprise, to joint government-private spin offs created by market-pull in promising application areas (Gabrynowicz, 2007). This is emphasized by NOAA/USGS/ASPRA (2006); "*The industry is undergoing rapid change as technology improves and potential clients realize the benefits of using geospatial data and analytical technologies for their information needs*".

17.1 Market Size

Eagle Eye will operate in the global SAR market. This market is in 2010 estimated to around 2,5 billion NOK. The SAR market has had a growth of more than 100% between 2001-2006 and projections indicates that this market will continue to expand at an annual growth rate of 8-14% the upcoming years (NOAA/NASA/ASPRA). Further, the European and Canadian market was estimated to 365 million NOK in 2010, where the Norwegian market potential is estimated to around 24 million NOK. Consequently the market estimates illustrate that there is a much larger and more lucrative international market Eagle Eye wants to operate in. USA has the dominant part of the global SAR market with nearly 50% of the market share. This is due to that they already in the late 1990s saw the value of the SAR technology. Moreover, the U.S. market share is estimated to decrease as the SAR technology becomes more exploited in other countries. Market shares are illustrated by Figure 17-1, were other markets are primarily constituted by Japan, China, India and Brazil (for all market estimations see Appendices XIII).

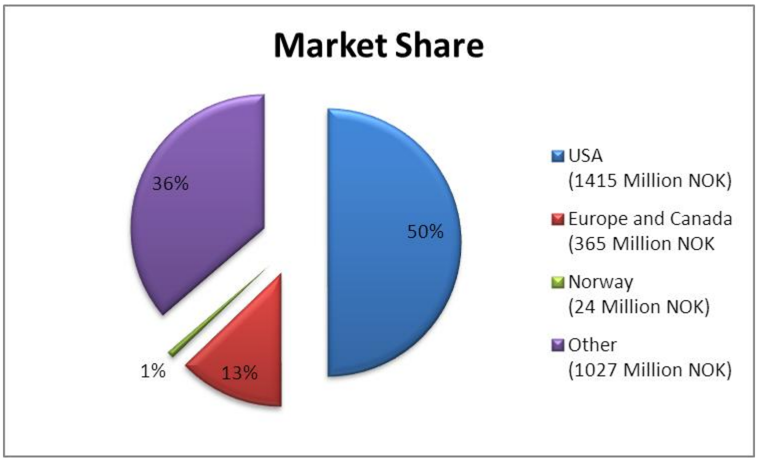


Figure 17-1 This figure illustrates how the shares in the SAR market are divided.

17.2 Trends Beyond 2010

Emphasized by Pacôme Revillon, CEO of Euroconsult, the satellite earth surveillance market has made a huge transition where the sales increased from 1,2 billion NOK to 5,3 billion NOK between 2000-2008 and are expected to quadruple by 2018. This is understating the fact that there are an increasing number of people who observes and understands the potential in using earth surveillance services (see trends in Appendices XIV, Figure A-12 and A-13). Today the global economic cost related to different natural disasters is 2,6 billion NOK and rising. Hence, SAR based technology similar to ours has during the recent years gained increased significance as an important tool for precise measurements of the earth's surface and its deformation (Rott, 2009). Further, also due to the environmental impact from human induced surface and sub-surface change, there is an increased demand of satellite observation services. Technical development will lower manufacturing costs and boost satellites launches. The new satellites will image the earth more frequently and offer higher image resolution, which will make it possible to receive more updated and accurate ground movement trends (Euroconsult (2008) and Wilson (2007)) (See Appendices XIV, Figure A-13 and A-14, for satellite launches).

17.3 Eagle Eye's Segment Focus

Eagle Eye have during early customer contacts and research projects with potential users developed and verified the product for assessing ground deformation that can be correlated with geo-hazards. Hence we have chosen to target two niche segments corresponding to these requirements strategically providing Eagle Eye with both strategic position on the potential market and large revenue streams (see Techno-Economic Analyze in Appendices XV, Figure A-15). Our ideal customer in the first segment is national geotechnical and geological institutions that have realized the potential of this technology and are acting to develop and verify optimal solutions related to geo-hazards for the Norwegian industry and society. Secondly we will target on-shore oil companies with superior buyer power that need our products to rationalize their oil production and monitor the surrounding environment in connection to their oil extraction and/or water or gas injection/storage. We have not been performing research projects within this segment but contact with interested customers has been initiated. Our target segments will primarily consist of Norwegian customers that will provide Eagle Eye with a better foothold in the unexploited Norwegian market. Hence we will be able to build a thorough brand, customer experience and understanding before entering the global market.

17.4 Industry Analysis

We have identified our market segment's external forces to determine the competitive intensity and its impact on Eagle Eye's business performance.

17.4.1 Satellite Data Suppliers

Satellite data suppliers are essential to Eagle Eye. However, there are several suppliers on the market providing their data to any paying customers. Cost of the images is fairly static unless customers purchase images frequently or in high quantities. In the case of Norway the government subsidizes the use of satellite data provided from the satellite named Radarsat in order to stimulate use through increased supply of SAR data to public organizations and institutions. Moreover, ESA's member states have recently approved a new data policy that will enable free-of-charge data access from the satellites Sentinel-1a and Sentinel-1b launched in 2011[12]. Hence our costs will be reduced and supplier will have less impact on Eagle Eye's business performance.

17.4.2 Customer

Our customers have different purchasing policies were private customers often purchase products on regular basis from chosen supplier. However, some private and most of the public companies base their purchases on procurements processes. Buyer frames their request and typically three to four suppliers will compete with their offers and its correspondence to the set requirements of the procurement, to get the deal. Nevertheless, based on early customer contact we have learned that if customer has realized our product value the procurements can be framed to our favor, reducing the potential of competitive offers. Buyers are in general fairly fragmented and the risk propensity considering innovative solutions varies a lot between the different buyer segments. Initially the buyer will get reduced prices in connection to pilot projects, however when our products are verified the buyer’s power will be reduced subsequently.

17.4.3 New Competitors/Entrants

Our software provider Norut has during nine years invested approximately 13 million NOK in research and development of our software. Development and verification of the unique software has been made in close collaboration with potential customers in order to meet the market demands for the technology. Consequently new entrants require access to cutting edge software and understanding of the satellite surveillance market in terms of data acquisition, use of the software, its possibilities and limitations. In addition, one must also possess valuable networks and strategic partners in order to receive buyers trust in the products and services one is providing. Consequently, some barriers of entry exist but they do not eliminate the fact that new actors might realize the rapidly growing market Eagle Eye is focusing on.

17.4.4 Other Solutions/Substitutes

Alternative of satellites monitoring is other remote sensing sources such as ground based laser detection (LIDAR) or conventional methods done by geologists and Global Positioning System (GPS) mapping. LIDAR can provide more accurate measurements in its surrounding areas however it is a much more costly, complicated method, and lack the ability to see back in time. Geologists are looking at structures, cracks and vegetation when they, based on experience, assume if the ground has moved. Geologists also have the possibility to place bolts with GPS coordinates in the area to see trends over time. Still, this is a time consuming and costly method, especially when considering large areas where it is impractical to measure the ground movement by hand. Hence, the comprehensiveness in the ground analysis will suffer when gathering of ground movement data since it can result in a lot of guesswork. None of the alternatives are seen as close substitutes why Eagle Eye’s business performance is not affected by substitutes.

17.4.5 Competitors

Our competitors constitutes of companies that are in possession of software’s that produce images, illustrating ground movement over time. Today there are five other actors on the market which is further explained in Appendices XVI. All of them are using techniques related to displacement analysis on single targets which typically correspond to features on man-made structures such as buildings, bridges, dams, water pipelines, antennas, as well as to stable natural reflectors (for example exposed rocks). All competitors are operating within a wider number of applications areas and are targeting a global market. However, our competitor TRE have recently seen the increasing demand of large scale ground movements analyzes of natural terrain and developed a technique called SqueeSar. This is a modified version of their original single target technology which is more suitable for large scale natural terrain analysis.

Our competitors TRE, Gamma and MDA offer, in addition to images, consultancy services within the area of geosciences. There is also another actor on the market, Erdas, who is only offering their software. This means that companies buying this type of software could become our competitors, however their software is still only focusing on single objects. Further, these technologies are complex and require experience, knowledge and it take a lot time to learn how to use them fully.

Considering only Norway the competition is practically non-existent. There are no other Norwegian companies and the few international competitors who have tried to establish customers have not succeeded. This is due to competitor's technology incapability to give sufficient results in the natural terrain of Norway. Nevertheless, when Eagle Eye will enter an international market there will be more comprehensive competition.

17.5 Competitive Advantage

Eagle Eye is the only company using a technology that is developed primarily to focuses on ground movements on large areas of natural terrain. The only adjacent technology, SqueeSar, has shown a better result than the single target technologies but is still behind in relation to Eagle Eye's GSAR technology which has shown to be more coherent and more informative. Therefore our technology is more suitable when one wants to identify ground movement on large areas of natural terrain such as mountainous areas, desert, and large farmlands.

There are today archived satellite images having almost a global coverage. While our software is able to analyze images from *all* the SAR satellites our competitors differ on how many they can utilize images from (see Appendices XIV, Figure A-14 for all SAR satellites and Appendices XVI for information regarding competitors). Eagle Eye's technology requires less amounts of images for each analyze (8-10 images) than our competitors, which needs at least 15 images, and still be able to deliver quality results. In certain areas of the world there are limited numbers of images accessible, which limits competitors ability to performed ground movements analysis! Hence Eagle Eye will be the only option for the customer.

17.6 Intellectual Property Rights

Norut is today the sole owner of all the property rights connected to GSAR. It is a novel software technology protected by copyright. To minimize the risk to expose our software to competitors we will keep our software in-house and are not planning to file for patents. Patent search has been done in order to analyze if there is any adjacent patented technology that could prevent commercialization and future technical developments. Only one patent was found that comprise TRE's Permanent Scatter Interferometry (PSI) method to map and analyze movements of specific objects (Frerretti et al, 2000). However, this patent does not obstruct our invention.

Further, the software has been distributed to three research institutes worldwide for research, development and feedback purposes. Norut has today good contact with the different holders of the software and the rights of each software holder are regulated by non-commercial licensing agreements.

18 Market Plan

To enter the market efficiently Eagle Eye is dependent on receiving customer's confidence in the products. We will through our network seek to join partnership with strategic actors already familiar with the technology and the growing market of Eagle Eye's products. Eagle Eye will also target customers uninformed about the potential of our products through important pilot projects. This will act as technology push while convincing for example onshore oil extraction companies with strong purchase power. Close partnership will open up for market oriented product development and potential expansion to new application areas.

18.1 Sales Strategy

18.1.1 Product Variation

Eagle Eye will be positioned, based on the product value, as the paramount and leading supplier that detect, measure and monitor ground movements of large areas in natural terrain over time. Our products will vary with customer interest and depends on the following motives;

- Geographic areas of interest
- Size of the areas of interest
- Time period of interest
- The frequency of measurements

Ground movement can be detected in areas from $100m^2$ to areas exceeding 10 000 km^2. By using stored satellite images we are able to illustrate ground movement that has occurred since 1992 and onwards. Another alternative is to order images from the satellite provider making it possible to detect ground movement that has occurred from ordering date and forward in time. Our millimeter-precise ground movement detection is dependent on satellite repeating cycle which today varies between 11-46 days.

