LAPPEENRANTA-LAHTI UNIVERSITY OF TECHNOLOGY LUT
School of Engineering Science
Degree Programme in Industrial Engineering and Management

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EVALUATING BUSINESS MODELS FOR HEAT PUMP PROJECT DELIVERY

Master's Thesis

Examiners: Associate professor Jouni Koivuniemi
Professor Janne Huiskonen

ABSTRACT

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Evaluating business models for heat pump project delivery

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Worlds concerns of carbon dioxide emissions have created wholly new market called decarbonization market. It consist of investment projects towards lowering emissions in any way possible. World is searching valuable ways to get rid of the high emissions of burning something and one way could be electrification. When producing heat through electrification a heat pump can be seen a valuable tool to produce it. Heat pump offers efficient way to produce heat with electricity and the technology has reached high maturity state.

This study is conducted on behalf of case company who offers services for energy production. The aim of the study is to get good knowledge of the decarbonization market and especially heat pump market to develop case company's business. The purpose of the study is to create a good base knowledge of business models features to offer decarbonization projects for customers making their energy production more efficient and emission free with heat pumps.

This study is conducted as a qualitative research, but it has quantitative parts like market research and case company's individuals opinion of change in the business model. Literature review and market analysis is made for gaining a knowledge of the market and business models. Customer interviews are made to gain a knowledge of the customer need. This thesis aims to find out how to create customer value and capture value in different business models chosen for evaluation. As a conclusion it gives case company's management team a decision making material how to develop the business model in context of heat pump project and service delivery.

The literature review revealed that in changing and developing market such as decarbonization market technologies and actors are changing fast and uncertainties are really high. The interview results showed that customers are interested in emission reduction in many ways and see that there is a huge need to electrify heat production, but are not interested in investing it if they see other sources more relevant economically. The individual evaluation of different business models revealed that there is a clear view that business model of the project delivery should be further developed. The potential of electrification in heat production through heat pumps is really high, but still has its disadvantages that should be developed further on.

TIIVISTELMÄ

Lappeenrannan-Lahden teknillinen yliopisto LUT
School of Engineering Science
Tuotantotalouden koulutusohjelma

Henri Häyrinen

Liiketoimintamallien arviointi lämpöpumppuprojektien toimitukselle

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Maailman huoli hiilidioksidipäästöistä on luonut kokonaan uuden markkinan nimeltään hiilenpoisto markkina. Se koostuu investointiprojekteista jotka tähtäävät päästöjen vähennykseen jokaisella mahdollisella tavalla. Maailma etsii tapoja vähentää polttamisesta johtuvia päästöjä ja yksi mahdollinen suunta on sähköistäminen. Sähköllä tuotettavan lämmön hyväksi vaihtoehdoksi on löydetty lämpöpumppu. Lämpöpumppu tarjoaa tehokkaan tavan tuottaa lämpöä sähkön avulla ja sen teknologia on saavuttanut korkean maturiteetin.

Tämä diplomityö on tehty kohdeyritykselle joka tarjoaa palveluita energian tuotantoon. Diplomityö tähtää kasvattamaan ymmärrystä hiilenpoisto markkinasta ja erityisesti lämpöpumppu markkinasta kehittääkseen kohdeyrityksen liiketoimintaa. Diplomityön tarkoitus on luoda hyvä tiedon pohja liiketoimintamallien ominaisuuksista, kun tarjotaan hiilenpoisto projekteja asiakkaille jotta pystytään muuttamaan heidän energiantuotantoansa tehokkaammaksi ja päästöttömäksi lämpöpumppujen avulla.

Tämän diplomityön tutkimus on tehty laadullisena tutkimuksena, mutta osa siitä on myös määrällistä tutkimusta, kuten markkinatutkimus ja kohdeyrityksen arviointi liiketoimintamallin muutokseen. Kirjallisuus ja markkinatutkimus on tehty tiedon saamiseksi markkinasta ja liiketoimintamalleista. Asiakashaastattelut on tehty tiedon saamiseksi asiakastarpeista. Tämä tutkimus tähtää tietämykseen miten luodaan ja kaapataan arvoa eri liiketoimintamalleissa jotka on valittuna arviointiin. Työn tuloksena on päätöksentekomateriaali kohdeyrityksen johtoryhmälle miten liiketoimintamallia tulisi kehittää lämpöpumppujen projekti ja palveluiden toimituksessa.

Kirjallisuuskatsaus toi esille, että muuttuvassa ja kehittyvässä markkinassa, kuten hiilenpoisto markkina teknologiat ja markkinaa muuttavat tekijät muuttuvat kovaa tahtia ja epävarmuustekijöitä on todella paljon. Haastattelut kertoivat, että asiakkaat ovat kiinnostuneita päästöjen vähennyksistä monin eri keinoin, mutta eivät ole kiinnostuneita investoimaan niihin teknologioihin, jos näkevät muut keinot parempina taloudellisesti. Yksilöarvioinnin perusteella projektitoimituksen liiketoimintamallin kehittäminen on tarpeellista. Sähköistämisen potentiaali lämmöntuotannossa nähdään todella korkeana, mutta sillä on vielä huonoja puolia joita tulisi kehittää jatkossa.

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I wish to thank my family. They have supported me throughout my studies. At last, I'm grateful for my friends who have given valuable discussion on the subjects concerning my studies and this master's thesis.

Helsinki, 10.6.2021
Henri Häyrinen

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1 INTRODUCTION

World is constantly more concerned about carbon emissions. Communities like EU (2018) are committed to Paris climate agreement and are targeting net-zero greenhouse gas emissions by 2050. In order to meet the targets of Paris agreement Europe's power production needs to go through a huge transition. Communities are seeking new ways to produce renewable energy and make the energy system reliable. Energy sector is not the only one where carbon emissions from burning are concerned. There is also other industry sectors where different kinds of fuels are burned and the produced heat is not used efficiently. Huge amount of waste heat from industrial processes is released to atmosphere without reusing it.

Europe (EU, 2018) is targeting emission reduction of 40% by 2030. In order to reach the target it means reducing the use of coal in power production (Alves Dias P. et al., 2018). Coal is one of the nonrenewable fuels used in power production, but it is seen one of the most polluting fuel in terms of carbon emissions. Shutting down coal and other non-renewable plants makes a gap in power production especially in heat production, where heating constitutes almost half of the European energy consumption (Amer-Allam S.B., Münster M., Petrovic S., 2017).

Companies are developing different solutions to produce heat in a sustainable way. Large scale heat pumps are seen as an opportunity to produce heat in district heating (DH) (Amer-Allam S.B., Münster M., Petrovic S., 2017) and also in industrial processes (Kirillova T., 2018). Large heat pumps in DH production have several benefits: they can consume renewable electricity when renewable electricity production is high and produce heat to replace production of combustion boilers (Lund R., Persson U., 2016). They use primary heat source from water sources, air and industrial waste heat. Heat pumps can be used also to make industrial processes more efficient by using waste heat and circulate it together with heat pumps back to the process.

This master's thesis is conducted on behalf of case company (further on company or the company), who is providing energy services for energy and industrial sector. Case company is developing new ways of power production and offering also heat pump delivery projects together with lifecycle solutions. Delivered projects aim to develop customer heat production more sustainable and efficient. There can be seen also opportunities to provide solutions for

industrial processes. Value creation of the case company is relying on services provided together with project delivery. Case company is seeking new opportunities to create customer value through new services and adding products to the offering.

1.1 Objectives and scope

This study examines decarbonization market and the factors affecting its future. Case company is seeing opportunity in heat pump solutions and have an invention on developing the business model when offering these solutions. Case company has a background delivering complex projects, but the market is new. There is seen a need to develop the business model and think about the opportunities in whole value chain of delivering heat pump projects. The development of current business model and customer value creation are the main objectives for this thesis. This master's thesis seeks answers for four research questions. Next, each research question is presented and further discussed.

How do each business model approach create value?

Business models for the study were chosen through discussion and they are studied through their value creation models. Especially need for a view how value is created in current model and what would the new business model approaches bring to the current business model. Value creation models are discussed and evaluated in different workshops. This study explores the evaluation framework and value creation in different business model approaches.

What are the benefits of each business model approach?

Benefits of each approach are explored through value capturing on each segment of created customer value. Some aspects for viewing benefits in this study are sustainability, market potential and value capture opportunities. Case company's desire to create value through own competence of expertise, but also want to expand to long term relationships with customer through added services and aftersales products. Digitalization in terms of project delivery and lifecycle solutions is seen as a helping tool to lower own risk and provide more reliable services.

What is the customer need regarding heat pump projects and services?

Customer need is explored through semi-structured interview and market analysis. Interviews try to get a clear view on how different customers are trying to implement decarbonization in their business and what choices have they found. Market analysis is a combination of different forecasts to find out how market is changing and what choices there is for different technologies in different industries. In this study customer need is explored through qualitative interviews and quantitative market analysis and prediction.

How to create competitive advantage in each business model approach?

Different business models have different competitive advantages. This study explores and compares two sections of competitive advantage, comparative advantage and differential advantage, in selected business models. Comparative advantage is the case company's ability to produce products and services more efficiently than rivals. Differential advantage can be seen as a choice of technology and quality of products and services compared to rivals.

1.2 Execution and research methods

This master's thesis consists of theoretical and empirical part. This study helps to identify market opportunities, business model approaches, value creation and evaluation. Outcomes are evaluated, compared and analyzed in this study.

The theoretical section in the study is conducted through literature review and market analysis reports. The theoretical section gives guidelines for evaluating different business models and giving good information of the market. Heat pump market review is explored to provide good understanding of the operational environment and different technologies. Theory of business models and value creation give a background for the empirical part of the study. The main sources of theoretical section are scientific publications, books, expert interviews and market studies.

The empirical section of the study is conducted as combined qualitative and quantitative research. Most of the study is conducted as qualitative research which is supported by quantitative market data. Qualitative research is based on customer interviews and workshops held for business model evaluation. Evaluation models are a combination of theory, case company's traditions and own innovation to help exploring the value creation and benefits of each business model. Market study is a helping aspect for evaluating different approaches, for example growth potential of different technologies or solutions can be used to evaluate attractiveness of the business models.

Qualitative research tries to understand the subject from customer's and case company's perspective. Qualitative research is concerned with both the customer's and the case company's experts thoughts and experiences. Qualitative research offers a good view of how people see company's current state and how customers are expected to create value. Theory of business models and value creation support qualitative research by combining evaluating methods to collected data.

Workshops for this study were conducted in the first quarter of 2021. Workshops were held internally and people from management team were involved. People had expertise from sales, business development and business management. Workshops were divided to two main subjects which were business model change and business model evaluation. In the first part the current business model was evaluated and two new models were discussed. In the second part all three models were evaluated through my own created score card. These workshops gave the guidelines for choosing strategic options how the current model should be developed.

Customer interviews were conducted in March 2021. People from three different companies were interviewed. Interviews were semi-structured and the main point on these was to see how customers see the investments to decarbonization technology, not only to heat pump technology. Semi-structured interview was seen the most suitable for this study's purposes. Subjects for interview discussion were technical feasibility and financial aspects for investments.

1.3 Structure of the thesis

Content and structure of the master's thesis is presented in table 1. There are eight main chapters in the thesis. Contents of inputs and outputs in each chapter are described in the table. Input column describes the information that is processed in the chapter and output column describes the information that is produced in the chapter.

Table 1 Structure of the master's thesis

Input	Chapter	Output
Objectives of the thesis	Introduction	Introduction of the topic, research questions and description of the research methods
Decarbonization market aspects and heat pump market analysis	Decarbonization through heat pumps	Clear view for heat pump market potential and what aspects are affecting it
Theory of business model innovation, value creation and value capture.	Business model	Theoretical outlook for business models (BM), BM innovation
Theory of business model evaluation and chosen tools	Business model evaluation tools	Theoretical outlook and chosen tools for business model evaluation
Chosen business model approaches	Business model approaches in project delivery	Introduction for chosen business models for this study
Value creation, value capture and tackling of market barriers in chosen business models. Customer interviews.	Customer value creation	Discussion of value creation, customer view for value creation and value capture
Data and discussion of workshops held.	Business model evaluation	Outlook how business models were evaluated during the study
Combined results of the study	Discussion and conclusions	Discussion of the findings and answers to research questions

Study consists of three theory chapters where business models and future of the decarbonization market is discussed. In chapter two decarbonization market, especially through heat pumps is discussed. Chapter contains also a view for heat pump market future until 2027 in Nordics, Germany and UK. Market review leans on purchased and open reports which will give an

overview how big the market is, how it is expected to change and what are the drivers behind it. In chapters three and four business models are discussed. Chapter three focuses on business model theory and chapter four business model evaluation what can be used and is used in the study.

Empirical part of the study consists of three chapters starting from chapter five. Chapter five goes through selected business models in the study and how these were chosen for the study. In the second empirical chapter value creation and customer view is discussed. Value creation is studied through theoretically and empirically through workshop discussion. Customer view for this chapter is captured during interviews. In chapter seven results of business model evaluation is presented and results are discussed. Finally, in the last chapter discussion of whole study, it's results and answers to research questions are presented. Also futuristic view for business model development is discussed.

2 DECARBONIZATION THROUGH HEAT PUMPS

Global energy production is shifting from fossil fuels to renewables (Deloitte, 2020). Both public and private organizations are working hard to decarbonize the world. This energy transition creates new ecosystems that create new technologies to produce energy. Development seeks value from new carbon neutral solutions, improving energy efficiency, not only in energy sector, and create new markets for carbon and other products as part of circular economy.

Many companies in energy sector have publicly declared that they have intentions to become carbon neutral by 2050 (Deloitte, 2020). Some of these companies have made this strategic goal and have also made committed to Paris agreement. Reducing of emissions in EU by 40 % until 2030 means giving up coal power in most of the countries (EU, 2018). That means there is becoming a huge gap in Europe's energy production, that countries and private organizations are trying to fill with other power sources mostly renewable, but also with natural gas power sources. Natural gas is seen as a transition phase power source while giving up coal and moving towards carbon neutral Europe by 2050.

Energy sector has gone a significant change already when low-cost natural gas has displaced coal, reducing sector emissions significantly (Deloitte, 2020). Wind and solar power have become one of the cheapest ways to produce electricity. In Finland wind power has emerged and have a huge potential to grow on market terms in the power production (Fingrid, 2020). While the power production is moving to renewable sources there is still lots to do in heat production. Electrification is seen as a valuable choice to lead the change of heat production towards decarbonization of Europe.

