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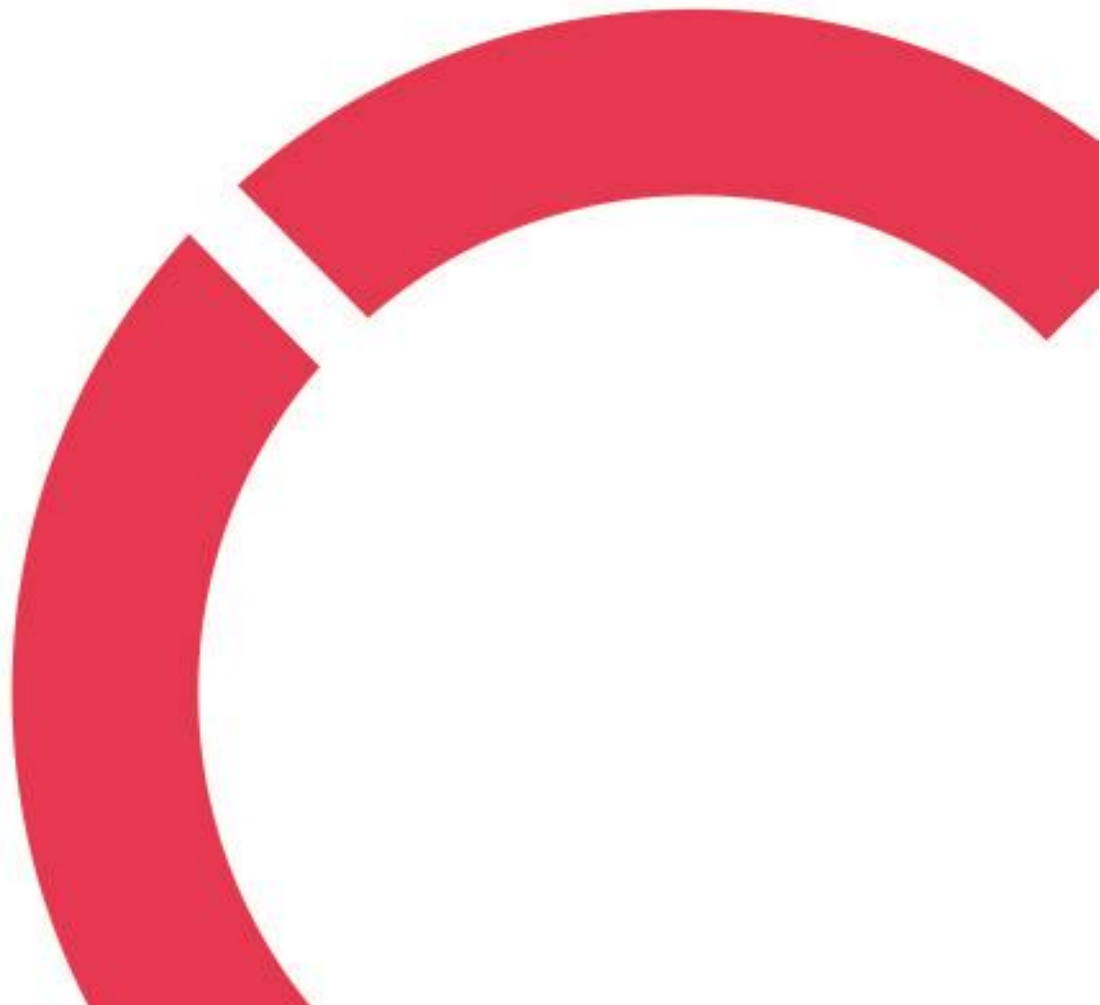
STRATEGIES FOR DECARBONIZING STEEL PRODUCTION

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ABSTRACT

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<p>This research was an individual’s objective view of describing and comparing the process of decarbonizing steel production, defining the challenges and the options that the companies that are included in the transformation process must face during the coming years. The objective of the thesis was to find out if the company, called SSAB, can gain competitive advantage with their strategies during the transformation.</p> <p>The main elements of the theoretical framework focused on the decarbonization of steel production, research methods, change management and theories of strategy. This thesis was based on qualitative research method. The data for the research was collected from different companies’ websites and from the materials handling the topic of decarbonization of steel.</p> <p>The results were presented in written text and indicated that acquiring a competitive advantage in strategies on steel production decarbonization is not easy. There are many competitors that are planning to do the same transformational things in their production with quite the same strategies. The outcome of the research was that minor aspects can provide some sort of advantages if the company can achieve their desired plans.</p>		
<p>Key words Change, Decarbonization, Steel industry, Strategy</p>		

CONCEPT DEFINITIONS

BF	Blast Furnace
BOF	Basic Oxygen Furnace
DRI	Direct Reduced Iron
EAF	Electric Arc Furnace
HBI	Hot Briquetted iron
OHF	Open heart Furnace
OEM	Original Equipment Manufacturer
PCI	Pulverized Coal Injection

ABSTRACT
CONCEPT DEFINITIONS
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1 INTRODUCTION

Decarbonizing steel is very important and relevant topic in the steel industry, as the industry itself has been criticized for being one of the biggest sources of CO₂ emission. This environmental aspect has initiated the need for a change and the need for decarbonizing the steel industry.

The purpose of this thesis is to analyse SSAB's strategic decisions regarding the change towards decarbonizing steel and compare SSAB's strategical actions with the strategical actions of their competitors. In this thesis the idea is to examine the differences and similarities with strategical actions, that the companies have been stating to do during this transformation, but also to find out if there are factors that are generating competitive advantage for SSAB. The data for this research is gathered from annual reports, public announcements and company webpages.

SSAB is a global steel company, headquarter in Stockholm, Sweden. President and CEO is Martin Lindqvist. According to SSAB website, the company have approximately 14000 employees in more than 50 countries. The locations of SSAB's production plants are in Sweden, Finland and USA. Their annual production capacity of steel is estimated to be around 8.8 million tonnes. SSAB have five divisions, that are called SSAB Special Steels, SSAB Europe, SSAB Americas, Tibnor and Ruukki Construction. The vision of the company is a stronger, lighter and more sustainable world. The company aims to be the first steel manufacturer to offer fossil-free steel in 2026 and has set a target that it has largely eliminated CO₂ emissions from its operations approximately in 2030. (SSAB 2024h.)

SSAB is one of the leading organizations that thrives for shaping the industry towards more environmental-friendly steel producing. The objective of this research is to define and explain the differences on the approaches towards more environmental-friendly steel producing, comparing SSAB's approaches and their targets with the main competitors, the plans that SSAB and the competitors have done regarding reducing CO₂ emissions. This research will follow the following questions: What are the plans for reducing CO₂ emissions? What are the planned investments and the schedule of the plans? How can SSAB create competitive advantage with their plans of decarbonizing steel production?

Research can be done based on two research methods, which are qualitative and quantitative research. Qualitative research is described to be as a term, that covers a variety of different research approaches

and methods, where the information and data is characterized as nonquantitative, consisting mostly of information that is in textual or visual form (Saldana 2013, 3-4). This research is based on a qualitative research method, and it was chosen because it fits better to the purpose of this research as the data contains mostly texts that are being interpreted and summarized to view a picture of the research topic.

Strategy has been described as a long-term direction of a company (Johnson, Whittington, Scholes, Angwin and Regnér 2017). Alfred D. Chandler has said that strategy determines the long-run goals, the objectives, the needed actions as well as the necessary resources for reaching the desired outcome in the future (Johnson et al 2017). A strategy creates or forms an overall approach plan which explains how the targets and objectives will be achieved, a strategy is created for maximizing competitive advantage and for minimizing the competitive disadvantage (Wheelen, Hunger, Hoffman and Bamford 2018).

Change in the business world, organizational change, is described as any way of doing things differently than before. Changes cannot be avoided because they are inevitable. Change can occur from multiple sources, for instance it can be an alteration in people, structure, technology or environment. (Murthy 2007, 2-10.)

This thesis is divided into seven chapters, and this first chapter introduces the topic of the thesis to the reader. The second chapter will concentrate on explaining the concept of decarbonization of steel industry. The third chapter explains the organizational change theories that are affecting the company and the strategies. Strategy theories are discussed in the fourth chapter of this thesis. The fifth chapter will focus on the company strategies and the next chapter is dedicated to comparing the results that have been discovered from these companies. The last chapter will focus on conclusions of the research.

2 DECARBONIZED STEEL

Many steel manufacturing companies at least in Europe and North America have started planning actions regarding the steel manufacturing in the future. Manufacturers have been focusing more than before on how the steel manufacturing affects the environment, and the main goal for these companies is to reduce their carbon dioxide emissions significantly or even close to zero carbon emissions. It is not the only reason that steel manufacturers are willing to reduce their carbon emissions, but there is also pressure from tightening carbon emissions especially in Europe, also the customers are demanding for more carbon reduced steel products as well as the growing interest in sustainability with investors and public (McKinsey & Company 2020).

Steel is one of the most recycled and also one of the most recyclable materials in the world. Steel itself is 100% recyclable and the increase in re-using the steel material reduces the amount of usage of raw materials. Steel can be re-used over and over again without it losing the key properties. It is estimated that more than 50% of steel produced in Europe is made from recycled steel. The life cycle of steel is described as starting from raw material extraction followed by steel production and steel manufacturing. Then comes the use phase followed by recycling of the material. The recycled steel, scrap, can be divided in pre-consumer scrap and post-consumer scrap. Pre-consumer scrap is described as the scrap that originates from the steel production, while post-consumer scrap is the scrap coming from used steel at the end of the use. (Eurofer 2020; Worldsteel N.d.-a.)

Decarbonization of steel is explained as a process of reducing or eliminating carbon dioxide emissions that are generated during the manufacturing of steel. The primary goal is to transition from traditional carbon-heavy methods of steel manufacturing to cleaner and more sustainable alternatives. This transition is crucial for companies as a response regarding climate change concerns and to achieve the global carbon emission reduction targets. (Shahabuddin, Brooks and Rhamdhani 2023; Kim, Sovacool, Bazilian, Griffiths, Lee, Yang and Lee 2022.)

The iron and the steel industry are described as the one of the largest consumers of coal and also one of the most intensive industries regarding greenhouse gases. According to conservative estimates, the steel industry is responsible of 7-9% of greenhouse gas emissions in the whole world. These industries are also mentioned to be among the highest consumers of coal, which is used in furnaces in order to make steel from iron ore, most of the coal is consumed in blast furnaces and the rest typically in sinter

and coking plants. Steel industry is referred to as one of the hardest industries for decarbonization due to the heat treatments and because carbon is one needed input for the production. In many of the steel manufacturing processes it is not easy to create the needed amounts of heat energy without generating huge amounts of CO₂ emissions, because coal is typically used as a heat source and as a part of several production processes in forms of coke and coke oven gas. (Kim et al 2022.)

Iron is made from iron ore by removing impurities from it, after that the iron is further processed to steel by adding carbon, recycled steel and other elements like manganese and sulphur. Steel is mainly manufactured in two ways: the blast furnace-basic oxygen furnace route, also called BF-BOF route, and also with the electric arc furnace route which is also known as EAF. The difference of these routes is mostly the raw materials they use: BF-BOF route consumes iron ore, recycled steel and coal while EAF is mainly using electricity and recycled steel. (Worldsteel N.d.-b.)

The carbon dioxide emissions for a ton of produced crude steel in 2022 according to Worldsteel was 1.91 tonnes. The report shows that the BF-BOF route CO₂ emissions were 2.33 tonnes per ton of crude steel. There is also data regarding steel scrap-based EAF production emissions, 0.68 tonnes of CO₂ emissions per tonne of crude steel. This indicates that CO₂ emissions can be very much at least cut in half with EAF technology and by not using coal as the heat source. (Worldsteel 2023.)

The picture (FIGURE 1) below is a good a good illustration of what needs to be changed in the process of steel manufacturing to reduce the carbon dioxide emissions.

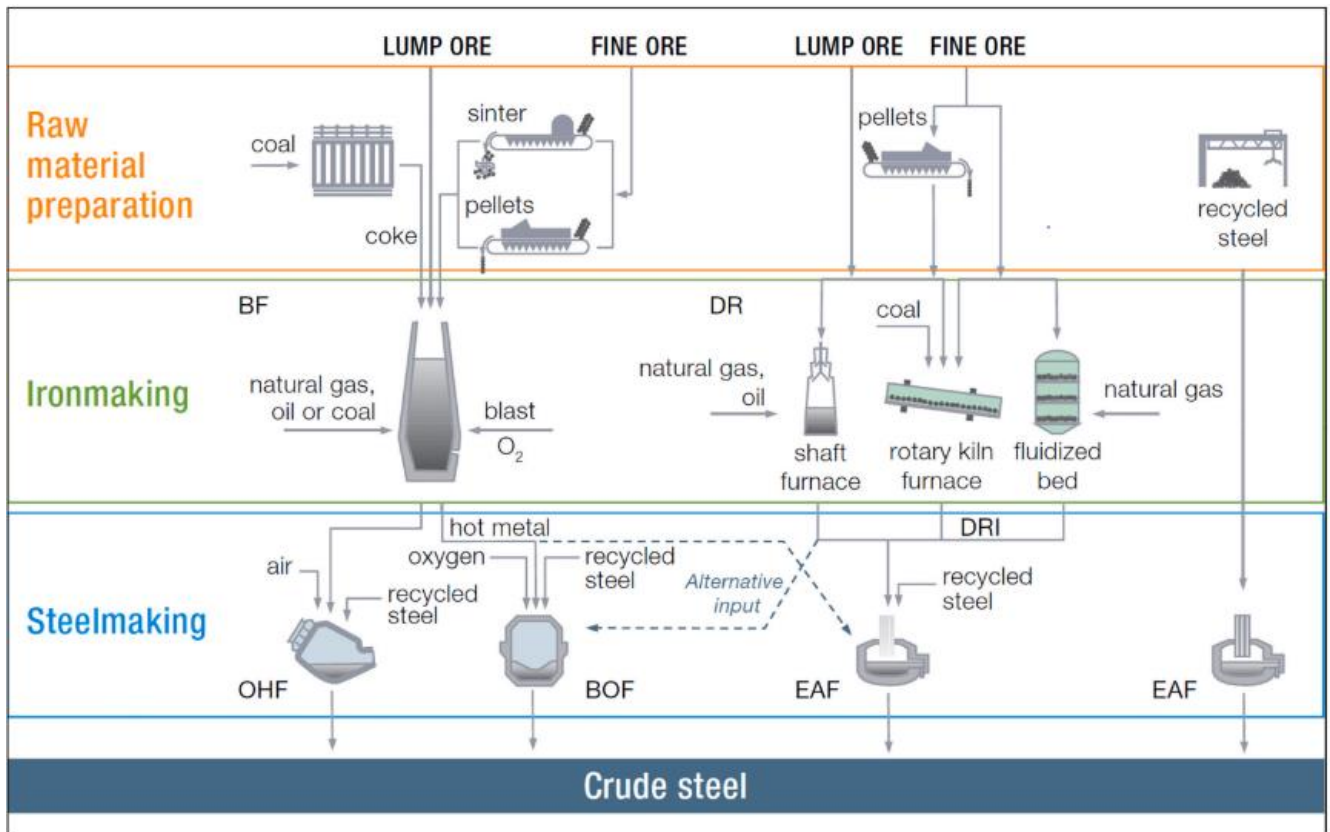


FIGURE 1. Iron and steel manufacturing methods. (Kim et al 2022)

As a clarification to the picture's abbreviations: BF means blast furnace, DR means direct reduction, BOF is basic oxygen furnace, EAF means electric arc furnace, DRI means direct reduced iron and OHF means open heart furnace. As described earlier carbon is needed to create steel, but in EAF-DRI model it is only used for making steel from iron in comparison to BF-BOF model where it is used for heating as well, which generates more carbon emissions. In the EAF model where steel is manufactured completely from recycled steel the added carbon is not needed as the recycled material is steel. Heating gases can also be changed to natural gas instead of coal, or at least use more natural gases instead of coal products like coal or coke oven gas.

