WP7: Sell - Develop new business models and markets

Institute of Technology and Safety
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Contents

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Abstract: Additive manufacturing (AM), also known as 3D printing technology, may change the way companies operate their businesses. Metal additive manufacturing is a promising technology that will help small and medium enterprises (SMEs) in the Arctic region to become more competitive upon utilizing it. This report covers five main activities related to work package seven in C3TS project, which is mainly concerned with the development of new business models and markets. The first activity in the report introduces an overview of SMEs in Norway, Sweden and Finland. The second activity highlights the main challenges that might face the implementation of the technology and what opportunities exist in the Arctic that will help implementing it. In the third activity, the relationship between operational risk and reliability factors, which may influence the local SMEs' international competitiveness and the technical specification of the available industrial metal 3D printers, is demonstrated. The fourth activity thoroughly explains a general business model, which can be suitable for the implementation of metal AM technology by SMEs in the Artic. Furthermore, based on a questionnaire distributed to multiple SMES in the Arctic, four tailored business models for three SMEs, located in Norway, were established in order to seek the opportunity in utilizing the metal AM technology by these SMEs. In the last activity, a learning loop was developed concerning the four main decisions SMEs should make when developing a marketing and commercialization strategy for utilizing metal AM in the Arctic.		
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Work Package Tasks

Activity 1	Map the state- of-the-art with respect to current operation and marketing structures of local SMEs, especially SMEs engaging on maintenance and repair activities, production of different types of mechanical equipment, etc. (literature study).
Activity 2	Analyze the main operation, maintenance, logistic as well as marketing challenges and opportunities when local SMEs in the Arctic employ 3D-printing. - Study the main marketing and logistics challenges of the SMEs', which operates in the Arctic.
Activity 3	Investigate the main operational risk and reliability factors that may influence the local SMEs' international competitiveness (including oil and gas, marine, mining, energy and process industries).
Activity 4	Create the operation and business model canvas for 3D-printing products for local SMEs, which are operating in cold climate region.
Activity 5	Develop a learning loop as well as a generic operation, marketing and, commercialization strategy.

Activity 1 MARKET ANALYSIS

The primary objectives of activity 1 are to explore new markets, identify potential business opportunities, and fruitful research areas for 3D-printing /additive manufacturing techniques. The other primary goal is to map the state-of-the-art with respect to current marketing structures and, strategies of small and medium-sized enterprises (SMEs') in Scandinavian countries (literature study).

In this section, we have covered some opening descriptions about what we mean by ''SME'' in the context of this study and what kinds of SMEs we emphasis on. The European Commission describes SMEs as sovereign enterprises that have fewer than 250 employees, and an annual turnover not surpassing 50 million EUR or a balance-sheet total not exceeding 43 million EUR [1]. Table 1 describes the SME definition by European Commission; and, the main factors determining whether an enterprise is an SME are:

- Staff head Count and
- Either turnover or balance sheet total

Tabell 1: SME definition according to the European Commission

Company category	Staff headcount	Turnover	Or	Balance sheet total
Medium-sized	< 250	≤ € 50 m		≤ € 43 m
Small	< 50	≤ € 10 m		≤ € 10 m
Micro	< 10	≤ € 2 m		≤ € 2 m

However, the Norwegian classification of SMEs is not the same as in other countries or regions of the world. The accepted definition in Norway, which is based on the number of employees as the key, and the SMEs are:

- Small = 1-19 employees
- Medium-sized = 20-99 employees
- Large = 100+ employees

For the purpose of this report, "the SME" is taken simply to mean the small- and medium-sized enterprises, which are currently working on metal manufacturing process, including the welding markets. These SMEs are potential future users of the result of this C3TS project as well as future industrial partners. Further, most of these SMEs are involving in metal manufacturing, maintenance and repair, production of different types of mechanical equipment, etc.

The ambition of the C3TS project, especially the WP7- Sell - Develop new business models and markets, is to strengthen the opportunities for region's SMEs to participate in the cross-border research and innovation environments, and to transfer 3D-printing/ additive manufacturing technology to Norwegian, Swedish, and Finnish metal and engineering industries. The idea is to facilitate local metal manufacturing businesses and make operating conditions for small and medium businesses better.

Through this project, continuous efforts have been carried out to identify and implement simplifications to various marketing strategies and structures. The regulatory requirements are often the same for small and large enterprises. However, the small enterprises have usually fewer resources to develop strategic marketing and business plan. These include market research (market segmentation and targeting, competitive environment, etc.) and tactical marketing (market positioning & strategy, marketing & selling model, etc.).

1.1. SMEs in Norway

The number of SMEs in Norway is more than 280,000 SME, which represents more than 99% of the total number of enterprises according to a survey conducted in 2013 Commission [2]. Furthermore, over a million personnel are hired in SMEs, accounting for 67.7% of the total workforce in the country, which is quite the same average as in whole Europe. The value added generated by SMEs in Norway is 156 billion euros, which is significantly higher than the European average.

The dominance of SMEs on the industry in Norway is because Norway is sparsely populated. Moreover, the Norwegian economy is not focused on large-scale industries that produce products in large quantities like automobiles, pharmaceutical products, etc. Additionally, most SMEs are owned and managed by individuals or families, and Norway has a persistent culture of effective and sound management of small companies. This cultural factor combined with the use of modern technology and access to local natural resources contributes to a strong business environment that makes many Norwegian SMEs successful.

The distribution of SMEs across sectors in Norway is different than in the EU, where 38% of the value added accounted for by SMEs is generated in the mining sector, compared to 1% in the EU. This reflects the fact that Norway is a major oil and gas producer.

Another feature of the Norwegian economy is the fact that SMEs play a major role in two economically essential and successful branches: aquaculture and the supply industry for the oil and gas sector, which both can be potential markets to benefit from AM technology.

In the following, an overview of some of the identified SMEs operating in the arctic region in Norway, which were also invited to participate and take part in the different work packages in the C3TS project.

1.1.1. Trio Oiltec / Castolin

Trio Oiltec is a contractor for the Oil & Gas industry. Using advanced welding and coating technologies, the company provide a wide variety of repair, rebuilding, wear-facing and production technologies for valuable components. Since advanced welding and coating is the core activities of the Trio Oiltec, 3D-printing (Additive Manufacturing) can be a promising technology to improve the overall activities.

Currently, Trio Oiltec is providing products and solutions to the following companies located in Northern Norway, Celsa, Glencore and Rana metall in Mo i Rana, Elkem Salten, Norcem Kjøpsvik and LKAB Narvik. Furthermore, Subsuppliers available for Trio Oiltec in Northern Norway are Mo mek and Acustus (Sørfold).

Figure 1: A) Cutter wheels & drill bits B) Thermal spraying C) Drill bits. © Trio Oiltec

1.1.2. EWOS Bergneset

EWOS is complete fish feed factory, specially designed to produces experimental diets, to test new feed production technology and to conduct process optimization. The company is located Balsfjord kommune in Troms County; and, have 26 permanent employees and around 20 seasonal employees.

To this date, the company have little systematic research activity on salmon farmed in Finnmark, and EWOS wants to be an important contributor to new, strategic knowledge when it comes to Arctic salmon fish farming. 3D-printing (Additive Manufacturing) can be helpful for EWOS Bergneset, in order to improve the performance of the available technology and, to test new equipment used for feed production, especially in the EWOS Technology Centre. In the center, the company conduct large-scale trials to improve the production process for different raw materials, and to test out new technology.