Electric driven heat pumps are seen one of the most promising technologies to reduce greenhouse gas emissions (Forsen, M., 2005). Heat pumps can be divided into different types depending on which heat source and heat sink they use. Considering industrial heat pumps there are several most commonly used heat sources like water sources, air, ground and different types of waste heat from waste water to industrial waste heat from a process. In commercial type ambient air is the most commonly used heat source, but in industrial side it is still in

development use (Company X, 2021). In district heating applications need for primary energy source is so big that sources commonly used are sea or lake water and waste water. Other sources that have been developed in DH use are waste heat from data centers and ground sources. In other industrial sectors heat is used in huge variety of processes (Jakobs, R.M., 2019). Drying process is one very prominent application for industrial heat pumps.

Heat pump is a machine which working principle is based on thermal compression (Industrial heat pumps, 2021). There are several types of heat pumps developed, but the most commonly used heat pump is a mechanical heat pump that is driven by an electrical motor. Heat pump working principle is based on compression and expansion of a working fluid which is called refrigerant. In picture 1 primary heat source passes evaporator and takes heat energy from it with refrigerant. Then refrigerant is compressed which lifts the temperature to higher level and then is released in the condenser for use. The best way to define heat pump performance is the efficiency which is measured through coefficient of performance (COP), that is defined from the ratio of heat produced versus used electricity of the system. There is large diversity in industrial processes that temperature requirements can be from below 0 degrees to over 1000 degrees (Marina, A. et al., 2020). Low temperature process heat below 200 degrees is typically demanded for DH and industrial processes like drying or dewatering. Heat pump technology is able to produce now under 150 degrees, where it is suitable for large variety of DH use and low temperature processes in the industry. Future development is aiming for up to 200 degrees where the technology is able to cover all temperature requirements in low temperature processes.

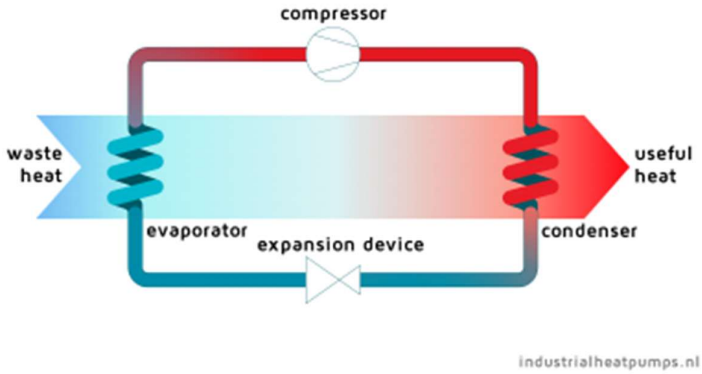


Figure 1 Heat pump working principle (Industrial heat pumps, 2021)

Industrial heat pump has many benefits in use of different applications. It is an efficient heat producing machine that is used for heating, cooling, or combined heating and cooling (Kirillova, T., 2018). Heat pump can be used to recover waste heat and reduce energy consumption to make process efficiency better. It has a long lifespan with minimum routine maintenance which makes it low cost to maintain.

There are also challenges when using heat pumps in industrial applications and district heating (Jakobs, R.M., 2019). The most significant barrier for industrial heat pumps is too high capital expenditure and too long payback time for many industrial sectors like pulp and paper. There are also problems in operating expense side in many countries where the price of electricity is too high. Other problem is lack of knowledge about heat pumps and how these could be used in different industrial processes (Kirillova, T., 2018).

In summary of heat pump use and decarbonization, a heat pump is a good solution for heat production with cost effective features. It has lots of benefits aiming for lower energy consumption and cost efficiency. In decarbonization context it has its place when producing heat, but it cannot be the only solution when aiming for carbon neutrality cause of electricity consumption. It can be seen as a supporting component in energy production and sometimes the only component on system level. In district heating use the heat map Europe estimates a potential increase of heat demand supply through electric heat pumps to be approximately 25-30 % of whole DH demand (David, A., et al., 2017).

2.1 Political decisions affecting decarbonization market

The last 18 years have been the warmest years on record in the modern age (EU, 2018). This has made it a huge concern in politics not only on EU level, but also on country government level. Europe has experienced extreme heat waves in the last decade and some parts of Europe have suffered droughts while Central and Eastern Europe have experienced flood events have affected in recent years. Based on scientific evidence, global warming has already reached 1 degree warming compared to preindustrial levels and is increasing at approximately 0,2 degrees per decade. Without setting up climate actions this means that global average temperature could reach 2-degree level compared to preindustrial levels soon after 2060.

This makes it politically sensitive, because clearly market economy does not solve the problem of emissions alone. There is also economical pressure where weather-related disasters caused 283 billion euro economic damages 2017 (EU, 2018). It affects also indirectly to the market economy's structures, because these will affect supplying of food, water and energy systems.

Europe is aiming for global lead of climate action in EU's long-term strategy and the vision is to achieve net-zero greenhouse gas emissions by 2050 through cost efficient transformation in a socially fair manner (EU, 2018). EU and its member states have made strong commitment to fully implement the Paris agreement. EU who is approximately responsible for 10 % of global emissions leads the way as a global leader in change towards net-zero-greenhouse emissions economy and has already made objective in 2009 to reduce emissions by 80-95% in 2050. Between 1990 and 2016 European energy use was reduced by almost 2 % and greenhouse gas emissions by 22 %, while European gross domestic product grew by 54 %. The emission reduction is accelerating and will reach estimated 45 % in 2030 compared to 1990 levels.

The transition will not happen only through market economy and will probably need also whole EU wide regulation of emissions. There is already highly regulated energy sector where regulation has already made a change mostly through EU Emission trading system (ETS) (Rogge, K.S., Schneider, M., Hoffmann, V.K., 2010). In Germany the emission trading system has made coal fired electricity already to run on negative profit rates (Fickling, D., 2020). There is also other side of the coin, where Germanys coal-burners have bought these so called carbon credits years ago with cheaper price which makes their production profitable for years to come. Political pressure and price trend of carbon credits is clear where Germany will retire its coal fleet by 2038, but switching off the 40 gigawatts of coal power currently in operation can happen early due to low or negative margins.

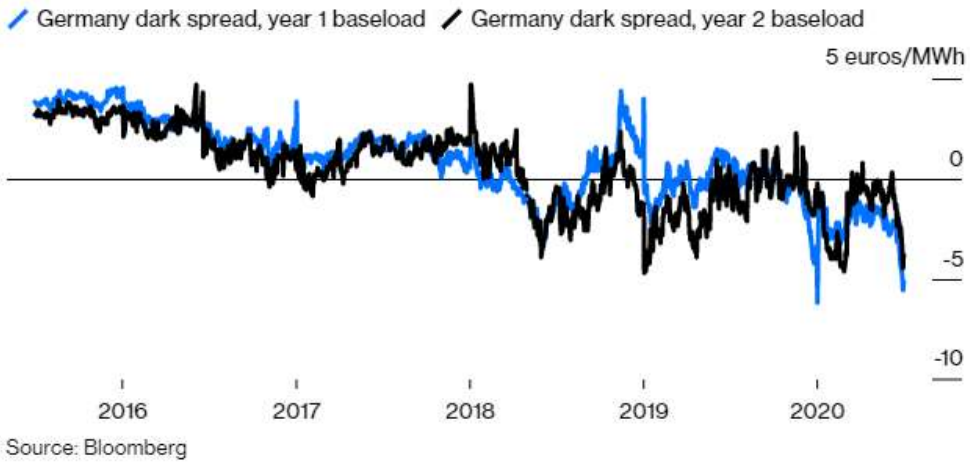


Figure 2 Notional profit that Germany's coal-fired generators make (Fickling, D., 2020)

Political pressure and regulation has had an effect to energy sector where coal fired plants are planned to shut down in the next two decades and new considerations are needed to make for producing power and heat. In electrical power production renewable sources like wind power have made a strong foot step in the market and new wind farm constructions are accelerating the change. While shutting down power production which is based on burning something like coal transition towards wind and other electric power production, a huge gap in heat production will form. This is happening more in the Nordics where CHP (combined heat and power) is a ruling way to produce heat and power, power to the electric grid and heat to district heating network. The market is often quite different in CHP, because normally when heat demand is high, electricity is only by-product.

Filling the gap in heat production EU has made supporting acts for renewable sources and electrification of heat demand (EU, 2018). Big renewable source with less emissions than coal and natural gas is biomass, which can directly supply heat through burning and can be transformed into biofuels and biogas. Also hydrogen is seen as a valuable burnable energy source especially replacing the use of natural gas. Due to support and high increase in renewable electricity, electrification is also one solution for producing heat and use of electricity in final energy demand is predicted to double, bringing it up to 53 % of whole demand by 2050. Through electricity produced heat with high efficiency can be seen heat pumps with DH or industrial process supply (David, A., et al., 2017). Efficiency compared to direct electric heating

can be over 3 times with heat pumps. Therefore heat pumps can be seen a valuable asset in EU's emission reduction. Decarbonization of Europe will be a mix of different renewable sources and increasing electrification in heat production and transportation.

Drivers in the European decarbonization market are very clear. EU will support directly larger projects which are in line with strategic guidelines and indirectly through regulation like Emission trading system. Market pull in decarbonization market is strong and has many factors affecting it like politics, company sustainability policies and strategies. In David A. et al. (David, A., et al., 2017) study 27 EU countries told their focus to be increasing DH levels to 50 % of whole heat demand. Results indicated that electric heat pumps become increasingly important on European level.

While energy sector is highly regulated, other industrial sectors are not (EU, 2018). ETS covers most of the energy intensive industries and there has been some changes in EU level regulation lately. In any case so called industrial decarbonization is yet starting up and means other than energy sector, but energy intensive industries. In practice it means more efficient industrial processes and use of huge amount of waste heat released from those. Energy sector heat coming from burning process is often used in heating purposes wholly especially for DH use in the Nordics, but in other industrial processes lots of useful heat is released in the air. This waste heat can be circulated back to the process or use it in district heating to make the process more efficient. Also in the future emissions of different fuels will probably be more regulated, so use of electricity and other more sustainable ways to produce process heat will be implemented.

The only way to reach targets achieving 95 % (EU, 2018) emission reduction in 2050 compared to 1990 levels is to make radical changes in the process operation of energy intensive industries (Marina, A. et al., 2020). Options to do that are reduce final energy consumption, make more efficient processes, re-use of waste heat and transition of energy and feedstock from fossil to renewable sources, which means significant reduction of burning fuels towards use of wind and solar electricity. Hydrogen can be seen as a beneficial fuel because of zero CO2 emissions and will also make a change if its price will come to interesting level compared to others.

2.2 Heat pump market study

When considering only heat pumps in heat production, we need to remember it's just one partly solution when considering the whole decarbonization market, but electrification is seen as one big solution for heat production decarbonization (EU, 2018). So called industrial heat pumps allow the utilization of industrial waste streams into more useful temperatures (GMI, 2021). Ongoing efforts to minimize the carbon footprint and increase energy efficiency at industrial premises will drive the industrial heat pump market growth. Industries are characterized by limited number of annual installations and lack of consumer awareness toward waste heat recovery opportunities or other sources in the district heating scene. Decarbonization efforts by European governments will stimulate the products adoption over the coming decade.

Industrial heat pump market is presently in its nascent stage, however ongoing regulatory measures towards energy optimization across industrial premises will surge the equipment demand substantially (GMI, 2021). The ambition of European economies to achieve energy sustainability by transforming themselves to a low carbon society has created a considerable potential for various clean energy technologies. Industries are increasingly adopting the heat pump technology powered by electricity due to the growing penetration of renewable energy sources in the energy mix.

Heat pump market in Europe is currently limited to only residential and commercial consumers (GMI, 2020). Industrial sector holds very less penetration due to their high payback period, lack of awareness and limited number of manufacturers or project implementation offering companies (Company X, 2021, GMI, 2021). However, declining prices and increasing awareness toward various heat recovery technologies will stimulate the product demand across over the coming years. Energy sector is clearly more aware of implementing heat pumps in production process, but other industries where energy is not the main product there is a lot to do to get customers know how they can make their processes more efficient. In figure 3 heat pump industry impact forces and how they will impact over time.

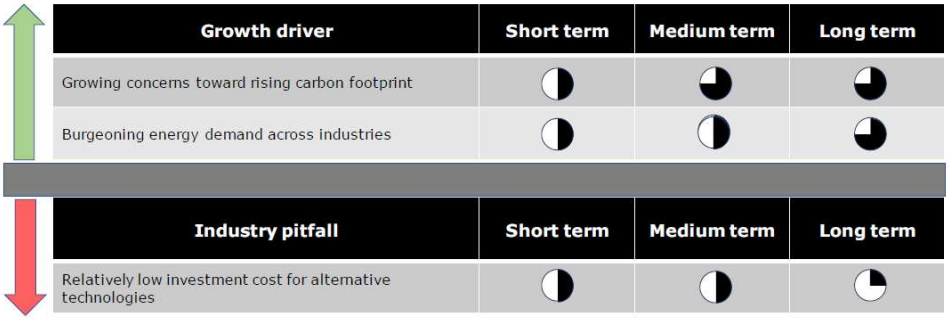


Figure 3 Heat pump industry drivers and pitfalls (GMI, 2021)

Ongoing global pandemic crisis has created a significant turmoil in the industrial heat pump market (GMI, 2021). Demand of these applications not only heat pumps were reduced in the 2020, but situation is witnessing a substantial improvement in the ongoing quarter of 2021 (Q1). Based on application, market can be divided into two segments where district heating is one and other energy intensive industries like chemical, pulp & paper and food & beverages are the other segment. In this study main interest is in market area consists of Nordics, Germany and UK, which are the main business area of the company. Areas like most of Nordic countries have a strong background implementing district heating and countries like Sweden have already a large capacity of heat pumps in DH use (David, A. et al., 2017). UK where 2% of heat demand is provided through heat networks is clearly a market under development (UK Department of energy and climate change, 2013). Heat networks could supply up to 14 % of the current heat demand by 2030 with large heat networks. UK government intends these networks could be supplied by heat pumps, CHP (combined heat and power) and other renewable sources.

European industrial heat pump market is dominated by key manufacturing companies (OEM's), but numerous companies are associated with the ecosystem when implementing these projects (GMI, 2021). Industry players are focusing forward integration to enhance operations and gain competitive advantage in the market. Existing distribution channel includes direct sales from OEM's, 3rd party installers and other project developers. In addition manufacturers also offer after sales services like maintenance, technical assistance and spare parts. Major manufacturers are concentrating on collaboration between various distributors and are building their own distribution channel. Value chain of industrial heat pumps are in figure 4.