Steel manufacturers are taking steps towards decarbonization of steel, the following three steps are mentioned as the manufacturers target for results quickly. As a first step, companies are focusing on reducing the emissions, repurposing steel with alternative materials and production efficiency. As a second step, methods such as increase of scrap usage and carbon emission free electricity are used to decrease the carbon emissions. Replacing coal as a reductant with biomass and implementation of smart carbon usage is also used by some manufacturers to reduce and capture of carbon dioxide emissions. (McKinsey & Company 2021.)

The existing manufacturers have two options for decarbonization with switching to hydrogen-based production of steel, it can either be implemented in the new upcoming sites or they need to rebuild and modify the existing facilities. The manufacturers need to evaluate and make a decision that suits best in their situation technologically and economically when mitigating their carbon dioxide emissions. The processes that are available are mentioned already, those are BF-BOF and EAF. If BF-BOF route is chosen, which is the most used method nowadays in steel making, what needs to be remembered is that it is dependent to coal and requires other technological inventions to reduce the carbon emissions significantly, but eliminating the carbon dioxide emissions and reaching carbon -neutral production is not possible. The possibilities for full decarbonization are limited to EAF as a production process option, which has several different production strategies to choose from such as: increasing share of scrap, DRI and EAF or DRI and EAF using hydrogen. (Kim et al 2022; McKinsey & Company 2020.)

Increased share of scrap means maximizing secondary flows and recycling, mainly by adding more scrap to melt in the EAF. EAF allows the manufacturer to be more environmentally friendly and offers flexibility in situations of changing demand. Needs to have renewable electricity supply and sufficient high-quality steel scrap supply. Increasing demand for high-quality scrap can create issues and increase the costs as the raw material process might be high. DRI and EAF option means that the process emits less carbon dioxide than the first option and makes it possible to produce high-quality steel. Production of DRI needs cheap and good availability to natural gas. DRI and EAF using hydrogen is explained as an option in which the green hydrogen-based DRI is used in EAF as a combination with scrap. Fossil fuels are replaced in the DRI production with hydrogen that is produced with renewable energy. This has proven to be nearly emission-free method to produce steel. In Europe especially this option has created interest, and many key players are planning to build or are currently building, or they are testing the hydrogen possibilities. (Kim et al 2022; McKinsey & Company 2020.)

Hydrogen has two ways to be used in the steel production: it can serve as a substitute for PCI, pulverized coal injection, in the blast furnaces to reduce the BF route carbon emissions approximately by 20%, but not totally decarbonizing as the BF still needs to have coking coal as reductant agent. Hydrogen can also be used in DRI production as an alternative reductant, DRI is then further processed to steel in EAF. DRI & AEF route has been proven to offer nearly carbon-neutral production, if it involves green hydrogen and renewable electricity source. A green hydrogen-based DRI & EAF steel production method has three core process steps which are green hydrogen production, DRI production and steel production with EAF. (McKinsey & Company 2020.)

3 ORGANIZATIONAL CHANGE

In organizational change, the two forces that are causing the need for a change are explained to be external forces as well as internal forces. External forces can create the need for a change from multiple sources, such as: marketplace, laws and regulations, technology, fluctuation in labour and economic changes. Change based on internal forces primarily originates from organization's internal operation and because of the impact of external changes: modifying the strategy, new equipment and employee attitudes as an example of internal forces. Forces that are pushing the organizations towards change have been categorized in key categories which are: people, technology, communication, information processing, competition and social trends. (Murthy 2007, 2-10.)

Robbins and Judge (2017) have stated that change is either planned or reactionary. The concept of change has been explained to be either continuous and intrinsic or extrinsic and discontinuous. The change can also be patterned and predictable or unpredictable and complex. (Robbins & Judge 2017, 315.)

Kamensky explained that all the organizations have the need to change and evolve, because the business environment is changing regardless it's wanted or unwanted. The sensitivity for changes varies a lot between companies, a rough categorization for company's sensitivity for changes is divided in five different categories. As a first category on the sensitivity the change has already occurred, but the company has not even noticed it. In the second one the change already has occurred and has been noticed by the company, but the impacts of the change are not understood and there is no reaction for the change. The third one is defined as the change already occurred and noticed, the impact is understood but the lack of capability or lack of will prevents to make a change. A definition of the next category is that the company notices and understands the impact of the occurred change and changes their operations. The last category is that the company predicts the coming changes and utilizes the opportunities that the change includes or even turns threats to benefits. (Kamensky 2008, 21-22.)

Robbins and Judge (2017) have listed four approaches to managing organizational change, which are: Lewin's three-step model, Kotter's eight-step plan, action research and organizational development. As a proactive approach towards change, meaning the methods to transform the culture in the organization towards embracing the change, the authors have listed three approaches: managing paradox,

stimulating an innovative culture as well as creating a learning organization. (Robbins & Judge 2017, 315-335.)

Lewin's three step model by Kurt Lewin has been explained as, that a successful change in any organization should follow these three steps: unfreezing, movement and refreezing. Unfreezing is explained to be the state where employees are being prepared for the change. Movement is the implementation of the changes, it has been shown that when the change process starts it is important to keep pushing the change through quickly to get better results. Refreezing is the last stage, that means that the new state should be refrozen right after implementation to make the change sustain. The objective of refreezing stage is to stabilize the established new state and minimize and prevent the attempts for reverting to the starting state. (Robbins & Judge 2017, 320.)

Robbins and Judge has written that Kotter's Eight-Step Plan has eight steps that should be followed during a change process. The steps are to establish a sense of urgency, to form a powerful coalition, to build a vision for change, to communicate the vision, to empower others to act according the vision, to build short-term wins, to strengthen the improvements and execute the changes, and also to imbed the changes in the organizational culture. (Robbins & Judge 2017, 320.)

The first step in Kotter's model named as to establish a sense of urgency, highlights the importance of the change. If everybody understands the need for the change the possibilities for good cooperation and motivation to work for the change and to make the actual change process work is much better than if only a handful of managers are aware of the situation or the need for a change. Satisfaction for the current situation needs to be tackled by the ones that are pushing the change by explaining why the change is so much needed. Reasons for overly satisfied employees could be, for example, no signs of clear or significant threat, management has painted too positive picture of current state, low demand on job performance, some people are not willing to admit the bad situation and key performance indicators are set incorrectly. Increasing the feeling of urgency and necessity requires eliminating or minimizing the sources of satisfaction. Kotter has listed some methods to provide evidence of the needed change and getting rid of the satisfaction, methods like: organize a crisis, sell some properties, describe the situation as it is without polishing the picture, insist that people discuss with unsatisfied customers or vendors and open discussion highlighting the issues and problems can be arranged. (Kotter 1996, 31-43.)

The second step, to form a powerful coalition, means that right kind of team for change management should be created. The reason why a powerful team is needed for completing the change, because it's impossible one person to handle the whole change process, no matter how skilful or how good leader the person is. The person would need to be able to alone create the vision for the change, sell the idea for numerous people, remove obstacles, generate short-term success and manage and control dozens of processes in the change and also imbed the change to the organizational culture. For selecting the right persons Kotter has listed four characteristics that are necessary for efficient directive team. The first one is to have enough of persons from key roles on the team, for example persons from production management. The second is defined as having the diversity of expertise (years in the company, work responsibilities, nationality etc.) to make rationalized and reasonable decisions. The third one explained as selecting people that have good reputation in the team so others will consider the team to be trustworthy and its decisions will be taken seriously. The fourth one is to have enough of leaders who have proved to be able to lead change processes. (Kotter 1996, 45-58.)

The team needs good leaders, and the leaders need to have good skills at leadership and management. Thing that should be remembered while building a team is that there are two kinds of individuals that should not be selected in the team. Those are the persons with too big egos and the persons that create mistrust inside the team. An effective team and powerful coalition are created by trust and a common goal, and the team members should be committed to work for the change. (Kotter 1996, 45-58.)

The next step is to build a vision for change. In order to reach to goals in the change process it is essential to build a good vision for the change. Vision is a picture the future and explains why people should work for reaching it. A good vision that supports the change process has three key goals: it clarifies the direction of the change which simplifies making other more detailed decisions, it encourages individuals to make decisions towards the change although they might seem hard, and it eases coordinating the actions of multiple units in efficient way. Vision works as a guideline to show the right path for employees and the organization, knowing the wanted direction helps to identify and reject projects that are not aligned with the vision and allocate the resources for the change process. Vision also encourages and motivates people to make decisions that might not be beneficial to themselves in short-term, in order to reach the better future for all. Effective and functional vision has six key characteristics, which are: imaginable, desirable, realistic, clear, flexible and easy to communicate. (Kotter 1996, 59-72.)

To communicate the vision is the fourth step. To be able to go forward with the change effectively the vision needs to be communicated well, there is no use for the vision if people do not understand what the vision is about. Kotter has mentioned seven factors that should be considered when communicating about the vision. The first thing is to keep the communication simple and straight, tell people how it is and leave out unnecessary information. The second factor explains that using metaphors and examples are an effective method for communicating about the vision, because people tend to remember well told stories. The third factor is about using multiple channels for communicating about the vision, using only one or few forums would significantly limit the amount of people receiving the message. Next factor is repetition, information about the vision needs to be repeated so the vision will be instilled into receiver's mind, most importantly the key individuals in the organization should be heavily involved because they are the ones that should act according to the vision and be an example for others. The last three factors are leading by example, handling spurious contradictions as well as giving and receiving information. Managers, management and leaders should be role models and examples, if they are not believing or working towards the change it will make others not to believe in the vision as well. It is very important that employees have a feeling that their thoughts and opinions are being listened to, so the communication must be working in both ways and not just from the top to the bottom. (Kotter 1996, 73-85.)

The fifth step is called empower others to act according to vision. This step is about removing all the possible obstacles that might disturb people to act and make decisions that are aligned with the vision. To keep the change process going smoother other people should be empowered and given the responsibility, because usually people who feel that they don't have the mandate to act are not contributing to the cause either. The most common obstacles that are blocking the change process and should be removed are structural, knowledge, managers and human resource systems and technical systems. Structural obstacles are explained as the organizational structure can prevent employees to act or to provide the needed efficiency on some tasks, it can also be that the employees are not listened because of hierarchy of the organization as they are just employees, there might also be communication issues between other teams. Knowledge as an obstacle is explained as organization is not having enough or right kind of trainings, that would support individuals to learn, use and adapt to the new required skills, attitudes and behaviours when the change is implemented. Another obstacle is supervisors and middle managers who don't believe in the change themselves, they can create obstacles and even prevent their subordinates to act or won't empower them, this will decrease motivation to work for the change. Technical systems and human resource systems can create an obstacle if they are not aligned to support the change process, therefore it is important to take care that the needed actions are done in these

systems as well. Identifying and removing the obstacles is needed to keep the change process moving and prevent it from stopping, the way to do that is to empower other people and to take the necessary actions with the obstacles. (Kotter 1996, 87-99.)

To build short-term wins is the sixth step of the plan. To keep the motivation up and to show some concrete results, especially for the ones who are against the change process, presenting short-term wins is a great way to convince people that the change process actually is taking the company towards better situation and their effort or struggle has not been a waste of time. A short-term win results have to be visible, undisputable and evidently related to the goals of the change process. Short-term win provides value for the change process in several ways: it shows that the made sacrifices have been worth it, it gives a positive feedback for the personnel, provides the information for finetuning the vision and strategy, proves that the sceptics are wrong and the change is needed, keeps the top management on-board by showing this is the right direction as well as turns the neutral individuals to supporters and the sceptical ones will get on-board as well. It is said that sometimes the change process will not succeed because the importance of the short-term wins is not completely recognized, or they are not even planned systematically by the management. (Kotter 1996, 101-113.)

In the seventh step, to strengthen the improvements and execute the changes, it is important to remember that as the changes are almost finished, they are not completed. Therefore, it is not the time to take things more relaxed but instead push the change forward more than before to prevent the change process to stagnate by the still existing resistance and the good feeling from the short-term wins. In this stage of the change process the focus should be on: pushing the change forward and adding new bigger change projects, to involve more people to help with the ongoing processes so the pace won't slow down and workload can be shared, to have the top management steering the process into the right direction, project management and leadership should be spread to lower levels in the hierarchy as well as identifying and eliminating unnecessary interdependencies. Leading the change process is a combination of leadership and management skills, without leadership skills the changes will fade out and the succeeding in the harsh business world will be difficult. (Kotter 1996, 115-126.)