The resulting product can be delivered either as;

1. 2-D image,
2. 3-D image or,
3. Numerical data that is input to customer's information systems for example Geographic Information System (GIS).

To quality assure the production process each product will be delivered with pertaining documentation stating how the ground movement analysis has been made.

18.1.2 Pricing Strategy

Eagle Eye's products will be very competitive in the SAR market by offering more detailed ground movement information, which will increase the customer value substantially in relation to competing products. Simultaneously, our products can replace manual methods that are used to map ground movement of larger areas. Figure 18-1 illustrates how much it would cost to map an area of five km^2 using conventional manual methods versus using satellite based technology. The sales price of our competitors can vary from 100' NOK to just below 500' NOK for one deformation image. This since each and every product is customized and will have different pricing.

Ground movement mapping	Conventional (manual) method	Competitors (i.e TRE, GAMMA)
Price (NOK)	466 000	200 000

Figure 18-1 The price comparison between using conventional methods and competitors when mapping ground movement of five km^2. Costs related to this example are illustrated in Appendices XVII.

As basis for our price strategy we will consider our competitors' prices. We believe that we can set a price that is on average 20% higher than our competitors and that this is feasible due to the following claims;

- Since our technology is specialized on mapping large areas of natural terrain we are the only supplier that can deliver more detailed deformation data over the complete mapping area. The user will be able to follow ground movements in the complete areas analyzed and not only movement of single objects.
- Our technology needs less satellite images during production. Many areas on earth do not have satellite coverage by more than nine-ten images. Hence competitors will not be able to produce deformation images while we will.

To be able to keep a higher price our focus will be to deliver products that maximize customer satisfaction. This will be of highest priority in order to receive trust among customers but also to identify our company as a high quality supplier.

18.1.3 Promotion and Sales

The partnership with Norut provides Eagle Eye with an established good public relation, and expanded network. This partnership with Norut, that has a well recognized brand, will facilitate increased promotion and recognition of the Eagle Eye brands will be established in connection to commercialization. Eagle Eye will join industry networks such as "Tromsø Centre for Satellite based Earth Observation Research"(SatCent), a researched based innovation center (SFI, an initiative made by The Norwegian Research Council and companies operating within earth surveillance. The goal is to create a cluster where members can share industry and research data.) providing further promotion of our brand to companies within the same industry as well as publicly. Additional advertising will be made through webpage, industry magazines (Nature, Teknisk Ukeblad etcetera) and through relevant trade fairs and workshops (European Geosciences Union, Fringe etcetera).

Sales will be made through customer meeting, either by phone or physical/virtual meetings as well as it will be possible to place orders through our web page. Processed images and documentation will subsequently be uploaded to a secured server, where customers will be able to download their documentation and if preferred these can also be sent by mail.

18.2 Business System

Eagle Eye's business model is illustrated in Figure 18-2. We will be the sole commercial actor that has access to Norut's software used in-house to process (produce) images monitoring ground movements over large areas. During the start-up phase we will hire production engineers from Norut as we receive customer orders, lowering the fixed costs related to production until we have developed a large enough customer base to employ own engineers to do full time production. When focusing only on the production part of the value chain potential up scaling of sales is easier since we only require computer power and production engineers. Eagle Eye will work in close collaboration with Norut in order to perform continuous technical development based on customer requirements. Since each product is unique the internal sales department will work in close contact with customer to provide the highest value to customer.

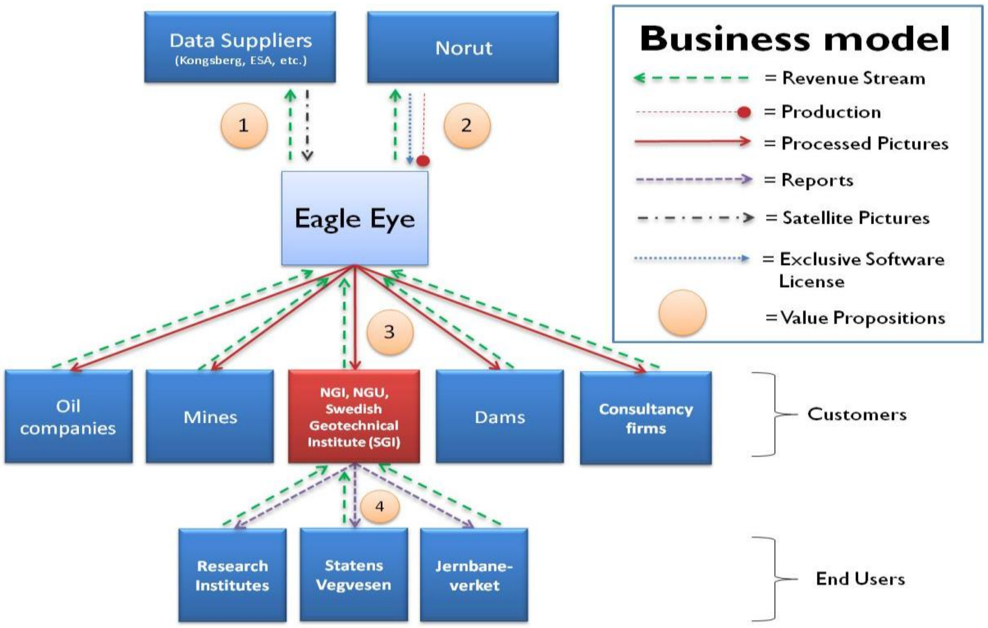


Figure 18-2 Eagle Eye's business model and value propositions

18.2.1 Strategic Partners

Eagle Eye will strive to sign strategic partnership with Norwegian Geotechnical Institute (NGI), that has through partnership with Norut, developed the GSAR software. NGI, a potential co-owner of Eagle Eye, will sell full reports partly based on our products to their customers. Consequently NGI will act as an early adopter to develop and verify optimal solutions related to geo-hazards for the Norwegian industry and society. Moreover, since NGI is an internationally known institute they can facilitate Eagle Eye's international promotion and reputation. Additional strategic partners are Norwegian Geological Survey (NGU), and the Swedish Geotechnical Institute (SGI).

18.2.2 Value Propositions

1. **Eagle Eye to Supplier**

Eagle Eye will increase sales and distribution of satellite data and therefore increase revenues and promotion for the different suppliers.

2. **Eagle Eye to Norut**

In return for the software and services, Eagle Eye will provide Norut with an annual fee and royalties based on our revenues. Eagle Eye will strive to increase the recognition of Norut's software through public relation and promotion to our customers. Moreover, as a part of Eagle Eye's product development process we will strive to provide Norut with the latest market demands which will enable an increased number of new innovative research projects. This will strengthen Norut's recognition and reputation as the world leading research within earth surveillance.

3. **Eagle Eye to Customer/End-Users**

Eagle Eye will provide products providing more detailed, reliable and robust information to customer facilitating a better foundation for important decision-making considering risk assessment of geo-hazards and strategic exploitation of natural resources.

4. **Eagle Eye to End-User**

End users who lack geotechnical competence is interested in full reports based upon the Eagle Eye products. Subsequently, geotechnical consultancy firms such as NGI will provide end user with a more detailed report of potential risks and movements in the specific area of interest based upon the information Eagle Eye has provided.

Eagle Eye to Society

Eagle Eye will by providing large organizations and companies that utilize our environment with comprehensive ground movement that is potentially correlated with geo-hazards. Therefore proactive actions by Eagle Eye will enhance the safety in organizations and the surrounding societies.

18.3 Long Term Strategy and Product Development

After having established a thorough customer base in Norway, we will expand our activities on an international market. We will target international customers possessing demand corresponding to our product values. Moreover, based on our close collaboration with Norut, product development will be of high priority for Eagle Eye. The modularity in our software enables time and cost efficient development of new functions that make it possible to target new application areas. Initial development focus will be on snow- and biomass mapping, single target analysis and illegal harvesting of rainforest (See further application areas in Appendices XVIII, Table A-9). Hence we will be able to increase our business activities and expand our product portfolio, increasing the competitive advantage when operating in various markets.

After we have joined collaboration with NGI we will evaluate the possibilities to expand vertically in the value chain and acquire geotechnical competence. We would then be able to offer full reports and consultancy services and thus expand our business into new markets.

19 Risks

Four major risks have been identified that can have negative impact on our business performance. These are illustrated in Figure 19-1 and measurements considered to avoid risks are further explained below.

Factors	Risk
Norut has no capacity to process our images	low
Collaboration with partners fails	medium
Unable to reach sales goals	medium
Technology is not accepted	low

Figure 19-1 Risks that can have impact on Eagle Eyes business performance.

Norut Has no Capacity to Process Our Images the Initial Years

A risk is that we will not manage the order capacity. If so we will do the following to mitigate that risk;

- Perform accurate sales estimations and collect financing to invest in processing engineers already by 2011. Finance can be collected by bank loans, business angels or VC's.
- Pay Norut extra to work longer days or weekends to handle order demand.
- Contact PhD students in our network (Stanford) that are doing research on our software to produce our images.

Collaboration with Strategic Partner Fails

There is a risk that our initial strategic partners NGI do not want to sign collaboration agreement. The following action will be made to mitigate the risk of this happening;

- Initiate contact with several potential collaboration partners to not be dependent on only one partner.
- Sign flexible agreements with partners that allow us to have different partners in various markets.

Unable to Reach Sales Goals

Being unable to reach sales goals can for instance depend on that the competition is too intensive or that the price of our product is too high. The following actions will be made to reach our sales goals;

- Develop better sales skills in the Management Team.
- Do more personal customer visits to explain benefit received with our product.
- Utilize customer feedback to constantly improve product.
- Use networks of suppliers, partners and customers to reach out to more customers.
- Join industry networks, attend trade fairs and join pilot projects to proof value in our technology.

Technology is not Accepted by Customers

A risk is that customers do not have trust in our product either due to novel technology or insufficient results. The following action will be made to mitigate the risk of this happening;

- Have customer meeting where we explain and illustrate the concepts behind our technology and how our products can help the customer.
- Perform a product development together with customers to meet their demands.
- Join collaboration with partners/customers that can verify that our technology is functional.
- Target customers that are using our product and build up a trust in one market segment before entering another market.

20 Action Plan

The action plan describes project Eagle Eye's estimated operations and milestones during 2010-2012. Figure 20-1 illustrates operations and milestones during 2010.