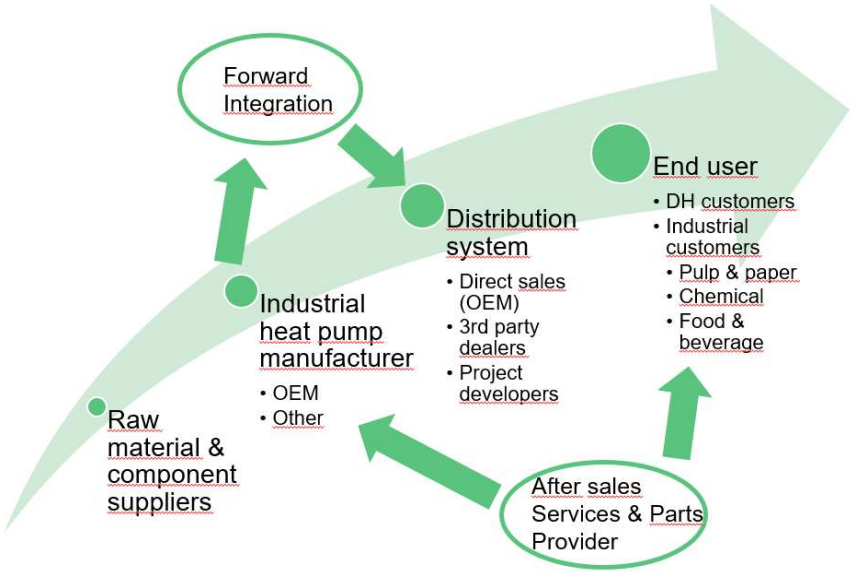


Figure 4 Heat pump equipment distribution value chain (Adapted from GMI (2021))

The whole economy has been hit hard due to the global pandemic COVID-19 and has had major impact on Europe's demand for industrial equipment (GMI, 2021). The pandemic will have a considerable impact on the overall industry growth and will result in a significant decline in the installation of various large scale projects. Anticipated economic recovery in 2021 along with critical nature of some end user industries including food processing and district heating will result improvement deployment of industrial heat pumps in some regions. In addition, governments spending to provide fiscal stimulus will lead to surge in investments across various manufacturing sectors including fueling the demand of heat pumps. Global market insights presents three different scenarios for economic recovery on industrial heat pump market, optimistic, realistic and pessimistic scenario (GMI, 2021). In this study all estimates are based on realistic scenario due to high fiscal stimulus and decarbonization drivers, but will not expand as much as in the optimistic scenario due to market barriers of industrial heat pumps. In figure 5 realistic scenario of industrial heat pump market development in 2021-2027. It consist of all different applications, where case company is interested in closed cycle heat pumps which run on closed refrigerant cycle, this market is roughly a bit over 30 % of the whole market (GMI, 2021).

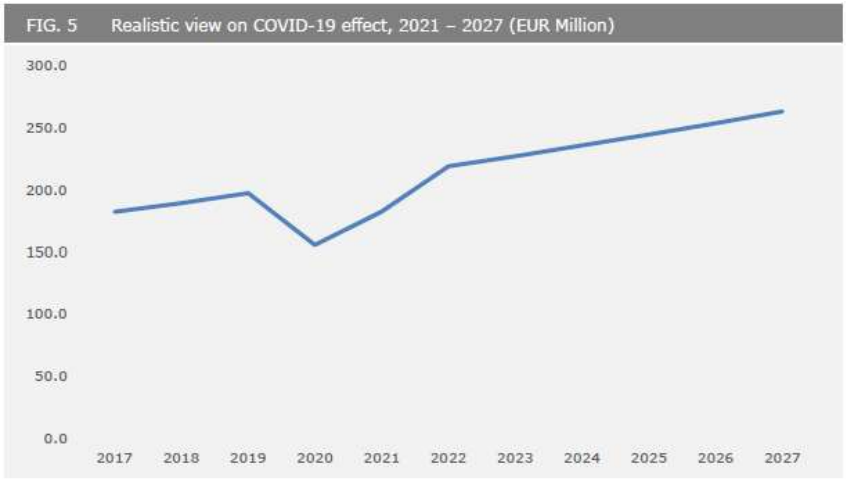


Figure 5 Realistic view for industrial heat pump market development 2021-2027 (GMI, 2021)

Industries can also be divided into segments when considering their growth potential for heat pump use and ability to capture the growth. All of these industries are expected to see different growths due to ability to produce process heat more efficiently and economically attractively (GMI, 2021). For example in chemical industry there are lots of low temperature processes suitable for heat pumps and lower fuel cost through capturing waste heat is seen attractive. Other examples are pulp and paper where high amount of fuel for energy production is coming from process streams and these solutions are seen not so attractive. In figure 6 growth potential of different industries heat pump sales is presented, where size of the bubble represents present revenue.

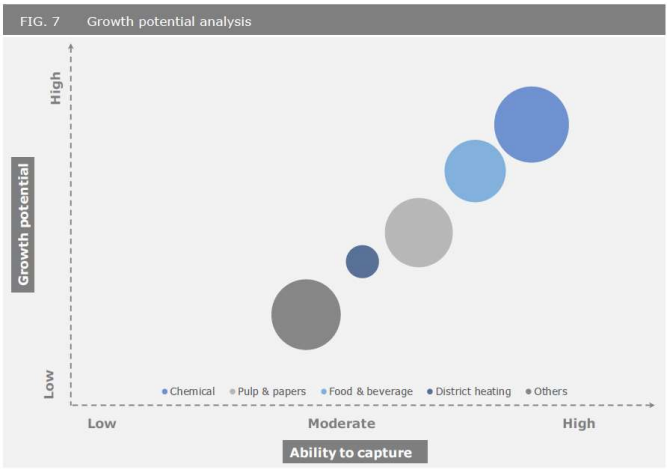


Figure 6 Growth potential analysis for different industries (GMI, 2021)

Company is interested in several countries in Europe as market area and only closed cycle mechanical compression heat pumps mainly in district heating, chemical, pulp & paper and food & beverage sectors. All these sectors consist most of the market nowadays and will see best growth in the estimations (GMI, 2021). In figure 7 countries heat pump sales are presented in years 2017-2020 and estimations for sales in years 2021-2027. Average GAGR for years 2019-2027 is estimated to be ~ 4,3 % yearly, comparison for 2019 is justified because it was a normal year on the market. Whole market size in these selected countries was 14,6 million euros in 2019 and is estimated to be 22 million euros in 2027.

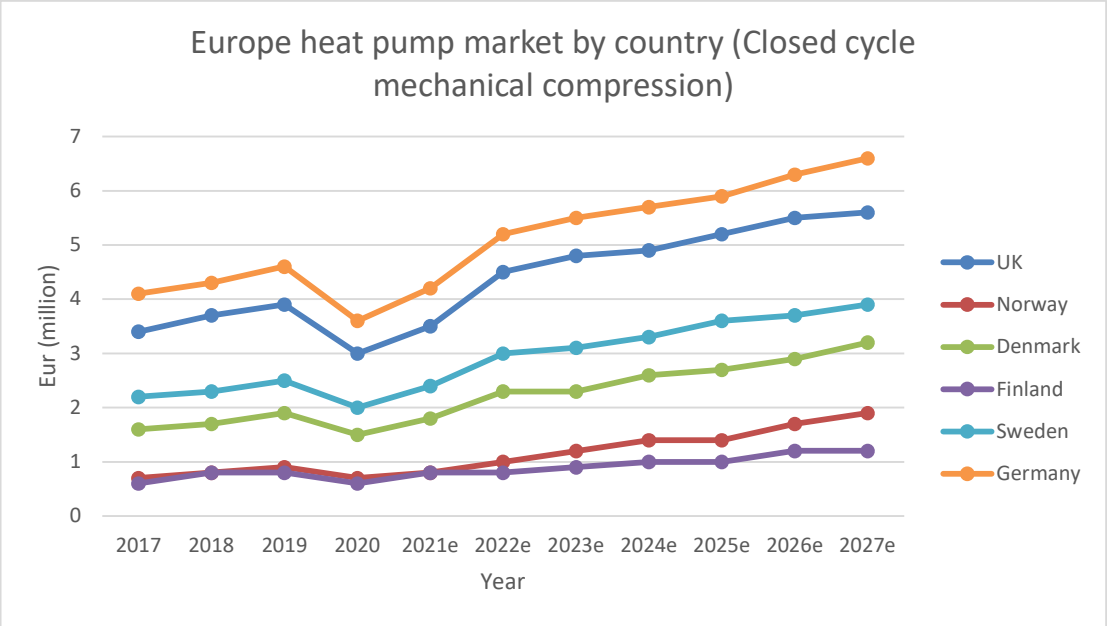


Figure 7 Closed cycle mechanical compression heat pump market estimation (GMI, 2021)

Market values consist only of heat pump, not other equipment or work regarding these projects. Rough estimation for heat pump as a component in whole project expense is 30 % of whole project price which means heat pump project market was 50 million euros in 2019 and is estimated to be 75 million in 2027 in the selected markets.

Market is relatively small in these selected countries and is growing slowly. Drivers for the market are clear, but barriers are still slowing down the growth. Most significant barriers in the market are too long payback times, too high capex compared to other energy sources and cheap prices of fuels used in energy production. Market is supported by fiscal stimulus from EU,

political intention to grow use of electricity in heat production and growing concern in the politics to make more significant actions regarding regulation of emissions. These drivers can make a change in the market in the coming years.

3 BUSINESS MODEL

Business which is based on delivering industrial equipment and implementing or creating a new process can be attached to project business. This can be a combination of delivering physical equipment combined with services and digital solutions. As a project supplier the company intends to be not only equipment or service provider, but also a solution provider (Artto, K. et al., 2008). Solution provider in the context of industry means often a system integrator, a provider who can offer a combination of services to integrate industrial equipment to the system often named industrial process. These solution providers also offer add-on services to operate, maintain and upgrade the equipment provided.

Heat pump as technology by itself has no single objective value (Chesbrough, H., 2009). Economic value of technology remains low until it is commercialized through a business model. In this context commercializing often means heat pump itself cannot be sold independently, but needs integration to the system through design and implementation. This means that original equipment manufacturer needs to offer these kind of services or sell the equipment to so called project developers who offer it to the end customers. Even the most potentialistic technologies may not have an obvious business model, but it is needed to find in order to be able to capture value.

3.1 Elements of business model

Elements of business model create and deliver value. Business model describes how company is delivering value, how the company uses its competitive advantage and competences to perform better than others over time (Aziz, S.A., Douglas, E., Fitzsimmons, J.R., 2008). It also tells how the company can make revenue now and in the future. There are several different approaches for definition of business model, but Johnson, Christensen and Kagermann (2008) propose that business model consists of four elements that are listed in table 2 and described further on.

Table 2 Four elements of business model (Johnson, M.W., Christensen, C.M., Kagermann, H., 2008)

Element	Definition
Customer value proposition	What and how value is created to the customer.
Profit formula	Defines how company creates value for itself and consists of the following: Revenue model, cost structure, margin model and resource velocity.
Key resources	Key resources are assets for example people, technology and products.
Key processes	Operational and managerial processes that allow to deliver value in a way to successfully repeat and increase in scale.

Customer value proposition in project related business consists of few critical components that are products delivered, services included and when talking turn-key delivery projects overall risk taken by the company. Customer value proposition is in the core of business model, without creating sustainable value for customers it is hard to make continuous business (Bocken, N., et al., 2013). In the context of heat pumps and delivering projects created value can be divided into economical, governmental and environmental value because the solutions rely on sustainability of energy. Heat pump as a technology creates both economic and environmental value while decreasing the cost of energy production and reducing emissions through the use of electricity. Governmental value is the most impressive value when thinking competitive edge of company who provides these solutions. Governmental value is created through fluent project management of delivery and services such as design, operation and maintenance of these solutions.

Considering revenue model of the company, there are several notable ways to offer these solutions. Whereas normal way still is to deliver the solution, invoice it partly during and wholly after the project. Ownership of the solution is transitioned to customer after the project. Continuous revenue is made through services added like operation and maintenance of these

products. There is also an ongoing transition towards investor and product service system type solution providers in some companies (Baines, T.S., et al., 2007). Wide range of manufacturing companies are actively exploring opportunities to become service-focused and rethink their revenue models to more continuous (Kapoor, K., et al., 2021). Rolls-Royce's power by the hour can be seen a futuristic step towards service focused revenue model, where Rolls-Royce offers jet turbines with a fee for use hours and includes everything needed to maintain these excluding fuel costs. One step towards this is also offering a solution as turn-key delivery instead of offering only products alone. These solutions can also include operation and maintenance services included. In case of large industrial heat pumps revenue model needs to be considered on a case-by-case basis. Energy sector customers are already investors for production equipment, so they might not be interested in these kind of services where ownership of the product stays with manufacturer, but other sectors where heat production is seen only an expense and investing capital goes to other solutions this might interest the customers.

Key resources are the company's assets such as people, technology and products which are created to deliver and capture value (Johnson, M.W., Christensen, C.M., Kagermann, H., 2008). Technology is just one aspect considering the resources which is supported by people, productization and brand. In any case technology of a heat pump drives the company towards some specified segment where the technology is suitable. Suitability of heat pump system can be considered by size of single pump, heat capability and heat source capability. Technology has driven companies for example towards district heating because of large capability of heat production (Over 10 MW with single pump) together under 100 degree temperature capability which is not suitable for large amount of industrial processes.

Key processes are the repeated processes which create a successful company. These include for example training, development, budgeting, planning and sales (Johnson, M.W., Christensen, C.M., Kagermann, H., 2008). These processes include also business rules, metrics and norms that companies have. Through suitable processes which can increase in scale business grow is possible.

3.2 Business model change

Business model change can be divided to four types that Cavalcante, Kesting and Ulhoi (2011) present in their study. These levels describe the change in the business on the high level and are described in table 5. It is important to understand that not all changes in the business lead to change in the business model. Changes in the core standardized repeated processes of business model will only lead towards change in the business model.

Table 3 Four types of business model change (Cavalcante, S., Kesting, P., Ulhoi, J., 2011)

Type	Description
Creation	Create a whole new business model
Extension	Adding processes to old business or expand current businesses core processes
Revision	Removing something that modifies in existing business model and replacing it with something else
Termination	Terminating processes or whole business models from core business

In this thesis business model change is considered on extension or revision level. Case company already has a business in context of heat pumps that tries to answer the customer need and create value. Adding or changing the business model tries to create even more value to the customers and on the other hand capture more value to case company itself. There is a need to consider the change through the strategy, how would change in the business model answer to strategic intentions.

3.3 Business strategy

Strategic management and strategic thinking are one of the most important things done by any company (Campbell, D., Edgar, D., Stonehouse, G., 2011). Business strategy often noted as plan strategy is a plan showing organizations the future way and intentions. Strategy is company's set of policies, plans and objectives that make the company and its approach on the market. It is hard or even impossible to demonstrate that one specific business strategy is optimal or know will it work in specific market (Rumelt, R.P., 1993). Strategy gives direction

to the business, but doesn't delimit the business happening too much. Normally strategy will fit in following broad criteria and those are later on discussed. Strategy that fails to meet one or more of the following criteria is strongly reason of the failure.