The last step in the process is, to imbed the changes in the organizational culture. After the change process is done the new ways of working must be anchored into the organizational culture and prevent reverting back to old habits. The problem is that the organizational culture is powerful, therefore it can overthrow change attempts. The power bases on influencing human behaviour, shared values and norms, which are not that easily changed because the change on behaviour, way of thinking and acting

would have to happen for all the people in all levels of the organization. To get the change stick and to be imbedded into the organizational culture requires a lot of communication and results that prove the new ways of acting, behaving and thinking to be better than the old way. (Kotter 1996, 127-137.)

4 STRATEGY

Strategy has also been defined as conscious decision of organization to define the main goals and guidelines for their operations, the definition highlights the following factors: constantly changing business environment is the base of the strategy, strategy includes goals and guidelines. Also forming a strategy is a matter of selecting the best options from a numerous number of choices, it is a matter of prioritizing and declining even from some good options. And as a last factor that the decisions have been made together with knowledge and awareness, in order to have determined and obedient implementation. Strategy is formed so that the organization can control its business environment, the surrounding environment has been divided in three levels: the organization adapts to the business environment, the organization shapes and has an impact on the environment as well as the organization chooses the business environment. (Kamensky 2008, 17-18.)

Strategy is usually measured in a longer time period like in few years, sometimes even in decades. The long-term view of the strategy and the importance of it is highlighted in the three horizons framework (FIGURE 2) that is presented below. (Johnson et al 2017, 45-46.)

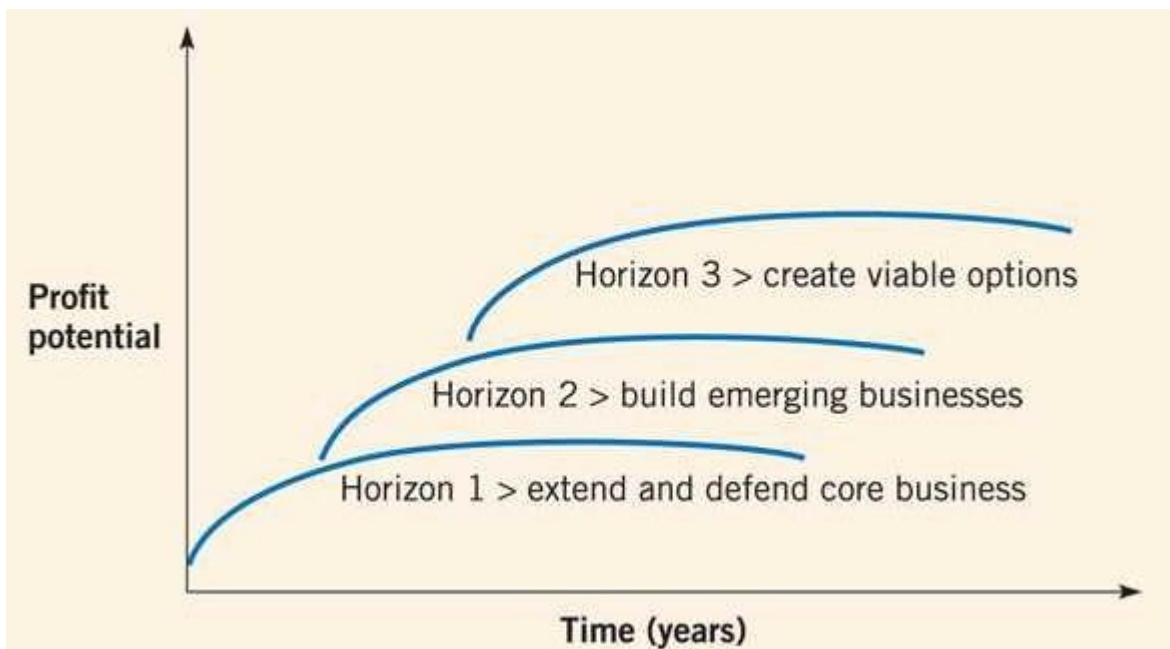


FIGURE 2. Three horizons of strategy. (Johnson et al 2017, 45-46.)

Horizon 1 stands for extend and defend core businesses: the current core businesses and activities needs to be extended and defended, but with an expectation that the profitability or other valued property of the business will decrease in the future. Horizon 2 stands for build emerging businesses and is explained as sources of profit from the activities that are emerging. Horizon 3 is named as create viable options, is described as the plans for possible activities that are unsure at the moment but might generate value in the future. (Johnson et al 2017, 45-46.)

The key is to avoid thinking and focusing only for short-term plans, activities and issues, but also bear in mind that future plans need to be considered. It is suggested to push Horizon 1 as far as it is possible while planning Horizon 2 and Horizon 3. (Johnson et al 2017, 45-46.)

The purpose of strategy is described with four factors that organizations are usually using for defining their purpose, which are: mission, vision, values and objectives. Mission explains to employees and stakeholders what the fundamentals of existence of the organization and their business are, why is the company actually established and what does the company do. Vision clarifies the future plans of the company, explaining what they want to achieve and what kind of company they want to be in the future. Values describe the principles that define how the organization wants to operate and how should employees operate, it also guides the strategy of the organization. Objectives describe the specified outcomes, that the company wants to achieve. (Johnson et al 2017, 42-48.)

Collins and Rukstad (2008) contributed an argument that all the organizations should be able to summarise their strategy in less than 35 words to make the strategy more understandable for everyone else, it is called strategy statement. The idea behind this argument is that the strategy statement would define the fundamental goals, which are mission, values and objectives of the organisation that they are trying to achieve, it would clarify the scope, and it would describe the competitive advantages that the organisation is seeking to gain from the strategy. Strategy statement should begin with a definition that explains what the strategy is planned to achieve. Scope defines customers and markets, geographical location of the activities and defines vertical integration. Vertical integration means clarifying activities that are done internally and activities that are outsourced. Competitive advantage is explained to describe what is the difference with the organization compared to competitors, in other words what is the company doing better than other companies to reach their goals. (Johnson et al 2017, 48; Collins & Rukstad 2008.)

Strategy can be divided into three different levels inside the organization: corporate-level strategy, business-level strategy and functional strategy. Corporate-level strategy explains the overall strategy of the company, it defines how value is added for the businesses, as an example it defines the geographical scope of businesses, diversity of products and resource allocation. This level works as a basis for other strategies. Business-level strategy defines how a specific business or division will compete in their market, strategies should be aligned with corporate-level strategy. Usually, strategy on this business-level deals with topics like innovation, response for competitor's action or adequate scale. The functional strategy deals with how the specific function of the company effectively utilizes and delivers the higher-level strategies into processes, resources and employees. (Johnson et al 2017, 50-51; Kamensky 2008, 22-25.)

Strategy in different contexts means that strategy fundamentals might be similar but the strategy and managing it has a variety as different types of organisations have different strategic issues. International organisations can benefit from sources of competitive advantage that domestic and smaller firms are not able to utilize, while managing might be more complex and formulating strategies in uncertain environment might be more difficult. No matter the size of the company, they must be adaptive, and they need to have flexibility to change or adjust their strategy to be able to compete in continuous change. Small businesses are more vulnerable for changes due the resources, so they need to pay close attention to their business environment to keep the business running. It is also said that usually in small and family businesses, the most important issue is the strategic purpose, which does not mean only profitability but also things like independence or family control. In short, it could be said as whether to allow their company to be acquired or not, instead of acquiring other businesses. In multinational businesses the differences come from geography, cultural differences and analysing the best options for new markets and/or existing markets. (Johnson et al 2017, 63-64.)

The exploring strategy framework handles topics like strategic positioning, strategic choices and strategy in action. In figure 3 the contents of these elements are visualized, not in a linear sequence as it is often shown. In reality the pattern of starting by understanding the strategic positioning, followed by making the strategical choices and finishing with turning decisions to action does not always work that way, and the strategy elements might not be following this linear sequence. It might be that decisions must be made before fully understanding the strategic position, or it might be that the strategic position is recognized after trying strategies in action. It's not always possible to fully understand the true strategic position by analysing, for example, sometimes a real feedback from the new product is worth more than estimations in terms of understanding the company's true positioning. Position, choices and

action should be looked at like they are closely related to each other and none of them are superior compared to others. (Johnson et al 2017, 52-53.)

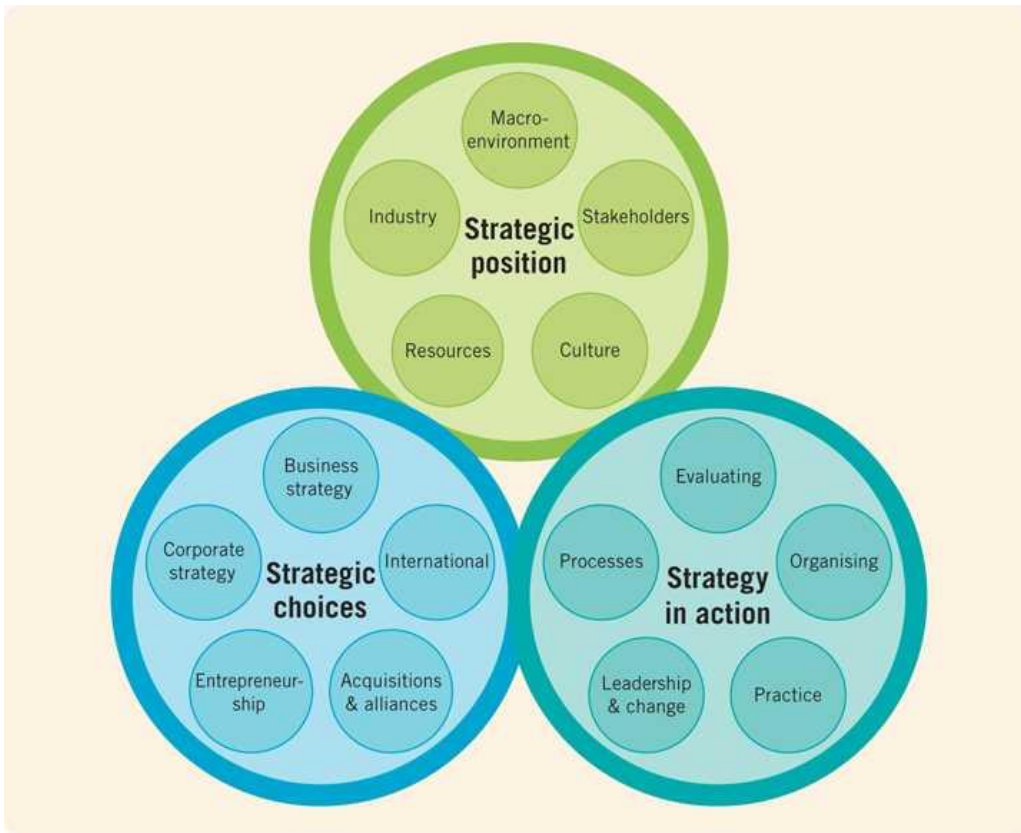


FIGURE 3. Exploring strategy framework (Johnson et al 2017, 52-53.)

Included in the strategic position are macro-environment, industry environment, resources, stakeholders and organizational culture. It is crucial to understand these factors when evaluating strategy for the future. Understanding the strategic position of a company by analysing internal and external environment is one of the most important elements on strategic decision-making process and strategy implementation. External environment means macro- and industry environment while internal environment refers to organization's resources and competences. Macro-environment is described as an environment, in which organisation is influenced by political, social, economic, ecological and technological as well as legal forces. In industry environment the analyses, competitors, customers and suppliers are the ones causing challenges to the company. Strategic capability is described as each company has their own resources and competences, which they need to utilize and improve. The key stakeholders are the ones that define the purpose of the company, and the most important thing is to understand stakeholders' different interests to identify this purpose. Organizational culture is also a factor, that has

an influence to the strategy, and the main thing to solve is how to operate in a way that the culture fits the strategy that is needed. (Johnson et al 2017, 53-54.)

Strategic choices are described as options for strategy, they include the direction where strategy could move as well as the methods how strategy is pursued. Company could have wide range of strategic directions to choose from, for example entering new market or launching a new set of products. The organisation can pursue these directions by alternative methods, for example by acquiring business that is already active on the market area or product area. The company can also try to create alliance or try to do this market entry on their own. Strategic choices are divided as follows: business strategy and models, corporate strategy and diversification, international strategy, entrepreneurship and innovation, and mergers, acquisitions and alliances. The business strategy and models cover the strategic choices of how the company is going to compete in the individual business level. Corporate strategy and diversification cover the strategic choices in the highest level of the organisation like which businesses are included in the portfolio. International strategy can be described as a form of diversification, which concerns new market areas in geographical terms. Entrepreneurship and innovation, in which innovation vital for the survival of the organizations and entrepreneurship is a form of innovation for new enterprises. Mergers, acquisitions and alliances are choices regarding methods to meet the strategical targets. (Johnson et al 2017, 54-56.)

Strategy in action has been explained to be about the fundamentals of forming and implementing strategies. Strategy in action is divided into five topics, which are strategy performance and evaluation, strategy development process, organising, leadership and strategic change as well as strategy practice. Strategy performance and evaluation includes managerial decisions of existing and forecasted performance is enough, also choosing the best option for the future that could improve the performance. Strategy development process involves the planning of strategy process and improving the current practices, instead of formal process how to process emergent strategic decisions when those occur. Organising is about successful implementation of the developed strategy, because for each strategy the company will need a specific plan to implement it. Leadership and strategic change, it showcases that strategy inevitably involves change and leadership is needed for managing change, strategic change causes changes to whole organisation. Strategy practice is explained as managing the work tasks and amount of work that the strategy process and change require, basically deciding who is doing and what. (Johnson et al 2017, 54-56.)

The strategy lenses are defined as alternative ways of look into strategical issues to be able to develop additional insights. Other perspectives help to be critical towards the existing approaches, which helps to figure out new issues or even solutions. The strategy lenses are called strategy as design, strategy as experience, strategy as variety and strategy as discourse. Strategy as design is defined as method, in which the strategic issues are valued by solid facts and objectivity by being systematic, logical and analytical. Strategy as experience means, that organizational culture and the ways of working and routines might cause the strategy most likely is driven by experience rather than studies or investigations. Strategy as variety, where strategy as design and strategy experience are unlikely to discover new ideas because they are too rigid, and focus is on the past. The variety approach views strategy as constantly evolving and it is open for new ideas. Strategy as discourse pays attention to the managers and to the language that they use to highlight strategic issues or problems and language that is used when making strategy proposals and communicating strategic decisions. There is a possibility that it could turn into a tool for shaping strategic analyses to managers' favour and a way to gain influence and power. (Johnson et al 2017, 64-65.)