Figure 2: A) Salmon fishing plant in the Arctic ©*EWOS* B) fish feed processing technology ©*EWOS*

1.1.3. Kjeller Vindteknikk

Kjeller Vindteknikk is an SME that offers services for the installation and operation of met masts and remote sensing devices that may be used to measure the wind conditions at sites potentially suitable to wind power development. The choice of met mast depends on climatic factors such as icing and extreme wind speed, and on the considered measurement tower height. The company is in the development phase of a new icing measuring equipment to be used for harsh conditions. For this new equipment, the company is planning to use 3D-printing (Additive Manufacturing) for the printing out the prototype and testing of new instrument. The reason behind employing 3D printing is that the product from 3D will reduce the ice accretion rate by improving the ice phobic characteristics of the equipment surface.

Figure 3 : A) Icing forecasts equipment B) Installation of masts © *Kjeller Vindteknikk*

1.1.4. Aker Solutions

Aker Solutions is a provider of products, systems and services to the oil and gas industry. Its engineering, design and technology bring discoveries into production and maximize recovery.

Aker Solution Tromsø Office mainly focused on the systems to be applied in the Arctic operating condition. The Harsh operating conditions of the Arctic requires new technologies. 3D-printing (Additive Manufacturing) can be used by Aker Solutions and its local SME suppliers, to create new systems and technological solutions that can sustain the harsh environment.

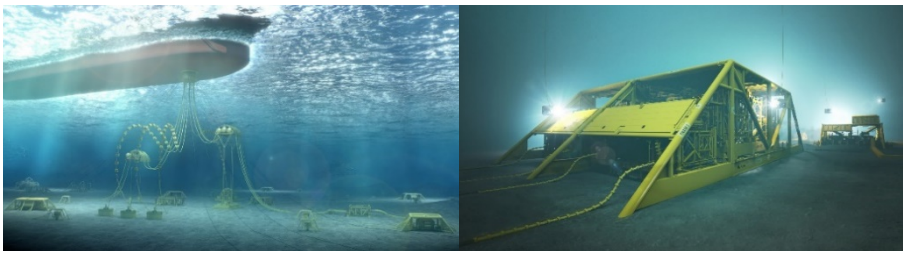

Figure 4: Aker Solutions offshore activities © *Aker Solutions*

1.1.5. Norut Narvik - Northern Research Institute Narvik

Norut is a research and innovation SME, which provides services of high quality and practical applicability for various clients. Norut develops technologies adapted to meet challenges in the Arctic climate. Several industrial operations in northern and Arctic areas demand new thinking on the use of materials, surveillance, emergency response and security. The company engages in research on Arctic technology because the action is occurring in the north. Norut's unmanned aircraft systems are utilized in an increasing number of areas. The company has a research unit to address the problems that drones and other unmanned vehicles encounter in a harsh Arctic climate. Drones and other remote-controlled and autonomous vehicles face a series of challenges when deployed in harsh and cold environment. Cool humid air ices down wings, propellers and crucial sensors on aircraft, and low temperatures drain batteries. 3D-printing (Additive Manufacturing) can be helpful to build an icephobic coating, which can reduce the risk of ice accretion on the drone operation in the Arctic area.

Figure 5: Unmanned Aircraft Systems at Svalbard © *Norut*

1.1.6. Subsea 7

The company is engaging in developing subsea products in the harsh and challenging environments of the Arctic region. Subsea 7 provide cost-effective technical solutions to enable the delivery of complex projects in all water depths and challenging environments. 3D printing (Additive Manufacturing) can be suitable technology for reducing the cost of products and services for these harsh operating environments. Further, it can reduce the environmental related pollution, for instance, by minimizing the use of raw material and energy. Moreover, it may enhance the ability of our sub-suppliers to extend their competence and to reach out the best practice.

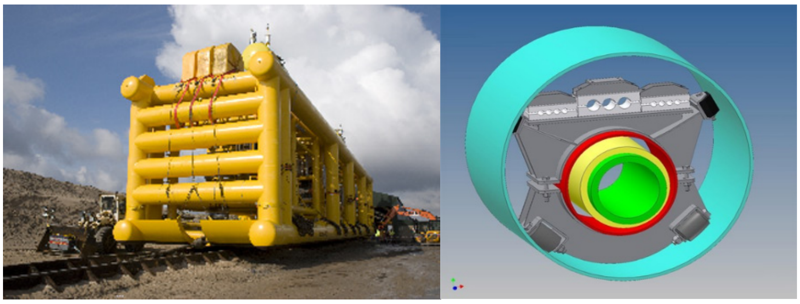

Figure 6: A. Pipeline bundle B. Bundle system © *offshore technology*

1.1.7. NaSTech AS

NaSTech AS is an SME located in Narvik, Norway. The company is active in the domain of renewable energy and hydrogen technology. NaSTech AS has the competence to engineer, construct, develop and operate projects related to renewable energy technologies. They endeavor to promote innovative low/ zero carbon technologies, especially Hydrogen energy and fuel cells as well as solar and wind energy technologies. NaSTech AS can benefit from metal AM technology in various applications related to renewable energy. Moreover, there is a cooperation between the company and The Arctic University of Norway in establishing a hydrogen refueling station (HRS) in Narvik for supplying hydrogen-based vehicles with hydrogen fuel, which represents a major step in utilizing hydrogen as a fuel in the Arctic. The photos below show a HRS based in Gardermoen airport, Oslo, owned by NasTech, which the company plans to move to Narvik.

Figure 7: A Hydrogen refueling station owned by NaSTech AS

1.1.8. Saltvik Plogen AS

Saltvik Plogen AS develops and produces innovative models of snowplows, which are sold not only in Norway and Scandinavia, but also outside the Nordic countries. The company has its own workshops, which are situated in Narvik in Northern Norway. Saltivk Plogen AS has developed nine models of snowplows and a parallelogram-lifting device. The company can benefit from metal AM in producing various snowplows parts. Such parts can be seen in section (Equipment) in the company’s catalogue (https://drive.google.com/file/d/1jzNtspzetQLirZByHjZ-oGhCwdqqL8Is/view).

Figure 8: Snowplows manufactured by Saltvik Plogen AS © *Saltvik Plogen AS*.

1.2. SMEs in Sweden

More companies are being registered in Sweden than are going to be bankrupt, reflecting a generally healthy economic climate. In year 2016, 71825 new companies were registered, a modest increase of 2.4 % compared with 2015. Swedish SMEs produce 61.2 % of value added and 65.5 % of employment. The value added per person employed in Swedish SMEs is about €65,000, which is more than the EU average of €44,600. However, the average number of people they employ is lower than the EU average. Swedish SMEs employ 3.0 people on average, while the EU average is 3.9. Swedish SMEs employ approximately 2.1 million personnel according to statistics. Nevertheless, the female entrepreneurship rate in Sweden is rather low [3].

Two of the most important SME sectors are wholesale and retail trade and manufacturing, together contributing 35.3% of SME value added and 35.4% of employment [3].

SMEs in Sweden have grown steadily in recent years. In 2014-2018, SME value added increased by 10.8 % and SME employment rose by 9.1 %. The construction sector had the strongest growth in SMEs' value added and employment. On the other hand, large firms had lower value added growth of about 5.3%, but higher employment growth of approximately 12.7% during the same period.

1.3. SMEs in Finland

SMEs contribute considerably to Finland's economy. They produce nearly 60% of total value added, slightly more than the EU average of approximately 56%. In contrast, the SME share of 65.2 % of total employment is slightly lower than the EU average of 66.6 %. Finnish SMEs employ 4.2 people on average, which is quite similar to the EU average of 3.9. However, the Finnish SMEs are more productive than the EU average. Value added per person employed in an SME in Finland is 39.9 % higher than the European average. The value added per person employed in Finnish SMEs is about EUR 66 000 against EUR 44 600 in the EU as a whole [4].