- *Consistency*: The strategy should not suggest mutually inconsistent goals and policies.
- *Consonance*: The strategy should represent an adaptive response to the external environment and to the changes appear within it.
- *Advantage*: The strategy should provide the creation and maintenance of a competitive advantage in the selected area of activity.
- *Feasibility*: The strategy should not overtax available resources or create unsolvable sub problems.

Inconsistency in strategy is not simply a flaw logic, while the key function of a strategy is to give directions to company's actions (Rumelt, R.P., 1993). A clear concept strategy can promote silent coordination that will work better than most administrative mechanisms. Many technology companies need to make a strategic choice between offering high-cost products with high customized engineering and low-cost products that are sold at more volume and are more standardized. In the context of heat pumps many companies offer more standardized commercial products and industrial size products very custom made for the customer.

Consonance means how business interacts with its environment (Rumelt, R.P., 1993). Business should both be adapted and match to its environment and compete with other companies at the same time. Environmental changes can make changes in the business by opening up opportunities and make market niches (Prajogo, D.I., 2015). Environment in business has been recognized as one of the factors in strategic management that have contingencies. Contingency view has replaced competitive strategies when determining the effectiveness of the strategies. Miller (1988) states examining contingency view of Porter's generic strategies suggest that differentiation strategies would fit better to growing or more dynamic environments and the cost leadership strategies would fit better for environments that are more stable and mature. Basically in context of decarbonization scene the market is relatively new, growing and throughout changing emerging market. Therefore strategy should not delimit different solutions or products in the offering, because contingency in the environment is really high.

Differentiation between companies is made during the next decade on the market and environmental change can make a significant impact on business when it's changing all the time.

Competitive strategy lays more on differences among companies rather than their common functions (Rumelt, R.P., 1993). It doesn't address so much ''How can this function be performed?'', but it addresses ''How can we perform it better than our rivals?''. Competitive advantage can normally be divided to three roots that are resources, skills and position of the company. In practice strategy should lead towards a state where all these roots are discussed and thinked about their importance. Skills of a company are typically organizational skills, rather than individual skills. They involve all collaboration and coordination skills that individuals are having to interplay of investment, work and learning. Resources include patents, interactual property rights (IPR), assets and capabilities that companies have when working with suppliers and distribution channels. Company's position means the services and products that it offers, the market segments it sells to and how much it is isolated from direct competition. In case of project business it might refer to what kind of products and services should the company buy outside, what they should make themselves and what kind of resources are needed to deliver real value.

Final broad test for strategy is feasibility (Rumelt, R.P., 1993). When strategy is designed companies need to think their physical, human and financial capabilities. Strategy easily forgets these resources, but of course some of them can be also fixed by hiring more employees, investing in physical assets or gaining capital from the market. In any case confrontation between strategy and these resources will lead towards failure of implementing the strategy.

Business model is a part of strategy where strategy gives bounds how to implement the business. Business models are there to execute the strategy in given bounds and should always be designed through the strategy. Like in figure 8 strategies are the long aim of companies and business model tells us how business is done now (DaSilva, C.M., Trkman, P., 2014). Business models and dynamic capabilities change over time when company is implementing its strategy into reality.

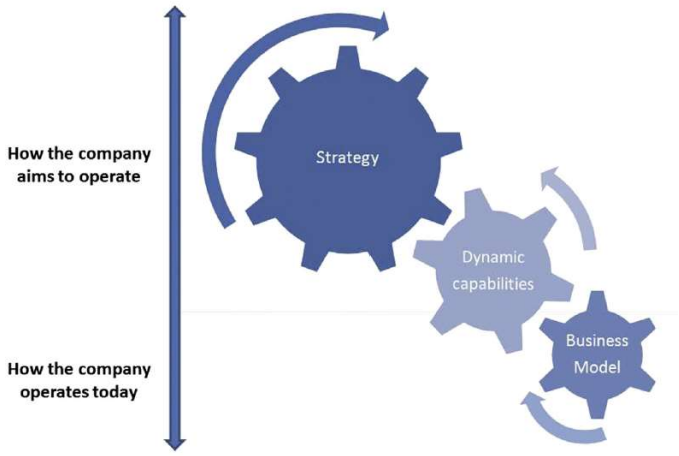


Figure 8 Generic framework of business (DaSilva, C.M., Trkman, P., 2014)

4 TOOLS FOR BUSINESS MODEL EVALUATION

Development in the global economy has made a change in the traditional balance between customers and suppliers especially in the decarbonization market. Envisioned new and dynamic environment has amplified companies to evaluate their business models and strategy to stay ahead of market dynamics (Kayaoglu, N., 2013). Market is in transition towards new technologies and uncertainty is really high when considering which technology is the winning technology. Too strict strategies where relying on certain technology might lead companies towards really bad economic performance. Whereas strategy gives directions for the business, business models are more flexible over time. It is good practice for all companies to evaluate their business models constantly and think how it fits into the changing environment.

People can have different ideas and plans converting these ideas into working and consistent business (Kayaoglu, N., 2013). Companies still are organizations who work together and everybody looks at these ideas from different perspectives. However, they do not know whether their plan will function and the main question for ongoing business is what should a company do to improve the business. In order to get everyone's voice heard, companies should evaluate the business together with the organization. This lowers the risk of individual managers decision failures.

In this thesis three different business models are evaluated to identify the best approach for delivering projects and compete on the market. As one of these business models is the current state and two others are add-ons to this model mainly creating different approach for customer value proposition. These approaches are commonly used approaches in project delivery that companies use and are evaluated in two different sessions. Through the first session we get feedback to use in the second session which is slightly different. First session consists of SWOT and business model canvas to create understanding the aspects of each approach and how they differ from each other. Second session consists of filling a score card from each approach to create quantitative evaluation to compare these with numeric grades.

Overall business model evaluation is a combination of qualitative and quantitative evaluation. There is lots of frameworks how to evaluate business models qualitatively, but eventually

effectual evaluation is drawing analogies from past business model innovations like in this thesis where business models have been discussed before (Tesch, J., Brillinger, A., 2017). Effectual evaluation is used for iterative exploration and experimentation of the business. In practice, it means active experimental of business models through individuals trial-and-error learning and continuous testing supporting the qualifying of central business model elements. Quantitative and combination of both is used in this thesis to evaluate the change in value proposition and risk in different business model approaches. It leans on individuals opinion and their given score for different value aspects.

This thesis evaluation of business models leans on qualitative evaluation from company's management team. Effectual qualitative evaluation is done through filling up business model canvas and casual qualitative evaluation through SWOT-analysis for each business model approach (Tesch, J., Brillinger, A., 2017). These offer a combination of innovation and evaluation of business, but after all the most important thing is to make people think the business through and make them find the way to make it better. Quantitative part of the evaluation leans on market research and presenting it to help decision making. Research consists of market prediction, analysis and technological forecasting. Combination of both qualitative and quantitative evaluation leans on the score card, which evaluates the value proposition and risk to get final numeric score for each business model approach.

4.1 Business model canvas

Osterwalder & Pigneur (2010) outline two types of assessments when evaluating business. Firstly, it provides a big picture of the business using their Business Model Canvas. Secondly, use their set of check list for assessing business model's strengths, weaknesses, opportunities and threats by using SWOT, which is explained later in this thesis. Triple layered business model canvas is similar canvas as Osterwalder & Pigneur presented their own, but it explores also businesses sustainability aspect by adding also environmental and social layers to it (Joyce, A., Paquin, R.L., 2016). All combined these three layers bring out all aspects of sustainability, economic, environmental and social impact to the business. This thesis uses mostly the economical layer of business model canvas to bring out aspects of each business model approach. Sustainability of each component can be thought also in the original layer.

The business model canvas presented by Osterwalder & Pigneur (2010) divides company's business model into nine components that are interconnected. These components are customer segments, customer value proposition, customer channels, customer relationships, key activities, key resources, key partners, revenues and costs. In practice it might align profit creation and purpose to support the sustainable value creation on its own, but for example in profit first or economic value oriented business other sustainability aspects might be left in the background. Osterwalder & Pigneur business model canvas presented in figure 9.

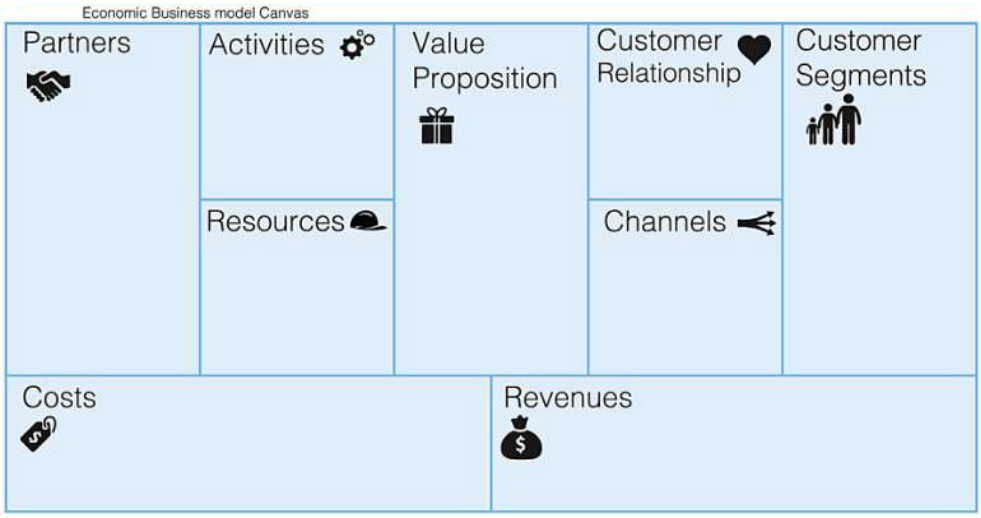


Figure 9 Economic business model canvas (Joyce, A., Paquin, R.L., 2016)

Customers can be seen as a heart of any business model (Osterwalder, A., Pigneur, Y., 2010). Companies have different customers and different relationships between the customers. In any case these customers can be divided to segments where companies need to make decision which segments are there to serve and which segments to ignore. When decisions are made a business model can carefully be designed around strong understanding of selected customers and their needs.

Customer value proposition is one of the reasons why customers turn to one company over another (Osterwalder, A., Pigneur, Y., 2010). Each value proposition consists of selected offering of goods or services that are proposed for different customers. This can be newness, performance or tailoring of a product or just simply value created through reliable delivery of

it. Price of a product can be seen one significant component of value offering in delivery of industrial equipment. While customers are trying to make profit out of the equipment high capital expenditure can be a barrier for investment. Heat pumps as a product seek value creation through cost reduction of heat production and have also environmental impact through the use of electricity instead of combustion technology, but have high capital expenditure as a barrier.

The customer relationships block describes the relationships companies have established within their specific customer segments (Osterwalder, A., Pigneur, Y., 2010). Company should sort out the types of relationships it has between different customers. These relationships can differ from personal relationship to automated relationship. These relationships can be driven by motivations for example customer retention, acquistion and boosting sales. When providing tailored services and customized products the type of relationship is normally based on human interaction between customer and provider.

Key resources block describes company's most important assets and human resources of business model (Osterwalder, A., Pigneur, Y., 2010). Basically every business requires key resources to offer its products, services and create value for the customers and itself. These key resources of a company can be financial, intellectual, physical or human, and can be owned by the company or leased or bought from key partners, which means a key partner can also be a key resource for the company.

Key activities block describes the must do things that make the companys business work (Osterwalder, A., Pigneur, Y., 2010). Key activities of a company are actions that company must do to operate and deliver value in the business successfully. Like key activities, key partnerships describe the necessary building blocks of suppliers and partners that are needed for the business to work. Companies establish partnerships for many reasons, and partnerships are a key factor of many company's business model. These partnerships are made to optimize their business models, reduce risk or acquire resources. Partnership ventures can be strategic co-operation between non-competitors or even competitors, venturing partnerships to create new businesses or the most typical buyer-supplier relationships to assure reliable suppliers.

The last two building blocks consist of the financial aspects of business (Osterwalder, A., Pigneur, Y., 2010). Revenue stream block describes how company's cash is generated from each customer segment. Pricing mechanism might differ in each revenue stream and can be for example fixed list price, bargaining, auctioning, market dependent or volume dependent. Business model can include two type of revenue streams which are made through transactions like one-time payments or recurring revenues resulting from ongoing payments. Normal way to generate revenue when selling industrial equipment is named asset sale where customer pays for ownership rights for assets and recurring revenues are created from different services maintaining these assets. Cost structure describes company's costs incurring from operating the business model. Creating and delivering value, keeping up customer relationships and making revenue all include costs. There are several approaches to operate business models, but for example cost-driven and value-driven can be seen the ruling ones. Cost-driven leans on low cost structure of business model and value-driven leans more on value creation than costs of the business.

Business model canvas creates a great picture of how different business models are operated. When comparing business models with each other a change between these can be seen. Basically in comparison it gives answers to what changes if we change our business model. In this thesis business model canvas is used to create an overall picture of business models and differences between them.

4.2 SWOT -analysis

Business model canvas describes the condition of business now, but SWOT-analysis is a tool to analyze the business condition now and look for the future also. While business model canvas is a tool for only internal analysis, SWOT is a tool for both internal and external process analysis (Gürel, E., Tat, M., 2017). Conducting external analysis, company can identify critical threats and opportunities in the competitive environment. Through SWOT competition evolvement in the business environment can be examined and implicate what threats and opportunities organization is facing. Internal analysis focuses on identifying organizational strengths and weaknesses. It helps to understand what capabilities and resources are the sources that make

the competitive advantage and what are the aspects that are not advantages. In the figure 10 SWOT-analysis is presented.

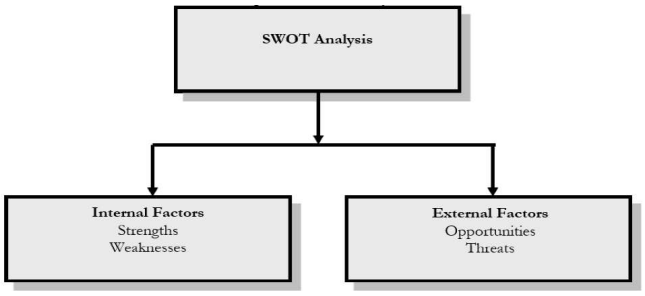


Figure 10 SWOT-analysis (Gürel, E., Tat, M., 2017)

Organizational strength is a characteristic that adds value to company's value creation and makes it more special than others (Gürel, E., Tat, M., 2017). These strengths are the source of organizational advantage and can be physical or abstract assets of a company. Weaknesses describe the competences where company is not good at or there is development to do creating the weakness better than competitors. Weaknesses are the aspects or activities in which a company is less effective and efficient compared to other competitors or compared to own expectations.