4.1 Strategic analyses

The strategic analysing methods in the external environment can be described as recognizing and evaluating the factors outside of the organization, that could impact on the organization's performance and success. Methods like PESTEL analysis, used for evaluation of political, economic, social, technological, environmental, and legal factors in external business environment. Also, an analysing method called Porter's Five Forces analysis is commonly used, it examines the competitive forces within the industry. Forecasting is a method that is used predicting with varying level of certainty and precision, it supports the PESTEL analysis providing predictions on megatrends, weak signals and inflexion points. Scenario analysis is a method which can be used for creating probable alternative views regarding the business environment development in the future, the purpose is not to predict the future but to learn about different possibilities for business environment changes. These methods help companies to understand their industry, the competition, market trends, and external risks. The purpose of the mentioned analysing methods is to support the organisations on developing effective strategies, which can be then utilized by the organisation to navigate and thrive in constantly changing business environment. These strategic analysing methods in the external environment are supposed to provide valuable insights for decision-making in the company and also provide the needed input for strategic planning. (Johnson et al 2017, 81-132; Kamensky 2008, 119-208.)

PESTEL analysis is described to be a comprehensive framework examining the macro-environmental factors making an affection to an organization. The analysis is created to systematically evaluate all the factors it includes, helping organizations to identify the most important drivers of a change and the potential risks as well as opportunities. Political factors of the analysis contain the government policies, stability, and regulatory frameworks. Economic factors include factors like economic growth, inflation, and exchange rates. Social factors handle factors like demographics, cultural trends and social attitudes. Technological factors of the PESTEL examines innovation, automation and technological infrastructure. Environmental factors focus on topics such as sustainability, climate change and ecological consideration. Laws and regulations that impact or might impact the operations of the organization are included in legal factors. (Johnson et al 2017, 83-98.)

Porter's Five Forces created by Michael Porter is an analysing method that helps on evaluating the competitive forces in the industry. The competitive forces contain factors like the bargaining power of buyers, bargaining power of suppliers, threat of new entrants, threat of substitute products or services as well as the intensity of competitive rivalry. The understanding regarding these competitive force factors will support the companies to build effective strategies, which then supports on facing the industry challenges. The bargaining power of buyers is described to be high when the buyers have many choices to choose from or if they have significant influence. The bargaining power of suppliers is described to be high if there are only few alternative sources or when suppliers have strong negotiating power. Threat of new entrants is high if the barriers for entering the market or business are low. Threat of substitute products is high if alternative material or product is available. The intensity of competitive rivalry is described to be high when the competition is fierce among the already existing competitors. (Johnson et al 2017, 121- 132.)

Strategic analysis methods like PESTEL analysis and Porter's Five Forces are providing important and valuable information for the organizations regarding evaluating the external business environment, they also enable organizations to make decisions based on information. The methods support organizations to forecast changes, to capitalize on opportunities as well as mitigate potential threats in the complex, evolving and uncertain business environment. (Johnson et al 2017, 81-132; Kamensky 2008, 119-208.)

Industry types and the dynamics should be evaluated carefully. The industry type and its economic characteristics must be considered, because it will have a huge effect on the attractiveness of the industry, and also to determine what competitive strategies are available to be used. The industry structures

might seem stable, but they will change and in some cases the change might be in flux for a long time. The three basic industry types are monopoly, oligopoly and perfect competition. Monopoly's characteristics are that it has one company, often with a unique product/service and the entry barrier is very high, the competitive five forces threats are very low. Oligopoly industry characteristics are that it has few competitors, often with varying differences on products and services, and the entry barrier is described to be high, the competitive five forces threats vary depending of the industry. Perfect competition characteristics are that it has many competitors, often with a very similar products and services, and the entry barrier is low, the competitive five forces threats are very high. There is also an argument for hypercompetitive industries, which has been described to occur when the frequency, boldness and aggression of competitor actions accelerates to develop a condition of constant imbalance and a constant change. Industry dynamics are referring to the patterns, trends, and forces that shape the competitive landscape and overall behaviour of companies within a specific industry. The industry life cycle is a model that outlines the stages in which industries typically evolve over time. The life cycle of industry contains of five main stages: introduction, growth, shake-out, maturity and decline. (Johnson et al 2017, 136-139.)

The industry level might be too broad scope to provide detailed enough understanding regarding the competition. These five forces can impact the companies in different ways, this requires more detailed understanding. Many of the industries contain companies which have very different capabilities, and they compete differently compared to other competitors, some of the differences between competitors can be caught by concept of strategic groups. Customers can have significant differences as well, these differences can be caught by dividing them in market segments. In broader industries the concept of different strategic groups and/or segments in the market can contribute to opportunities to develop highly distinctive positionings, it can also help to reveal the concepts of value creation differences between competitors. Strategic groups are described as companies that belong in the same industry or sector and have similar strategic characteristics. Meaning that these companies are having similar strategies or that they are competing on similar bases, and their characteristics are different from the companies belonging in other groups in the industry. Strategic groups can be divided in two main categories: based on the scope of the company activities like product offering, geographical scope and the channels for distribution that are used as well as according to their resource commitment, which means factors like brands, marketing and the extent of vertical integration. There are differences regarding which characteristics are relevant between the different industries, the important ones are the characteristics that makes the difference between the successful companies and the companies that are not so successful. The concept of strategic groups is described to be useful for at least the following three

reasons: to understand competition, to analyse strategic opportunities and to analyse the mobility barriers. (Johnson et al 2017, 134-145.)

Industries can be divided into smaller and more specific markets that are called segments, the focus in segments is on the differences in the needs of the customers. In other words, market segment is a group of customers with similar needs and the need differentiates from the need that other customers have. Niche is a segment that is very small in terms of the amount of the customers. The segmentation strategies should be in line with company's strategies, the strategies that are created based on market segments must consider the needs of the customers. Two important factors that should be kept in mind in market segment analysis are variation in customer needs and specialisation. (Johnson et al 2017, 145-146.)

Although the concepts and the frameworks mentioned earlier provide more knowledge regarding the factors in the macro-environment, industry environment, and competitor and market environments of a company and the critical thing is the interpretation and how the knowledge is used when guiding company's strategic decisions and strategic choices. The next step, recognizing the specific strategic opportunities as well as threats for the company from the environmental analysis, is very crucial. The strategic choices for the future are greatly affected by identification of the opportunities and threats, as they provide fifty percent for the SWOT analysis, which has a big role on strategy formulation for many of the companies. As a strategical response the aim should be to reduce threats and exploit the advantages from the opportunities which have been identified. The other half of SWOT analysis, strengths and weaknesses, are done based on internal environment analyses. (Johnson et al 2017, 150; Kamensky 2008, 119-208.)

All the analysing methods mentioned are important tools, which provide a better understanding and knowledge of the strategic positioning of the company, still should be considered subjective and not as a solid proof that the results are the absolute truth. The methods are helpful for challenging the assumptions that already exist, and they encourage to think from other perspectives. To summarize, analysing competitors and markets is a proactive and a strategic approach that helps the companies' management and decision makers to navigate through the complex business environment, to take advantage of opportunities as well as effectively address the upcoming challenges. (Johnson et al 2017, 150-151.)

The strategic analysis of the internal business environment includes assessing and understanding the internal factors which could have an impact on the performance and competitiveness of the company. There are several methods that can be used for this purpose, the choice of method or methods usually depends on the specific goals as well as from the context of the analysis. The most important methods for strategic analysis regarding the internal business environment are resources and capabilities, SWOT, value-chain analysis and VRIO analysis. While making a strategic analysis of the company's internal environment, it is very important to consider a combination of these methods for greater understanding and for better overall picture of the current situation. (Johnson et al 2017, 152-199; Kamensky 2008, 119-208.)

Resources and capabilities of the company contribute to the company's survival in a long-term, and they have the potential to contribute to the company's competitive advantage as well. The analysis of resources and capabilities is very important factor of strategic management, which focuses on the understanding of internal strengths and competitive advantages of the company. The analysis itself includes identification and evaluation of the recourse and capabilities that supports the ability to achieve the strategic targets of the organisation. Resources are described as the tangible and intangible assets that the organization has. Tangible resources include the physical assets like equipment, facilities and financial resources. Intangible resources are described as assets like brand reputation, organizational culture and know-how. Capabilities are referring to the ability of the organization to exploit the resources effectively in order to achieve the outcomes that are desired, capabilities are described to be dynamic, and they can be the source of competitive advantage. Operational capabilities are described as the daily activities and processes of the company. Dynamic capabilities are focusing on the ability of the company to adapt and innovate as a response to changing business environment. The understanding of the interaction between the resources and capabilities of the company is described to be essential in order to formulate effective strategies. The understanding of these factors will also provide a solid foundation for the resource-based view of strategic management, it also emphasizes the internal drivers regarding sustained competitive advantage. (Johnson et al 2017, 164-172.)

SWOT analysis is described as tool for strategic planning that is also used for evaluating the internal strengths and weaknesses of the organization, it is useful for identifying the factors that can be leveraged for a competitive advantage and the factors that can create challenges to its performance. The internal part of SWOT analysis focuses on aspects that are directly related to the organization itself. Value Chain Analysis is a tool for strategic management that can help in breaking down the activities into primary activities and to support activities, which helps in identifying the sources of competitive

advantage. The value chain helps companies to understand the level that each activity contributes to the creation of customer value. Primary activities are described as activities such as inbound logistics, sales and marketing as well as operations. Activities like procurement and human resource management are included in the support activities. Value Chain Analysis is also described as a dynamic tool which can be used to different industries and organizational contexts. It provides insights for factors like strategical position and competitive advantage. VRIO analysis defined as framework for strategic management and it helps in evaluating the internal resources and capabilities that the organization has for determining the potential of creating competitive advantage. The framework has four key factors, which are value, rareness, imitability and organization. VRIO analysis guides the organizations in terms of identifying and utilizing their internal strengths for competitive advantage. (Johnson et al 2017, 172-202; Kamensky 2008, 119-208.)

4.2 Strategic choices

Strategic choices are defined as the selection of actions and approaches that companies pursue to achieve their objectives and to gain competitive advantage. These strategic choices are critical in terms of shaping the direction of the company and for determining company's long-term success. Strategic choices require very careful consideration of both internal and external factors, on top of that organizations may need to adapt, but also refine their strategies over time as a response to the changing business environment. The process of deciding between strategic choices involves evaluating different alternatives and selecting the most appropriate actions from the alternatives to gain a competitive advantage. (Johnson et al 2017, 315-350; Kamensky 2008, 233-323.)

Michael Porter has proposed three generic competitive strategies that businesses can pursue to gain a competitive advantage in their respective industries, also known as Porter's Generic Competitive Strategies. The three competitive strategies by Porter are: cost leadership strategy, differentiation strategy and focus strategy. Cost leadership strategy means that the company's strategy is to become the low-cost producer in an industry. Companies that are choosing this strategy aims to achieve economies of scale, operational efficiency, and a good cost control to offer products or services cheaper than their competitors. In differentiation strategy the company focuses to offer unique products or services that are valued by the customers, which is described to be achieved through innovation, branding, quality or other distinctive features. The focus strategy means that the company decides to concentrate on a specific segment or niche. It can be either cost focused which means that they are offering low-cost

products or services to a niche market, or differentiation focused which means that they are offering unique products or services to a niche market. There are also hybrid strategies which are described to combine the elements of different generic strategies to create more unique approach that suits better for specific circumstances of the company, one of the single generic strategies may not be feasible or optimal for all the companies. Some of the most common hybrid strategies that are worth to mention are: cost leadership with differentiation, differentiation with focus and integrated cost leadership with differentiation. It is very important to acknowledge that the implementation of these strategies might vary in different industries and organizations. The hybrid strategies allow companies to be more flexible and serve as a more responsive strategy in dynamic market conditions than the generic strategies. (Johnson et al 2017, 322-331; Kamensky 2008, 233-323.)

The strategy clock is described as tool for strategic management that helps businesses to analyse and position the company's competitive strategies in the market. This tool is often used for assessing the competitive position of the company compared to its competitors and is based on two key factors, which are price and value. The strategy clock contains eight strategic positions, each of them representing a different combination of price and perceived value. These strategic positions support the company leaders to understand their competitive advantage and to make informed decisions about their strategic direction. The eight positions on the strategy clock are: low price/low added value, low price, hybrid, differentiation, focused differentiation, risky high margins, monopoly pricing and loss of market share. Strategy clock is described as a conceptual framework, and not as a strict set of rules. Companies can use the strategy clock as a starting point for evaluating their current position and for exploring the potential strategies for improvement. (Johnson et al 2017, 333-334.)

Interactive strategies are described as approaches or techniques that are involving active participation, engagement and communication between the individuals or groups. Interactive strategies are commonly used in various fields of businesses to enhance collaboration, learning, problem-solving, and overall user experience. Interactive learning strategies are focusing on engagement of the learner through activities like as group discussions, hands-on projects, simulations and collaborative problem-solving. Interactive learning strategies lean on active participation, critical thinking and retaining the knowledge. Interactive marketing strategies involve two-way communication between brands and consumers. The goal with interactive marketing strategies is to encourage user participation and build stronger brand-consumer relationships. Interactive business strategies are focused on engaging customers, business partners and employees to participate into creating value. Interactive technology strategies focus on topics like designing user interfaces and experiences that facilitate intuitive and engage

interactions. Interactive entertainment strategies are structured to create engaging experiences for users. Interactive strategies may overlap, the effectiveness of the interactive approaches depends on the contexts and the goals of the specific situation. (Johnson et al 2017, 335-343.)

Cooperative strategies have been described as collaborative approaches that companies are using to achieve common goals, to solve shared problems or to exploit on mutual opportunities. Cooperative strategies involve two or more companies that are working together in a coordinated way aiming to enhance their competitive advantage, to achieve synergies and to create value. Cooperative strategies can have various forms and the effectiveness is usually depended on the nature of the collaboration and the goals that have been set by the participating companies. Examples of cooperative strategies: strategic alliances, supply chain partnerships, joint ventures as well as licensing and franchising. Strategic alliances are described to involve at least two companies that are forming a partnership in order to pursue mutually beneficial objectives. Typical for supply chain partnership is to have coordinated and integrated activities among different entities in the supply chain, for example suppliers, manufacturers or distributors which then helps to improve the efficiency, to reduce costs as well as enhancing the overall supply chain performance. Joint ventures are described to involve the creation of a new entity by at least two companies with shared ownership and control, which allows the companies to combine the forces of their resources and capabilities to pursue specific business opportunities. Licensing and franchising means that companies may enter into cooperative agreements with licensing or franchising arrangements. (Johnson et al 2017, 338-537.)