The Finnish government as well as local governments have put considerable effort into supporting entrepreneurship and start-up companies. Manufacturing, wholesale, and retail trade are the two largest SME sectors, which is almost the case in whole Europe. These two sectors together contribute to 35.1% of overall SME value added and 37.4% of employment. The construction sector has attained strong growth in recent years. In 2017, SMEs in construction accounted for 17.6 % of total SME employment, a significantly higher share than the EU average of 11.8 %. The sector as a whole has benefited from strong renewed domestic demand for industrial facilities, offices and warehouses as well as residential buildings, following a substantial slowdown in investment in 2012-2015.

Activity 2 Challenges and Opportunities

There are multiple challenges SMEs in the Arctic face when implementing metal 3D printing, as discussed in the following points:

2.1. Challenges:

- Transportation of raw materials and equipment: one of the major concerns for SMEs in the Arctic is having access to efficient transport nodes and corridors to other parts of the countries and to international markets. There is a need for good roads to the regional centers, good interconnections, railway corridors and upgrading of the main European connection and east-west connections to neighbouring countries. In addition, good harbours and terminals need to be established at all strategic locations in Northern part of Scandinavia. From local quarters, there are ambitions and proposals for national and cross-border investment projects in order to meet future transport needs among countries in the Arctic. In order to guarantee efficient use of resources, a combined assessment of the various local initiatives for transport solutions in terms of traffic data is necessary.

- Dispersed area: The Arctic is known to be less populated compared to other parts of the same country, and people as well as industrial investments might spread over long distances from each other in the Arctic. This imposes more costs on delivering items to the customers, which will add to the total cost of manufacturing a part.
- High-energy prices in the region: High and unstable energy prices are a poor foundation for future industrial development. Metal AM is an energy intensive process since laser beam or electron beam with high power density are used to fully melt materials. The laser is the most power-consuming unit. The power consumed by the laser is 2.24 kW for an output power of 100 W, which represents 68% of the total machine tool power [5].In addition, people in Norway for instance depend on electricity for heating, and in the Arctic the need for heating increases, which imposes more loads on electricity.

Moreover, high energy prices has made it difficult to establish and develop large renewable energy resources that the region possesses in the form of wind power, wave power, offshore turbines, etc.

- Changing and unpredictable climate conditions will likely lead to increased investment and repair costs. The harsh weather will also affect delivering the 3D printed parts to the customers, cause personnel to be absent from work due to sickness. Workers might suffer from depression during winter due to long darkness period, and they might suffer from sleeping issues during summer due to long daylight periods.
- Lack of qualified and competitive personnel in metal 3D printing as it is still a new technology is one of the main challenges to SMEs. In addition, the weather conditions in the Arctic are not appealing for skilled workers and professionals to move to work there.

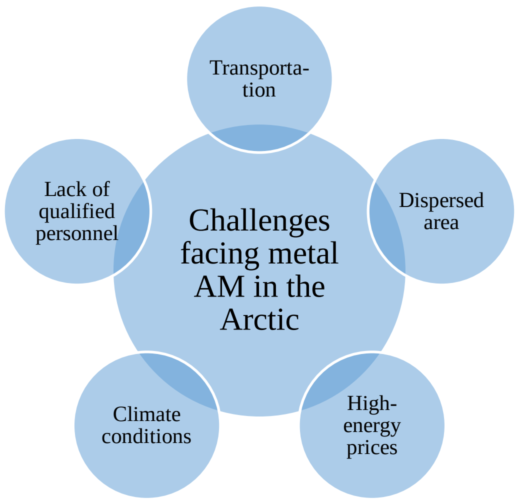

Figure 9: Challenges facing metal AM utilization in the Arctic

2.2. Opportunities

Implementing metal AM by SMEs in the Arctic will be considered a breakthrough for this new technology and a milestone in the history of SMEs in the Arctic. SMEs will benefit from several opportunities when making use of metal AM, such opportunities are:

- Replacing conventional manufacturing methods with metal 3D printing will make SMEs and other industries benefiting from metal 3D printing less dependent on foreign suppliers located in other countries and suppliers who are located far from the SMEs.

This will result in less downtime for many industries in the Arctic during critical situations where spare parts are needed for machines to continue functioning.

- Central governments could offer incentives for SMEs in the Arctic for implementing new technologies such as metal 3D printing. Incentives can be in form of low tax rates on profits and property and land use.
- Political and economic stability in the Arctic play a major role in making the region a competitive investment climate. Moreover, the countries that are part of the Arctic region are famous for having very good living standards, such as Norway, Sweden and Finland, which encourages competent labors to move to these countries for work. In addition, egalitarian values manifested throughout these countries stimulate innovation in different ways in the industry.
- Having a metal AM facility available in the Arctic will trigger closer cooperation between the industry and R&D. This will improve the research activities in metal AM and will improve the technology of AM and related science.

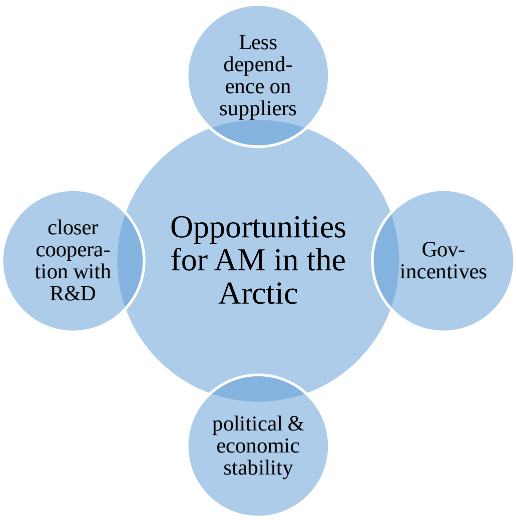

Figure 10: Available opportunities for metal AM in the Arctic

Activity 3 RISK AND RELIABILITY FACTORS

The main operational risk and reliability factors that may influence the local SMEs' international competitiveness are dependent, to some extent, on the technical specification of the available industrial metal 3D printers. The risks and reliability factors affecting SMEs' international competitiveness can be as follows:

- Size Restrictions: 3-D printers are only capable of producing objects smaller than the size of the printer casing. However, Larger 3D printers exist, but they need a large space enough to accommodate their size [6]. Moreover, the cost of a 3D printer increases as its size increases.
- Production time: when it comes to mass production, conventional manufacturing methodologies are preferred over AM technologies. AM technologies are more likely to be used in mass customization manufacturing, as it offers the ability to create highly customized products in limited inventory. However, the speed of a 3D printer can be improved by using higher quality components, optimizing the designs and movement of the lasers [7], and by adding multiple print heads, which all add to the cost of the printer.
- Cost: the price of a metal 3D printer meant for industrial purposes is high. For example, The SLM 500 HL comes between the price range of $1-2 million [8]. However, prices are decreasing and at the same time, technological specifications of 3D printers are improving. Metal 3D printers are not the only component in the AM process that is expensive; rather, the materials required for printing are also expensive. Printing material prices can be reduced by creating competition between companies and finding ways to produce cheaper kinds of it
- Competing with other markets such as China: The Chinese government is playing a huge role in advancing the technology of 3D printers and has committed approximately $245 million to drive the advancement [6]. In addition, the labour cost in china is much lower than the cost in other countries in the Arctic, which leads to more challenging comptetion to SMEs operating in the Arctic.
- Regulations: current rules and regulations need to be pushed forward when it comes to 3D printed parts, as the manufacturing process does not require more than acquiring a CAD model and an available 3D printer. This can lead to societal security risks, such as the incidents where someone can print his/her own weapon [9].