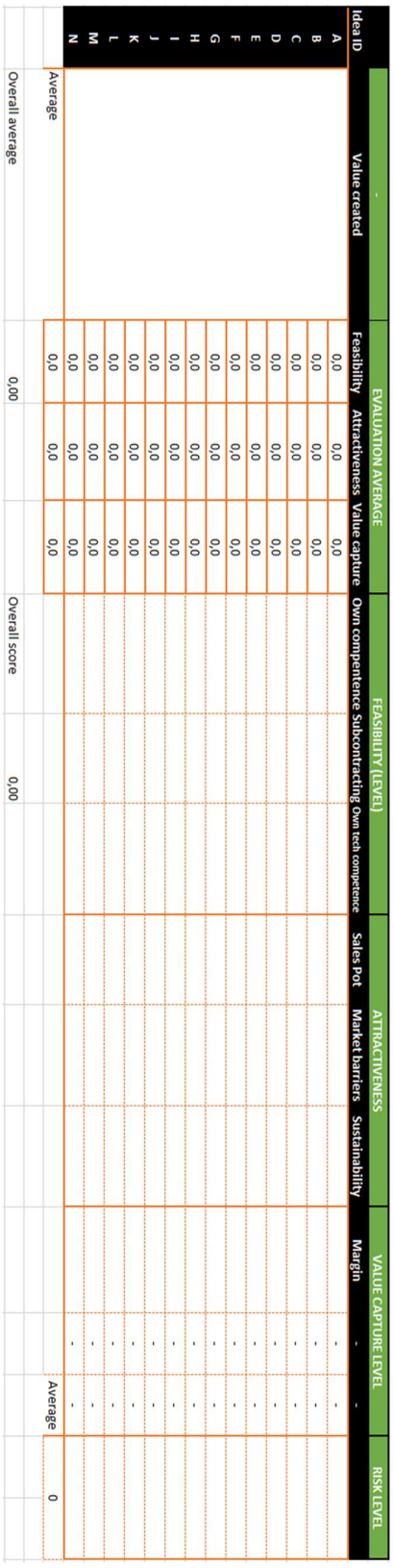
Environmental opportunities tell about situation or condition suitable for an activity and which is not yet established in the organization (Gürel, E., Tat, M., 2017). Opportunity is an advantage of the business and drives the force for an business activity to take place. Opportunities are conditions that take place in external environment. These allow an organization to take advantage and are likely to yield towards positive business results. Environmental threats are a condition or situation that endangers the actualization of an activity. Threats refer to disadvantageous situation and has negative characteristic for the business that should be avoided. These threats can make significant changes in the environment and the business.

SWOT-analysis is a good tool for internal and external environment analysis. It can be used to make evaluation for strategic choices and understand the business environment better. Strategic options are associated with vision, mission, objectives and external and internal analysis of the organization and its business. Analysis of the environment is important when choosing the

strategic vision. SWOT as a tool itself is not enough when choosing strategic approach and should be used together with other tools.

4.3 Score card to evaluate value components and risk of the offering

Final evaluation of business model consists of a score card where value components of the offering are evaluated in three different business models. Score card also consists of risk evaluation. It leans on quantitative evaluation of different value components through feasibility level, attractiveness and value capture. Last component risk is separated from others and gives picture of risk in every offer component. Overall meaning for the score card is to give numeric score for each of three business models under evaluation. Score card is presented in figure 11 and discussed further. It's developed by me for this evaluation process, but is inspired from Laukkanen & Patala's (Laukkanen, M., Patala, S., 2015) workbook towards sustainable business and co-operation models.



Idea ID	Value created	EVALUATION AVERAGE			FEASIBILITY (LEVEL)			ATTRACTIVENESS			VALUE CAPTURE LEVEL		RISK LEVEL
		Feasibility	Attractiveness	Value capture	Own compentence	Subcontracting	Own tech competence	Sales Pot	Market barriers	Sustainability	Margin	-	-
A		0,0	0,0	0,0									
B		0,0	0,0	0,0							-	-	-
C		0,0	0,0	0,0							-	-	-
D		0,0	0,0	0,0							-	-	-
E		0,0	0,0	0,0							-	-	-
F		0,0	0,0	0,0							-	-	-
G		0,0	0,0	0,0							-	-	-
H		0,0	0,0	0,0							-	-	-
I		0,0	0,0	0,0							-	-	-
J		0,0	0,0	0,0							-	-	-
K		0,0	0,0	0,0							-	-	-
L		0,0	0,0	0,0							-	-	-
M		0,0	0,0	0,0							-	-	-
N		0,0	0,0	0,0							-	-	-
	Average	0,0	0,0	0,0							-	Average	0
			0,00			Overall score		0,00					
	Overall average												

Figure 11 Score card for value component and risk evaluation

In the first section of score card value components are listed. These components can be products or services that create value for the customer. These components are evaluated through feasibility, attractiveness and value capture, and their sub components which are further discussed. Risk level of each offering is evaluated separately. Overall score is created through averaging first the three components sub components into three, then averaging these again into one average and last overall score is gain through multiplying this average together with risk average. This gives a great picture of different business models benefits, but also how risk is progressing between different business models under evaluation.

First section feasibility consists of three different sub components which are own competence, subcontracting level and own technology competence. Whether the value component is a service, product or combination of both, own competence and own technology competence can be evaluated with a number. Own competence basically means human competence or expertise, and technology competence means the tools for value creation for example software, physical products or other digital products. Subcontracting means the subcontracting level of each value component, so basically if some service or product is bought outside to create customer value. All these components are discussing with each other and for example if own competence is high, subcontracting level should be low, but there are also exceptions where wider value component might have good own competence, but some parts are bought also outside.

Second section is about attractiveness of the market and how sustainable each value component is. Sales potential basically means individuals opinion for it and how it changes between the models. Market barriers are known barriers from the market study, but can be evaluated based on how big they are and will some models tackle these barriers for example company's ability to affect the price of a product might change between models. Sustainability is mainly a comparison between the models, how sustainable each component is now and how much can the company affect for each value components sustainability for example if the component is fully outsourced.

Value capture in this score card is all about margins of each value component. It tells the condition now and how would it change if company intends to change its business model. There

are also other value capture components that the company can affect, but margin is the easiest one to evaluate.

Risk level of each value component is important to know. Risk might change between the models if outsourcing of the component rises or lowers, so basically the risk moves from the outsourcing company towards the company who earlier bought these services or products outside. Risk is also about how much the company can affect to it, if its outsourced or done by some co-operation between other companies. Rise in the risk level is affecting the overall score by lowering it.

Score card gives a great picture of each business model approaches value creation. It tells how the competence is changing between the models and how feasible is it. By gaining more own competence company intends to create more value for the customer and for itself, but because there are always uncertainties an own competence might not always be the best case. High risk and low value capture level is a direction where any company doesn't want to go.

5 BUSINESS MODEL APPROACHES IN PROJECT DELIVERY

Company has chosen three different business model approaches under evaluation through discussion and mirroring how other companies and competitors are establishing their business on the market. All of these three business models have different positions in the value chain of delivering the industrial size heat pumps and energy systems. Business is relatively new for the company and approach on the market should be considered. Concerns for lack of value creation for customers and especially value capture are the drivers for changing the business model. New models seek value creation through co-operation or acquirement of technology to create more competence for product wise sales, project implementation and design. Business model now is more likely to be compared to these two new business models. Chosen business model approaches are:

- Value added reseller (VAR) – Selling others products by adding own services for overall solutions.
- Co-operation model – Selling partner's products is pretty similar than VAR-model, but intends to create more value through partnerships.
- Technology ownership – Selling own products and services, products are made through own manufacturing or through subcontractors by owning intellectual property rights (IPR)

These are typical models that can be seen already established on the market. In the bigger deliveries of energy solutions a combination of these models can be seen especially turn-key delivery providers who have some own products. Company intends to create more value and gain competitive advantage, by adding competence this can be possible. Business models under evaluation are presented and discussed further on.

5.1 Value Added Reseller (VAR)

Value added reseller (VAR) is the business model how company executes its business now. VAR is a business model where company implements its business through selling other companies products and adding customer value through own services created over the product

(Gupta, S., Väätänen, J., Khaneja, S., 2016). The services are mainly such as solution design for the whole system, product installation, life cycle management for the whole asset, maintenance and operation of the system. In this case co-operation between the manufacturer and the company is nominal where company buys the product from any manufacturer without close co-operation on the basis of tenders.

Company sees itself as system integrator who provides these solutions as a turn-key delivery type deliveries. System integrator means a provider who implements these heat pump solutions by bringing together component subsystems into a whole and ensures these subsystems function together. Main component of the system integration is automation, which purpose is to bring all the pieces together and functional. Heat pump is just one component in these kind of systems and is not functional itself without properly working automation. Rather than performing all the productive tasks in-house, company intends to build capabilities to design, integrate and implement these solutions with networks of component and subcontractor suppliers. This basically means a strong competence in overall automation know-how (integration) and project management in-house. Some other services like manufacturing of components, installations and some specific design tasks are bought outside.

System integrators who offer physical capital intensive products move downstream into more service-intensive offerings to transform and expand revenue streams more continuous (Hobday, M., Davies, A., Prencipe, A., 2005). System integration business has two sides where the first is internal activities of companies where they integrate and develop the inputs they would need to make new products and second is the external activities of companies where they integrate components, knowledge and skills from other companies to produce complex solutions for customers. These external companies include component suppliers, users, government regulators and agencies, production partners and sometimes even competitors who offer different value for customers. System integration can be defined different ways depending of the system being integrated, integration processes and the way how system is bounded for analytical purposes. System integrator in one point is more likely to be a value added reseller, even if there are own products. Integrating together own and others physical products and services to create solutions is probably the most common way on the market when talking about these overall solutions. In this case company doesn’t have any own physical products to sell,

but relies own services which are made to integrate, maintain and operate others physical products.

Company working as a value added reseller has several benefits. Business leans more on services than products which makes it less capital intensive than manufacturing of physical products. Notable benefits are listed below and discussed further.

- Value for the customers is made through added services (Design, implementation, operation and maintenance)
- Long term customer relationship is created through asset lifecycle management solutions
- Not committed for one component provider

Value creation and also value capture leans on the added services, because physical components are bought outside. By selling others products capturing margins or other value is hard and probably the manufacturer itself is the capturer of this value. The key of value capturing and creation are the services which are created to integrate different companies products to one solution, in this case energy production system. Long term relationship between the company and customer is made through asset lifecycle management which creates value through reliable operation of the asset and maintenance of the components. Customer in this case can basically just capture the value through using or selling the energy produced. One important aspect and benefit is the independency from component provider. While committed VAR-companies are relying on the partnerships technology, in this case company can choose the best technology for each project and customer segment. This can also make the projects more cost efficient from customer's perspective when choosing the best possible product to produce energy.

While there are good notable benefits there are also notable risks and weaknesses when operating business with VAR-model. These weaknesses and risks are listed below and discussed further.

- Pricing ability weakness, but in large integration projects importance decreases
- Future integration risk of component manufacturers towards distribution system
- Economical value capture risk

Pricing ability is the most significant weakness and risk of this model, because most of the components and installation are bought outside. There are few points when integrating others components with outsourced workforce. One point is that while high capex of heat pumps is a significant market barrier (GMI, 2021) and the company doesn't have ability to affect the price, it is harder to sell these solutions when customers see it too expensive. Other point is that all outsourcing might have high volatility of price without strong partnerships with these companies. Strong integration of manufacturing companies towards distribution system and especially intentions to be a system integrator can be seen a risk, if these companies offer the same customer value as the company. Risk is significant in that case, because these companies have better ability for pricing and also have an effect of their products offering on the market. Value capture risk comes from type of these projects. Offering of these solutions are typically high risk and low margin projects. Component sales have a significant share of the overall price in the projects and as said typically value capture of these components flows towards the manufacturers.

VAR-model is a flexible business model as described here. It offers flexible low capital intensive approach without commitment to one technology. It is a great way to create value for customers through services, but hard to make competitive edge to different competitors on the market. As the market is relatively young and all the time changing, transformation of the competitive field is ongoing and makes it unpredictable in the longer term. As Global market insights (GMI, 2021) told transition is strong towards the distribution system and project implementation as system integrator. This can make VAR-model really vulnerable in the long term.

5.2 Co-operation between technology company

Difference between the first presented VAR-model and this co-operation model is small. Main difference as speaking about value added resellers is the level of co-operation between the

component manufacturer and company providing these added services. In the first case company creates competition between different manufacturers of critical components in every project implemented. Components for each project are chosen on aspect of suitability and price. In this case co-operation between the manufacturer is strong and the company basically uses partners' products in every project. There are large variety of relationships between manufacturers and companies who implement these projects, but in this case access to component suppliers supply chain is the main point. Value for the customer is created through services which are supported by strong supply chain of the partner providing equipment and after sales components like spare parts.

Effectiveness of business relationship is based on benefits received by parties involved in the partnership (Gupta, S., Foroudi, P., Yen, D., 2018). Offering these benefits which are relevant to resellers would place the manufacturer's equipment in better position compared to its competitor's and ultimately would drive sales of these equipment which need tailoring and building of systems which these manufacturers are not intended to do. In B2B business and capital intensive energy investments brand of the equipment is not the top priority, but on the other hand it might tell about reliability. More prioritized aspects are typically reliability of equipment, technology type, if there's difference between similar products, and price. These types of relationships can also be called as collaborative relationships, because both of the companies might be in touch with the end customer who has ordered the delivery of energy system. Benefits in this case come true in both sides. Manufacturer gets sales for its equipment in those cases where it is not possible without system integration. Company itself typically gets benefits which are listed below and discussed further.

- Access to different sales channels
- Support of service delivery for the equipment through spare parts and expertise
- Possibilities for lower pricing of equipment
- Lower risk possibilities

Main benefits for creating co-operation network for the company are supporting aspect for the own service delivery like project implementation, operation and maintenance of these assets. Access to partners supply chain in the best case is supporting also time of delivery of equipment

and services. As price is one significant barrier regarding heat pumps, a partnership together with manufacturer can offer pricing possibilities through discount of equipment. Typically this is bounded to sales volume of partners equipment. There are also possibilities to lower project related risks through partnerships. Company as a main contractor of course has the main risks, but partnerships can offer reliability of delivery and risks of equipment delivery can be moved towards the partner. Partnership model offers basically pretty similar benefits as the first model, but is more committed to one supplier of equipment and seeks value together with the partner.

There is also the dark side of relationships, where both or one another doesn't get the expected value from the co-operation. When talking about system integrators or project developers, typical risks and weaknesses of co-operation are listed below and discussed further.

- Commitment to one supplier can delimit out of market segments or projects
- Profits from components are still going towards manufacturer

Commitment to one supplier can drive the business towards selling of partners equipment to every project where they are suitable. This can cause a problem where the main business as system integrator of intelligent energy system can transform towards product wise solution provider. Commitment can also delimit the market significantly from technology perspective for example towards district heating segment as mentioned in the global market insights report (GMI, 2021). Both parties are trying to make profit out of the projects, manufacturer from components and system integrator through added services. When looking at normal projects on energy sector these solution projects are normally high risk and low profit projects from VAR-provider perspective. This is mainly caused by outsourced workforce and components bought outside on both project implementation and services except project management and upper level design. There is basically no way that these providers could get higher profits from components if they want to stay competitive on the market.