The business model is a described as conceptual framework that defined how the company creates, delivers, and captures value. Business model also explains the value propositions for customer and the other parties that are involved. It also explains the activities that create the value, associated revenue and cost structure and describes how the business and the pieces of it work. Value proposition is the main concept of business model. Business model canvas provides a one-page overview of a company's key components which makes it easier for entrepreneurs, managers as well as the stakeholders to understand, communicate and iterate on their business strategy. The business model canvas consists of nine blocks, which are: customer segments, value propositions, channels, customer relationships, revenue streams, key resources, key activities, key partnerships as well as cost structure. (Johnson et al 2017, 344-350; Murray & Scuotto 2015.)

Horizontal integration is described as an acquirement or merger with competitors that are on the same stage of the value chain. Vertical integration is explained as expanding into other stages of the value

chain, it can be backward or forward and it can improve the control over the supply chain or distribution channels for example. Outsourcing is defined as a business practice in which a job function or a service is hired out to a third party by contract. The reasons for outsourcing can vary depending on the company's need, but some most common reasons are cost savings, focus on core competences, flexibility and access to skilled professionals. The risks and challenges of outsourcing are communication barriers, loss of control and dependency on service providers. (Johnson et al 2017, 376-382.)

Business growth is a key objective for most of the companies and it can be attained by various methods that companies can use. Here are several methods for achieving growth: organic growth, inorganic growth, geographical expansion, diversification, business innovation, licensing and franchising. Organic growth can be divided into market penetration which means increasing market share by selling more for existing customers and to product development which is explained as developing new products based on customer needs. Inorganic growth can also be divided into mergers and acquisitions to expand the market or into strategic partnerships in which company collaborates with other company for mutual benefits. Geographical expansion can be either domestic or international but in both cases the aim is to achieve more market reach. Diversification can be horizontal or vertical: horizontal is described as expanding into new product or service categories that are related to the existing business, while vertical is described as moving into different stages of the value chain. Strategic innovation focuses on continuous innovation of products, services or business processes to stay on top or ahead of the competition. (Johnson et al 2017, 364-382.)

International strategy is described as a comprehensive plan and as the set of actions that a company utilizes to compete and to succeed in the global business environment. Making decisions regarding resource allocation, market entries and product positioning on a global scale are all involved in international strategy. Developing an effective international strategy is vital for businesses that are aiming to expand beyond the domestic markets and are trying to capitalize the opportunities in the global market. The methods of international strategy are exporting, licensing, franchising, strategic alliances and joint ventures, foreign direct investment, localization, risk management and compliance as well global marketing and branding. Exporting means selling goods or services that are produced in one country and sold to customers in another country, the advantages are low initial investment and low risks as well as quick entry into foreign markets. Foreign direct investment means establishing a physical presence into a foreign country either by acquisition, merger or by building new facilities. The advantages of foreign direct investment are complete control over that business, better understanding of local markets and possibilities for long-term growth. In global product standardization vs localization companies decide

between offering standardized products globally or if they adapt the products to meet local preferences, difference in advantage is that standardized products are cost efficient and localized products highlight market relevance. Local marketing and branding means that the company creates marketing strategies exceeding the national borders to establish a global image for the brand increasing the recognition of the brand. The purpose of risk management and compliance is to identify and to reduce the risks in international business environment, like legal or regulatory compliance. (Johnson et al 2017, 413-446; Czinkota & Ronkainen 2010, 2-33.)

4.3 Strategic management

Strategic management has been described as decisions as well as actions by management that are determining the performance of the organizations in long-term (Wheelen et al. 2018). Strategic management is encompassing process, it involves the formulation, the implementation and the evaluation of long-term goals and objectives of the organization, the process itself is repetitive. Strategic management is described as a management activity on the top-level that seeks to align the resources of the organization with its external environment to achieve sustainable competitive advantage for the organization. Strategic management covers multiple functions such as strategic planning, environmental analysis, internal analysis, strategy formulation, the implementation as well as continuous evaluation and control of the strategy. (Kamensky 2014,13-56; Courtney 2013, 36-38.)

Strategic decision making is very important aspect of strategic management, which involves the process of choosing the best actions from multiple courses of action for reaching the long-term goals of the organization. It's typical for strategic decisions to contain big impact in the success of the organization, and it involves decision making between various options. The key points of strategic decision making include the following aspects. Identification of strategic issues is described as recognition of the challenges and opportunities that are requiring strategic attention. Generation of alternatives means developing the possible courses of action to meet the identified strategic issues. Evaluation of alternatives is explained as assessing the potential benefit, risk and feasibility of each strategic alternative. Decision making means selecting the most suitable and beneficial course of action based on the strategic evaluation. Implementation defined as execution of the chosen strategy as well as adapting the organizational structures and processes according to the choices. Monitoring and adjustment are continuous review and adjustment of strategies when needed to have the ability to respond in changes in internal and external

business environments. (Johnson et al 2017, 54-56, 552-762; David 2011, 163-191; Kamensky 2014, 300-315.)

The key to survive in fast changing business environment is to be able to cope with the growing uncertainty, company must have the ability to sense, seize and handle external changes. The best-known foresight methods or practices that are developed to help decision-making in these kind of business environments are environmental scanning, scenario analysis, real options analysis as well as product and technology road mapping. These methods are developed for identifying the driving forces of change in the business environment and to study the evolution and impact on the company. (Vecchiato 2015.)

When there are continuous drivers of change the ones who are making decisions should emphasize strategic planning and they should be using foresight approaches to indicating and predicting the possible evolution in the industry. In case of discontinuous drivers of change and with limited uncertainty, the decision-makers should be focusing on strategic flexibility as well as learning, so that there is a change to notice the changes when its emerging and to be able to adapt to the changes as quickly as possible. (Vecchiato 2015.)

Environmental uncertainty arises if managers are not feeling confident on their understanding of the key events or changes in the industry. The uncertainty can be relieved or tackled by strategic planning and future-oriented tools that are planned to enhance the strategic decision-making process in corporate and business level, tools like environmental scanning, for example. Adaptive approaches guide to avoid prediction as much as it is possible and encourage to react on changes as they emerge, emphasis is on continuous experimentation as well as on ability to react quickly if needed. (Vecchiato 2015.)

According to Steve Tighe environmental sensitivity, strategic transformation and strategic distinctiveness are the key fundamental challenges for empowerment of organizations as well as succeeding in business nowadays. The strategic challenges that business leaders have to deal with are increasingly uncertain environment, time of constant change and time of expanding competition. Increasingly uncertain environment requires developing sensitivity to predict emerging shifts in the market and the ability to turn future ambiguity to strategic advantage. Time of constant change requires organization to transform their business and how they run their business to stay relevant and succeed in the future. Time of expanding competition means that companies need to develop a distinct strategic outlook which differentiates the company from their competitors and creates a sustainable advantage for the future. (Tighe 2019, p. xiii.)

5 IMPLEMENTATION OF THE STUDY

In this section of this study the focus will be on introducing and explaining the chosen companies and their plans and the actions that companies have been doing and are planning to do in the future regarding decarbonizing their steel production. The sources of information are companies' websites and announcements that they have come out with regarding the topic, such as marketing presentations and annual reports. SSAB will be handled first and then followed by its main competitors and few potential start-up companies that are entering the industry with decarbonized steel. The interesting part is to see, what are the differences between these companies and how the companies will face this transformation challenge ahead of them. Also, the aim is to figure out the similarities with the strategies with facing the decarbonization of production that is coming up on them.

In the start of a research the researcher must choose a research method, and it is very important to take into consideration the type of needed data for succeeding in the research, for example, in qualitative methods the goal should be on providing good understanding on the needs and experiences regarding the research issue (Creswell 2014, 45-46). For this research topic the qualitative research method was selected because it serves the purpose this research better than any quantitative method. Qualitative research is defined as research method that helps to understand and explain the reason, why people behave certain way or why do people say things they say, for example (Myers 2009, 5-13; Eriksson & Kovalainen, 2011, 4-9.) The purpose is to find out differences in strategical decisions or plans and those are mostly described not in numerical way but in words. Quantitative research is for finding out numerical answers for business operations while qualitative research is meant for finding out behavioural answers of people's decision making which can't be presented by numbers (Myers 2009, 5-13; Eriksson & Kovalainen 2011, 4-9). The data is mostly collected from company webpages and no interviews have been included in the research.

All research methods have issues that could cause problems regarding research reliability, and it is a task for the researcher to minimize the amount of reliability related issues in the research (Alasuutari 2011, 149-150). This research is done in an objective way and without being bias to any company. Although the researcher could have own expectations or intuitions regarding the research topic, it can't have an effect on the structure of the research. (Alasuutari 2011, 149-150).

5.1 SSAB

Steel is being used for building the world as we know it, the use of steel is very broad, for example steel has major role in cars, houses and bridges. Steel itself has many advantages as a material as it is recyclable, strong and durable. Steel production has a significant impact on climate as the industry is a significant emission source of carbon dioxide. SSAB wants to be a revolutionizer of the industry by eliminating the carbon emissions from its operations. The aim is to reduce carbon dioxide emissions in Sweden by 10% and in Finland by 7%, these are the percentages that SSAB is emitting in these countries. (SSAB 2024i.)

SSAB's values are driven, true and ahead. Driven means that value is created together, which is explained as at SSAB people work to create value, people work together for success and that people are result-oriented. True means that people do what is right, which is explained as safety comes first, showing respect for each other and acting with integrity. Ahead means that the future has to be in mind always, it is explained as continuous strive for improvement, new innovations and actions towards a better world. (SSAB 2024i.)

SSAB's strategy is called taking the lead and it is described as strengthening the leading position of their home market and strengthen the global high-strength steel producer position as well as strengthen their leading position as a provider of value-added services. SSAB is willing to be the first company that provides fossil-free steel. Their strategy also includes the desire of most flexible operations, being a high-performing organization and focusing on superior customer experience. Their strategy also includes having the industry-leading sustainability performance in all business areas. The ambition is to achieve the status of the safest steel company in the world and to gain leading profitability in the whole industry. (SSAB 2024i.)

SSAB operates in a competitive business environment where it has several competitors in several markets, for example on quenched and tempered plates in Europe the main competitors are ThyssenKrupp AG, AG der Dillinger Hüttenwerke and Salzgitter AG. For strip products the main competitors in Europe are ArcelorMittal S.A., Dillinger Hütte AG, Salzgitter AG, ThyssenKrupp and VoestAlpine. They also have several other competitors in other market segments in Europe and more competitors in other market areas like Asia and the US. The customer segments that are highlighted in SSAB's websites are heavy transport, automotive, material handling, construction machinery, energy, construction, protection and tooling. The Nordics and North America are defined as home market and products are mainly

sold straight to end customers, steel service centers and distributors. Ideology of close collaboration with the end customer provides understanding of customer needs and the performance of the products. SSAB has an offering of one of the largest portfolios in the market. (SSAB 2024c; SSAB 2024a.)

The steel market has been uncertain with its ups and downs throughout the history, according to SSAB they have been successful even during the challenging economic and geopolitical times. The demand of steel varies during years, but there has been interest for high-strength and low carbon products in the market during low demand. SSAB is well positioned in their home markets and the demand of more sustainable products is expected to be increasing. European legislation seems to make conventional blast furnace steel unprofitable in the coming years. SSAB is a minor actor in global flat carbon steel market, steels that has some carbon content in it, but it has some segments that it holds the leading position: special steels, automotive premium steels, flat steel and tubes in Nordics as well as heavy plate in North America. The demand and the prices at the end of 2023 decreased in the European market, especially with standard products. On the other hand, the outlook for 2024 seems to be that process and demand should increase during the year and the raw material costs to are estimated to be a bit higher than earlier. (SSAB 2024m; SSAB 2024g.)

The steel industry is affected by several global trends that are impacting all the companies within the industry: climate change and scarce resources, growth of population and urbanization, digitalization and changing market conditions globally. The impacts at the steel industry regarding climate change and resource issues are that the demand of low carbon emission products is increasing, the costs of carbon emissions are increasing, need of developing products and processes with more efficiency regarding resources and carbon emissions as well as the climate change might have impact on production and supply chains. Urbanization and population growth has increased the demand of steel for construction and increased demand for energy-efficient solutions for buildings and traffic. Digitalization effects on the market dynamics and creates more transparent value chain. (SSAB 2024f.)

According to SSAB the reputation of the company and the brands are one of the most valuable assets, the parent brand SSAB is shared by all the company brands. SSAB as a brand stands for performance and sustainability. To develop new and innovative solutions SSAB works together with the customers throughout the value chain, aiming towards improved sustainability and performance for the products. With a strong end customer focus and with a help of product branding strategy SSAB allows the customers to benefit from their strong brands. Most unique brands are Hardox® Wear Plate and Strenx® Performance Steel. Other brands are Docol®, Toolox®, Armox® and GreenCoat®. Then on top of

these SSAB offers six SSAB branded product groups like for example SSAB Weathering and SSAB Boron. The business model is based on close and long-term relationship with the customer collaborating and continuously developing new products and applications to be able to have better offering in the market. Direct work with OEMs, end customers and subcontractors by own sales and by external distributors in comparison to many other companies that sell only with using distributors. Customer support aims to help customers in development of better and more competitive products and to increase the productivity of end-users. (SSAB 2024d; SSAB 2024e.)

The policy decision has been made to transform all the SSAB sites towards fossil-free steel production approximately in year 2030. SSAB has successfully produced the first fossil free sponge iron and HYBRIT® technology which has been developed together with their partners LKAB and Vattenfall, LKAB being one of Europe's largest iron ore suppliers and Vattenfall one of the largest electricity providers in Europe. In HYBRIT® technology the idea is that the traditionally needed coking coal in steel making is replaced by hydrogen resulting in eliminated Carbon dioxide emissions, this is the exact same process that was described in the decarbonized steel -chapter at the beginning of the document. SSAB has also launched SSAB Zero™ during 2023, a product are made from recycled steel and with fossil-free energy resulting in no fossil carbon emissions and nearly emission free as the product is made from scrap and that scrap includes coal and fossil fuels from earlier production of steel. SSAB is planning to transform its current, Nordic blast furnace based production setup to sustainable mini-mill setup with EAF and where the energy source will be electricity and hydrogen, at least there is information regarding transforming Oxelosund, Luleå and Raahe production sites in Sweden and Finland to be operating with the new setup. SSAB's strategy is to offer Fossil-free steel in 2026. Fossil-free steel is SSAB's naming for carbon emission free steel. (SSAB 2024i; SSAB 2024n.)