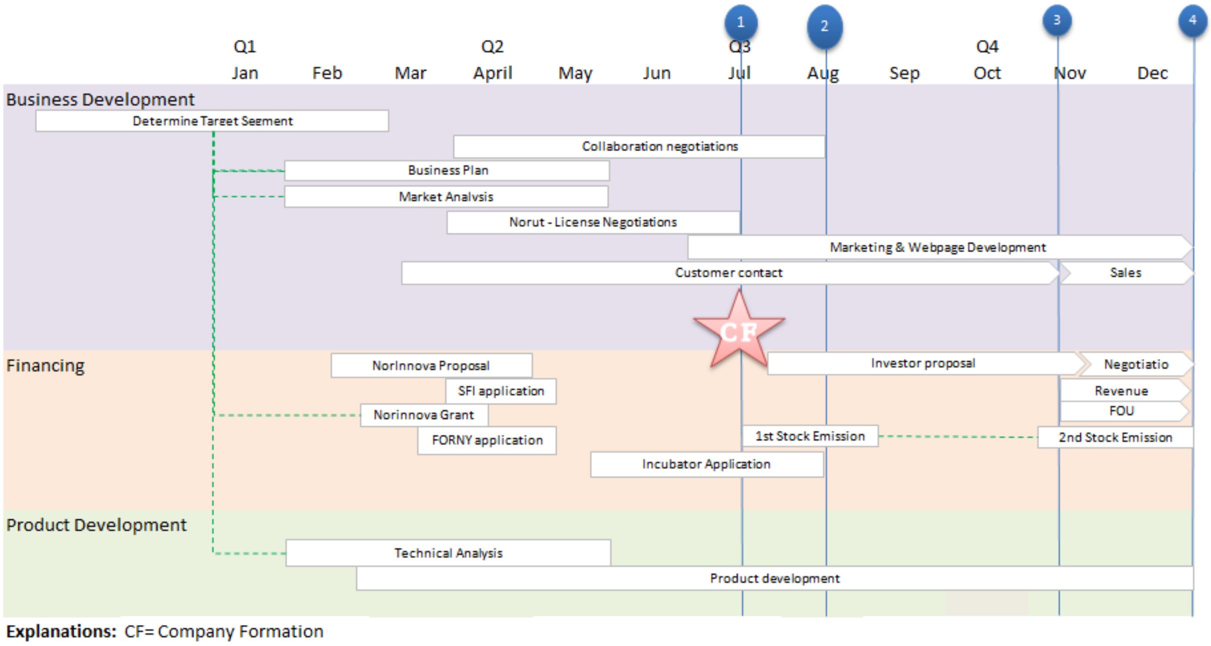


Figure 20-1 Action plan during 2010

Milestone 1 – Company Formation

By 1st of July 2010 licensing agreement with Norut will be constructed and signed simultaneously with the company formation. Norinnova will invest 400 000 NOK by company formation and it is the Management Team's responsibility to ensure that all legal agreements are signed in connection to the company formation.

Milestone 2 – Collaboration Agreement and Incubator Application

As soon as we have established the company Botha and Cetinic will focus on establishing the collaboration agreement with NGI. Parallel with this activity Nilsen will together with Norinnova apply for Innovation Norway's incubation scholarship. This scholarship will give us an additional financing of 800 000 NOK divided on two years. Both activities will be accomplished by 1st of August 2010, to be processed in six weeks and hopefully granted to cover cost of initial sales.

Milestone 3 – Initial Sale and Pilot Project

After establishing the collaboration with NGI, Botha is responsible to carry out Eagle Eye's first sale through NGI, generating first revenues by 1st of September. Parallel with first sale, Nilsen and Cetinic have the responsibility of establishing our first pilot project within geo-hazards or on-shore oil extraction/injection/storage. Nilsen is responsible to apply for research and development agreement (FOU) in connection to pilot project.

Milestone 4 – Investor Proposal

After Eagle Eye's first sales we will initiate investor proposals to cover costs in 2011. Nilsen will have the main responsibility connected to investor proposals or alternative bank loans, to be granted by the 15th of January 2011.

2011-2012

By 2011 we are expecting to have good collaboration with NGI. This will be to our favor as they have a large national and international customer base providing us with continuous projects and international recognition. Further sales will be the main focus and we are preparing to go internationally 2012. The same year we are expecting to have 20 orders where in-house processing will be most cost efficient. Hence investments in data capacity will be made. At the same time the company will need to find new offices space since the incubation period will end.

Additional Grants

The FORNY (Research based innovation scholarship is a financial ordering with the purpose to increase value creation in Norway through commercialization of results from the Norwegian research institutes) application of two million NOK provided by the Research Council of Norwegian is pending, from 21 April 2010, and will be processed to the end of July.

20.1 Alternative Actions

If we do not succeed to manage the deadline connected to our milestones we have constructed alternative actions illustrated in Figure 20-2.

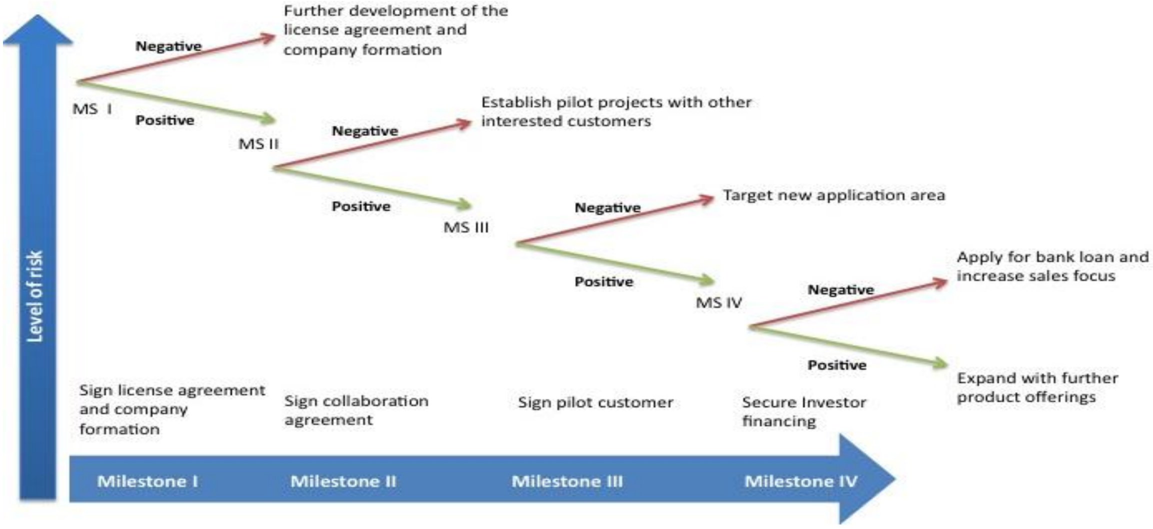


Figure 20-2 Alternative Actions to Action Plan during 2010.

21 Finance

The following essential financial data describing Eagle Eye's economic attributes and performance is presented in detail in Appendices XIX;

- Key financial assumptions
- Income statement
- Cash flow statement
- Balance sheet

21.1 Profitability

Initial customers of Eagle Eye will be used to proof the concept of our technology for the SAR market. Once the technology is proven our sales negotiation position will be strengthen towards our customers. Since the profit margin variance is limited there is not much room for negotiations of price. For customers to pay our set price, focus will be to offer them high quality products that maximize their customer value. With sales revenue estimations of 8,3 million NOK in 2013 the company will turn cash positive with a profit of 23%. The following year's sales will increase rapidly and high increasing expense connected to the start-up phase will stabilize which will lead to an expected profit of 35% (see Table 21-1). The operating expense per each unit sold will decrease as a result of a more efficient production and sales departments.

Table 21-1 Key Financial estimations (thousand NOK)

	2010	2011	2012	2013	2014
Total revenues	720	1,483	3,437	8,261	13,236
Total costs of goods sold	307	616	555	1,394	2,239
Gross profit	413	867	2,882	6,867	10,997
Total operating expenses	1,114	2,511	3,852	4,938	5,143
NET INCOME	-701	-1,644	-970	1,928	4,603
Profitability	-97%	-111%	-28%	23%	35%

21.2 Revenue Assumptions

Based on our initial customer contact and future market growth we have estimated to sell 8 products and reach a market share of 12% in Norway by 2012. By end of 2014 we are estimating to have a market share of 41% in Norway, together with other European customers our European & Canadian market share equal to 3% and correspond to 53 products sold. Our sales price will vary depending on customer need and how frequent the customer needs our products. Having customers that repeatedly order our products will lower the production time which in turn will lower the price to customer. As the Norwegian government is subsidizing satellite images from the Radarsat satellites in order to support the use of satellite images by governmental institutions and organizations, we will be able to receive Radarsat satellite images at no cost, and thus the sales price will be based on time needed to produce our deformation images. We estimated our average sales price to 240' NOK in 2010 (Figure 21-1), which is based on the average cost of receiving images from various satellites and the time needed to produce a deformation image.

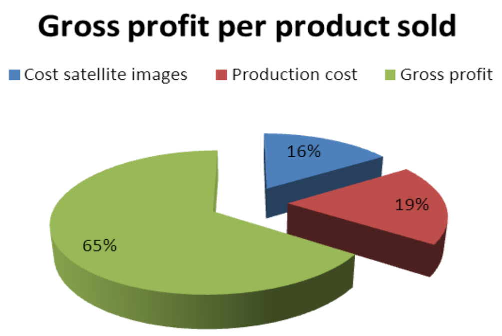


Figure 21-1 Profitability per unit sold.

21.3 Cost Factors

Highest cost factors of Eagle Eye are personnel and satellite images. Initially we cannot influence the price of satellite images since we have low amount of orders, however by 2013 the amount of orders will be sufficient for us to receive quantity discounts. In the initial two years the personnel cost of production will be kept at minimum by bringing in consultants from our software provider Norut when we have an on-going project. Consequently we will initially have large variable cost with the benefit of controlling costs as a function of sales. By 2012 we will invest in own engineers and computer park to boost further sales and lower cost per each unit produced. We will keep the personnel cost at minimum by limiting salary levels but instead offer attractive option packages for the employees.

21.4 Subsidies

Part of the initial cost will be covered by various national subsidies (Such as Innovation Norway, Research Council of Norway). Strategic partnership, product development and new customer contact will be more easily applicable when joining the national subsidies scheme SFI. As Norut will handle the main part of the product development it is in the company's interest to provide Norut with research projects that are supported by various subsidies. We will therefore have a very active policy to apply for all possible grants and networks that are available in Norway and the European Union.

21.5 License – and Royalty Fees

An annual license fee will be paid to the software provider Norut. This fee will be valid once we turn cash positive. The amount paid will reflect the updates connected to the software. In addition to the cost of holding the exclusive license, royalties will be paid to the software provider. The royalty fee is 4% of the company’s revenue less license cost. This is made in order to prevent the software provider to charge an unrealistically high amount for the exclusive license.

22 Sensitivity Analysis

A sensitivity analysis has been made that affects the results and the investments needed.

Table 22-1 Most quantitative effects of the different scenarios.

Factor	Change (+/-)	Pessimistic	Base	Optimistic
Price	25	225	250	275
Sales	10%	-10%	-	10%

In Table 22-1 time to market was not considered since Eagle Eye has already received customer orders and will start our business during the second half of 2010. Price will primarily be determined by how well we communicate the time and cost savings with our product to the customer. Sales will mainly vary with efficiency in marketing, product acknowledgement by customer and its purchase power.