Partnerships offer really good benefits to boost the business, but also lack mostly in higher profit making. Access to partners supply chain and different sales channels can support the making of services and boost the sales more product wise way. These partnerships can make the business more sustainable in many ways and lower the uncertainties on the market from

case company's perspective. The difference in the first two models is really narrow and the first one probably will develop towards partnerships with other companies.

5.3 Technology owner – Acquisition of technology

Technology ownership means manufacturing of heat pump equipment or owning intellectual property rights (IPR) for this technology. These approaches are really different to each other and that's why they are presented separately. Basic business is leaning on selling these equipment and in this case sell these equipment as a solution. In any case company intends to be a solution provider not equipment seller or retailer. By owning a technology, it could boost up the sales by having more sales channels and capturing of value through higher margins. In this case sales changes towards product wise more than solution wise and value capturing leans on sales volume of these equipment manufactured or bought through the IPR's. This model is by doubt the most business changing and brings very different aspects to consider when implementing the business.

Company is intending to grow the business and create more competence to compete on the market. One way could be to create own manufacturing or buy intellectual property rights, but not having a relevant competence that is a hard way without merger and acquisition (M&A) process. Merger and acquisition is a general term to describe the consolidation of companies or assets through various types of financial transactions, in this case acquisition of a company (Hayes, A., 2021). In acquisition, other company purchases the other company outright and takes over the business. In this case it can be also called product-extension merger or congeneric merger, where company seeks other company for acquisition to extend product offering. Normally target company's business is in the same market and can also be offered to same customers as own business. This is a great way to get more competence and products, but consists of lots of risks to be considered.

Two different approaches are discussed in their own sections, because of really different ways to implement the business. Risks of technology are also needed to be considered, because compared to other models this model leans on a specific technology approach of the target company. Risks of M&A and technology are discussed also further on.

5.3.1 Manufacturing of equipment

Manufacturing of something physical always ties up capital more than other ways to sell technology. Investments for manufacturing processes affect the competitive priorities of the company (Pirttilä, T., Sandström, J., 1995). In this case it would come through an M&A so the investments are already done in the past. There are several benefits when talking about own manufacturing like the ability to impact the price of the products more than in other models. This can really create a competitive edge, because as known too high capital expense is one of the barriers of heat pumps (GMI, 2021). When talking about manufacturing there are several ways to implement that. Nowadays lots of companies have outsourced manufacturing to specific companies who offer different kinds of manufacturing services. Outsourcing mainly transfers the capital expense towards the subcontractor, but is more expensive on the other hand.

Manufacturing business builds on products rather than services. Services are used to support the sales of physical products. Growing the business often means combining of products and services as a solution that creates value. In the basic level this could mean selling of products, installing them and offering maintenance services as a whole contract. Although the most important competitive priorities of manufacturing are following priorities (Pirttilä, T., Sandström, J., 1995).

- Cost – Production and distribution of product at low cost
- Delivery – Reliability of delivery and time
- Quality – Manufacturing of goods with high quality and performance standards
- Flexibility – Product mix and volume
- Innovativeness – The capability to introduce new products or product variations effectively

These priorities can be seen as benefits of manufacturing rather than when components are bought outside. Priorities listed are the aspects that only a manufacturer can affect on directly. Cost of production and products can be said as an important aspect when selling industrial heat pumps, because of high capital expenditure as a key market barrier (GMI, 2021). Owning a technology or technology rights is the only way to affect the price of the end product directly.

Reliability of delivery can be prioritized if faster delivery even project or customer wise. In some cases quick and reliable delivery can be more important aspect than price of the product. Quality and flexibility of products can affect the price and margin of the end products and are also risks of manufacturing. While the market is in its niche state and customer awareness is really narrow (GMI, 2021), innovativeness of products and solutions are the key for sales. Innovativeness means not only product innovations, but also product driven innovativeness of solutions. Product development should follow the solutions developed rather than solutions follow the products developed to find the solutions to tackle the barriers on the market.

Acquisition of manufacturing company has several benefits that can be established in energy solution provider business. Own manufacturing or subcontracted manufacturing are slightly different, but have similar benefits. Subcontracted manufacturing leans on close co-operation between the subcontractor and the company, where normally the design process of products is made in the company and subcontractors build up the products and develop the production. Typical benefits compared to other models are listed below and discussed further.

- Pricing ability of end products
- Reliable supply and ability to affect quality and flexibility of products
- Technical knowhow competence of products
- Ability to supply after sales products for service support
- Close relationship with the customer through services

One of the key barriers mentioned before is the high capital expenditure of heat pumps. While owning a technology is the only way to affect the price of end products directly and that way can have effect of the volume on the market. Comparing to other business models reliable supply and flexibility is decided in the component supplier company who can prioritize its own projects rather than customers projects, which can become a problem in some cases where schedules are tight. Through ownership of technology prioritizing and flexibilities of products can be decided as decided the best way. Competence is always the key to success, if company is buying all products and services outside it is most likely to end up in low margins and capturing the value goes towards the subcontractors. Thought of what competence is needed inside the case company and what is not so relevant should be decided business specific. Added

services like maintenance is the key to ensure long term relationship with the customers. This is enabled for industrial equipment through maintenance services and spare part supply. Normally the value is captured more from spare part supply than human services.

5.3.2 Intellectual property rights (IPR)

Intellectual property rights (IPR) are very much different approach to use and sell products. These include copyright, patent rights, rights in a trademark, utility model rights, design copyright, rights to use the commercial name, layout design and plant variety rights of a product (Euraxess, 2021). All these rights are granted for limited time and can consist of different copyrights not all rights. These rights are normally bought from a manufacturer of equipment and can be limited only to some specific products. IPRs can create value and competitive edge through selling these products as own product and brand. IPRs can be also created through co-operation model where manufacturer boosts its own sales through selling IPR's to the case company. This can create more sales channels mainly to the manufacturer not to the case company, but it can create advantage through a branding of these equipment.

Subcontracted manufacturing is normally protected by IPRs where the subcontractor cannot sell these equipment as their own. These are normally made protecting the technology patents and brands to protect the financial performance of the manufacturing company (Willoughby, K.W., 2013). IPRs do not give same benefits for the case company, but are one way to sell own equipment. Main benefits coming from IPRs are mostly the use of brand when selling the equipment and possibilities of a closer co-operation with the manufacturer. In any case normally the manufacturer wants to keep its financial performance high and so it doesn't give advantage through pricing.

5.3.3 Benefits and risks of technology M&A

Merger & acquisition process has always benefits that companies are looking for, but also notable risks. There are always two parties in M&A transaction which are the buyer and the seller of target company (Bruner, R.F., 2001). Both of these parties look for different value to benefit from the transaction. While seller is mainly looking for good price of the transaction,

the case company is looking for also broader things to achieve than financial performance. In this study M&A process means whole takeover of the target company where target company's shareholders get financial transaction for shares of the company.

There are many risks in M&A where these transactions create or destroy value (Bruner, R.F, 2001). There is always need to proof of significance and materiality, that transaction effect is something that different stakeholders would benefit. In this case significance would mean financial benefits coming from acquiring a target company. Materiality in this case would mean technology and the IPRs. Case company is seeking for own technology so it should prioritize the technology relevance and seek the suitability for target company's technology from the projects implemented and upcoming projects. Without technology suitability for the business that case company executes synergies are hard to find and acquisition would be a step for other markets.

This study examines the M&A through ownership of the technology and that's why it has slightly different aspects than some typical acquisitions. Case company is looking for example benefits from M&A listed below.

- New deeper competence to serve customers better
- Synergies from the products to offer in current business
- Faster strategy implementation
- Business growth

As case company's strategy is to provide solutions to decarbonize energy production in energy sector and other especially energy intensive industries, competence to offer these solutions is needed to grow the business and implement the strategy. Synergies are looked through the products and of course from typical costs like management and facilities. Typically business synergies appear from cases where both of the companies can offer beneficial aspects to each other. These can be for example sales channels, new markets and customers, competence differing from each other, and financial position if the target company is smaller than the case company or has financial problems. These all combined would create a base for sustainable

business growth, better than both companies working separately. When company acquires other company it is clearly aiming for growth.

Risk in M&A can be defined in two aspects where one is the risk itself which is measurable and one is uncertainty which is immeasurable (Ott, C., 2020). In this definition risk can mean any hazard, threat or exposure to happen for the company. Uncertainties are related to market development, political decisions towards decarbonization and technology related uncertainties. Uncertainties about technology as told earlier are mostly related to competition between different heat production technologies, but also between development of heat pumps on the market. Typical M&A risks that need to be considered are listed below and discussed further.

- Overpaying the target company
- Overestimating the synergies
- ESG-risks
- Technology related risks

According to Christensen et al. (2011) mergers and acquisitions fail to create value somewhere between 70 % to 90 % of the time. When talking about this value, in this case overpaying the company leads towards situation where financial return expectation is lower than expected and lower than company would normally do with its normal business. This can be a combination of overestimating the synergies, growth in the profits and failure in integrating the target company. Consideration of what are we buying is always needed, for example in this case, is the case company buying technology, business or a combination of both. This leads to a situation where valuation of the target company is hard and can lead to overpaying the target company. When estimating the target company's technology customer view should be considered, what value of products are the customers looking for. ESG-risks (Environmental-Social-Corporate governance) have become really important aspect when considering M&A risks. Sustainability is important for brand and continuity of the business especially when thinking about decarbonization market which is all about sustainability and therefore some risks in sustainability can overthrow the decision for acquisition. While case company is looking for own products, consideration of what technology is the most suitable and what market segment it is trying to approach. Some technologies are suitable for only some market segments and for

example only for some sectors like district heating. Universal technology might be hard to find or there should be a large variation of products to be universal, therefore different technologies should be evaluated considering which market segments they intend and what are the aspects there to be competitive. Also IPRs of the products should be considered to know if there are business limiting factors.

M&A is a great tool to grow the business and invent new business models. Process for acquisition should be done objectively to achieve value capture through the M&A. Must-buy attitude is clearly a risk when considering acquisition of other company, technology or business (Christensen, C.M., et al., 2011). M&A is most likely to succeed when both buyer and target company has something to offer for each other.

6 CUSTOMER VALUE CREATION AND VALUE CAPTURE

Business is all about customer value creation. Different customers prioritize different value out of decarbonization, but the basis is the same. Sustainability is one of the most significant aspect in its all matters. Customers look for carbon neutral solutions which still can make good or even better profit than other solutions. In this chapter customer value creation through heat pump solutions is first gone through on high level, then how it changes in different business models on same aspects and last how would these models tackle the barriers on market to create better value and be more interesting for customers to invest. Table 2 is explaining what value customers are searching from heat pumps and decarbonization itself. Data is collected through discussion with different customers and through empirical study how customers typically would like to invest and implement these solutions.

Table 4 Customers searching value through heat pump solution delivery

Aspect	Searched value
Environmental	- Lower the direct emissions when producing heat - Better process optimization through reliable and stable heat production - More sustainable production without using worlds fuel resources (directly)
Social	- Branding for sustainability - Straight impact from lower emissions
Governmental	- Sustainable more profitable business compensations of employees
Financial	- Lower operating expense costs of heat production - Low capex cost (still a barrier) - Higher return for investment (ROI or ROCE)
Reliability	- EPC contract delivery in most cases - Reliable operation of assets - Reliable and predictive maintenance of assets
Technology	- High coefficient of performance (COP) of heat pumps - High level automation - Suitability for different heat sources

Customers are more and more interested about sustainability and have made up different strategies to move towards sustainable production. Electrification through heat pumps would bring direct emission cuts to places where the heat has been produced with burning something.

Customers are also able to cut indirect emissions by choosing renewable electricity as a power source for the heat pumps. Sustainability as a brand aspect has been increased in the eyes of consumers last years and therefore companies are branding themselves sustainable.

Corporate governance and financial aspects relate to each other quite much, where governance aspects are more related to company's employees and financial aspects to company itself. Compensations are not straight related to what case company can affect through delivering sustainable energy solutions, but are key drivers for customers where they implement their sustainability strategies into reality. When looking at the financial aspect of these solutions, customers are looking for good return for investment which they typically measure from ROCE or payback time of these solutions. Basic idea for energy production investment is to choose the financially best solution whether it is combustion technology, heat pump solution or other. This driver runs over every other aspect in the most cases, because investing something more expensive solution than other has a straight affect to cost and competitiveness on the market. Basic value that heat pump can bring to heat production is lower operating expense, but the main barrier is still too high capital expenditure in some cases.

Many Nordic companies in different industries have lighten their staff over the years and they do not have so much of expertise anymore to implement these projects (Company Y, 2021). Therefore many of these customer companies are buying some investments as a turn-key delivery with a EPC contract. Trust is build up through reliable solution delivery for the customers. EPC contract is mostly used in smaller investments and customers might try to save money in the larger ones by purchasing the solution as separate packages. These packages might include for example heat pump system, civil works and other construction works separately from different suppliers. In these cases system providers like manufacturers typically can offer more value through lower price than case company who buys the technology outside and adds its own profits to offer. Customers are even more leaning on purchasing the services to maintain and operate these assets. Reliable asset management is the key to achieve predictive and low operating expense costs in the longer term. Nowadays it is not only selling these solutions but creating more value through maintaining them in the long term.

When talking about technology in case of heat pumps, it could be said that most significant aspects are performance and price. Heat pump performance typically is measured through coefficient of performance which tells how much of heat would get from amount of electricity (Industrial heat pumps, 2021). For example if the price of investment is the same but others COP is 2 and others 3, there is no guess which one is selected because it affects the operating cost through the use of electricity so much. Heat pumps are quite mature technology, but ongoing development tries to get better performance through the pumps to achieve more valuable solutions. Typically investments are always done with a lifecycle cost calculations where investment price is one and operating expense is the other point. Combination of low capital expenditure and operating costs would lead towards volume in the long term.

6.1 Customer value creation and value capture in different models

Different business models can create different value or can add customer value creation to the business. In table 3 different business models are compared to each other in the same aspects what customers are looking for in table 2. In some cases difference in value creation towards customer is narrow and the difference is more on the value capture side than value creation side.

