

# CREATING VALUE THROUGH WATER IN MINING

Case: Sotkamo Silver Oy

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Master's Thesis  
International Business Management  
Master of Business Administration

2021

Kaupan ja kulttuurin koulutusalan  
International Business Management  
Tradenomi (YAMK)

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<b>Työn nimi</b>	Arvonluonti veden avulla kaivosteollisuudessa – Tapaus: Sotkamo Silver Oy		
<b>Sivu- ja liitesivumäärä</b>	81 + 2		

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Tässä opinnäytetyössä tutkittiin voiko vedenkäsittelyn avulla suunnitella arvolupauksen, jolla tuotetaan arvoa yhteisöille ja sidosryhmille, sekä samalla mahdollistaen yritykselle uudenlaisia liiketoiminta tai ansaintamahdollisuuksia. Työn tavoitteena oli saavuttaa ymmärrys siitä, millä tavalla uudella ja innovaatiomaisella vedenkäsittelyllä voidaan vaikuttaa kaivosteollisuuden jätevesien aiheuttamiin ongelmiin ja voidaanko kaivosteollisuuden lisääntynyt kestävyys korostus nähdä kilpailuetuna.

Opinnäytetyö on toteutettu laadullisena yksittäisenä tapaustutkimuksena. Liiketoiminnan mallintamisen ja arvolupauksen suunnittelumenetelmät yhdistettynä kaivosteollisuutta käsitteleviin teoksiin muodostivat opinnäytetyön teoreettisen viitekehityksen ja joiden teorioita yhdistämällä on muodostettu opinnäytetyön tulokset.

Kerätty tieto koostuu haastatteluista sekä kaivosteollisuutta ja liiketoimintaa käsittelevistä teoksista sekä dokumenteista. Kerätty tieto on analysoitu laadullisin menetelmin. Opinnäytetyön teoriaosassa muodostetaan ymmärrys kaivoksen jätevesien syntymisestä sekä niiden vaikutuksista yhteisöön ja sidosryhmiin. Ymmärryksen perusteella on suunniteltu arvolupaus, jolla vaikutetaan positiivisesti kaivoksen jäteveden aiheuttamiin vaikutuksiin. Suunnitellulla arvolupauksella voidaan lisätä sosiaalisen toimiluvan ansaitsemista sekä vaikuttaa tapausyrityksen ja kaivosteollisuuteen liitettyihin ennakkokäsityksiin sekä mielikuviin.

Kestävyys ja sosiaalisten vaikutusten korostus on tänä päivänä lisääntynyt ja aiheuttanut kaivosteollisuudelle uudenlaisia haasteita. Opinnäytetyössä tuloksena syntynyt arvolupaus on esimerkki tavasta, jolla tällaiset haasteet voidaan kääntää myös mahdollisuudeksi kehittää liiketoimintaa uudella tavalla sekä mahdollistaa uudenlaiset innovaatiot, joilla voidaan vaikuttaa kaivosalaan positiivisesti.

Avainsanat                      Kaivosteollisuus,                      liiketoimintamalli,                      arvolupaus,  
vedenkäsittely

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Master's Degree in Business  
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<b>Title of Thesis</b>	Creating Value Through Water in Mining – Case: Sotkamo Silver Oy		
<b>Number of pages</b>	81 + 2		

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This thesis work examines whether water treatment can be used to design a value proposition that generates value to the community and stakeholders and enables the company to create new types of business or earning opportunities. The objective of this thesis work was to gain understanding of how new and innovative water treatment can impact on the issues caused by mine wastewater in the mining industry and whether the increased emphasis on sustainability in the mining industry can be seen as a competitive advantage.

The used method in the thesis work is qualitative single case study. The design methods of business modelling and value proposition are combined with the mining industry theories to form the theoretical framework for this thesis and by combining these theories, the results of this thesis have been formed.

The data collected consists of interviews, literature and documents on the mining industry and business. The collected data was analysed using qualitative methods. The theoretical part of the thesis forms an understanding of the formation of the life cycle of a mine, and why the mine generates wastewater, and how the mine wastewater impacts on the community and stakeholders. The achieved understanding is used to design a value proposition which creates positive impacts on the community and stakeholders who are influenced by mine wastewater. The value proposition design can increase the earning of a social license and impact on the prejudices of the case company and the mining industry.

The emphasizing sustainability and social impact has increased and brought new challenges for the mining industry. The designed value proposition created as a result of the thesis is an example of the way in which such challenges can also be turned into an opportunity to develop the business in a new way and to enable new types of innovations that can enable positive impacts on the mining industry.

Key words                      Mining Industry, Business Model, Value Proposition,  
Water Treatment

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## ACKNOWLEDGEMENTS

I would like to say thank you for this opportunity to the Sotkamo Silver Oy, and many other people who have supported me in the thesis project. The thesis project gave me a lot of new kind of knowledge about mining and its business development. After all the process was a very interesting experience although it took me a lot of time and effort.