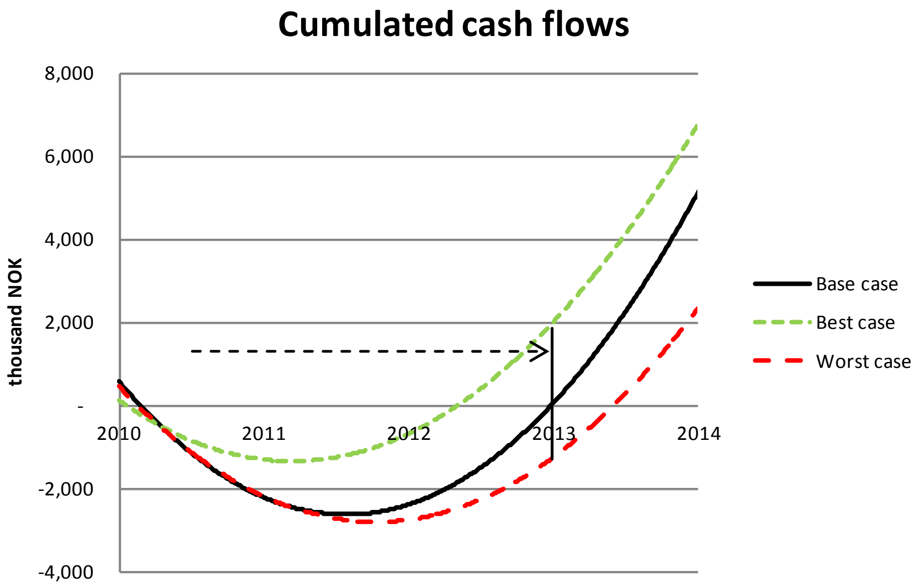


Figure 22-1 The accumulated cash flow analysis and the payback period for three scenarios

Product sales is the most influencial factor in the analysis in Figure 11. Required financial investment for the optimistic and pessimistic scenario is 2,1 million NOK and 3 million NOK respectively. As seen in Figure 22-1 the Base Case is more related to the pessimistic scenario before turning cash positive.

23 Company Valuation and Investment Proposal

Using the Venture Capital method we have calculated that the present value of the company is 22,6 million NOK based on the net income in the exit year 2014. This is calculated using a P/E-ratio of 12 which are corresponding to companies operating in the similar industry (See Appendices XX for calculations).

Investment needed is three million NOK divided into two phases. For this investment you will receive 13% of the company stock and you will be offered the chairman position in the board. In addition to the investment proposal, our idea provider Norut is interested to preserve their independence as a research institute and not interested in owning shares. This could provide the investor with majority shares in the company and these shares are open for negotiations.

Investment Phase One.

In the first phase we will need two million NOK and the investor has to commit to invest the following year if the investment criteria are fulfilled. The board will decide if the investment criteria are fulfilled by the end of 2011. The first investment will be used in connection to pilot projects and in relation to new customers, promotion and sales activities.

The following criteria shall be fulfilled by the end of the first investment phase;

- Establish an efficient sales and marketing channels
- Have four customers.
- Find a competent processing and development engineer to hire in 2012 in order to handle increased order capacity.

Investment Phase Two.

In the second phase we will need an additional one million NOK which will be used to the following criteria.

- Invest in a computer park.
- Establish an international customer base.
- Initiate development of new application areas and find new business opportunities.
- Find competent processing and development engineer to hire in 2013 in order to handle business expansion.

24 Master’s Thesis Conclusions

The Technical - and Market Study has provided us with comprehensive knowledge as regards to GSAR's functionality, the existing satellite (SAR) surveillance market and potential customers. This knowledge will be of greatest importance considering management of Eagle Eye in a commercial context and its future business development.

We have verified that there is a big unmet need among organizations that have responsibility to protect its societies and surrounding environment from geological hazards. In addition on shore petroleum companies need a complementary monitoring data to their seismic technology in order to rationalize their oil extraction. These are in need of time and cost efficient products that can deliver ground movement data of large areas.

Having developed a Business Plan, based on the initial two studies, we believe that Eagle Eye can provide extensive societal, economic and business value and could due to its potentially disruptive technology deliver high profits in a long-term perspective.

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Jürgen Hoffman, Chief geophysics, DNO International (2010-03-30)

Kjell Are Vassmyr, Project manager, Artic web (2010-04-06)

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Haavard Stensvand, Head of public relief, Sogn and Fjordane County (2010-04-07)

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Sverre Barlindhaug, Civil ingeneer, Multiconsult (2010-04-09)

Martin Landro, Professor Geophysics Seismic, NTNU (2010-04-13)

Johnny Sjøberg, Senior researcher, specialist rock mechanics, LKAB (2010-04-16)

Appendices I – Example of Disruptive Technologies

"The table below (Table A-1) offers examples of modern technologies and innovations that can be seen as disruptive. It is important to recognize that while these disruptions are obvious in hindsight, at the time of their introduction they were considered by established players and industry watchers to be of value to only a minority of customers, and unable to meet performance levels of existing technologies." - *Eastwood, (2009)*

Table A-1 Examples of disruptive technologies. Source: Business Insight through Eastwood (2009).

Technology	Timeline	Disruptive impact
Disk drives	1970s	The evolution of the disk drive industry acts as a 'petri dish' for observing disruptive technology, with established players usurped time and again by leaps forward in technology, performance and capacity since the 1970s. Of 17 firms leading the industry in the mid-1970s, 16 had failed or been acquired by 1995 (with exception of IBM).
PCs	1980s	PCs and the client-server model spelt the end of the existing mainframe and minicomputer model, creating new markets and a new industry.
Mobile phones	1990s-present	The advent of the mobile phone has significantly reshaped the entire telecoms industry, and become an essential technology.
VoIP	2000-present	Initially, voice over IP was limited to a minority of users and had quality issues – the classic hallmarks of a disruptive technology. However, its improved performance, and promise of free voice calls, now impacts telecoms' revenues and has created a new generation of handsets.

Appendices II –
Characteristics of an Early Stage Disruptive Technology

- Often perceived as a ’low value’ innovation
- Performance does not match that of existing technology, at first
- User application not always apparent
- Evolves ’under the radar’ of market leaders
- Changes customer behaviour
- Serves a customer need to a small group of users, thus creating a new market
- Offered at lower cost that existing technology
- Provides new or additional functionality
- Tackles and old problem in a new way
- Easier to use than existing technology
- More convenient/smaller/portable

Source: Business Insight through Eastwood (2009).

Appendices III – Example of Techno-Economic Analysis

The Figure A-1 illustrates how various concepts and variables can be linked for one product area. This is an example for a company (Ericsson) between1987-1991.

"Only linkages between the main differentiating utility dimensions during this period (portability and accessibility) are shown in the figure. Note also the rapid performance improvements and cost reductions of the terminals and the rapid diffusion among buyers" – Lindmark, 2006.

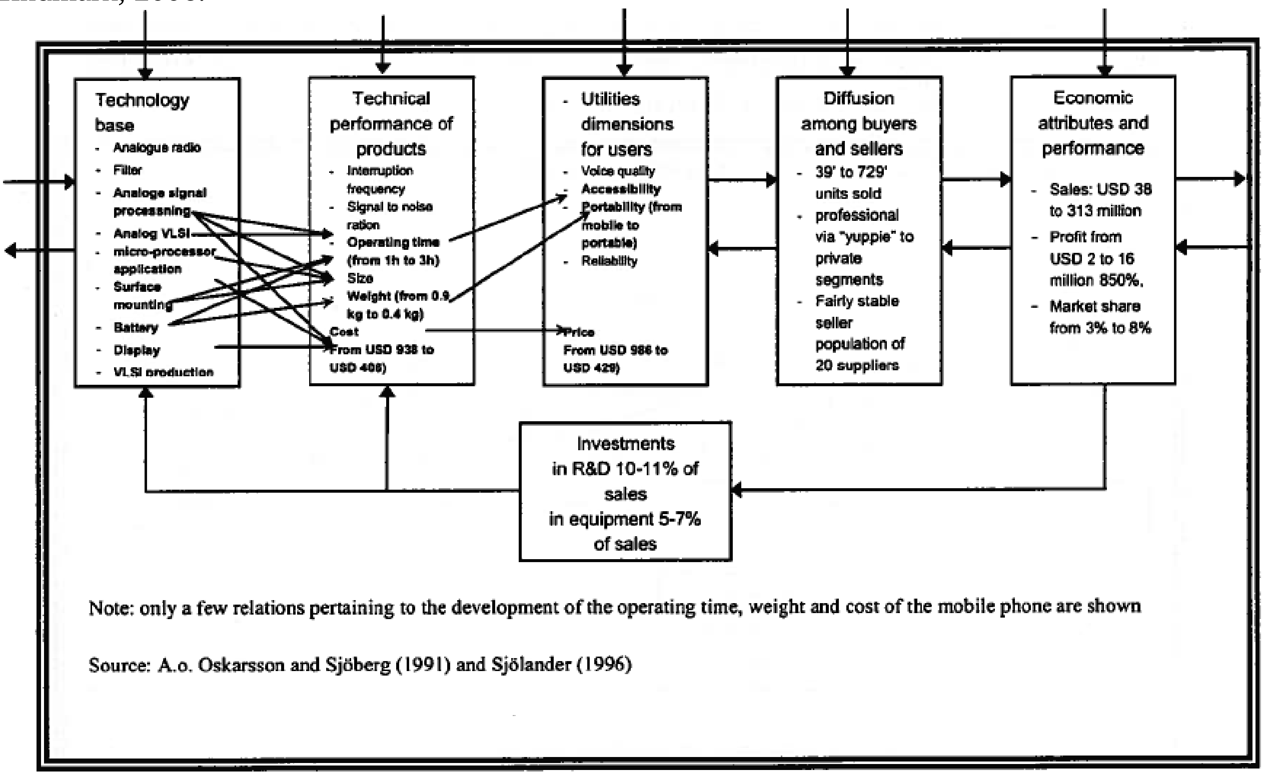

Figure A-1 Summary of a techno-economic analysis of Ericsson mobile business between 1987-1991.

Appendices IV – Operational Satellites Carrying Satellite Aperture Radar Instruments

Table A-2 The operational satellites and the corresponding satellite agencies.

Mission Name Short	Mission Agencies	Orbit Altitude	Repeat Cycle	Orbit Sense	Mission URL
ALOS	JAXA*	692 km	46 days	Descending	http://www.jaxa.jp/projects/sat/alos/index_e.html
COSMO-SkyMed 1	ASI / MiD (Italy)	622 km	16 days	Ascending	http://www.asi.it/SiteEN/ContentSite.aspx?Area=Osservare+la+Terra
COSMO-SkyMed 2	ASI / MiD (Italy)	622 km	16 days	Ascending	http://www.asi.it/SiteEN/ContentSite.aspx?Area=Osservare+la+Terra
COSMO-SkyMed 3	ASI / MiD (Italy)	622 km	16 days	Ascending	http://www.asi.it/SiteEN/ContentSite.aspx?Area=Osservare+la+Terra
Envisat	ESA	782 km	35 days	Descending	http://envisat.esa.int/
ERS-2	ESA	782 km	35 days	Descending	http://www.esa.int/ers
RADARSAT-1	CSA	798 km	24 days	Ascending	http://www.space.gc.ca/asc/eng/satellites/radarsat1/
RADARSAT-2	CSA	798 km	24 days	Ascending	http://www.space.gc.ca/asc/eng/satellites/radarsat2/default.asp
TerraSAR-X	DLR	514 km	11 days	Ascending	http://www.terrasar.de/

- ASI = Agenzia Spaziale Italiana, CSA = Canadian Space Agency, DLR = Deutsches Zentrum fur Luft-und Raumfahrt, ESA = European Space Agency, ISRO = Indian Space Research Organization, JAXA = Japan Aerospace eXploration Agency.