Table 5 How different models can affect the customer value creation

Aspect	VAR	Co-operation	Technology owner
Environmental	- Lower emissions by choosing the best technology	- Lower emissions using partners technology	- Lower emissions using own technology
Social	- Provide low emission solutions	- Provide low emission solutions together with partner	- Provide low emission solutions with own supply of components - Create branding together with customer
Governmental	- Lower the emissions through solutions	- Lower the emissions through solutions	- Lower the emissions through solutions
Financial	- Choose the best provider by price - Offer low cost ALM services like operation and maintenance	- Lean on partners ability to be price competitive - Offer low cost ALM services like operation and maintenance	- Create price competitive products - Offer reliable lifecycle solutions with operation and maintenance services - Increase value through aftersales parts etc.
Reliability	- Choose the best provider - Create own reliable services	- Lean on partners reliability - Create reliable services together with partner	- Create own reliable supply and services
Technology	- Choose the best technology/price solution	- Lean on partners ability to provide competitive technology	- Create own technology to be competitive on the market

All models create quite similar sustainability value for the customer and the sustainable value creation leans on lowering the emissions through offering the solutions. Narrow difference between the models is in the product offering where VAR-model can choose the technology for use quite freely, co-operation model leans on partners ability to create good products and technology owner leans on own products and their development. Sustainability branding

through products flows towards the manufacturer and is greater while owning technology than offering others products in VAR-model.

Price competition is one of the most significant aspects in value creation. In VAR-model price competition is the hardest because products are bought outside and flexibility in price comes from the added services. This creates a situation where there is a need to be flexible in pricing, capturing the value from projects is hard cause of lowering the margins from own service production, and outside bought products do not have flexibility in the price. The other two models can give possibilities to be more flexible in pricing, especially when owning the technology pricing is in own hands. Co-operation model can give this ability through partnership contracts where partner gives discounts for example volume based. Basically having an own supply chain of products and after sales parts the pricing ability and reliability to supply is in own hands more than in the other models.

Technology is an important part of business model. In VAR-model flexibility in technology is significantly bigger than in the other models. VAR-model leans on providing the best value for money by choosing the best technology to use in the projects by price and performance of technology that different providers sell. The least flexible is the co-operation model where technology is provided from partner and ability to affect the offering is narrow. Owning technology creates an opportunity to even develop more intelligent solutions that can compete on the market, of course in the best case acquired target company has already competitive technology for case company's purposes.

All of the models create and capture value differently. While VAR-model is more flexible and low risk compared to others it is hard to be competitive in the long term without ability to affect the prices. Co-operation model is dependent on partner's ability to create value and doesn't differ much from VAR when thinking about competitiveness. It brings risk of partners company abilities, but is also quite risk free because jumping towards VAR-model is relatively easy. Technology ownership changes the case company's place in the value chain towards component provider and brings risks of manufacturing. Value creation is more on own hands in this case because affecting the prices and technology development can be done inside the house.

6.2 Heat pump technology barriers

Decarbonization market is relatively new and constantly changing. New technologies come to market, but as known market seeks the best economical solutions to produce heat. Almost all new carbon neutral solutions have similar barriers, which are related to price compared to other non-carbon neutral solutions like combustion.

Table 6 How can different business models effect on technology barriers

Barrier	VAR	Co-operation	Technology owner
High CAPEX	- Choosing the cheapest solution	- Lean on partner to develop cheaper solutions	- Create supply chain which can make end products cheaper
High OPEX	- Choosing best performing solution - Creating low cost services around the solution	- Lean on partners ability to create good performing technology	- Develop great performing technology to lower customer operating expenses

Heat pump technology's market barriers are mainly economical. Technology itself has reached mature state, but industrial sized pumps have low volume which can make them expensive. Most of the pumps are made tailored which can grow the expense compared to mass produced consumer sized heat pumps which are non-tailored and the market is significantly bigger than on the industrial sized heat pumps (GMI, 2021). Through business model affecting the most significant operating expense, price of electricity is impossible to have an impact directly, but better performance of pumps have an affect directly to amount of consumed electricity. The only way to affect directly to the barriers is by owning own technology production, but it has its own difficulties and risks.

Different models can affect differently to these costs, but there is need for other external support as well. The support now is coming from fiscal stimulus for green investments and European emission trading system. Combustion is the main competitor and is seen still valuable investment in some parts of Europe. Carbon neutrality will not be reached through normal market economy's way and needs a supporting tools. At the start of the year 2021 European emission trading system (ETS) stepped to phase 4, which means a cut in the overall number of emission allowances (EU, 2021). This means declining the allowances at an annual rate of

2,2%, compared to previous 1,74%. This has also made a significant impact to carbon allowance prices, which have surged 50 % at the start of the year and risen to record high 45 euros a tonne in April 2021 (Chestney, N., 2021). It is also expected that carbon allowance prices should rise even more to push the industries forward investing to carbon neutral solutions. ETS system has made an impact already lowering especially coal power margins significantly, but as known not all power and heat is produced with coal. In the big picture EU ETS covers only 40 % of the EU's greenhouse gas emissions, so there could be changes towards covering 100 % of emissions.

Business models can have an impact when talking about customer value creation. Adding services together with products is a great way to produce value for the customers. When comparing these three business models a basis of how they create and capture value is similar, but there are differences especially in the price competitiveness. When thinking about heat pumps, they also need an external support through politics to increase electrification in heat production. European emission trading system supports the value of electrification in the long term by cutting the emission allowances, but might not have a significant impact in the short term.

7 BUSINESS MODEL EVALUATION

Case company is intending to rethink its business model. It started from deeper review of the market and evaluating the business model now. It is important to prime up the knowledge before any evaluation to create a view of market development and competition on the market. Basic knowledge how market and competitors work gives an advantage to create differentiating business model to compete better on the market. It is also very important to evaluate the business condition regularly while the world and especially decarbonization market is changing all the time.

In this thesis business model evaluation started from evaluation of business condition now with more qualitative tools SWOT-analysis and creating a business model canvas. This created a view where the case company is competitive and what are the pain points in the business. Through the noticed pain points in current business model evaluation of the two other business models is easier. Current pain points bring the aspect of how can case company tackle the pain points in the business by reinventing its business model. Other aspects to consider were how will it fit to the strategy and what new will the business model bring to the core business. In the second workshop all the business models were evaluated with the score card created for this thesis. This gives an opinion how the value creation and value capture will change in different models and gives a score which describes individual's opinion which of the models will be the best for creating and capturing the value. Overall score can be averaged to give a consensus of different individuals opinion.

7.1 Business condition now

Condition now was firstly evaluated qualitatively in a workshop where 6 individuals filled business model canvas and SWOT-analysis. Overall situation is described widely further on to describe the business condition and the pain points that are needed to consider.

Business now consists of two different customer segments which are energy sector and other industrial sector customers. The dividing to two different segments is done mainly through how they see the energy production, for energy sector customers energy is the product that they sell

and for other industries energy is the expense that they need to produce their products. The customer relationships are typically long term if there are services included like operation and maintenance. The projects are sold through own sales channels typically really similarly to every customer. The biggest competitors are the equipment manufacturers, which can offer similar services or have intentions to integrate into the distribution system (GMI, 2021), and other similarly working companies.

Operating model already consists of different partners which might change for every project sold and are not so deep related. These partners consist of different equipment providers and subcontractors. Key capabilities are related project and risk management which are important in subcontracting project lead business, which are supported by different digital tools. Revenues are coming from project implementation and recurring revenues from operation and maintenance services. Cost structure is heavily related outside bought services and components. The business is enabled through component providers, subcontracting partners and other partners.

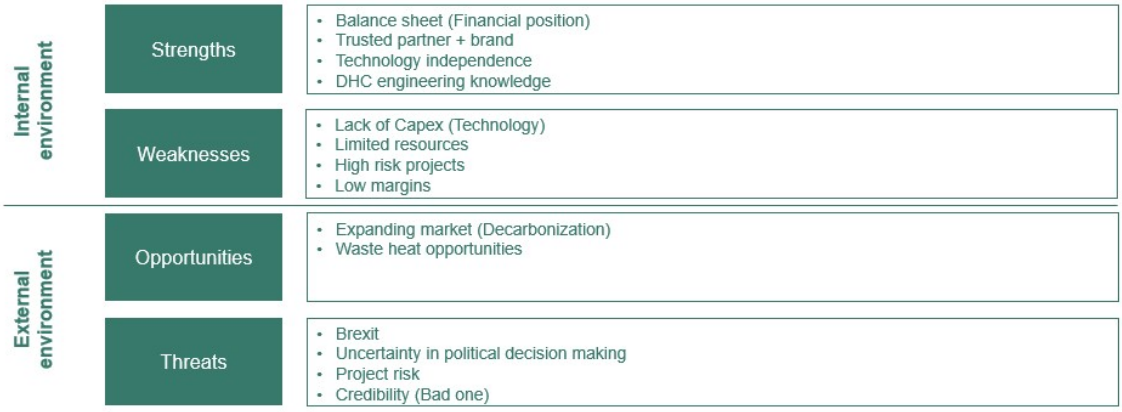


Figure 12 SWOT-analysis made in workshop

When thinking about SWOT-analysis and internal environment, VAR-models business strength leans on technology independence where case company can every time choose the best technology to offer for the customers. Other internal strengths are related to engineering knowledge (district heating & cooling) and brand. The weaknesses are quite typical that were mentioned earlier in this thesis when talking about VAR-model. When thinking about technology independence it is seen also as a weakness when considering the value creation.

Lacking of competence in some engineering and high risk of large projects due to almost fully subcontracted model can be seen the other significant weaknesses.

The external environment offers opportunities through the expansion of decarbonization market and implementation of waste heat into use in different industries. Threats are mostly political, because of uncertainties in political decision making can make significant changes in decarbonization market. Other threats are related to own internal sustainability risks which can have an impact to case company's brand and project risks where one project failure can have a significant impact to company's business.

As told earlier VAR-model has its benefits and also weaknesses, and is really competitive when serving the customer to create the best solutions available. It is lacking in many ways like project risks, but due to low assets for example manufacturing assets it is one of the least risk heavy regarding to political decision making. VAR-model offers a great business model to create customer value in all aspects except price where it is lacking. When thinking about value capture and risk to value capture ratio low margins compared to high project risks can be really harmful for the business.

7.2 Business model change and score card results

The aim of this thesis is to consider how should the case company change its business to create more value to the customer. Workshops consisted of evaluation of all the models through business model canvas, SWOT-analysis and score card created for this purpose. Business condition now was more evaluated as it is and the other two models were evaluated on base how would they change the value creation and how would they answer to the pain spots that have been noted in current business model.

When thinking about the other two business models in this thesis, they would refer to extension or revision of current business model. Co-operation model would be on revision-level when removing normal procurement of heat pump equipment and moving towards partners supply chain. Technology ownership model would be a combination of extension and revision where expanding service offering and revising procurement processes towards own manufacturing or

subcontracted manufacturing. Both of these models will bring something new and remove something old from the current business model.

Through the workshops held a view for how would the new models change the current model and its value creation were individually thought through. Both of the new models are seeking similar value creation and capture with different approaches. Table 6 presents the aspects and opportunities collected in workshops that case company seeks from business model change.

Table 7 Workshop data how new models support value creation and create opportunities (Case company, 2021)

Wider customer value	Opportunities
Deeper knowledge of products	Boost the sales through own products or strong partnership
Wider aftersales opportunities	Competitive advantage through better pricing ability
Support of EPC packages	Larger market area
Support of operation and maintenance services	Ability to affect R&D activities

Both models try to answer the need for own competence in case company's current business model and support sustainable business growth. The most important aspects for the change are growing own competence and create a supply chain of components for the projects (Case company, 2021). Through the change in these aspects would give ability to grow competitive advantage and create more customer value. This would see to lead towards business growth and better ability to serve customers more widely.

Models also try to help case company to get rid of VAR-models weaknesses and threats. When thinking about weaknesses of VAR-model and especially the financial weaknesses which are high risk projects and low margins, the only model which would try to find solution to these is the technology ownership model. Partnerships try to find benefits for both sides, but doesn't end in a situation where technology partner would want to lower its value capture. Therefore co-operation model has financially pretty similar weaknesses that VAR-model, but seeks for value through other aspects like combined sales channels or subcontractor manufacturer

relationship where other produces the component and other installs them for the customer. Technology ownership is seen to give more opportunities to create and capture value, but is seen significantly more riskier than other models. None of these three models seemed to have an effect to lower the risk of political decision making, but technology ownership is seen to even grow the risk.

Score card evaluates the models through value creation and adds risk to identify, if the risk would be too significant to take compared to abilities to create and capture value. If individual evaluator thinks that risk is high it would lower the score and same the other way. Figure 13 shows of seven individuals evaluation score of all the business models and the overall average.

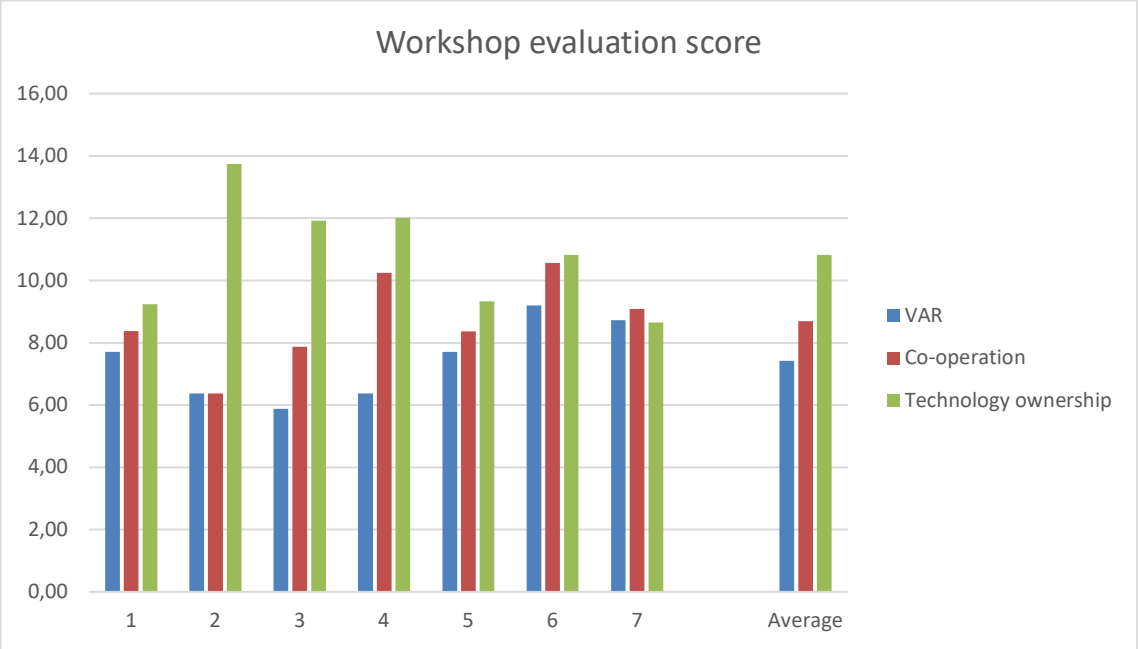


Figure 13 Results of workshop evaluation

All individuals are thinking almost similarly of the value creation in different models, except one. Results are supporting my own research and opinion of how would value creation change in different business models which are selected for evaluation in this thesis. This also supports the decision making in the future by giving a numeric score for mostly qualitative evaluation of different models.