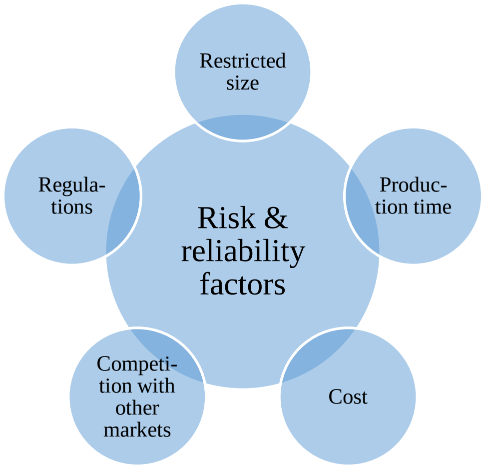

Figure 11: Operational risk and reliability factors influencing SMEs' international competitiveness

Activity 4 BUSINESS MODEL

4.1. GENERALIZED BUSINESS MODEL

A business model describes how a company creates value for itself while delivering products or services to its customers. While new technologies can sometimes be implemented with existing business models, AM technologies are disruptive to the extent that they may require some reshaping or reinvention of the business model in order to capture its value [10].

4.1.1. Business Model Canvas

The business model canvas proposed by Alexander Osterwalder [11] allows us to think of all pieces of a business, not only the sales part or the engineering part, but all parts of a business. The business model canvas can describe any company whether it is a Small Medium Enterprise (SME) or a large-scale company.

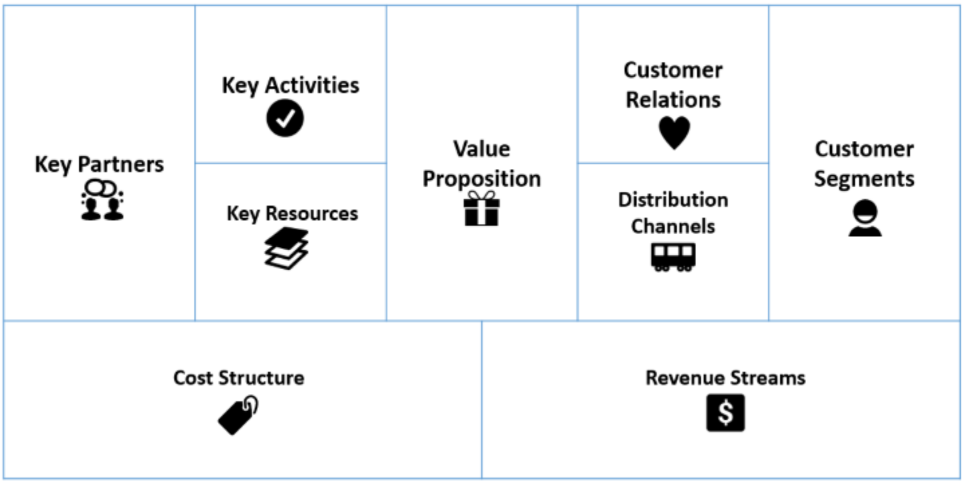

Figure 12:(Business model canvas [12]

The business model canvas consists of nine main blocks, as shown in the figure. A brief description of theses blocks with relation to metal AM technology implementation in the Arctic is provided below:

A. Value Proposition:

The first element to discuss in a business canvas is the Value Proposition. Value proposition is about the importance of the product or the service the company provides. Such product or service must solve a problem or provide a need for the customer. Value preposition answers the question: *What are we building and for who?* In the case of AM, it is not definite that there is a problem in the current manufacturing techniques that needs to be solved, but rather, AM technology takes the manufacturing process to a completely new level. In order to answer the question, features, benefits, and advantages of AM can be listed as follows [13]:

- Freedom of design: AM can produce an object of virtually any shape, even those not producible today.
- Complexity for free: Increasing object complexity will increase production costs only marginally.
- Potential elimination of tooling: Direct production possible without costly and time-consuming tooling.
- Lightweight design: AM enables weight reduction via topological optimization.
- Part consolidation: Reducing assembly requirements by consolidating parts into a single component.
- Elimination of production steps: Even complex objects will be manufactured in one process step.
- Production of spare parts locally.

The mentioned advantages and benefits concern mainly the technical aspects of technology, but there are also other advantages concerning other aspects of implementing AM technology, such as:

- Shortening the manufacturing value/ supply chain: 3-D printing makes it possible for consumers to print their own parts. Simple spare parts will primarily be sold globally by downloading a 3-D printing file. Consumers can become micro-manufacturers.
- Decentralized manufacturing: the technology reduces the need for logistics as designs can be transferred digitally and manufacture them close to the end destinations, which reduces the needs for logistics and the environmental impact [14]. This also reduces the time from production to sale.
- Minimizing Inventories: AM allows having parts printed in remote locations by local distributors and service providers. Therefore, the delivery of goods is no longer a restriction. This results in shipping savings and stockpiling inventory is not necessary. The need for large bulk inventories will be a thing of the past.

B. *Customer Segments:*

It is vitally important in building the business model to define who the customers of additive manufacturing are. The business model is built for SMEs utilizing metal 3D printing in their manufacturing system; those SMEs belong (fully or partially) to 1. The base industry (mining, metal-making, oil & gas, wood, paper, energy), 2. Testing business, or 3. Clean technology products. There are also other targeted sectors, such as transport, machinery, non-metal parts such as polymers, ceramics. The customers are those who benefit from the 3D printing technology utilized by those SMEs. In that case, customers can be segmented as follows:

- SMEs owning the 3D printing facility: The SMEs who utilize and own the metal 3D printing facility can be the customers of their own manufacturing system. These SMEs can print spare parts for their own machines and vehicles.
- Other SMEs: SMEs who work in any of the mentioned above industries or any other industry, and do not own a metal 3D printing facility. These SMEs can benefit from facility utilized by the SMEs owning it in case they needed metal parts to be printed. Therefore, they are considered as customers.
- Large-scale companies: such as oil and gas companies, construction companies, etc., that can benefit from metal 3D printing technology. These companies can be governmental or private companies and they might require few high quality complex parts for their own machines and vehicles.
- Individuals: Individual customers who want to benefit from 3D printing technology on minor scale for their own personal purposes, such as printing cars spare parts, etc.

C. Channels:

Channels represent the gateways to deliver the product or the service for the identified customers. A certain model should be investigated in order to make it accessible for all segments of customers to benefit from metal 3D printing.

Customer can reach the manufacturing facility through internet, either by sending their designs by email or through a specially designed internet platform, where customer upload their designs and preferences and order to print the parts. Consultancy services related to metal AM can be also provided through the same platform.

Customers can also reach the manufacturing facility physically, which can be oriented as a job shop. Job shops present as a practical manufacturing orientation and a distribution channel, especially when the business deal with customized products with relatively small production runs like metal 3D printed parts. Moreover, Job shops can offer a more feasible way to serve as many customers as possible in the arctic region, where communities are located dispersedly. SMEs can together invest in a job shop and set it up in a location where it serves as many customers as possible.

Job-shops should include the 3D printing equipment, machining and tooling equipment for post processing of the produced products and packaging and storage areas if needed. Job-shops can, in cooperation with mail services deliver the printed items upon customer's request.

In a Job-shop's layout, similar equipment or functions should be grouped together, in which 3D printers are located in one designated area, post processing equipment are grouped and oriented according to the flow of the post processing process. The layout has to be designed to minimize material handling, cost, and work in process inventories.

When a design of a part arrives in the job shop through a platform, the part being worked on travels throughout the various areas according to a sequence of operations. Starting with the 3D printer and then through the post processing, packaging, storing and finally delivering to the customer as shown in figure .