The transformation of the sites will not be simultaneous, instead the transformation will start from Oxelösund Sweden and then followed by either Raahe or Luleå, which will then be followed by the remaining steel producing site of these two. The investment decision with a cost of approximately 6.2 billion SEK for Oxelösund was decided in June 2023, replacing the current blast furnace with EAF. The investment decisions for Raahe and Luleå transformations will be made around 2024 and 2026, it is important to remember that they will be reality only after the decision is made. (SSAB 2024k; SSAB 2024n.)

As said the plan of the company is to replace the blast furnaces in all steel making sites with electric arc furnaces. The blast furnace process uses coal as a reductant which removes oxygen from the iron

ore, resulting in liquid iron. SSAB wants to get rid of this process because it uses coal which creates large amounts of carbon dioxide emissions, over 90% of the company's CO₂ emissions. The transformation process involves building new production system and decommissioning the old blast furnace when the new one is fully running at the site. The difference between Oxelosund transition compared to Raahe and Luleå sites is that in Raahe and Luleå the investment is not only EAF but instead they will get mini-mill on both sites. Mini-mills are described as integrated steel production facilities, that includes all process steps of steel making, it starts from melting the fossil-free sponge iron and steel scrap to rolling products. These mini-mills typically include an electric arc furnace, a ladle furnace or a vacuum furnace for chemistry controlling, continuous caster to have the possibility to convert molten steel to a solid form and a reheating furnace as well as a rolling mill. Below is a picture of the mini-mill concept for visual support. (SSAB 2024k.; SSAB 2024n.)

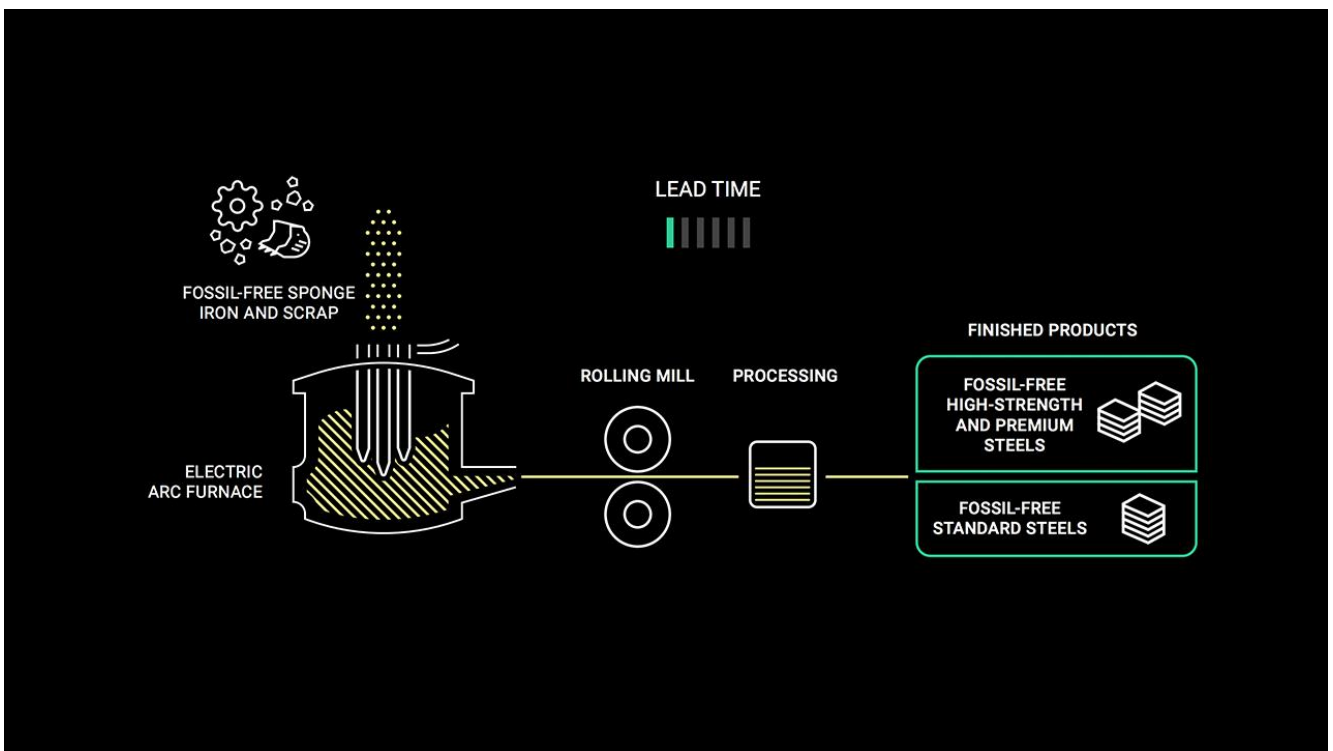


FIGURE 4. Mini-mill concept (SSAB 2024n).

The transformation is expected to increase profitability of the company in long-term. The costs of carbon dioxide emissions in Europe especially are expected to increase which would make the current blast furnace technology uneconomical. The reason for this is that the free ETS allocations will be gradually withdrawn and reaching zero by 2034. ETS means European Commission Emissions Trading System, and they charge companies for the emissions created in production processes (European Commission n.d.). Transforming the production process is not the only thing that needs to be invested

in, green energy is also needed, and the estimation is that after all the sites are transformed the need for electricity would be around 4.5TWh compared to current 3TWh. If the production of emission free sponge iron process is counted as an addition, the need would increase by 5TWh more. (SSAB 2024n.)

On March 2nd SSAB announced that they will continue transforming their production processes toward emission free production by investing approximately 4.5 billion EUR to a mini-mill in Luleå. The new mill in Luleå is expected to be in full operation by 2029. The new set up consists of two EAFs, a advanced secondary metallurgy, direct strip rolling mill and a cold rolling complex. It will have the capacity to produce 2.5 million tons of steel annually. The mini-mill is going to be supplied with a mix of fossil emission free sponge iron, that is coming from the Hybrit demonstration plant from Gällivare in Sweden and it is also supplied with recycled scrap. It is also said that SSAB will save around 2 billion Euros with this investment due to required investments for the current blast furnace process, that can now be avoided. The decision that Luleå production is going to transformed before Raahe is based on financial reasons and equipment condition. The time of transforming the third site, Raahe, will depend on finance, execution capacity and the knowledge from the Luleå transformation. The transformation of Luleå production will reduce Sweden's carbon dioxide emissions by 7% and if the Oxelösund investment is added on that the total effect will reduce 10% of carbon emissions in Sweden. (SSAB 2024b.)

According to SSAB's annual report from 2023 the operations in the United States are using scrap metal as a raw material with almost a rate of 100% and in Nordic mills the rate for scrap metal as a raw material is around 20%. The annual scrap metal usage is approximately 3.7 million tons while they had around 7.1 million tonnes of steel produced in 2023. (SSAB 2023.)

5.2 Competitors

Competitors that have been chosen to be compared with SSAB regarding their decarbonization plans are already big players in steel industry also the SSAB's main competitors in Europe: ArcelorMittal, ThyssenKrupp AG, Tata Steel Europe, Salzgitter AG and VoestAlpine. Also, a new company called H2Green steel, which is planning to enter the steel industry with green steel production will be taken into comparison. The focus will be on plans that the companies have regarding re-adjusting their operations towards more environmentally friendly steel production, or if they are even planning anything regarding it.

5.2.1 ArcelorMittal Europe

ArcelorMittal is a global steel manufacturer with around 126000 employees that is manufacturing steel in 15 countries and serving customers in 140 countries. Their crude steel production in 2023 was 58.1 million tonnes. According to them steel has a huge role of building the future. Their goal is to innovate steel making processes to be more efficient, more energy efficient and decrease carbon emission level in operations. The focus will be on ArcelorMittal Europe which is the largest flat steel producer in Europe and one of the main competitors of SSAB. ArcelorMittal Europe has around 62000 employees and production in 9 countries in Europe. The production set-up in Europe includes 10 integrated steel mills and 1 mini-mill, which is located in Sestao, Spain, where they have scrap yard and 2 electric arc furnaces. At least for now most of ArcelorMittal's steel production is based on blast furnace route. They also have several other sites in Europe for further processes of steel. ArcelorMittal Europe serves customers in several segments like automotive, shipbuilding, renewable energies, oil & gas, construction and packaging. (ArcelorMittal 2024e; ArcelorMittal 2024a.)

ArcelorMittal states that its values are safety, sustainability, leadership and quality. Safety is the base for every task in the company and they state that every accident can be avoided. Sustainability is among the importance of economic and market perspective as the sustainability is shaping the industry, they are aiming to decarbonize their operations in the future. Quality is a key aspect to success according to their webpage, and innovation plays a role in quality aspect. ArcelorMittal is targeting to remain on the leadership position in their main customers eyes, highly competitive thinking is required. (ArcelorMittal 2024g.)

As there is no separate strategy for ArcelorMittal Europe the ArcelorMittal corporation strategy will we opened up here. The strategy is to stay in the position of leading steel and mining corporation in the world in an industry where the steel demand is increasing, and sustainability matters are forcing the companies to act. ArcelorMittal states that is valuable to be present in both developing markets and the high-value products. With the help of digitalization, the company assumes to have the ability to change some parts of the whole steel value chain. They also focus on taking advantage of steels ability for recycling and use that for processes with less energy consumption and less costs which leads to more sustainable steels and less carbon emissions. Strong balance sheet ensures flexibility in tough times and helps to take advantage from opportunities regarding future of steel making. (ArcelorMittal 2024i.)

ArcelorMittal Europe has stated that their objective is to decrease the CO₂ emissions in Europe with 35% by 2030. They are also thriving towards carbon neutrality by 2050. The technological pathway for ArcelorMittal is consisting of hydrogen used for reducing iron ore, increasing the amount of recycled steel and replacing more blast furnaces with EAF production. There are several investments planned and to be approved by EU authorities including 5 steel production sites with DRI + EAF and one site with EAF. (ArcelorMittal 2024c.)

The investments regarding the decarbonization plans will be focusing on Europe sites of ArcelorMittal, they have announced several big investments according to their pages like in different countries such as Spain, Belgium and France. In Gijon, Spain, the plan is to build fully carbon emission neutral steel plant by 2025, which is based on over 2 million tons green hydrogen DRI unit with over a million tons EAF and the estimated cost of 1 billion euros (ArcelorMittal 2024h). In Belgium, Gent, the plan is to build 2.5 million tonne DRI plant and two new EAFs to operate alongside the existing blast furnaces, the estimated cost of the project is around 1.1 billion euros (ArcelorMittal 2024b). In France, Dunkirk, their plan is to build DRI furnace of 2.5 million tonne annual capacity and two EAFs, also to build EAF in For-sur-Mer. The estimation for these investment in France is in total around 1.7 billion euros. (ArcelorMittal 2024f; ArcelorMittal 2024d.)

The company has already launched their first brand group related to decarbonized steel called XCarb™, that includes three initiatives of greener steel: a reduced, low and zero-carbon emission products and activities. The decarbonization plan includes operations over the world but it seems according to their statement that Europe and Canada operations are in accelerated status. The roadmap of net-zero production, meaning achieving carbon neutrality by 2050 in all operations globally includes: Steelmaking transformation, energy transformation, increased scrap usage, clean electricity and offsetting residual emissions. (ArcelorMittal 2021.)

5.2.2 Salzgitter AG

Salzgitter AG is a steel producing and manufacturing company that has its roots in Germany, but the operations have spread out in different countries in Europe and rest of the World. The company has existed for more than 150 years, and they are employing around 25000 people nowadays. The core competence of the company is mentioned to be production of rolled steel and tubes. The company has international production and services. (Salzgitter AG n.d.-a.)

According to CEO of Salzgitter AG, Gunnar Groebler, their strategy focuses on circularity and on the resource-conserving closed loops of energy, and also to materials that have low carbon emission and low carbon footprint. Their strategy is named as Salzgitter AG 2030, it is a response to political and social demands towards sustainable steel industry. The importance regarding creating a valuable and future-proof sustainability is highlighted and concerns all the business units. The company focuses on tradition, profitable independence, diversification as well as strength of implementation to reach an offering of innovative and sustainable products and services. The vision is to be a leading company in circular economy of the whole world. Mission of the company is described to as transforming the future together and forging partnerships. The most important strategic goals for steel production unit are transforming the BF technology to low carbon emissions steel production, scrap recycling, leadership in profitability with carbon emissions neutral steel as well as stable production and business processes. The steel processing unit strategic goals are securing sustainable carbon capture and CO₂-storage solutions, qualitative growth and expansion of partnerships in the green steel market. Regarding the topic circularity it can be mentioned that the idea is to reduce the usage of finite resources, reuse the raw materials as long as it's possible, recycle product at the end of the use to save resources and rethinking the habits and processes that are in use. (Salzgitter AG n.d.-e.)

Salzgitter's sustainability strategy consists of ecological, social and entrepreneurial strategies. Ecological section includes climate protection targets 2030 and environment, which means increased energy efficiency and extending actions for decarbonization in production by cutting 50% of their total carbon emissions and, also reducing resource usage. Social section includes employees and supply chain, that is explained as continuous training and thinking for future in every level with safety at work as an important topic, it also highlights the community responsibilities (Salzgitter AG n.d.-d.). Entrepreneurial section includes integrity and transformation, they are explained as transparent guidelines, viable structures and clarity in processes as well as driving the business towards transformation together with partners. (Salzgitter AG n.d.-f.)

In July 2022 the company approved to spend 700 million euros on the first stage of their decarbonization project called Salcos (Recharge 2022). The Salcos project includes the transformation in production, and a project regarding wind power as a basis for green hydrogen production (Salzgitter AG n.d.-c). The technological changes in Salcos-project compared to current production is that they will replace the blast furnaces with direct reduction plants and EAFs, this will cut down their CO₂ emissions by 95% when the project is planned to be completed in 2033. The project has three stages aimed to be

completed in 2026, 2030 and 2033. The first stage that was approved by the company is said to reduce carbon emissions by 30%, the second stage by 50% and the last stage by 95%. (Salzgitter AG n.d.-b.)