Combining the results of score card would be that by owning an own production of components and combining it to services to create solutions for customers is seen the most valuable alternative to grow the business. It consists of many different risks that are more higher than in other models, but are seen to give more in return for taking the risk. Score card results are more individuals' empirical view for the value creation and risk, and cannot be seen the most reliable answer how would it be in reality. Combining many answers together will lower the possibility of individual evaluators empirical opinion error compared to reality.

8 DISCUSSION AND CONCLUSIONS

Emissions are really significant concern politically and growing concern also for consumers and the companies. World is seeking solutions to get rid of different fossil fuels like oil and coal, which are one of the most emission emitting fuels consumed in the world. Fossil fuels will play a significant role in energy production for the next decades, but due to emission reduction targets they are expected to see significant reduction during long period. In short term according to International energy agency (IEA, 2021) oil demand is expected to grow by 4 % compared to pre-pandemic 2019 levels by the end of 2026, but use of coal is expected to decrease. Situation is difficult globally where demand of energy is growing and relevant energy sources are in focus.

In Europe political decision making is the most important driver of decarbonization and is driving the energy production investments towards renewables. In Europe the European union is controlling the emissions through the EU emission trading system (ETS) which aims to reduce the emissions yearly (EU, 2021). EU emission trading system stepped to stage 4 in the start of 2021 that means declining of emission allowances with increasing speed compared to previous, last ending number of allowances that meet the targets of 2030. Politics are also supporting these emission reduction project straight through fiscal stimulus packages and relatively cheap debt. Politics will play a significant role in decarbonization when making polluting unprofitable.

Solutions for decarbonizing the heat production are still a bad investments in many cases, compared to combustion solutions. The energy sector is leading the transformation towards emission free production through electrification. Heat pumps are seen really valuable solution to electrify heat production, because of high maturity of technology and efficiency. Heat pumps have lots of technological benefits, but also significant market barriers like too high capital expenditure compared to other energy sources mainly combustion. According to IEA (IEA, 2021) and their sustainable development scenario, heat pump sales will increase significantly compared to other sources in this decade. However to meet the sustainable development scenario more efforts are needed. The efforts are mainly related to political support of electrification and heat supply through heat networks like district heating. Drivers for

electrification in heat supply are clear, but still need lots of efforts from politics and also from suppliers to make the technology cheaper and more efficient.

Inventing a business model needs a knowledge of the market and customer need. Through this knowledge a competitive business model can be designed. All the three models chosen for evaluation offer pretty unique approach to create and capture value, but have also similar properties. Evaluation tells case company's intentions to change the business model to support value creation. In figure 14 different possibilities of value creation in chosen two models that are tangible or intangible.

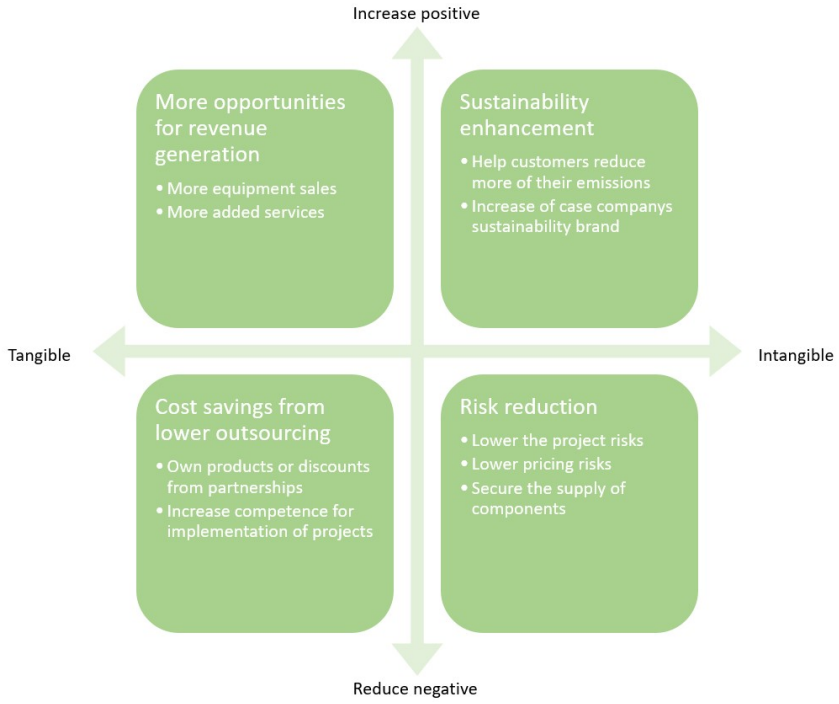


Figure 14 Searched possibilities of value creation

Change in business model would support case company's intentions for business growth and bring other relevant more intangible benefits like risk reduction and sustainability branding. New business model would give an opportunity to grow equipment sales and create more innovative services over the products. Risk in these two models would be higher than in VAR-model, but are more controllable and give more in return for taking it. There is also a concern of value capture where projects are risky and come out with low profits, which is untenable

situation in the long term. Change in business model would give an opportunity to increase value capturing through higher profits of equipment, lower cost structure of projects through decreased subcontracting level and possibility to create more services over the equipment. The most intangible benefits would come through sustainability aspects both on customer and case company side. Sustainability aspects are the main intangible drivers on the market.

8.1 Answers to research questions

How do each business model approach create value?

Each business model create value differently, but aim for same targets in value creation. The end customer sees the value similarly in every business model, but can see financially difference of the solution price and through services where different models can offer more added services. Figure 14 explains the change in the value chain and discussion how would value chain change affect to end customer value is discussed further.

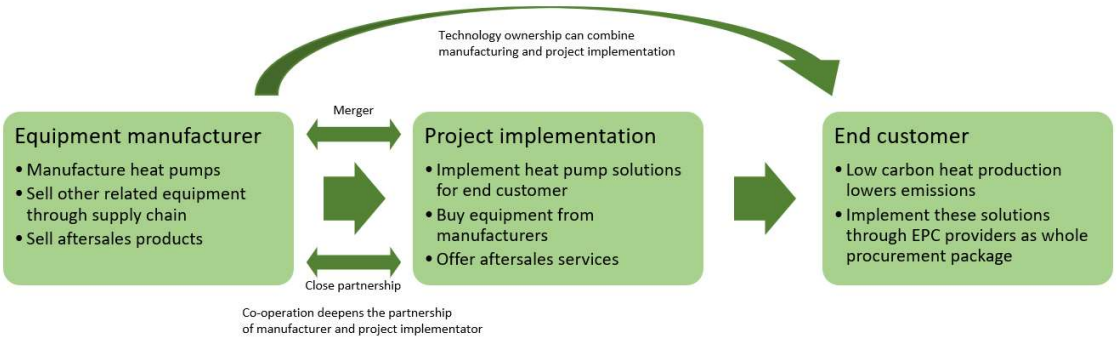


Figure 15 Value chain change between different models

In VAR-model where the supply chain is decentralized and equipment are bought outside customers main value is the approach of the solution. Case company can choose the best solution to every project that offers customers the best available technology to their purposes. Negative side of value creation is the price, because of highly outsourced implementation and components are bought outside which leads to low margins and higher prices for customers. Basic value of value added reseller comes through added services which in this case are design, implementation and asset lifecycle management services. In case of physical equipment service

offering in this case can be narrow without relevant supply chain of aftersales components to offer.

Co-operation model acts similarly as VAR-model when thinking about value creation. It adds possibilities for higher value creation through services which are supported by partners supply chain. This means not only sales partnership, but service partnership where the partner mainly supplies components for the equipment and services are made by case company. Relevant services could be maintenance services and upgrading services. Co-operation model leans on partnership where the manufacturer offers manufacturing of the components and case company offers the services like design, project implementation, maintenance and operation. The model has its blind spots in value creation like leaning on partners ability to provide the best technology that can be vulnerable part of the model.

Basic idea for technology ownership is to merger it to case company and provide a combination of own physical products and services added. This can also be called direct sales where the manufacturer or technology owner (subcontracted manufacturing) offers its products directly to the end customer as a solution. This creates value for both case company and customer more than the other models, but has much riskier approach. Basic idea of value creation is offer more expertise of the products and implements projects as EPC provider. This is supported by services and supply chain of aftersales parts that can be sold directly to end customer. Direct sales offers more financial value and price competitiveness without project developers that also try to make profit out of the equipment and services.

What are the benefits of each business model approach?

Every business model has its benefits that should be considered. Table 8 presents the most notable benefits of each business model approach. Most of the benefits are also highly related to value creation.

Table 8 Notable benefits in each business model approach

VAR	Co-operation	Technology ownership
- Value for the customers is made through added services	- Access to different sales channels	- Pricing ability of end products
- Long term customer relationship is created through asset lifecycle management	- Support of service delivery for the equipment through spare parts and expertise	- Reliable supply and ability to affect quality and flexibility of products
- Not committed to one component provider	- Possibilities for lower pricing of equipment	- Technical knowhow competence of products
- Easiest business model to modify	- Lower risk possibilities	- Ability to supply after sales products for service support
		- Closer relationship with the customer through services

VAR-model offers benefits that are the least riskiest. Low capital intensity of service business creates a situation where also business model can be modified quite easily. Value creation benefits are related to commitment of technology where case company can have a significant impact to value of technology by choosing the best available from the market and offer it to customer. VAR-model and co-operation models benefits differ from each other mainly financially where partnership can offer pricing competitiveness and move some project related risks towards the manufacturer. Partnership also offers possibility for reliable supply for different components to support the service value creation.

Technology ownership offers benefits quite differently than the other two models. Benefits are mostly related to gaining more competence and competitiveness. Own technology offers pricing ability, which is one of the most significant aspect when selling industrial equipment. By owning own supply network for components and ability to affect it offers possibility for higher competitiveness and ability to differ from the competitors. It could be said that in this model value creation possibilities are more in the own hands than in the other two models, but it is the most riskiest model when comparing these three. Technology itself opens doors for

different subsegments in the heat pump market, which can be roughly divided to small, medium and large size heat pump stations. Different sizes can work better in different applications depending of the need for heating power, temperature and in district heating depending of how decentralized would the network be. In any case due to uncertainties where the world is going in district heating or other industrial segments it is hard to know what is the largest market segment when dividing it by size. Best guess would be more decentralized power and heat production systems when the burning will decrease significantly.

Technology ownership opens also doors for deeper service business compared to other two models. This is significant benefit compared to other two models where recurring revenues are harder to make. Normally benefits of service business goes to supplying company like the manufacturer which can offer expert services and spare part supply for the customers. In VAR- and Co-operation models this would be outsourced or at least spare part supply would be bought from manufacturer or the partner company.

What is the customer need regarding heat pump projects and services?

Customers differ from each other in different industrial sectors, but all these face the same problem they need to reduce emissions in the long term and it should be done economically friendly (Company X, 2021, Company Y, 2021, Company Z, 2021). In this thesis customer need was discovered through customer interviews and empirical study of customer value through my own expertise. First notices from customer interviews were that they actually think quite similarly no matter what industrial sector they work in. In the market economy it is not a surprise that economical aspects come first when thinking about the investments. That basically means in this context that customers are most likely to make decarbonization investments when these are valuable economically and if some other source of energy like combustion is more valuable the investments are going there. It is sure that customers are looking these in long term and are concerned about the emissions, but value for money weights more and economically bad investments would lead decreasing the competitiveness especially in the energy intensive sectors. Customers are looking for investment viability at quite short term, typically for example 3-7 years (Company X, 2021, Company Y, 2021, Company Z, 2021). Also some sectors value these kind of investments so that payback time should be under 5 years. Some customers might

think it a bit differently than others especially on the sectors where fossil fuels are the main energy source and concerns about price of emission allowances are taken into account.

Almost every customer value contractors who can deliver projects as an EPC (Company X, 2021, Company Y, 2021, Company Z, 2021). This situation has caused in the past where customers on different sectors have decreased their human knowledge of project implementation and resources to do these. Basic need for heat pumps projects and services is to find a partner who can implement the solution and maintain it. In some cases also operating the solution would be in consideration, but most of the customers in energy and other industries have own operation where they operate their whole fleet of assets and different processes. The customer need of how projects are delivered is dependent of customers own organization.

Organizations differ from each other inside the industrial sector and between the sectors. Smaller projects are purchased as one purchase package, but bigger ones might be bought as separate packages. These packages can be roughly divided to technology, civil works and electrification/automation package (Company X, 2021, Company Y, 2021, Company Z, 2021). The separation between packages is made in cases where there can be seen decline in the overall price of project. The line between how projects are purchased is looked case by case in most cases. This has an effect to case company's business where nowadays projects are delivered as an EPC and in those cases where customers want to purchase these projects as separate packages. In that case when customer purchases for example heat pumps, civil works and some other works separately, case company's ability to compete between specified companies is hard.

How to create competitive advantage in the market?

Decarbonization market is relatively new and all the time changing. Heat pump market is relatively consolidated when thinking about large industrial heat pumps. Many manufacturers have intentions to grow their service business and take a step towards the distribution system offering design, build and maintenance services. In this kind of industrial equipment market where there is many similar products on the market competitive advantage is made through the differing offering and price. Typical manufacturer tries to make value by selling its products to distributors like similar companies operating with VAR-model who implement these

components to create solutions for the customer. Basically if you can offer both of these, the manufacturing where you can affect the price of products and offer services that create value for the customer you are more likely to succeed in the market. Basic idea is always to offer what the customer wants and offer these effectively.

Making the difference in the market needs a continuous monitoring of the market and customer need. Competitive edge is created through differing from the competitors on high level by offering or the price. As the market is in niche state and there is no constant way to produce these solutions, difference in the offering can gain more competitive edge than the price competitiveness. Offering the most efficient heat pump solution with affordable services to maintain the asset can bring the operating expenses down, although it would have more capital expenditures, can have a significant difference to the pay-back time which in this case is the market barrier.

8.2 Future research

Future research is mostly related to development of the decarbonization market and what is the path to choose for case company. Uncertainties in the market make a situation where a clear path how would the decarbonization of heat production will happen is not clear, but electrification can be seen really valuable option in case where renewable electricity production grows significantly and reasonable priced green electricity is available. Heat pumps have reached really high maturity of technology and will lead the way towards electrification of heat production, but there is coming other technologies that compete with heat pumps and are still in development phase.

Future development of the market is highly dependent of political will of decreasing the emissions. Many of investigating offices like international energy agency (IEA) see the net-zero emission path coming through high electrification of everything (IEA, 2021). This basically will need political decisions to make combustion really non-profitable and support new electrification technologies. Future is always unpredictable in many ways and therefore continuous monitoring of the development and acts towards that development should be done.

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