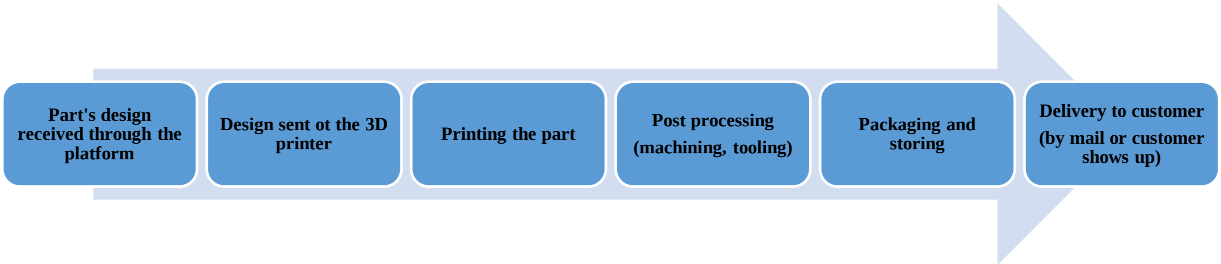

Figure 13: 3D printing job-shop process flow

Employees in a job shop are typically highly skilled craft employees who can operate several different classes of machinery. These workers are paid higher wages for their skill levels. Due to their high skill level, job shop employees need less supervision. Workers may be paid a standard hourly wage or by an incentive system. The role of management is to bid on jobs and to establish prices for customer orders.

Orders received by job shops differ in specifications and lot size; therefore, jobs require accurate costing of labor, materials, and equipment as well as accurate assigning of overhead to the job. Because the job shop makes specialty, custom items, it competes on quality and customer service and not on price.

D. Customer relationships:

The relationship between the customers who were identified in the customer segments part and the SMEs owning 3D printing facilities is s essential to keep the business thriving. Following up with customers after a sale is important to make sure they satisfied with the 3D printed parts. Customers might have views or comments regarding the quality of the product and the post processes including tooling and machining. Feedback from customers helps in improving the quality of the work's processes, which results in improved quality of the 3D printed products.

Customer experience reflects the customers' holistic perception of their experience with a business or brand. According to Hotjar [15], bad customer experience is primarily caused by:

- Long wait/ response times: Which depends on the complexity of the printed part and how much material will be used to print it. The time for a 3D printed part is divided into design time, printing time and machining time. Customers can be informed of how long time each of these phases require for a specific part. For example, the part shown below requires 8 hours for designing, 8 hours and 33 minutes to print one batch, and in case of printing four batches, it requires 16 hours and 30 minutes. The post processing takes approximately 25 minutes.

Figure 14: 3D printed part by C3TS project

- Employees who do not understand customer needs is another reason for bad customer experience. Therefore, employees should be highly skilled in order to understand the technical preferences of their customers.
- Service that is not personalized, which is mostly not the case when utilizing metal 3D printing as the number of items printed by each printer is small and limited, and each printed part has to be designed or redesigned according to customer's needs.

In order to manage a company's interaction with current and potential customers, customer relationship management (CRM) is a well known approach used to achieve that purpose. CRM analyzes the gathered customer's data through specific period and use the analysis to improve business relationships with customers, specifically focusing on customer retention and ultimately driving sales growth Dyché [16]

CRM systems compile customer's data from a range of different communication channels, including a company's website, telephone, email, live chat, marketing materials and more recently, social media, which will help businesses to learn more about their target audiences and how to best cater to their needs.

E. Revenue streams

Revenue streams simply represent the source of revenues of a company or organization. In case of SMEs manufacturing 3D printed metal parts. The stream of revenues is dependent on selling the printed items to the customer, which can describer in other words as asset sale. An asset sale is achieved when the buyer acquires the assets sold by a company Divestopedia [17]. When an SME sells a 3D printed part to a customer. By doing this, the SME sells the ownership rights to the buyer, giving him/ her complete freedom over what to do with the part. This type of revenue belongs to the transaction based revenue model, which is based on what is earned by a transaction from a customer Mars [18].

F. Key resources:

There are many resources that have to be acquired by SMEs who aim to manufacture metal parts using 3D printers and sell produced parts to customers. Key resources can be categorized into four main categories:

- Physical: physical assets include the manufacturing facilities, which comprise mainly the 3D printers, the material used for printing the objects (which is usually metal powder), the building where the job shop is facilitated and the machines and tools used for post processing of the manufactured parts, all of which add up to the overhead cost of the facility. Additive manufacturing can be described as capital-intensive technology as most of the costs are spent during the initial stages of preparing the job shop to start manufacturing the parts. Moreover, point of sale systems and distribution networks come into this category as well.
- Intellectual: Under intellectual resources come the brand of the manufactured items. Job shops can be developed to have their own brand. The reputation of the brand rely on different factors such as the quality of the manufactured items, customer treatment, timely service, price, etc. Moreover, job shops can have their own patents and copyrights for the parts or item they manufacture, which are considered intellectual resources. Partnerships with other SMEs, suppliers, and large-scale companies are important intellectual resources as well as customer databases.

- Human: Additive manufacturing is a creative type of industry and it requires highly skilled and knowledgeable personnel in order to create new designs or redesign parts to be suitable for 3D printing. The human asset is very important to additive manufacturing industry. Furthermore, skilled personnel is needed to deal with customers, listen to their requests and deliver their items.
- Financial: SMEs investing in job shops will require financial capital to invest in infrastructure, buying the 3D printers and metal substances used for manufacturing the parts, hiring the required personnel, and pay for software and systems. SMEs can receive financial support from investors, local authorities and institutions, etc.

G. Key Activities:

Key activities describe the most important actions SMEs must perform to operate successfully, through fulfilling the value proposition of their business model, reaching customer segments, sustaining customer relationships and ultimately create long-term revenue streams. The key activities for SMEs utilizing Additive manufacturing comprise designing or modifying existing designs, manufacturing parts using 3D printers, and delivering parts in substantial quantities and/or of superior quality.

H. Key partners:

SMEs might not own all the resources related to all additive manufacturing activities. Therefore, SMEs tend to have deals with partners and suppliers. Example of suppliers could be the 3D printer suppliers, metal powder suppliers, software and systems suppliers, maintenance contracts suppliers, which could be the same suppliers of the 3D printers and the other machines required to complete the manufacturing process. SMEs can have partnerships with mail delivery services companies to deliver the manufactured parts to customers, which can described as a strategic alliance type of partnership.

A Job-shop is a joint venture type of partnership between SMEs to develop new businesses. This type of partnership is common when there is a mutual interest between companies in developing new business, possibly due to the emergence of a new market, like additive manufacturing or access to a new geographic area, such as the Arctic. A joint venture between SMEs can be more profitable than in case they were to operate separately.

Moreover, local authorities (municipalities) can be considered as partners in supporting and encouraging the implementation of metal AM technology in the Arctic. New investors in the northern region can be attracted to support metal AM and benefit from it, especially investors in mining industry and energy sector. In addition, universities, academic institutions and research parks in the Arctic are essential partners in R&D and improving the implementation of metal AM technology.

I. *Cost structure:*

Cost structure can be divided in to cost-driven and value-driven structures. Cost driven business models focus on minimizing costs whenever possible. This approach aims at creating and maintaining the leanest possible cost structure, using low price value propositions, maximum automation, and extensive outsourcing [19]. Value driven business model focuses on value creation rather than the costs of manufacturing the product. High degree of personalized service usually characterize value-driven business models.

Additive manufacturing cost structure can be thought of as a combination of both types of cost structures, cost-driven and value-driven. Cost plays an essential role in additive manufacturing, which technology developers try to decrease. The high costs of AM are due to the high price of the 3D printers, printing material (metal powder), and high skilled personnel. For example, manufacturing one patch of the part shown in figure1 costs 660 Euros, while manufacturing four patches of the same part costs 1,320 Euros, which is considered quite high compared to other manufacturing technologies. However, additive manufacturing can help reducing the amount of material wasted during the manufacturing process compared to conventional methods. Moreover, AM allows for manufacturing personalized objects, which means that the cost structure is leaning towards the value driven cost structure.