I would also like to thank Lapland University of Applied Sciences and its teachers and my classmates. The Master of Business Administration programme is an excellent choice if you want to learn multidisciplinary business and studying is best done with a good attitude and an open mind. The programme also gave me new friends during the studies. They inspired me in many ways, and I also learned much from them.

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## ABBREVIATIONS

BMI	Business Model Innovation
CSR	Corporate Social Responsibility
CVP	Customer Value Proposition
MBBR	Moving Bed Biofilm Reactor
MRO	Mineral Rights Owner
NGO	Nongovernmental organizations

## 1 INTRODUCTION

Mining has a positive impact on the economy and mining can build a sustainable future by providing raw materials for the applications required for sustainable development. However, mining also has undesirable impacts to community and stakeholders, and such impacts of the mining are reflected in environmental and social issues. The undesirable issues of mining create demand for new kind of value creation, the aim of which convince the community and stakeholders that mining is responsible and necessary, which enables obtaining a social license from the community and the stakeholders. The mine wastewater is one of the impacts which create undesirable impacts to the community and stakeholders, but the impacts of mine wastewater have similarities, and similar pain and need caused by the impact allow value creation which can have a diverse influence. This thesis work's aim is to design a value proposition which create value to the community and stakeholders who are influenced by the mining activities and the objectives of value proposition are to satisfy the pain and needs caused by mine wastewater. The thesis examines the life cycle of a mine from exploration stage to mineral processing stage to gain a more comprehensive understanding of the phenomena and the impacts of mine wastewater to identified community and stakeholders are analysed.

The importance of the mining economic, ecological, and social sustainability has been emphasized in recent times and mining companies are expected to act responsibly and ethically in pursuit of mining company's objectives (Niemenmaa & Vedenkangas, 2021, 2). These issues challenge the current business models of mining companies and provide a framework for development work that creates and captures value from a wide range of mining company stakeholders. The thesis faces such challenges in a new way where value is created by an unusual method. The results made it possible to make observations that could improve the company's image and strategy, and on the one hand, and on other hand, the work also shows that the nitrogen removal technology required by the environmental permit can also be seen in a different way than the cost structure.

The thesis combines theories of the mining industry and the business model, which is not a frequently used combination in the mining industry, but the research questions posed by the case company create the need to use these theories. Therefore, this thesis can be considered unique.

### 1.1 Company Sotkamo Silver Oy

The case company Sotkamo Silver Oy is a mining company which core business is a mineral exploration. Sotkamo Silver Oy is subsidiary of Swedish Sotkamo Silver AB. Head quarter and other corporate functions are in Sotkamo Finland. Company has also other mining projects in Tampere Finland and Mo I Rana Norway, which are currently in feasibility study stage. The 370 hectares mine site in Sotkamo has started in year 2019 and its reported 7.3 million tons mineral reserves are consisting of silver 80 g/t, gold 0.24 g/t, zinc 0.6 % and 0.3 % lead. The Sotkamo mine site reported ore reserves 2.76 million tons are consisting of silver 124 g/t, gold 0.41 g/t, zinc 0.9 % and lead 0.3 %. The estimated life cycle of the mine site is over ten years. Today the Sotkamo Silver Oy's parent company, Sotkamo Silver AB is listed in Nasdaq Helsinki and in NGM Stockholm and the current CEO is Erkki Kuronen. Main products of Sotkamo Silver mine site in Sotkamo are silver-gold-lead and zinc-silver concentrates. (Kaivosvastuu. 2016; Sotkamo Silver History 2021.)

The occurrence of Sotkamo mine site has been found in 1980's when University of Oulu discovered minerals from boulders which are found from the beach of Tipasjärvi and after the found of occurrence, Kajaani Oy reserved the mineral rights of the Tipasjärvi area in 1980's. After eight years of exploration the Kajaani Oy made contract with government Outokumpu Oyj in year 1988 for developing of the area. The investments were made for the 2.6 kilometres tunnel and 350 metres deep ventilation tunnel between 1988 to 1990, however the global mineral prices were decreasing after the investments and in year 1991 the price of one ounce of silver was four dollars when the price of one ounce was 5-10 dollars in the beginning of the project. That meant that neither of the companies did not invest in this project anymore, and after the analysing

of the mining feasibility, the mine site and project, both companies decided to shut down the project and other related activities. The mine site had years of silent life before Sotkamo Silver Oy started the feasibility studies again in year 2006 when the old owner of mineral rights decided to abandon its mineral rights of the area. This meant that Sotkamo Silver Oy can capture mineral rights to itself and start the developing work of the future mining area. The Sotkamo Silver Oy has been investing and develop the area since 2006 and after many years in 2019 the production of the mine site was opened. (Sotkamo Silver History 2021.)

Sotkamo Silver Oy is committed to responsibly improve and elaborate its activity. The current missions are to discover, mine and deliver metals and value while being responsible and local. The responsibility means that the business is sustainable, transparency, respectful and reliable. These elements are the company's natural elements. The supply of metals, job creation, shareholder value and social cohesion contribute to the well-being of the local community and stakeholders. (Sotkamo Silver AB Strategy 2021-2025, 7.)