Appendices V – Microwave Radar System Components

Components included in a microwave system are displayed in Figure 35-1. A pulse generator sends out a pulse of electromagnetic radiation energy at specific wavelength and at a specific *pulse length* (μsec) to the transmitter. The duplexer then sends via the antenna the pulse of energy towards a target. Once the electromagnetic wave hits a target, it is backscattered and picked up by the same antenna and duplexer. Information regarding the backscattered pulse is then sent to a receiver and finally recorded or displayed

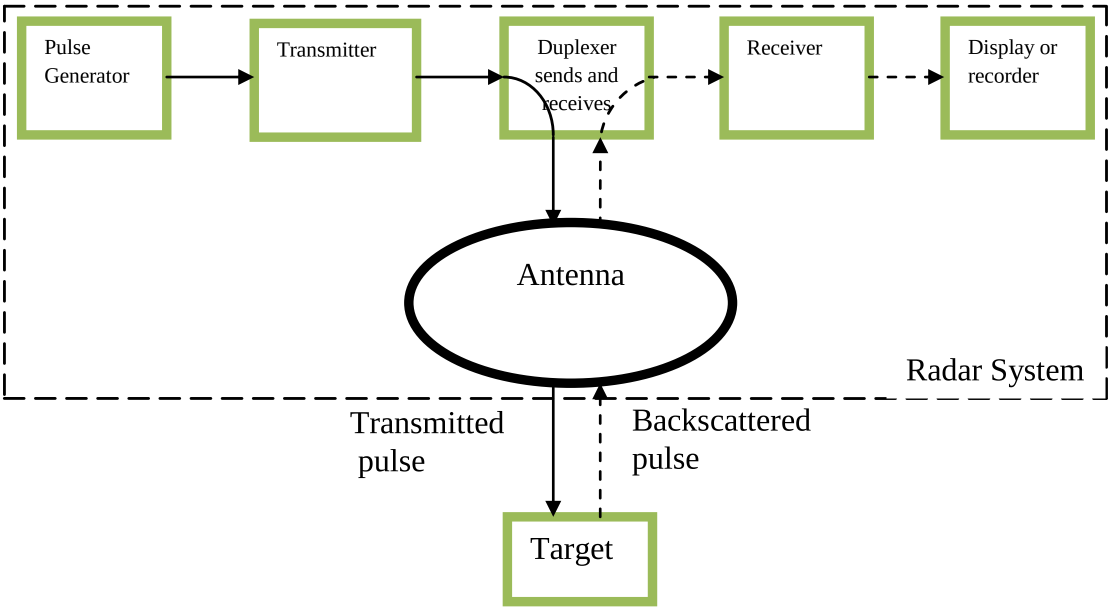

Figure A-2Microwave (Radar) system.

Appendices VI – Electromagnetic Radiation

Electromagnetic radiation is conceptualized like a phenomenon that has a form of a wave and that travels in a vacuum or in matter. The electromagnetic wave travels at the *speed of light, c,* 299,792,458 meters per second (ms^{-1}) and is generated when an electrical charge is accelerated. Two fluctuating fields – one electric and the other magnetic (Figure 25-3) constitute an electromagnetic wave. The two directions of the fields are at right angles orthogonal to one another, and both are perpendicular to the direction of the wave travel. The wavelength (λ) is defined as the distance between two consecutive maximums (or minimums) in a periodic pattern (Figure A-3). The wavelength is usually measured in micrometers (μm) or nanometers (nm). The number of wavelengths that pass a point per unit time is called frequency (ν). The unit of frequency is hertz (Hz). One wave that completes its cycle in one second is said to have a frequency of 1 Hz.

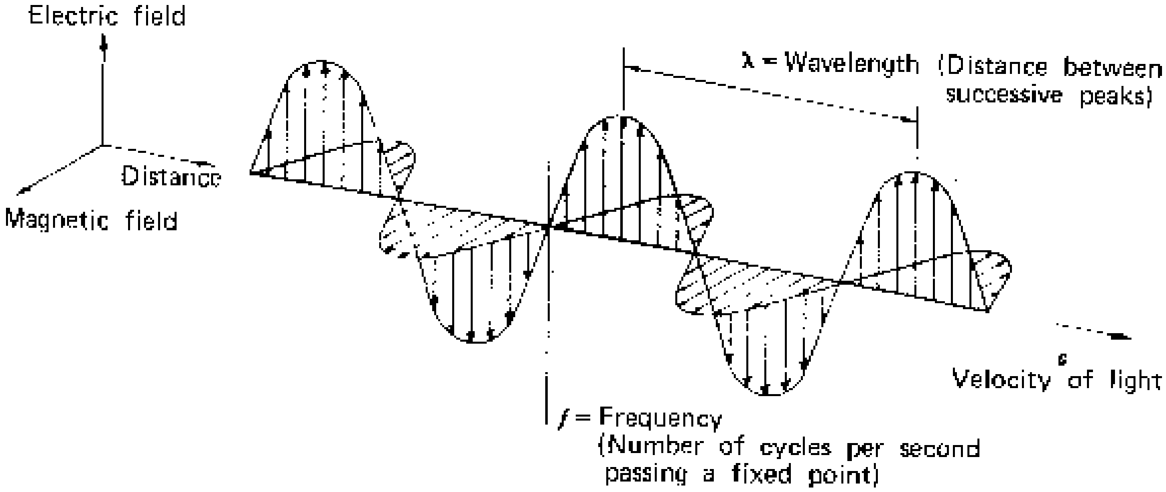

Figure A-3Electromagnetic Wave Model.

The relationship between frequency (ν) and wavelength (λ) of electromagnetic radiation and the speed of light © is based on the following formula (Jensen, 2007 through Rott, 2000):

$c = \lambda * \nu$,

$\nu = c / \lambda$,

and

$\lambda = c / \nu$.

Notice that frequency is inversely proportional to wavelength; the shorter the wavelength, the higher the frequency and the longer the wavelength, the lower the frequency. This is only valid when the speed of light is constant.

Phase, Amplitude and Pulse Length

Figure A-4below shows the amplitude, A, which is the magnitude of an oscillating wave. T represents the duration of one period in the repeating wave.

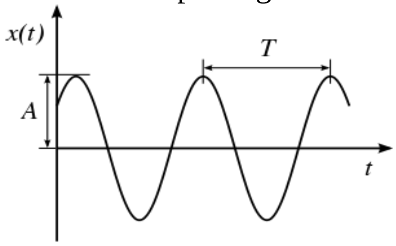

Figure A-4 Phase, Amplitude and Pulse Length

The phase can simply be understood as the harmonic motion of electromagnetic wave. In Figure A-5 below there is a *phase shift, θ,* between the two waves.

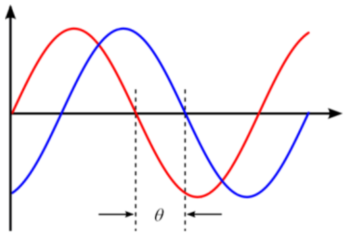

Figure A-5 Phase Shift, θ, between the two waves

Pulse length is defined as the interval between the time (**t_0**) that the pulse (signal) reaches a specified level (50%) of its final amplitude and the time (**t**) that amplitude drops to the same level (As illustrated in Figure A-6)

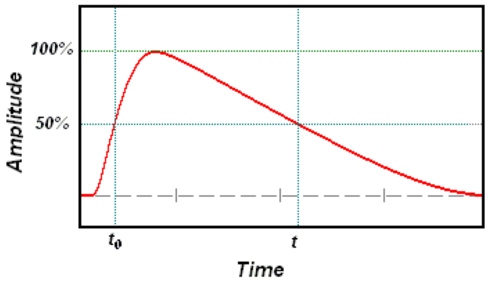

Figure A-6 Pulse amplitude variation

Appendices VII – Doppler Effect

The Doppler Effect is the change in frequency of a wave for an observer moving relative to the source. As seen in Figure A-7, the frequency is higher during the approach to the observer, it is instant when the source passes by and it is lower when the source recedes from the observer.

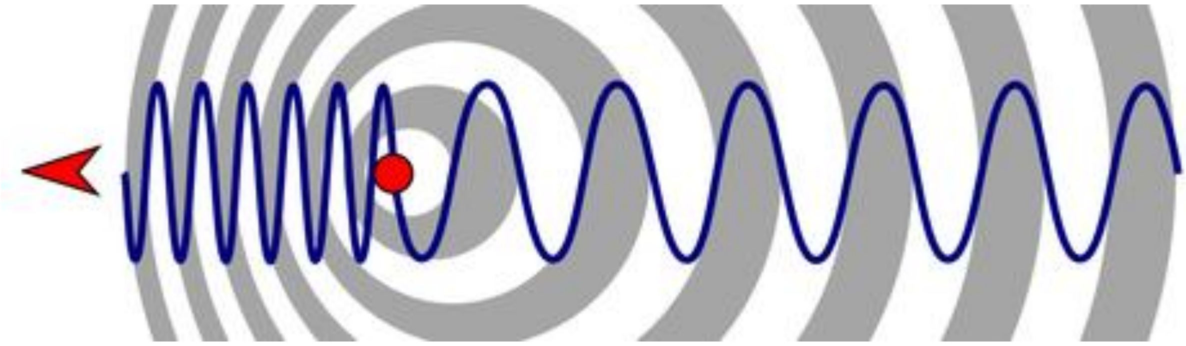

Figure A-7 Doppler Effect

Appendices VIII - Consumer & Organizational Criteria

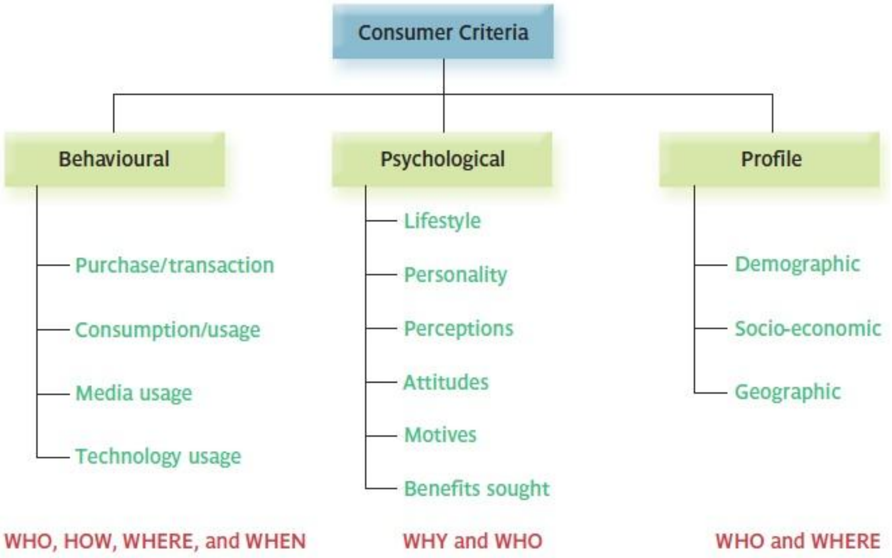

Figure A-8 Business to Consumer Market segmentation criteria, Source: Baines (2008)

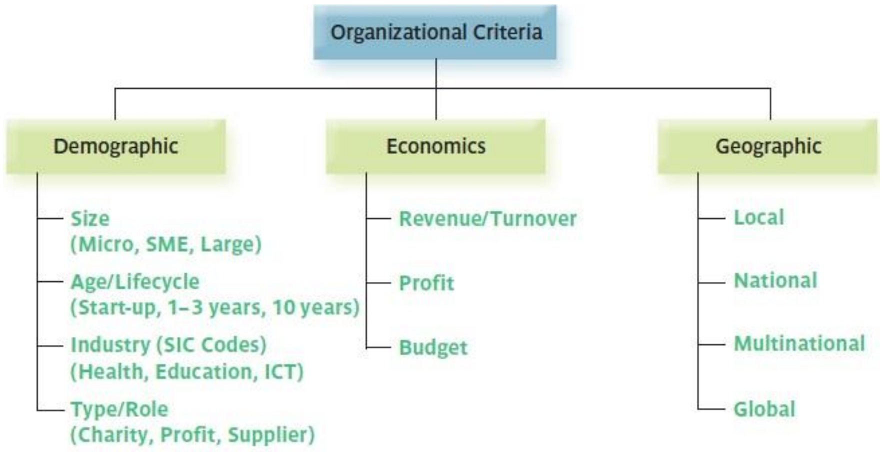

Figure A-9 Business-to-Business Market Segmentation Criteria, Source: Baines (2008)

Appendices IX - Method, Interview Template

The interview guide has been used during every interview, some information is gathered prior to contact but most of the questions are phrased to the customers.