5.2.3 Tata Steel Europe

Tata Steel Europe is a branch of Tata steel, which is a part of Tata Group. Tata steel Europe has operations in the UK and Netherlands. They provide premium flat steel products and services to customers in Europe, and also to other parts of the world. The main market segments are construction, automotive, infrastructure, packaging and engineering. (Tata steel Europe 2024a.)

The company has stated that their mission is to be a leading European steel company which is also a leading company in sustainability. The sustainability aspect is described as sustainable operations and sustainable in products and services as well as taking care of the environmental topics in the company. The purpose is to improve quality of life in the communities they serve, this is done by thriving for leadership and global competitiveness in all the businesses. The vision is to achieve global steel industry benchmark in creating value and corporate citizenship. The values of the company are pioneering, responsibility, excellence, unity and integrity. In Europe they value long-term customer relationships. They also highlight that the safety is the most important thing for their employees. (Tata steel Europe 2024c.)

The company has stated that their ambition is to reduce their CO₂ emissions in the UK with 30% and in the Netherlands with 40% by 2030 as a first steps on their journey towards carbon neutral production that they hope to achieve by 2045. They are continuously innovating their products and services, trying to find out sustainable solutions that will last longer, use less resources in production and that are stronger. Strong steels allow cars to be lighter and consume less fuels. They are encouraging the recycling and reuse of steel and raw materials. (Tata steel Europe 2024d.)

Tata steel announced that they will proceed with their decarbonization plans related investment in Port Talbot, UK. The plan is to build EAF and to close two blast furnaces on the same site. They are estimating that the transformation reduces their CO₂ emissions by 5 million tonnes each year. The estimated cost of this investment is around 1.25 billion pounds. Their plan includes closing down two blast furnaces in June 2024 before starting to demolish them and replacing with a new EAF. The plan also includes closing down further processes, at least continuous annealing line in would be closed in

March 2025. They are justifying this kind of decision with general safety on the site if there would be a BF in operation and demolishing the other one at the same time it could be not so safe environment to work at. The company has been focusing to secure the needed number of slabs and hot rolled coils to run their other processes to ensure that the business keeps on going while other process steps are altered. (Tata steel Europe 2024b.)

The company is also planning to transform their operations in the Netherlands, at least there is a project called Zeremis that means zero emissions. The idea is to transform current BF technology with EAF technology and DRI technology with hydrogen and with access to green energy. They have an offering with their Zeremis Carbon Lite, a declaration-based solution to lower carbon emissions on products, and this is based on utilizing the CO₂ emission savings that company has gathered by investing in decarbonization projects (Tata steel Europe 2024f). Tata steel explains that zero-carbon targets require fundamental transformation on iron and steel production processes that are creating challenges to every company in the industry. (Tata steel Europe 2024e.)

5.2.4 Thyssenkrupp Steel Europe AG

Thyssenkrupp Steel Europe AG is a part of ThyssenKrupp AG that is a multi-industrial corporation operating in several industries, the focus on this report will be on the steel. Thyssenkrupp Steel Europe AG, also known as Thyssenkrupp steel that originates from Germany employs approximately 26000 people. They describe themselves as one of the leading high-grade flat steel suppliers. The annual crude steel production capacity is approximately 11 million tons. The main market in Europe and they also sell their product outside Europe. The main market segments are automotive, industry, household appliance, packaging, mobility and energy. The production and manufacturing sites are mainly located in Germany, where they have 9 sites, but there are also sites in France, Spain and Switzerland (Thyssenkrupp steel 2024d; Thyssenkrupp steel 2024c.)

The purpose of the company is defined as sustainably produced steel being the basis of their value creation. Vision of the company is explained as they want to be the company chosen as partner by the customers because of leading producer of green premium steel. Values of the company are responsibility, courage, openness and appreciation. By responsibility they mean that proactive approach is the key, courage is determined and bold actions, openness means to be open to different alternatives and

appreciation translates to being interested in opinions and views by others. (Thyssenkrupp steel 2024e.)

The strategy is called Our Way Forward, it consists of performance, portfolio and transformation. The base of it is coming from market development and the requirements from customers. Strategy focuses on investing to premium grades, to increase in performance and on the transformation towards decarbonization of the steel production and digital transformation. The investment on premium grades is explained as developing the quality and performance of high-end premium products, it includes new production sites that will be built in Duisburg and Bochum, in Germany. Efficiency means restructuring the organizational structures as competitiveness set limits on cost structures, the estimation is that in total around 3750 jobs will be reduced. The transformation towards climate-neutral steel means that the focus is on transforming the blast furnace-based processes to hydrogen based production methods. It also means that their goal is to cut 30% from their direct emissions and energy procurement emissions by 2030, and by 2045 they aim to have completely climate neutral steel production, which includes emissions from their own value chain. The plan is to combine hydrogen-based DRI with innovative melting units by replacing coal not the steel mill itself. The direct reduction plant is planned to be commissioned in 2027. Digital steel means digitalization of the company, and the emphasis is on uniform platforms, harmonized data and standardized solutions regarding infrastructure. The next steps are implementing the investments in the facilities. (Thyssenkrupp steel 2024f.)

Thyssenkrupp steel's climate strategy describes that a project in Duisburg, Germany involves the replacing of four blast furnaces with the first direct reduction plant with green energy and hydrogen. The transformation will be done completely before 2045 leading to carbon-neutral production. The direct reduction plant operates on natural gas or hydrogen instead of coal and the process generates DRI from iron ore to be melted in liquid hot metal which will be further processed to steel in EAF at the site. The liquid hot metal capacity of the first direct reduction plant is said to be 2.3 million metric tons from 2.5 million metric tons of DRI. Estimated amount of investment of the first stage is 2 billion euros (Green steel world 2022). The second blast furnaces will be removed in 2030 and replaced by DR-based technology, the remaining two blast furnaces is planned to be handled before 2045 to reach the aimed carbon neutrality (Thyssenkrupp steel 2024a). (Thyssenkrupp steel 2024b.)

5.2.5 VoestAlpine AG

Voestalpine AG is a global steel and technology company and their headquarters are located in Linz, Switzerland. The company has four divisions that are steel division, high performance metals, metal engineering and metal forming. It serves customers in around 50 countries and 5 continents, they have approximately 50000 employees. The steel division is the largest business unit at least when it comes to revenue, they produce hot and cold rolled steel, galvanized steel and organically coated steel (Voestalpine 2024c). (Voestalpine 2024d.)

Voestalpine group has stated that they are committed to the global climate goals and that they are investing in technologies of decarbonization to reduce their CO₂ emissions in long term, the substantial investments to research and development are important in terms of product offering and environmentally friendly production (Voestalpine 2024d). The company is not clearly stating their overall strategy, but the sustainability strategy goals are described to be acting in economical, ecological and social manners that supports sustainability. The company achieves to reach twelve of the United Nations 17 sustainable development goals. The target to reduce 30% of production and energy CO₂ emissions by 2029 and 25% reduction in raw material purchases and transports. The goal of the company is to be climate-neutral by 2050. This strategy also includes consideration of the complete life cycle of products, development of sustainable solutions in products and efficient utilization of resources used for production of steel. Research and development are vital for reaching company's ecological goals and the priorities for research are digitalization, innovative products, circular economy and climate-neutral steel production. (Voestalpine 2024b.)

The steel division is producing heavy plates, hot and cold rolled steels, galvanized and organic coated steels, the main divisional company for steel is voestalpine Stahl GmbH which is located in Linz. The most important customer segments are automobile manufacturers and suppliers, white goods, mechanical engineering, oil & gas industry and renewable energy sector. The steel division has approximately 10500 employees worldwide. (Voestalpine 2024c.)

The company has a plan for green steel production, which is called greentec steel and it is planned to be starting in 2024. The first stage of the plan is to have one EAF powered with green electricity in both Linz and Donawitz sites, production is planned to be started in both during 2027, in total these EAFs will have around 2.5 million tonnes annual capacity for CO₂ emission reduced steel. The plan also involves replacing one other BF from both sites, Linz and Donawitz. They are also searching for

opportunities to purchase high amount of green renewable energy with a competitive price to support their climate actions. The traditional BF route steel production should be phased out before 2050 from company operations. The CEO of voestalpine, Herbert Eibensteinner, stated that the company is investing around 1.5 billion Euros to greentec steel in the coming years, meaning the first stage of the plan where the first BFs are replaced by EAFs. The first stage of transformation is estimated to save around 4 million tons of CO₂ and the EAFs in Linz and Donawitz are using scrap, liquid pig iron and HBI with no fossil fuel used in the operation. (Voestalpine 2024a; Green Tech Valley 2023.)

5.2.6 H2 Green steel

H2 Green Steel is a start-up company that is trying to compete with existing companies by building a fully digitalized, integrated and circular steel plant in North Sweden, Boden. The purpose of the company is to decarbonize European steel industry. The company is planning to produce green steel with fossil-free electricity resulting in water and heat as the main emissions. They are estimating that their production methods emit approximately 95% less CO₂ emissions than the traditional method with BF route. (H2 Green Steel n.d.-a.)

Their production route is explained to include DRI and EAF with continuous casting and rolling as well as downstream operations. They are planning to produce mainly hot rolled coils, further operations include also cold rolled coils, and galvanized products. (H2 Green Steel n.d.-b.)

The plan is to start producing green steel in 2030 in Boden with annual capacity of five million tonnes. The estimated annual net export value is around 3 billion Euros, and they are estimating to have in total 10000 jobs directly and indirectly. Boden is said to be chosen as the location because of the access to clean energy, iron ore and infrastructure. The company estimates that because they have no legacy it is easier to optimize all the processes and move forward faster. The Boden plant will be powered by a green hydrogen plant which operates with renewable electricity. According to the company they have already make agreements regarding supplying 1.5 million tonnes of green steel in 2025, that is when the production has been estimated to start (H2 Green Steel n.d.-d; H2 Green Steel n.d.-c.)

The company has been raising funds over the last years and the latest updates describe that the company has raised over 4 billion euros in debt financing for their green steel plant plans. The company

has also been awarded with a 250 million euros grant by the EU innovation fund. In total the funding is now up to 6.5 billion euros. (H2 Green Steel 2024.)

6 RESULTS OF THE STUDY

In this chapter of the study the results found during the research will be handled. The focus will be on the strategies, the investments, future production methods and the schedules of transformation for each company that have been discovered in the earlier parts of the thesis.

6.1 Strategies and goals

Starting the comparison of the companies and their plans for the decarbonization with strategies and goals that each company have stated to have, these are based on the information given in the earlier section of the research. SSAB strategy involves aspects such as: strengthen the leading position in home market, strengthen the global high-strength steel producer position, first in fossil-free steel, industry-leading sustainability performance and to be the safest steel producer in the world. ArcelorMittal Europe aims to stay in the position as a leading steel and mining corporation in the world, to take advantage of steels ability for recycling, to have a strong balance sheet and to focus on sustainable steels and less carbon emissions by recycling and consuming less energy in the processes. Salzgitter AG plans to transform towards low carbon emissions steel production and scrap recycling, to reach leadership in profitability with carbon neutral steel, to have stable production and business processes while securing sustainable carbon capture and CO₂-storage solutions. They also focus on qualitative growth and expanding partnerships in the green steel market and on circularity, the resource-conserving closed loops of energy, and materials with low carbon emission and low carbon footprint.

Tata Steel Europe strategy involves the target to be a leading European steel company and a leading company in sustainability. Thyssenkrupp Steel Europe AG's strategy focuses on investing to premium grades, the increase in performance and the transformation towards decarbonization of the steel production and digital transformation. Voestalpine AG strategy includes acting in economical, ecological and social manners that supports sustainability, it also includes consideration of the whole life cycle of the products, development of sustainable solutions in products and efficient utilization of resources used for production of steel. Research and development are vital for reaching the company's ecological goals and the priorities for research are digitalization, innovative products, circular economy and climate-neutral steel production.

H2 Green Steel states that purpose of the company is to decarbonize European steel industry. The company is planning to produce green steel with fossil-free electricity resulting in water and heat as the main emissions. Entering to market as a new player with sustainable production, strategy includes being a company that can optimize all the processes and move forward faster compared to existing companies.

The similarity regarding sustainability topics is easy to notice from all the companies, they all seem to be interested and are focusing on sustainability topics, and they also seem to have the desire to improve their production in terms of carbon emissions. There is also a force from outside the companies that is pushing the companies to be interested on developing and adjusting their production towards producing low carbon emissions steels in the market, that driving force is the EU regulations that are created for the EU commitment towards climate neutrality by around 2050 and emissions reduced by 55% by 2030 compared to emission levels in 1990 (European commission 2022). In addition to that the free allowances for companies in the Eu Emission Trading System are to be phased out starting in 2026 until 2034 (European Commission 2023).

These two factors add pressure and willingness to all companies in Europe to adjust their production to emit less carbon emissions than currently. For the steel producers the changes are large scale operations where the old technology needs to be replaced by new and more sustainable, more efficient equipment and machinery. The emission trading system means that more pollution causes more payments, the permits are bought from auctions and the prices per CO₂ tonne are affected by the demand and supply, but there are some permits are allocated free of charge (European Parliament 2023). This factor also adds another notch for the companies to focus on emitting less carbon emissions than currently.

The European Central Bank estimated that the carbon emission prices per tonne on CO₂ will be increasing from 85 euro in 2021 to 140 euro by 2030 (The European Central Bank 2023). The estimated price increase per tonne of CO₂ emissions would cause that it would be almost impossible to compete and make profit from the businesses, it would be even hard to be able to have positive balance sheet for the companies as the prices for CO₂ emissions are almost doubled. It's no wonder that the companies are focusing on sustainability topics as much as they now seem to be. It is also worth to mention that it seems that the demand for low carbon emissions products has been increasing in recent years and looks like going forward demand continues to increase.

Tata Steel aims to be the leading European steel producer, and ArcelorMittal is aiming to stay as a leading steel and mining company in the world, other companies have not stated any similar targets for a leading position as these two companies, except for SSAB that is aiming to stay on a leading home market position, also to strengthen the position. SSAB is also aiming to strengthen their leading global position as a high-steel producer. ArcelorMittal and Tata Steel are competing for the same spot, they are expressing it a bit differently but the essentially the goal is the same, to be the leading steel producer in the world. ArcelorMittal claims to have the leading position in the world and as they are also mainly producing in Europe, Tata Steel would have to top them to be the leading producer in Europe. SSAB targets are not that broad as the two other companies and they have smaller market and segment that they are targeting to lead in the future as well, this of course does not mean that they are easier to fulfil as the competition is heavy all over the steel industry and requires companies to perform year after year to meet their targets.