General business model Canvas for SMEs implementing metal additive manufacturing/ 3D printing in the Arctic

<table>
<tr><th>Key partners</th><th>Key activities</th><th>Value proposition</th><th>Customer relationship</th><th>Customer segments</th></tr>
<tr><td rowspan="3">SMEs.
3D printers suppliers, metal powder suppliers, software and systems suppliers,
maintenance contracts suppliers.
Mail delivery service providers
Investors in the northern regions.
Local authorities (municipalities).
Individuals.
Academic institutions.
Research Parks (Forskningsparker) in the Arctic.</td><td>Design and manufacturing of 3D metal printed parts.
Solutions for designs of complex parts.
Modifying designs to be compatible with 3D printing.
Delivering parts in substantial quantities and/or of superior quality</td><td rowspan="3">3D printing technology is evolving and becoming viable.
3D printing provides high quality metal parts.
The implementation of metal 3D printing in the Arctic will help in decreasing the downtime resulting from lacking spare parts for machineries and equipment. Thus, decreasing monetary losses.</td><td>Provide metal 3D printed parts.
Provide after sales services.
Design according to customer demands.
Offer various engineering solutions.
Consultancy services related to metal 3D printing.</td><td rowspan="3">SMEs owning the 3D printing facility.
Governmental and private SMEs and large-scale companies in mining, metal-making, oil & gas, wood, paper, energy industries.
Testing business.
Clean technology products.
Sectors such as transport, machinery, non-metal parts such as polymers, ceramics
Individual customers.</td></tr>
<tr><th>Key resources</th><th>Channels</th></tr>
<tr><td>Expertise of staff.
Network.
Design and manufacturing of metal parts.
Sales and marketing resources.
Financial support by the SMEs and/ or investors, institutions, local authorities, etc.</td><td>Reaching customers through an internet platform or email
Direct sales of manufactured parts at Job shops.
Delivery of manufactured parts through mail services
Sales of consultancy services.</td></tr>
<tr><th colspan="2">Cost structure</th><th colspan="3">Revenue streams</th></tr>
<tr><td colspan="2">The cost structure should be in a balance between value-driven and cost-driven. The aim is high quality resources at competitive prices.</td><td colspan="3">Direct income from sales.
Direct income from consultancy services.
R&D activities.</td></tr>
</table>

4.2. Tailored business models

Partner companies have been contacted in order to create tailored business models for them and to study the challenges and opportunities they might face in case they would invest in metal AM technology. Unfortunately, only few of them responded. UiT prepared the following questionnaire in order to simplify the process of data collection from these companies.

General information about the SME:
Name of the SME:
Location:
Type of Industry:
A. Value preposition
1. Is the 3D printing/ Additive Manufacturing technology going to be used to print parts for the company's activities? Or are the 3D printed parts going to be sold or rented out to other customers?
2. What is the type of parts that are going to be manufactured using AM? What is/ are the targeted part(s) used for?
3. What is the cost of manufacturing (using conventional methods)/ ordering such part (s)?
4. How often do you require new parts? What is the rate of consumption of those parts? (no. of parts per year) – life time of the parts.
B. Customer Segmentation:
5. Who are your customers and what type of Industry do your customers have?
C. Channels:
6. If the printed parts are going to be sold, how are your customers being reached? Physical stores, by mail, etc.?
D. Customer Relationships:
7. How do you get, keep and grow customers?
E. Revenue Streams:
8. Does the company earn its revenues from direct sales of its products, or are there services that the company provide to its customers? Like consultation services.
F. Key Resources:
9. What are the main key resources to your company? (Physical, Intellectual, Human, Financial)

G. Key Activities:
10. How does the company fulfill its value proposition?
11. How does the company reach its customers?
12. How does the company sustain its customer's relationships?
H. Key Partners:
13. Who are the company's main partners and suppliers?
I. Cost Structure:
14. Is the cost structure of the company cost-driven or value-driven?
J. Maintenance and Logistics Challenges
15. Where are the suppliers of such part(s) located? (Inland, outland)?
16. How long does it take from the moment you order the part(s) until you receive it/them (downtime)?
17. In case of implementing AM/ 3D printing, will you let go of some of your suppliers?
18. What are the implications imposed by the failure of the part(s)? Could be down time, shifting to costly solutions, etc.
19. Are there any challenges that the company might face when acquiring their parts and products? Whether the company buys those products or manufacture them?
K. Market Challenges
20. Do you have other competitor companies that provide the same service you provide or produce the same products you produce in the Arctic region?
21. Based on the understanding of AM and 3D printing, what are the aspects and needs does AM provide for the company?
22. Knowing that a 3D printer costs ,,,,, and the cost of printing such parts is ,,,, do you think it is viable to implement AM in your industry in the arctic region?

UiT has contacted the following partner and non-partner SMEs throughout the project, seen in the table below:

Tabell 2: Companies UiT contacted throughout the project to build business models

No.	Company name	Contact person	Date and means of communication
1	Subsea7	Yngve Vassmyr, Manager Tromsø office	Personal meeting in January 2019 contacted via phone multiple times in April, May, June, August 2019, met personally September 2019
2	NFTR Næringsforeningen i Tromsøregionen	Emilie, Stavanger Office	Contacted via phone April 2019
3	Maritim Sveiseservice	Roar Karlsen	Personal meeting in January 2019 Contacted via email, March 2019
4	Norinnova Technology Transfer Tromsø		Contacted via email, March 2019
5	Norut Narvik	Terje Nordvaag	Contacted via email and phone, April 2019
6	Kjeller Vindteknikk	Øyvind Byrkjedal Research and Development Manager	Via phone April 2019, Skype meeting April 2019
7	Trio Oiltec Services Castoline	Jill Sømme	Skype meeting in August 2019 Via email in May and June 2019
8	NaSTech AS	Eman Khalil, Narvik	Personal meeting in September 2019
9	Saltvik Plogen AS	Ole Saltvik	Personal meeting in October 2019

Based on the data collected from three companies, which are:

- Trio Oiltec Services/ Castoline
- Subsea 7 Co.
- NaStech AS
- Saltvik Plogen AS

UiT was able to create the following three tailored business model canvases:

Business Model Canvas for Trio Oiltec Services/ Castoline.

<table>
<tr><th>Key partners</th><th>Key activities</th><th>Value proposition</th><th>Customer relationship</th><th>Customer segments</th></tr>
<tr>
<td rowspan="3">Statoil
GE Oil & Gas
National Oilwell Varco
Archer
Halliburton
Aker Solutions
FMC Technologies
Schlumberger
Baker Hughes
Weatherford
Vetcogray

Sub-suppliers in Northern Norway are:
Mo mek
Acustus (Sørfold)</td>
<td>Producing metal components for oil and gas industry, such as Drill bits, cutter wheels & drill bits, using C.N.C. lathes and milling machines.
Reverse engineering of components.
Refurbishment and reclamation of damaged components.
Wear testing services.</td>
<td rowspan="3">Producing a full range of components for oil and gas companies, with the highest quality finish.

Components are fully tested and certified with traceable ISO documentation

Can deliver refurbished components superior to original specification.

Can re-machine, coat and finish components in remarkably short turnaround times, thus saving down time.</td>
<td>Have vast experience and are always ready to offer advice and guidance.

Offering 24 hours service on mechanical breakdowns.
Carry out the work quicker, with high quality.

Saving down time and additional expenses.</td>
<td rowspan="3">providing products and solutions to the following companies located in Northern Norway:
Celsa,
Glencore and Rana metall in Mo i Rana,
Elkem Salten,
Norcem Kjøpsvik and
LKAB Narvik.

Generally, the oil and gas companies.</td>
</tr>
<tr><th>Key resources</th><th>Channels</th></tr>
<tr>
<td>Highly trained technicians with vast experience.