Table A-3 Interview Guide

<table>
<tr><td colspan="2">INFORMATION GATHERED PRIOR TO CONTACT:</td></tr>
<tr><td>GEOGRAPHIC

Regional/National/Multinational/Global</td><td>Context:</td></tr>
<tr><td colspan="2">DEMOGRAPHICS

Size, what size of companies should we serve?

Industry – segments by industry; public services, oil, infrastructure, or focus on all?</td></tr>
<tr><td colspan="2">ECONOMIC

Revenue/turnover, what is the annual turnover?

Profit, what are the annual profits?

Subsidized, s there opportunity to gain subsidy for these kinds of projects/solutions?</td></tr>
<tr><td colspan="2">INTERVIEW QUESTIONS:</td></tr>
<tr><td colspan="2">BEHAVIOUR

Buyer Readiness Stage /Awareness

Have you read our product description that we sent to our prior to this interview?

Did you understand the product/service-value?

We see that this would provide great help to you in consideration to your …(depending on customer contacted), Have you heard of this solution before?

If so, in what context? By whom?

How much do you spend on this today?

Have you heard about Norut in this context before? (Nature of existing relation, purchase criteria, perception of them)

Do you have knowledge about the satellite-based services in this area?

Do you have geotechnical competence?

How interested are you in testing/implementing these solutions/services?</td></tr>
</table>

Do you find these types of services interesting/desirable?
Technology/service usage How are you monitoring geo-hazard /deformation in areas of your interest today? Are you satisfied? Who are delivering these services? Why (or why not) did you choose other supplier? (Purchase criteria below) What is the budget for these types of services? (Economic) What do you lack in today's offers? (I.e. Gamma, TRE etc.?) What kind of agreement do you have? (Purchase) How many suppliers have you been in contact with? How long have you worked with them? Are you interested in implementing new services for land observations? (Attitude, coming below) Have you considered other related application areas of this type of service?
Attitude Would you consider implementing/testing novel Innovative/technologies to deliver efficient solutions of large scale monitoring? Are you interested joining pilot project based on this technology? Enthusiastic/positive/indifferent/ negative or hostile? Risk seekers or risk avoiding customers? What are your benefits when working with these kinds of services? ○ Social responsibility? ○ Increased security? ○ Prevent high damages and expenses?
Usage rate How often do you use land observation services <u>today</u>? How often <u>would you require</u> services within land observation? If differ, why? (Economy, experience, lack of employer)

Do you have certain people working within this area? If so, how many? How many have you employed within this area the last years? (Trends)
Customer capabilities What range would you need additional services from based on our competencies? Interferogram, full reports, subscription 24/7 call centre?
Purchase / Transaction *Are you privately and publicly owned?* How do you get in contact, with new solutions/technologies? How do you decide on new investments? How are your purchase/transactions carried out today? Are your purchases highly centralized or decentralized in the organization? • Who is actually making the choice? • How does the decision making process look like? General purchase policies; service contracts, system purchase, sealed bidding, Procurement? Are you only interested in the occasional service for projects or would you consider general agreements? Purchase criteria, what do you value the most/why would you consider to buy these services? (Purchase/motives) ▪ Technology, possible to see back in time… ▪ Price – time efficient?   ▪ Would you consider frequent purchase if price were reduced? ▪ Fast delivery? ▪ Competence additional consultancy? ▪ Further presentation in other formats (GIS etc.)? How does/would your needs be fulfilled in the best way?

Appendices X - Contacted and Expurgated Customers

Table A-4 Expurgated customers contacted

Consultancy	***R&D***	**Oil companies**:	**Hydro Power**	**Government**
NorConsult	SINTEF	Altinex	Statkraft	NVE
Rambøl	Geology	CanArgo	Eidsiva	
Sweco	Studies	Interoil		
Geovest	Tromsø	Questerre		

Appendices XI - Selection Theory, Segment Evaluation Matrix

Table A-5 Segment Attractiveness

Segment Attractiveness Factors	***Weight***	**Money Makers**	**Strategic Partners**	**Potential Customers**	**Long Term Custo -mers**	**Easy Come**	**Little Attrac-tive**
Potential Growth	*5*	8	7	5	5	4	5
Geography	*5*	9	6	6	1	6	6
Competitive intensity/potential differentiation	*5*	5	10	6	5	6	7
Quantity demanded	*15*	9	8	4	6	3	2
Purchase power/budget	*20*	10	7	6	4	3	4
Potential Collaboration	*20*	4	10	1	1	8	1
Conformation Product-Customer need	*15*	7	10	5	5	8	4
Attitude/Early adopters	*10*	8	10	5	6	6	4
Purchase procedures	*5*	7	4	5	5	3	5
Total	*1000*	**7.0**	**8.2**	4.1	4.0	5.1	3.2

Table A-6 Segment Evaluation Matrix

SEGMENT ATTRACTIVENESS FACTORS	RATING		
	HIGH (10-7)	MEDIUM (6-4)	LOW (3-0)
POTENTIAL GROWTH	Expressed expansion	Maybe	No intention to increase
GEOGRAPHICAL	Multinational	National	Regional
TECHNOLOGY USAGE/COMPETITIVE INTENSITY	Low similar technology usage	Medium similar technology usage	High similar technology usage
QUANTITY DEMANDED	>5 Products/year	3-5 Products/year	1-3 Products/year
PURCHASE POWER	>1000' NOK/year	500'-1000' NOK/year	0-500' NOK/year
CONFORMATION PRODUCT-CUSTOMER NEED	Precise	Ok	Inadequate
POTENTIAL COLLABORATION	Expressed interest	Can be negotiated	Not an option
ATTITUDE/EARLY ADOPTERS	Ready to adopt and purchase continuously	Will purchase occasionally	Only interested in single projects
PURCHASE PROCEDURES	Ordinary purchase	Procurement in certain occasions	Procurement

Appendices XII - Project Board Details

Kjell-Arild Høgda – Technical Advisor

Høgda is head of research at Norut and has long experience of research within the area of GSAR and is established within the local research environment with large network within the field. Hence Høgda has good relation to potential partners and customers that will be exploited throughout the project. He will be responsible for the development of the GSAR software.

Ragnar Brataas – Commercialization Advisor

Brataas works as a technology transfer advisor at TTO and has long experience from consulting and assessing business opportunities creating start-ups in the Tromsø. He will act as a business advisor involved in the strategic decision-making of the project and work in close contact with Norut and the masters' students.

Bård Hall – Business Advisor

Hall is today the chief executive at Norinnova. He holds a Master's degree in Electrical Engineering from Georgia Institute of Technology and a MBA from INSEAD with specializations in finance and ventures. Hall will contribute with very valuable knowledge and networks and also be involved in the strategic decision making.

Thomas Føre – Business Advisor

Føre is today managing Norinnova's efforts with Research based innovation (FORNY) as well as the commercialization of the Norut project Arctic Earth Observation and Surveillance Technologies. He holds a Civil engineering degree in Industrial Management from NTNU. Føre will contribute business consulting, valuable networks and strategic decision making.

Appendices XIII - Market Estimations

World SAR Market

Remote sensing is the standoff collection through the use of a variety of devices (e.g. aircraft, satellite, spacecraft etc.) for gathering information on a given object or area. NASA, ASPRS and NOAA did a comprehensive study in 1999-2003. Here they forecasted that the Remote Sensing market in 2010 would reach approximately 35.373 million NOK (6.000 MUSD to NOK) (see Figure A-10). Further they state that; "*The industry is undergoing rapid change as technology improves and potential clients realize the benefits of using geospatial data and analytical technologies for their information needs*" (NOAA/NASA/ASPRA).
Out from this market they estimate that the SAR market represented 4% of the Remote Sensing market in 2001 and was expected to increase to 8% in a five year period (see Figure A-11). This concludes to that the world SAR market in 2010 is estimated to 2830 million NOK (8% of 35.373 million NOK). Hence, in 2006 did NOAA/USGS/ASPRA a documentation study to verify their findings from 1999-2003 study further and here they had indications of that this market had expanded even more than estimated in 2001. In the same study did they have an optimistic view of future industry growth and estimated an increase of 8-14 percent per year. The industry is undergoing rapid change as the technology improves and potential clients realize the benefits of using geospatial data and analytical technologies for their information needs.

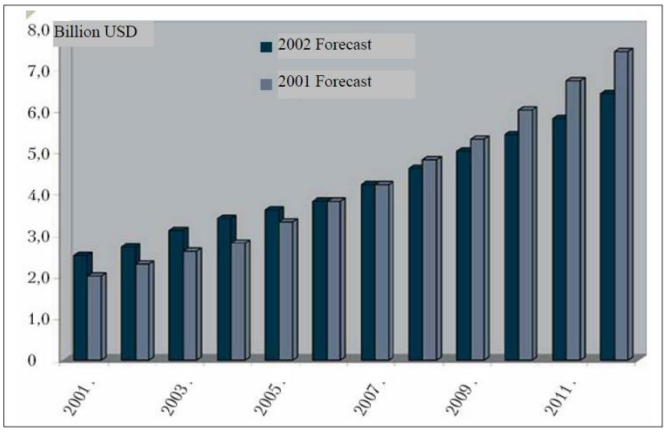

Figure A-10 Estimated Revenue Growth of world Remote Sensing. Source: (NOAA/NASAASPRA)

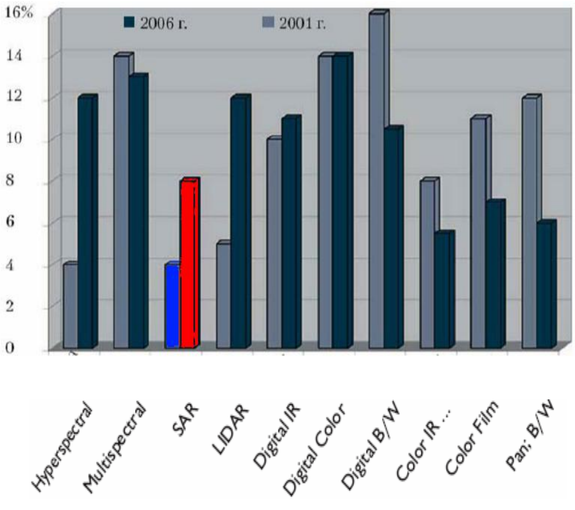

Figure A-11 Change of demand of data source, Remote sensing 2001–2006. Source: (NOAA/NASA/ASPRA)

European and Canadian Market

Phil Curtis at VEGA Group analyzed in 2007 the situation for private sector service providers within earth surveilance over the time period 2003-2006 in Europe and Canada. 151 companies were identified and in this study information from 74 companies were gathered and further they got financial information from 40 companies. These 40 represented 1855 million NOK (233 million EURO to NOK)(including the 10 known largest) and if you apply the estimations of the 111 non-submitting companies the total revenue including data sales is estimated to 3279 million NOK (412 million EURO to NOK) in 2006. Here we also see that 89% of the profit was delivered by just five companies. In this report two Norwegian companies were included; however it does not say which ones.