Thyssenkrupp are focusing on investing in premium grades and increasing their performance which presumably would be increasing their profitability as the premium grades in general are more profitable than the standard grades and if in addition to that they focus on the performance the expected outcome would be better economical and efficiency results for the company. ArcelorMittal is stating strong balance sheet in their strategy as a target, but the other companies does not have directly mentioned anything regarding their profitability targets, although Thyssenkrupp is not stating it in a similar way but their statement indicates towards the same goal. Salzgitter targets are mostly related to sustainability matters, but they are also aiming to be more stable with the production and the business processes as well as reaching qualitative growth. The targets match partly with Thyssenkrupp regarding performance as the goals targeting for growing the business and having better performance, which also indicates that the profitability is expected to be increasing within the organization.

6.2 Decarbonization goals, production methods and schedules

The plans for decarbonization in terms of decarbonization goals, future production methods and the schedules for the transformation are compared next. The focus in on the future production setup and schedules of transformation and also in amounts of decreased CO₂ emissions.

SSAB plans to transform all the European sites to fossil-free steel production around 2030. Transformation started during 2023 with SSAB Zero. Oxelösund transformation started in 2023. Decision

regarding first mini-mill in Luleå, Sweden made in March 2024, production is planned to be starting around 2028. The decision regarding second mini-mill in Raahe, Finland to be made approximately 2026. All the BFs replaced with EAFs operated by fossil free electricity and feed by scrap and DRI.

ArcelorMittal Europe has set an objective is to decrease the CO₂ emissions in Europe with 35% by 2030 and stated that a carbon neutrality is achieved by 2050. Future production planned to be consisting of DRIs + EAFs. The company plans to build fully zero-carbon emissions steel plant by 2025 in Spain, and several other DRI and EAF investments in the future but there are no statements regarding execution year. Salzgitter AG has plans of cutting 50% of their total carbon emissions and to reduce the resource usage. Company's sustainability strategy includes climate protection targets in 2030. The Salcos project is said to reduce carbon emissions by 95% by 2033. First stage of the project is to be completed by 2026, and it reduces 30% of CO₂ emissions. The second stage by 2030 reduces 50% of the emissions and third stage by 2033 reduces 95% of emissions. The company plans to replace BF based production by DRIs and EAFs.

Tata steel Europe states that they are reducing CO₂ emissions in UK with 30% and in Netherlands with 40% by 2030, carbon neutral production is to be achieved by 2045. The company is closing down two blast furnaces in UK in June 2024 and replacing those with a new EAF. In Netherlands, on the company's Zeremis project will replace BF based production with EAF and DRI production route.

Thyssenkrupp Steel Europe AG is transforming the blast furnace processes to hydrogen-based production methods. The methods are mentioned to be DRI and EAF in Duisburg. The plan is to cut 30% of direct emissions and energy procurement emissions by 2030. They are aiming for 2045 to have completely climate neutral steel production. The direct reduction plant is planned to be commissioned in 2027. Second blast furnace replaced in 2030.

Voestalpine AG has set the target to reduce 30% of production and energy CO₂ emissions by 2029 and 25% reduction in raw material purchases and transports. The goal of the company is to be climate-neutral by 2050. The first stage of the plan is to have one EAF powered with green electricity in both Linz and Donawitz sites, the production is planned to be started in both during 2027. The plan also involves replacing another BF from both sites, Linz and Donawitz. The company is also searching for opportunities to purchase high amount of green renewable energy with a competitive price to support their climate actions. The traditional BF route steel production should be phased out before 2050, the goal is to replace all BFs by EAFs.

H2 Green Steel has stated that their plan is to start producing green steel in 2030 in Boden with a completely new facilities having an annual capacity of five million tonnes. Their operations are described to be carbon neutral.

6.3 Planned investments

The estimated and announced investments are compared next between all the companies that have estimated the costs of their planned investments. SSAB has estimated that the EAF to Oxelösund will cost around 600 million euros and the mini-mill to Luleå approximately 4.5 billion Euros. The planned mini-mill investment costs to Raahе are not estimated by the company yet, but the cost of the first two investments are in total more than 5 billion euros. ArcelorMittal Europe estimates that their investment to Spain will cost around 1 billion euros, the DRI with two EAFs to Belgium around 1.1 billion euros and the costs for similar investment to France around 1.7 billion euros. That makes the total cost of almost 4 billion euros.

Salzgitter AG has only estimated the costs of the first stage of their Salcos project and they are stating that it will cost approximately 700 million euros. Tata Steel Europe has announced a cost estimation for their UK production changes, which will be around 1.25 billion pounds. Thyssenkrupp steel Europe AG estimated the costs for first stage of their transformation to be approximately 2 billion euros, there is no estimation for the second stage of their plans, but presumably it will be at least quite similar as the first stage.

Voestalpine AG is investing around 1.5 billion Euros to greentec steel in the coming years, meaning the first stage of the plan where the first BFs are replaced by EAFs. H2 Green steel have raised over 4 billion euros in debt financing for their green steel plant plans. The company has also been awarded a 250 million euros grant by the EU innovation fund. The total funding is now up to 6.5 billion euros. No estimation of costs regarding building facilities.

6.4 Summary

The research question was to define strategical advantages for SSAB, in which ways can they create competitive advantage in this journey towards low emission steel making. The future production set up

is somewhat same as the main competitors will have, of course there are some differences as explained earlier, like building up an EAF and two mini-mills in Scandinavia to replace their current BF steel making routes versus most of the competitors are replacing their current blast furnaces with EAFs, some with DRI and some without DRI plant. Maybe one advantage could be on the production systems, although it is very hard to say which set up will be the best option. Some set ups might serve other companies better than the others, but it is quite hard to really estimate how it will actually be in reality. Mini-mill system is so called integrated system that includes steel production to slab to further production to for example a steel coil (Danieli n.d.). This production system is described to be flexible with the production and are ensuring a low costing operation. Basically, it is a solution for the whole production chain. EAF, on the other hand is a solution in which, the blast furnace part of the production is replaced with the more sustainable production method, the EAF either uses DRI or scrap steel for steel production (Kim et al 2022). Then the further processing can happen in different locations or at the same site if the company has planned it so, which can also a benefit for some companies. It has to be mentioned that also in the mini-mill concept the further processing after a steel coil, can be processed in other locations. The goal of the research is not to create believes or to be biased leaning to way or another, the result in this factor must be undefined, as regarding production methods the advantage can turn out to be for both ways or none of them.

It is also very hard to estimate if the strategies will benefit any of the companies as most of them are focusing on the same things mostly. The emissions are in a huge role to all of them, not even surprisingly. Some of the companies are paying more attention on the balance sheet as an addition and some are heavily focusing on emission free production and sustainable solutions. As many are focusing on the sustainability topics it is a matter of how the companies handle their daily business and serve their customer needs, that has a big impact on the income for all the companies. Smooth transition and employee engagement also has a big role on how these companies can survive through the change that is a head of them. The ones that will thrive are the ones that succeeds in all the aspects of the transformation. The strategies themselves have so many similarities that it is almost impossible to pick any company that has a winning plan as the plan itself might sound or look like a winning plan, but the execution has a potential to turn everything upside down. Without any optimistic or pessimistic views, the strategical plans do not deliver any competitive advantage, at least a well-reasoned one. It must be mentioned that of course the full view of strategical plans is not available from the companies' websites, hence these strategical plans and goals are only the tip of the iceberg from all the companies and there should be a lot more detailed plans from all of them on how to succeed in the coming years which cannot be analysed in this research.

The decarbonization plans from all the companies provide a picture that all the companies will be carbon emission neutral at some point in the future, most of the companies between 2035 to 2050, but SSAB, Salzgitter and the start-up company H2 Green Steel are stating that they will have carbon neutral production in the early 2030. That could be one factor that will create competitive advantage if it can be reached. As mentioned earlier the CO₂ emission costs will affect more heavily on the companies going further in the future, the aspect of having carbon neutral emissions on the production would support the decreasing, or at least not increasing costs on steel production. Of course, carbon emission costs are not the only concern when producing steel, but all the companies must deal with carbon emission costs that are mentioned in the EU commitment. If being the first or even one of the first companies that could provide carbon neutral steel products it could have a huge impact on the company regarding succeeding in the business and creating advantage when comparing to other companies that are viewed as main competitors.

What needs to be remembered is that the changes in this scale are heavy on every company, it is not only the financial aspect or the plans itself that the difficulty/heaviness to execute is focused on, but there is also the personnel side that need to be handled well so that the change process goes smoothly. The change management in the companies has also a big impact in each company, it is essential for all the companies to sell their view and the new ways of working to their employees and to minimize or at least deal with the resistance they will most likely face during the transformation. The way the companies handle the change process paves the way for the coming years.

Regarding SSAB's competitive advantages for the future production it is important to focus on the strength, weaknesses, opportunities and threats. If taking into consideration the whole scenario of the decarbonization: the strengths are the schedule and carbon emission costs in the future, as a weakness the similarity with strategies compared to other competitors could be mentioned. As opportunities the schedule and different setup for production compared to competitors and as threats the competitor schedules and similarities in strategies. The schedules are of course estimates and the desired states of where the company wants to be in certain point of time, if they succeed it will be beneficial for the company but if the plans are delayed then the company will face issues if other companies have success in their timetables or if some can do it faster than initially planned. The carbon emission costs are quite tightly connected to the schedules, so it can either be a strength or threat. Of course, all these factors can turn against or in favour of the company in the future, for example the different production setup because it is hard to predict how each company will manage with their future production plans.

7 CONCLUSIONS AND DISCUSSION

This thesis was done to showcase the different options from which these companies must choose the most suitable approach for them towards more sustainable steel production, and to highlight the paths that each of them have chosen. This study was not commissioned by any company, but was result of author's interest. The subject of the research is related to the industry in which the author is working, and in which the transformation towards emission free production is a huge topic.

The research question was defined to figure out if SSAB can gain any competitive advantages from their strategies regarding the transformation, and to compare similarities and differences between the planned investments. The last research question was to define the ways that companies have planned to reduce their CO₂ emissions. The research revealed that many of the companies have quite similar strategies on how they will build up their future production.

Choice of doing the research as qualitative research was basically the only option as it would have been quite hard to gather the needed data by using quantitative methods. Quantitative method could have been used for comparing mostly numerical data, but in this research the topic required more of analysing descriptive texts. Regarding the reliability of the research, it must be mentioned that this research had no interviews, and the data is collected directly from the web pages of the mentioned companies, so there is a lesser chance to have errors on interpreting the collected data than if there would have been answers from interviews. The author believes that the validity of this research is on a good level as the research was designed to compare the aspects that have been compared during the research process.

Regarding the research ethics, this research or the results of it should not cause any harm to any of these companies as their collected data was collected and presented in the research as they are presented in their own publications, of course without copying the texts straight as they appear in the original source. Also, the intention has been to not be bias, assuming that the result of the study supports that view.

The research also revealed that all the companies are heavily focusing on sustainability related topics in their strategy statements. Most of the companies aim to be the leading company in sustainability. Many of the companies are also focusing on strong balance sheet and some of them are aiming to be

the leading company in steel industry. Those companies are of course among the biggest players in the European market area and naturally have the desire to claim that leading company status. There are also more detailed and narrower targets for some of the companies, for example SSAB that aims to be the leading company in their home market and the leading producer of high-strength steels in the world.

Regarding the differences on planned investments and ways to reduce emissions by transforming the production methods, the companies do not have so many options to choose from, as the choices are quite limited currently. They are basically between EAF with or without DRI or the mini-mill concept that also has an EAF build into the system. Then there are alternatives for the hydrogen usage. The usage and the availability of steel scrap will also have effects on production costs and the desired production method. The future will show if there will be any methods that are as good as the current solutions, or if there will be even better alternatives that some of these companies or even new companies will focus on.

One key aspect is also the availability and price of green energy for the companies. To succeed in the plans to be a leading sustainable steel producer, many key aspects need to be in favour to the company. Success is a sum of production methods, the availability and the prices for green energy and the raw materials, but sustainable steels as any other products also need to have the demand in the market where the companies can supply their products.

Strategy is not the only aspect that defines the outlook of the company, the change management needs to be successful as well as these transformation projects are so large-scale change projects, it must be handled well to keep the company thriving through the process. People can be stubborn to stick in the old ways and are naturally resisting new things that they are not familiar with, or they might be scared to jump into and give their best effort to the new ideas and plans.

The research revealed that there are not that many aspects of strategical differences, where SSAB can gain competitive advantage, but if they succeed to be one of the first companies that has a stable and cost-effective sustainable steel production as they are planning, that might be possible. It requires a lot of efforts and success in many areas like keeping the business profitable, having a stable demand in the market and good customer relationships to be able pull off a big change that the company has planned, it also looks like all the competitors are facing the same challenges. It also requires great execution,

and that the transformation is done according to the planned schedule so that the production with new production methods can start when it is planned to start.

By succeeding to be among the first companies completing the transformation they can achieve a position where they are ahead of the competition and have the possibility to even expand their business to new customers, which would make their business position even stronger. It is hard to see that the company would have the same possibility of expanding their business if the transformation would delay significantly and many other companies would have started their low emission steel production a lot earlier. And it needs to be remembered that even the success with transformation schedule does not guarantee the success on expanding the business, but it provides a better possibility for that.

Also, an aspect that must be acknowledged is that it is not only SSAB that will have the pressure on the transformation project. The same need of succeeding in the projects applies to the competitors as well. It will be interesting to see how the steel industry will look like in 5 to 10 years from now and to see how the low emission projects for decarbonized steel production from these companies have turned out to be eventually.

This research process has been useful for the author as it deepens the understanding of strategical theories, transformation processes and has provided a good overall understanding of how companies in the respective industry are planning long-term investments. Finding out and comparing the strategies of different companies was useful for understanding the differences and similarities that the companies in same industry might have. The research process also provided many learnings on how to do this kind of research, if one was needed in the future. It is important to have the research topic and research questions narrowed down right from the beginning so that the research does not become too long or broad.

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