Physical assets: C.N.C. lathes and milling machines, hard-banding test machine and advanced welding and coating technologies.</td>
<td>Reaching customers via website through a 24 hours/7 days a week SERVICE.

Direct contact through sales of produced components.

Direct contact through sales of consultancy services.</td>
</tr>
</table>

<table>
<tr><th>Cost structure</th><th>Revenue streams</th></tr>
<tr><td>It is recommended that this business starts as a value-driven then switches to cost-driven when well established. The aim is high quality resources at competitive prices.</td><td>Direct income from sale.
Direct income from repair services.
Direct income from consultation services.</td></tr>
</table>

Business Model Canvas for Subsea 7 Co.

<table>
<tr><th>Key partners</th><th>Key activities</th><th>Value proposition</th><th>Customer relationship</th><th>Customer segments</th></tr>
<tr>
<td rowspan="3">International partners like:
Equinor Co.
Shell Co.
OneSubsea Co.
Aker BP Co.
Woodside Co.
Saipem Co.
Rystad Energy Co.
i-Tech 7
Seaway 7

State government.

DNV and other insurance companies.</td>
<td>Design, engineering, procurement, construction, installation, and decommissioning of highly complex offshore oil and gas infrastructures and offshore wind farms under challenging environments.
Inspection, repair and maintenance of offshore structures.</td>
<td rowspan="3">Providing full energy lifecycle services to clients, from early engineering to decommissioning.

Provide cost-effective technical solutions to enable the delivery of complex projects in all water depths.

Lowering the costs for clients through risk management and optimized work schedules.</td>
<td>Design according to client demands.
Offer various engineering solutions.
Carry out the work quicker, better and more economically though digitization.
Reduce the total cost of energy production for the clients.</td>
<td rowspan="3">Northern region industries.
Wind energy industry.
Local authorities.
Central governments
Oil companies.

Private companies and customers for the design and construction of offshore engineering systems and consultancy services.</td>
</tr>
<tr><th>Key resources</th><th>Channels</th></tr>
<tr>
<td>Government subsidies for offshore wind energy projects.

Intellectual property of design.
Physical assets: Remotely Operated Vehicles (ROVs), tooling products and chartered life of field vessels.</td>
<td>Reaching customers through website and social media.

Networking with governments and energy sector community.
Direct contact through sales of consultancy services.</td>
</tr>
<tr><th colspan="3">Cost structure</th><th colspan="2">Revenue streams</th></tr>
<tr>
<td colspan="3">It is recommended that this business starts as a value-driven then switches to cost-driven when well established. The aim is high quality resources at competitive prices.</td>
<td colspan="2">Direct income from investments.
Direct income from consultancy services.
Lease of equipment to investors and other customers.</td>
</tr>
</table>

Business Model Canvas for NaSTech AS.

<table>
<tr><th>Key partners</th><th>Key activities</th><th colspan="2">Value proposition</th><th>Customer relationship</th><th>Customer segments</th></tr>
<tr><td rowspan="3">Forskningsparken i Narvik.
Norske hydrogen forum.
Statoil.
Avinor.
Nordkraft vind.
Vindkraft companies.
Investors in the Northern regions.
Oil companies.
Local authorities (Kommune).
Aviation and FC companies that do not have technology.
Individuals
Academic institutions.</td><td>Sales of Hydrogen and establishment of hydrogen refueling stations.
Design and manufacturing of energy saving systems such as solar, wind, fuel cells and thermal systems.
Solutions for energy efficiency optimization such as heat recovery, waste treatment for energy production and district heating
Standard engineering solutions.</td><td colspan="2" rowspan="3">Hydrogen economy is evolving and becoming viable. The introduction of hydrogen fueled fuel cell cars will increase the demand for hydrogen and hydrogen fueling stations.</td><td>Provide Hydrogen for fuel cell cars.
Provide equipment.
Provide after sales services.
Design according to customer demands.
Offer various engineering solutions.
Consultancy services in the energy technology sector</td><td rowspan="3">Owners of Fuel cell cars and installations (Individuals and companies).
Operators of fueling stations
Northern region investors.
Wind energy industry.
Private companies and customers for the design and fabrication of engineering systems and consultancy services.
Any company or clients that need technology services.
International customers.</td></tr>
<tr><th>Key resources</th><th>Channels</th></tr>
<tr><td>Expertise of staff
Network
Design and manufacturing assets (to be acquired in due course).
Sales and Marketing Resources
Financial support from NFR, Skattefunn, fpn and Innovasjon Norge … etc.</td><td>Reaching customers through web and networking with research and business community.
Direct sales of equipment.
Direct cost of installation and setup services.
Direct cost of design and manufacturing.
Sales of consultancy services.
Online and offline channels</td></tr>
<tr><th colspan="3">Cost structure</th><th colspan="3">Revenue streams</th></tr>
<tr><td colspan="3">It is recommended that this business starts as a value-driven then switches to cost-driven when well established. The aim is high quality resources at competitive prices.</td><td colspan="3">Direct income from sales.
Direct income from consultancy services. (technology consulting)
R&D activities.</td></tr>
</table>

Business Model Canvas for Saltvik Plogen AS.

<table>
<tr><th>Key partners</th><th>Key activities</th><th>Value proposition</th><th>Customer relationship</th><th>Customer segments</th></tr>
<tr><td rowspan="3">Forskningsparken i Narvik.
UiT the Arctic University of Norway
Steel companies
Local authorities (Kommune).
Car companies (Trucks and heavy vehicles)
industrial companies
Steel welding and tooling companies</td><td>Developing and manufacturing of snowplows.

Manufacturing the Parallelogram device for the snowplows</td><td rowspan="3">Manufacturing reliable equipment that works optimally all the time.

Manufacturing different types of snowplows that suit different types of vehicles.

Giving low repair costs and, not least, the lowest lifetime cost.</td><td>Provide equipment (Snowplows).
Provide after sales services.
Design according to customer demands.</td><td rowspan="3">Local authorities (Kommune).
Research institutions.
Road authorities.
Private companies and customers for who want to buy snowplows.</td></tr>
<tr><th>Key resources</th><th>Channels</th></tr>
<tr><td>Design and manufacturing assets.
Sales and marketing resources.
Expertise of staff
Intellectual asset through the brand (Saltvik) of the snowplows.</td><td>Reaching customers through web, email and phone.

Through direct sales of snowplows.</td></tr>
</table>

<table>
<tr><th>Cost structure</th><th>Revenue streams</th></tr>
<tr><td>It is recommended that this business starts as a value-driven then switches to cost-driven when well established. The aim is high quality manufactured parts at competitive prices</td><td>Direct income from sales of snowplows, parallelogram and related equipment.
Direct income from after sales services</td></tr>
</table>

Activity 5 MARKETING AND COMMERCIALIZATION STRATEGY

Marketing and commercialization strategy development is a dynamic process that is impacted by many factors. In developing a marketing and commercialization strategy for new technologies, four main decisions must be made in early in the strategy development that will lay the foundation for other decisions to be made: segmentation, target market selection, positioning and branding [20].

5.1. SEGMENTATION:

In segmentation, SMEs are required to have a clear understanding of the customers present within the market of metal AM in order to create groups of customers who share the same needs. In other words, a defined segment includes the customers who have similar needs, whereas customers that are categorized in different segments have different needs. Segmenting the market will help SMEs to be able to address the specific needs of each subgroup through unique marketing strategies that deliver the value desired by each segment.

It is important for SMEs, in segmenting the market of metal AM, to define the appropriate segmentation base that will allow SMEs to understand the different needs customers have with respect to the technology of metal AM. In addition, it is important to understand who the customer is for metal AM. For example, SMEs can target individuals as one of the customers segments, which implies selling the manufactured parts in a *business-to-consumer* context. In that context, it may be more appropriate to segment customers based on their geographic location, demographic, or consumer lifestyle, etc. [21].