The biggest market for the European companies was in Europe and there was little sign of growth in export. However what had changed was the widening range of earth surveilance services. Before it had been used within Land Use Monitoring, Cartographic & Topographic Mapping, Marine and Coastal Surveillance and Agriculture but now it had expanded to include in Environment, Regional Planning, Oil, Gas, Mining and Forestry too. Further, the largest single market segment is defense and the major customer type is public sector operational entities.

If you look at the long-term revenue trends you firstly see that the Earth surveilance market has nearly doubled from 1990 until 2001. The annual growth of the companies submitted in their report is just above 7% between 2003 and 2005. Further they are expecting a long-term growth on approximately 8% per year (Curtis, P., 2007). The sales within earth surveilance in Europe, Canada and US are rapidly increasing as the technology is getting known, more people see the potential. If we assume that the SAR market represents 8% of the total Earth surveilance market when estimating the Canadian and European SAR market in 2006 it will be 262,32 million NOK (8% of 3279 million NOK). Further, when the growth is expected to be 8% per year the expected market size in 2010 is estimated to 365 million NOK. However, these numbers shall be verified with further market research according to the action plan.

Appendices XIV - Trends

Global market expenditure illustrating the growth trends in the different markets, Figure A-12.

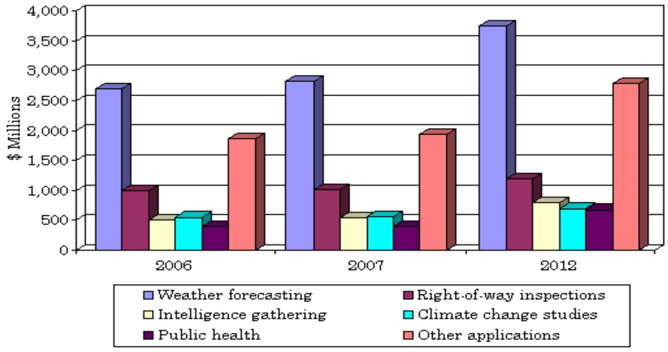

Figure A-12 Global market expenditure, remote sensing products. Source: [13]

Global satellite launches during the years 1997-2016 is illustrated in Figure A-13.

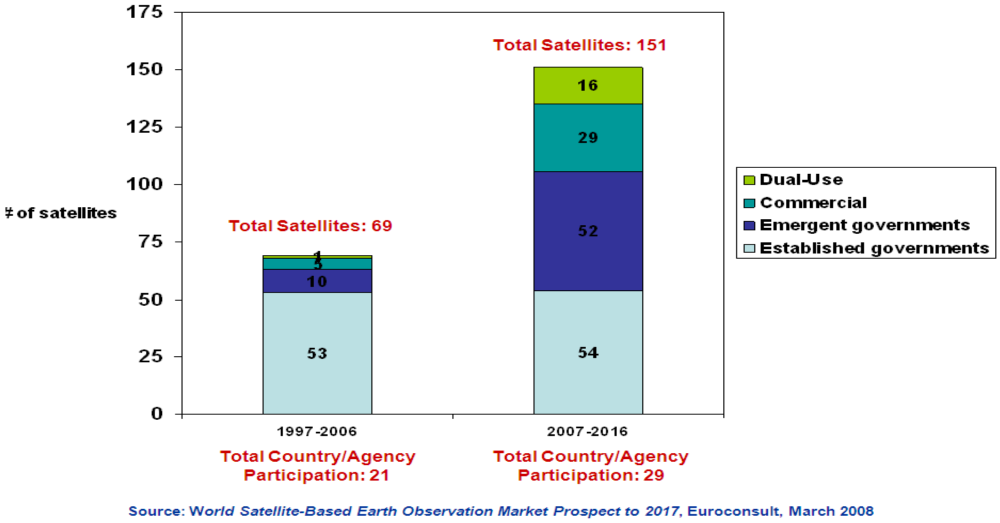

Figure A-13 Global Satellite launches within the remote sensing market

Figure A-14 illustrates the history of all the SAR satellites which our software can utilize images from.

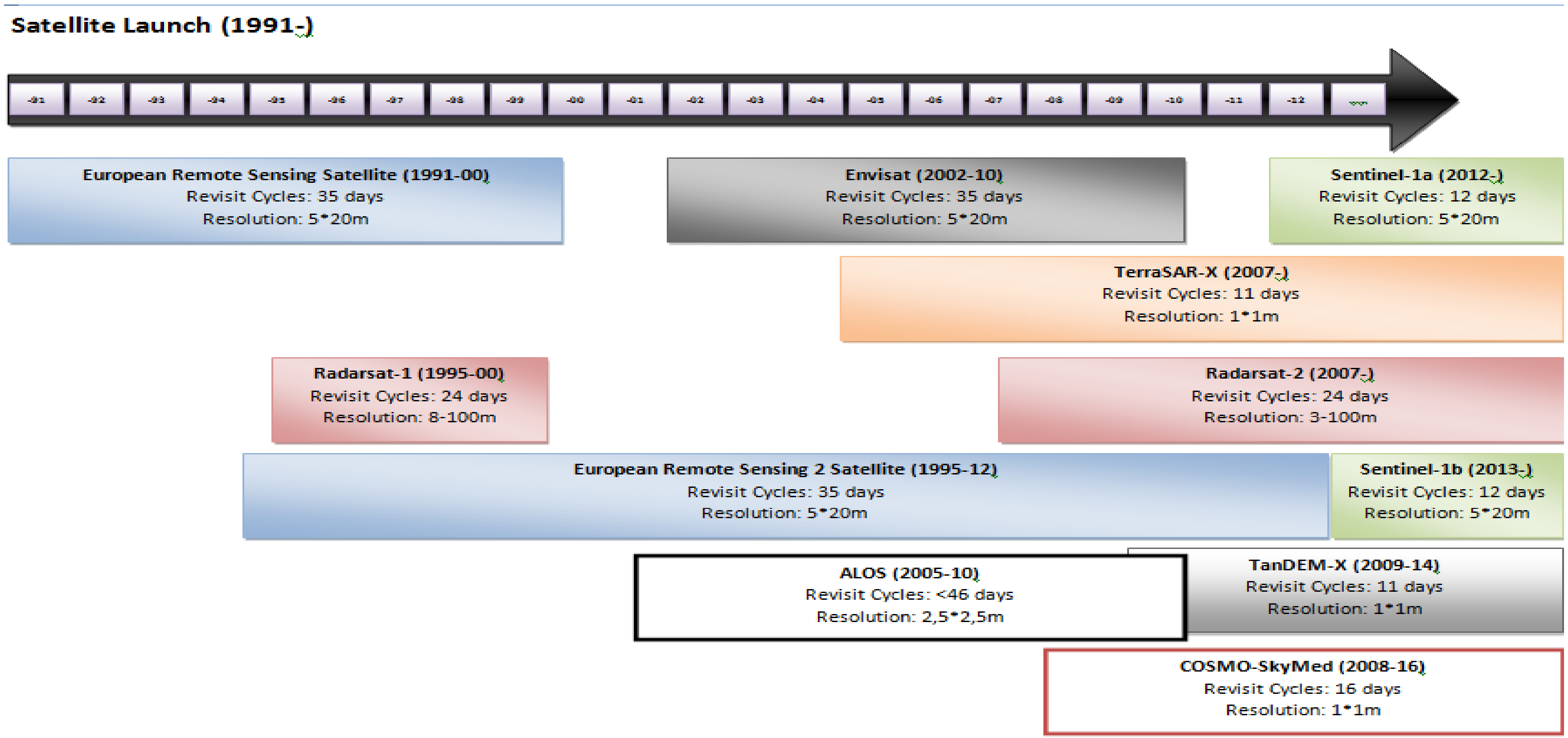

Figure A-14 Global Satellite launches within the remote sensing market (1991-)

Appendices XV – Techno-Economic Analyze

The purpose of a TEA is to map and analyze the relations and interactions between technological and economic variables (Lindmark, 2006). We have performed this analyze to understand how the technology most feasibly can provide functions and technical performance to best applications. The application is offered to customers who have expressed their corresponding needs, enabling us to make strategic segmentations to target (See Figure A-15).

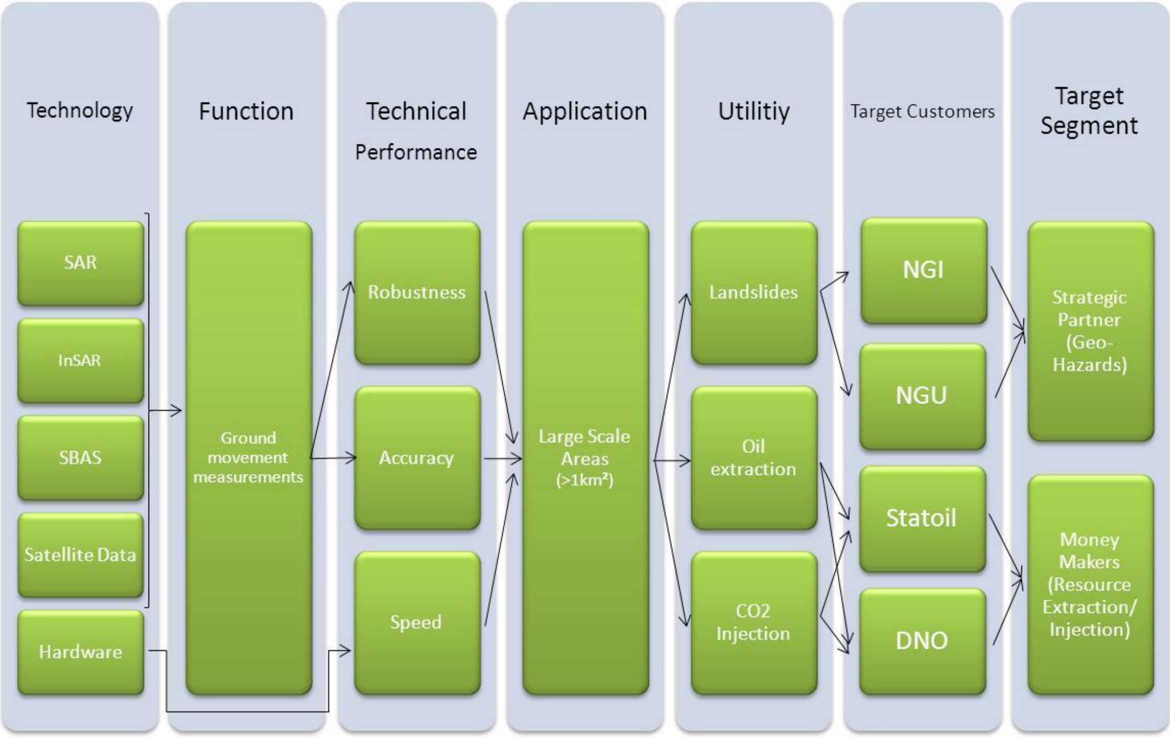

Figure A-15 Concluded TEA

Appendices XVI - Competitor Analysis

Our competitors are listed in Table 4 and the level of competition is indicated in the last column, scaled as follows;

**** = Competitors with substitute technology and strong research backing.

*** = Competitors with non-target markets, can become competitors when we will focus towards an international market.

** = Competitors with narrow target markets, low level of satellites the software supports, can become competitors when we will focus towards an international market.