In case of *business-to-business* context, which is usually the case when it comes to metal AM technology, SMEs may segment their customers based on several factors, such as

- Business size: Small and medium enterprises or large-scale companies?
- Usage rate: How often are the manufactured parts needed?
- Product application: Spare parts for vehicles and machines for example.
- Industry type: Oil and gas, construction, mining, maritime, etc.
- Geography: Dispersed locations such as in the Arctic.

The next task after segmenting the market is to ensure that there is a sufficient opportunity present through evaluating different groups of customers by following a criterion that consists of *measurability* and *substantiality*. Measurability indicates the size and purchasing power of a customers' segment. It is important for SMEs in the Arctic to have a clear indication of what the potential payoff of a segment will be. This leads to the second part of the criterion, which is substantiality and it implies investigating whether the segment is substantial enough to warrant the investment, in metal AM, required to market to that segment [20]. For example, it might be more substantial to market the application of metal AM to the segment of oil and gas companies than any other segment in Norway. Furthermore, it is important to estimate the market potential of different segments before investing in metal AM technology. This can be done by estimating the size and growth of the oil and gas companies segment for example.

5.2. TARGET MARKET SELECTION:

There are three main traditional approaches for targeting markets: mass marketing, differentiated marketing, and niche marketing [22]. In mass marketing, also known as undifferentiated marketing, the whole market is treated as one segment with no subgroups. In other words, all customers in mass marketing approach have similar needs and desires with respect to the technology of metal AM.

In mass marketing, the same product is commercialized to all customers with the same price and the same channels are used to reach all customers. In case of metal AM, the products are customized according to customer's needs and desires. Therefore, price of each manufactured part differs depending on the design complexity of the metal part, the technology and material used. In addition, the price depends on the number of manufactured batches of the same part. The use of mass marketing in its traditional concept is not preferred when it comes to hi-tech or customized products.

In case of differentiated marketing, SMEs segment their customers based on their needs and characteristics. The characteristics and needs of customers within each segment must be similar, while they differ across different segments [23]. After segmenting the market, SMEs will develop a unique marketing mix based on the characteristics of the customers within the segments they are pursuing. In that case, SMEs can market metal AM technology for industrial companies such as oil and gas, construction and mining, etc. Such industries have their own standard designs regarding the metal parts they require to be manufactured using metal AM. Furthermore, they order their parts on frequent bases, which gives more stability to the market. On the other hand, individual customers represent another segment that can benefit from metal

AM technology. However, that segment is not appealing for SMEs since individual customers do not order parts frequently, bearing in mind that individual customers do not possess the purchasing power industrial companies possess, considering the cost of manufacturing using metal AM.

Niche market, also known as concentrated market, focuses on a unique target market. Instead of marketing to all industries who could benefit from metal AM [24]. SMEs can focus on marketing the technology exclusively for oil and gas companies for example, which might benefit from metal AM more than other industries. This however, will limit the potential metal AM has, which is manufacturing metal parts no matter how complex they are for all types of industries.

5.3. POSITIONING

The third decision that has be made by SMEs in the Arctic regarding developing a metal AM marketing and commercialization strategy is positioning, which reflects how the technology of AM is perceived by the targeted segments in the market. Positioning implies why customers should replace conventional manufacturing systems they are used to, which are mostly based on subtractive methodologies and start depending on metal AM to manufacture the metal parts they need.

Several positioning strategies can be used to distinguish metal Am technology from other existing manufacturing technologies. These include the attributes of the technology itself, the value (i.e., price vs quality), and the characteristic of manufactured parts, which were mostly demonstrated within the discussion related to the value proposition part of the business model canvas in Activity 4 in this report.

5.4. BRANDING

SMEs utilizing metal AM technology and offering it to customers in the Arctic region market should have their own brand. Having own brand helps in differentiating SMEs' products from other competitors in the market. Having an effective brand gives many advantages to SMEs like higher recognition, increased customer awareness and increased perception of product quality and brand loyalty. It is noteworthy to mention that SMEs should not only focus on the features of the parts they manufacture but rather should provide an overall message about the company. An SME's name, logo, website are important parts of the brand. It should be remembered that a name alone means nothing to the customer rather it is the experience created and delivered consistently over time that adds value and builds trust.

In the following is a learning loop that concludes the four main decisions SMEs in the Arctic should consider when developing a marketing and commercialization strategy for metal AM technology.

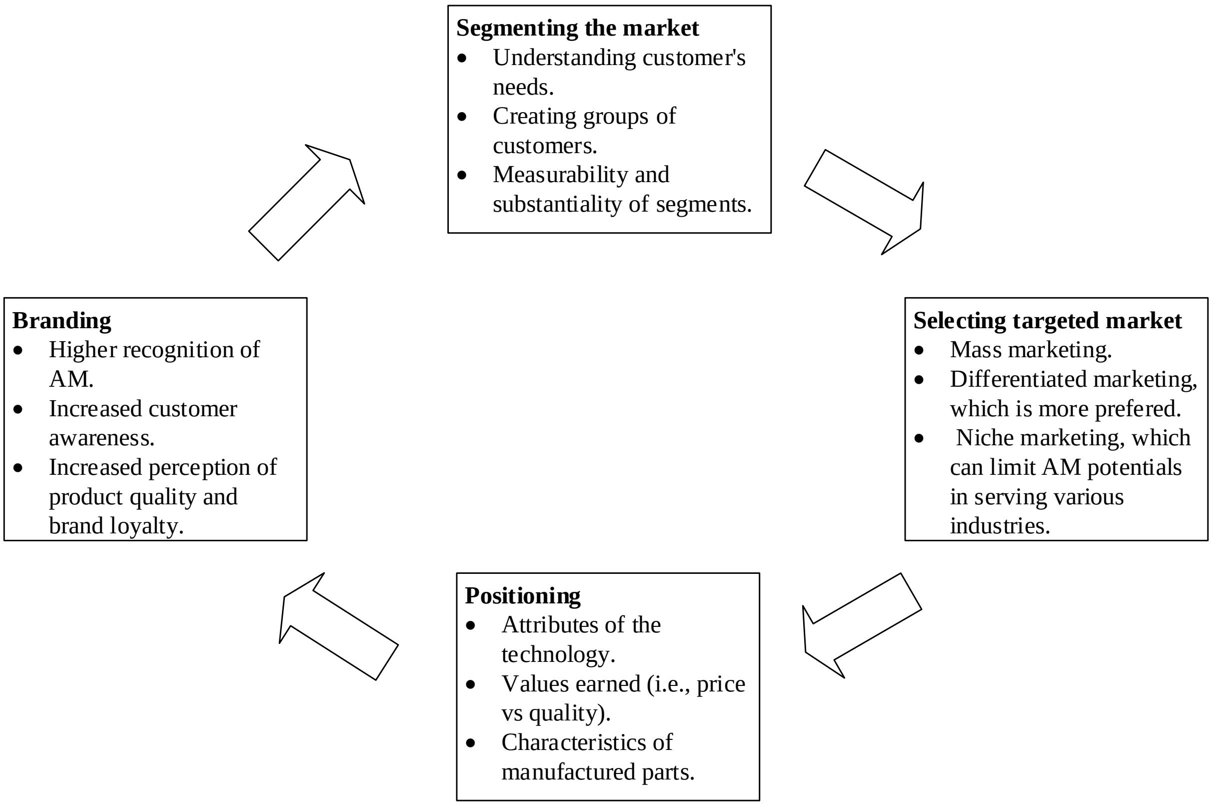

Figure 15: Learning loop for marketing and commercializing metal AM in the Arctic

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