* = Focusing on selling substitute software, can also be a potential threat if they start to process themselves.

Table A-7 Competitor Analysis

Company name and location	Est.	Target Market	Number of satellites which the software supports	Technique used when analyzing (number of images required to be able to do an analyze)	Level
Altamira Spain	1999	Wide	7 different satellites	Displacement analysis on single targets; Stable Point Network (15-20)	***
MDA Canada	1968	Narrow	2 different satellites	Displacement analysis on single targets; Permanent Scatterer Interferometry (15-20)	**
NPA England	1972	Wide	4 different satellites	Displacement analysis on single targets; Permanent Scatter Interferometry (15-20)	***
TRE Italy	2000	Wide	7 different satellites	1) Displacement analysis on single targets; Permanent Scatter Interferomnetry (15-20) 2) Displacement analysis of natural terrain; SqueeSar (20-30)	****
Gamma Switzerland	1995	Narrow	4 different satellites	Interferometric Point Target Analysis (15-20)	**
Erdas USA	1978	Narrow	5 different satellites	Displacement analysis on single targets; Erdas Imagine (15-20)	*

Appendices XVII - Cost Difference Using Conventional Method vs. Satellite Image Mapping.

Table A-8 Cost of using conventional methods vs. Eagle Eyes products (Size of the area of interest is 5 km^2). Example below assumes that there are satellite images covering the area of interest.

Parameters	**Conventional method**	**T.R.E**	**Eagle Eye**
Method used	Manual land based measurements using laser and GPS.	Point analysis	Large area analysis
Field work (2 persons)	4 weeks/year		
Personnel costs (1500NOK/pers./hour) related to field work	37,5 hours/week/pers. = 50'NOK		
Personnel cost (1500NOK/pers./hour) related to image processing and data analysis		37.5 hours/week/pers.= 56'NOK	37.5 hours/week/pers.= 56'NOK
Field data analysis - 1 week 37.5 hours	1 week (37.5 hours) = 56' NOK		
Satellite images needed for analysis 2400 NOK /image		(20-30 images) 48'-60' NOK	(10-20 images) 24'-48' NOK
Total cost of analysis	**466' NOK**	**104'-116' NOK**	**80'-104'NOK**

The size of area of interest, which satellite the images originates from and the amount of satellite images used in the data processing. The example illustrates costs related to ground movement mapping of an area of interest using various technologies where the difference in production cost between Eagle Eye and our competitors is basically non-existent. Conventional methods are impractical, time consuming, more costly and cannot deliver highly accurate historical ground movement data. Using satellite images is at least four times more cost efficient than conventional methods and can in addition provide historical deformation data.

Appendices XVIII – Feasible Application Areas

In Table A-9 you can see all the feasible application areas with our software. Both Initial focus and long term focus.

Table A-9 Feasible applications areas with our software

LAND AREAS	
Initial focus	**Long term focus**
Ground monitoring, soil conditions:	**Environment and land use:**
- **“**Geo-hazard”	- Rainforest
(Landslide monitoring/warning)	Vegetation maps
Infrastructure:	- Varmints mapping
- Large construction monitoring, buildings,	- Agriculture
- Urban planning	**Weather related applications:**
- Dams	- Snow processor
- Mine monitoring	- Flood mapping
- Road system	- Wind mapping
- Railway	**Constructions and modeling**
Oil extraction	- 3D –modeling
	- Cartography

Appendices XIX – Finance

Eagle Eye - Financial Assumptions (thousand NOK)

			2010	2011	2012	2013	2014
Norwegian market value, growth 8% /year		8%	24,000	25,920	27,994	30,233	32,652
European & Canadian value, growth 8%/year		8%	368,000	397,440	429,235	463,574	500,660
Norwegian Public sales*			2	4	5	7	8
Norwegian Private sales			2	3	11	28	45
Total European & Canadian Sales			4	8	16	35	53
Number of customers			3	6	12	24	40
Sales data	Growth/year						
Average Sales Price (NOK/unit)	3%		240	247	255	262	270
Average Sales Price (NOK/unit)*	3%		120	124	127	131	135
Pilot projects			-	-	-	-	-
Discount (50%)			-	-	-	-	-
General VAT-rate	25%						
Total sales			720	1,483	3,437	8,261	13,236
Market shares Norwary			3%	6%	12%	27%	41%
Market share Europe & Canadian			0%	0%	1%	2%	3%
Cost of Goods Data							
Total units sold							
(average price 1900 NOK/image)	1.9		4	8	16	35	53
*Units sold based on Radarsat images**			2	4	5	7	8
Total cost satellite images							
(20 images/unit)	20		76	152	418	1064	1710
Direct consulting costs 1190/hour		1.2	179	357			
Consulting 40 hours/unit produced		38					
Operating expenses and tax data							
Personnel							
Management	Growth/year						
CEO	3%		200	400	412	424	437
Commercial manager	3%		200	400	412	424	437
Commercial manager	3%		200	400	412	424	437
Company board			30	70	150	150	150
Production & development	Growth/year						
Senior Engineer	3%		0	0	650	670	689
Engineer			0	0	-	650	670
Holiday pay (10,2%)	10.2%		61	130	208	280	288
Salary tax (14,1%)	14.1%		93	187	295	405	417
Tax Rate	28%						
Total personnel expenses			784	1,587	2,539	3,427	3,524

Eagle Eye - Financial Assumptions (thousand NOK) cont'd

		2010	2011	2012	2013	2014
Marketing & travel						
Advertisement		100	300	300	300	300
Web page fees		16	31	31	31	31
Travel expenses		90	300	500	600	700
Total marketing & travel expenses		206	631	831	931	1,031
Housing & facilities						
Office rent		30	60	100	100	100
Office consumables		19	37	50	70	70
Office equipment		30	30	40	60	60
Computer expenses		15	30	-	50	50
Total housing & facilities expenses		94	157	190	280	280
Administrative						
Accountant fees		20	20	20	20	20
Distribution fees		10	16	22	30	38
Software updates(License fee)		-	100	200	200	200
Total administrative expenses		30	136	242	250	258
Investments		-	-	500	-	-
Subsidies						
Innovation Norway		400	400			
Balance Sheet Ratio's						
Accounts Receivable (days)	30					
Accounts Payable (days)	30					

* RadarSAT images - retrieved at no cost when doing work for public organizations in Norway

Eagle Eye - Income Statement (thousand NOK)

	2010	2011	2012	2013	2014
Revenues					
Images	480	988.8	2,801	7,343	12,155
Images (RadarSAT)	240	494.4	637	918	1,080
Total revenues	720	1,483	3,437	8,261	13,236
Costs of goods sold					
Consultants	179	357	-	-	-
Satellite Photos 20 st (ERS, Envisat etc.)	76	152	418	1,064	1,710
Support	24	48	-	-	-
Royalty fee, 4% of (income-software license expense)	29	59	137	330	529
Total costs of goods sold	307	616	555	1,394	2,239
Gross profit	413	867	2,882	6,867	10,997
Operating expenses					
Personnel expenses	784	1,587	2,539	3,427	3,524
Marketing & travel expenses	206	631	831	931	1,031
Housing & facilities	94	157	190	280	280
Administrative expenses	30	136	242	250	258
Depreciation (10%)	-	-	50	50	50
Total operating expenses	1,114	2,511	3,852	4,938	5,143
Income before interest and taxes	-701	-1,644	-970	1,928	5,853
Interest expenses	-	-	-	-	-
Income before taxes	-701	-1,644	-970	1,928	5,853
Tax on income (28%)*	-	-	-	-	1,251
NET INCOME	-701	-1,644	-970	1,928	4,603
Profitability	-97%	-111%	-28%	23%	35%

***Loss-cary forward 2013 & 2014**

Eagle Eye - Cashflow Statement (thousand NOK)

	2010	2011	2012	2013	2014
Sources of cash					
Operating activities					
EBIT	-701	-1,644	-970	1,928	5,853
Tax(28%)	-	-	-	-	-
Depreciation	-	-	50	50	50
Inventory change	-	-	-	-	-
Change unpaid VAT	7	-9	70	158	168
Change unpaid holiday pay	61	68	78	72	8
Change unpaid salary tax	31	0	18	18	2
Accounts receivable (trade debtors)	-150	-5	-204	-502	-518
Accounts payable (trade creditors)	16	-	28	67	67
Total operating activities	-736	-1,589	-930	1,791	5,630
Investing activities					
Computer park	-	-	-500	-	-
Total investing activities	-	-	-500	-	-
Total casflow after investing activities	-736	-1,589	-1,430	1,791	5,630
Financing activities					
Accounts	400	-	-	-	-
Subsidies	400	400	-	-	-
Increase in short term debt	-	-	-	-	-
Increase in long term debt	-	-	-	-	-
Issuing of additional Stocks	-	-	-	-	-
Total financing activities	800	400	-	-	-
TOTAL CASHFLOW	**64**	**-1,189**	**-1,430**	**1,791**	**5,630**
Accumulated cashflow	**64**	**-1,125**	**-2,555**	**-764**	**4,866**

Eagle Eye - Balance Sheet (thousand NOK)

	2010	2011	2012	2013	2014
Assets					
Cash	64	-1,125	-2,555	-764	4,866
Accounts receivable	150	155	358	861	1,379
Inventory	-	-	-	-	-
Current assets	214	-971	-2,197	97	6,245
Computer Park	-	-	450	400	350
Intangible assets	-	-	-	-	-
Fixed assets	-	-	450	400	350
TOTAL ASSETS	**214**	**-971**	**-1,747**	**497**	**6,595**
Liabilities					
Accounts payable	16	16	44	111	178
Unpaid VAT	7	-2	67	225	393
Unpaid holiday pay	61	130	208	280	288
Salary (payroll) tax	31	31	49	67	69
Unpaid tax	-	-	-	-	1,251
Short Term Debt	-	-	-	-	-
Long Term Debt	-	-	-	-	-
TOTAL LIABILITIES	115	174	368	683	2,179
Stockholder's Equity					
Capital Stock	800	1,200	1,200	1,200	1,200
Retained earnings	-701	-2,345	-3,315	-1,387	3,216
Dividens paid	-	-	-	-	-
TOTAL EQUITY	**99**	**-1,145**	**-2,115**	**-187**	**4,416**
TOTAL LIABILITIES & EQUITY	**214**	**-971**	**-1,747**	**497**	**6,595**

Appendices XX – Valuation Assumption

We have used the Venture Capital method to calculate the exit value of the company in 2014.

The Venture Capital Method;

$$PV = \frac{\text{Net Income} * P/E}{(1+r)^t}$$

Net income in 2014 is 4,603 million NOK

R = Discounted rate = 25% (Calculations see below)

P/E = An average P/E-ratio in the ICT industry is 12.

Total NPV =	22,6 million NOK
Capital needed =	3 million NOK
Pre money value=	**19,4 million NOK**

Discount Rate Assumptions

We have chosen a discount rate, to reflect the risk of the company. We are a company close to market and do not have any loans. All capital invested is owners' equity. Since we are a start-up company the stocks are not tradable. However we are aiming for an exit in 2014 through a trade sale. Therefore we set a discount rate to 25%.