## 1.2 Background and Motivation

The mining industry has recently been widely under discussion in modern times because of its significant impacts on the environment and community. However, in the future, the mining industry will become a more common line of industry in the High North due the demand for raw material and technological developments as well as consumer consumption behaviour. Currently, in Finland ore and minerals mining has significantly increased in the 2010s (Kaiva.fi 2021). Mining operations are supervised by the authorities and the mining industry must be responsible and ethical and in the future mining companies' responsibility and ethics will be further emphasized (Kauppi, Kohl, Myllyoja, Wessberg & Wessman-Jääskeläinen 2013, 13). Corporate social responsibility (hereinafter CSR) is under constant development and global trends are putting pressure on investing in environmental technology and impacting the social impact of mining operation to referring own experience.

Many large companies are committed to purchasing minerals and other raw materials from responsibly operating mines, and for example German car manufacturer BMW and Korean electronics manufacturer Samsung have refused to purchase cobalt from Congo due its weak sustainability and they are preparing to launch their own co-operated pilot project to improve the sustainability of the Congo's mining industry (Gabriel 2020).

The business environment in the mining industry has changed in the 2020s and mining industry has faced many challenges due to the environmental, social and economic perspectives which will mean that mining companies need to develop their business model constantly to meet these demands or otherwise these kinds of challenges can cause non-market influence on mining company's operation (Niemenmaa et al. 2021, 2). As was stated above, the business model method itself is not frequently used in mining industry but it will be an efficient way to improve dynamic innovation techniques and at the same time it is a method that allows ways to manipulate and describe the current business model to create strategic advantages. (Osterwalder & Pigneur 2010, 15.) In this thesis work, the research approach follows the business model principle, and therefore, in these times of change, it is important to bring new perspectives and methods to the mining business to make it possible for the mining industry to take a new and more sustainable direction.

The mining industry has significant effects on the Finnish economy and at the same time it affects the economic downturn and the reduce of disappearance of small municipalities by creating economic wealth effects for local communities. And when certain industry has significant role at national economy it will also demand lot of from the government and public authorities and great examples of this kind government funded support action is the Mining Finland program which has produced many inventions to the mining industry. Establishing a mine in Finland is a long project, and under normal circumstances, the ore reserves after the discovery will take 10–15 years for the mine to be started (Kaivosteollisuus ry. 2018).

The establishment of a mine begins with take-over where mining company or exploration company reserves certain area for exploration use and already at

this stage the mining company often receives criticism and opposition reactions. These kinds of reactions are natural but there have also been accidents in Finland that affect negatively to all mining companies which are operating in Finland. The standard business model of a mining company after feasibility studies starts by investing in the construction and infrastructure of the mine site and after that the operation can be launched. Mining company will deliver value by paying royalties and taxes to mineral rights owner (hereinafter MRO) and government. Local community importance will be highlighted when they are delivering tangible value to the mine by providing service or products that the mine could be operated. This action will create ecosystem where mining company, government, MRO, and community are engaged to each other operations. However, this will not guarantee any benefits to the local community. As previous mentioned, the importance of local community is crucial due its capability to cause non-market influence. For these reasons, business model needs to be developed to meet the needs of other mining stakeholders as well. Social license is largely determined by gaining local community acceptance. (Dunbar, Fraser, Reynolds & Kunz 2020, 263) Nonetheless, there has been cases in Finland where social license has not been earned and it has resulted in detrimental effects on operations. The effects can be economically costly and have long-lasting consequences. (Omotehinse & Tomi 2019, 525.)

Own personal motivation for choosing this topic as the topic of the thesis comes from the author's own backgrounds. Author is working in the field of water treatment, and has empirical knowledge of mining water treatment, and mining in general. The mining industry is also geographically concentrated in the High North, where the author himself lives, and the increased debate about the responsibility and sustainability of mines created motivations to do the thesis. The author is motivated by the fact that by studying this topic he can gain an understanding of the phenomenon and thus find ways to influence the problem areas brought about by the phenomenon.

### 1.3 Research Objectives and Questions

The main objective of this thesis work is to understand how water treatment can create a new value proposition to the case company. Value created through new way of water treatment can improve achieving the social license and create new kind of business opportunities. Mining water treatment is concrete factor which influences the stakeholders, and its importance has been emphasized over time. To achieve a new value proposition, it is also necessary to gain an understanding of the pains and needs of the community and stakeholders which is the second objective of this thesis work. The third objective is to understand how water treatment can improve the case company's business. The mining industry future changes in emission values and attitudes can also be seen as an opportunity to create competitiveness which may have country-wide effects when concern with industries whose products are exported. Although environmental and social factors challenge companies to modify their business model there may also be opportunities related to these factors and the trend of global development is going toward to sustainable direction where social needs and environmental needs are to be fulfilled.

The objective of the thesis is also to create a framework for new ways of creating business in the mining industry. Although the value is mainly delivered to parties other than the community and stakeholders, the thesis work's value proposition design framework will define that it is possible to create a new type of business based on the mine that can also generate value for these factors, and thereby improve the social license achieving.

The research questions addressed in this thesis work as listed, discussed, and motivated below.

1. Can a new way of water treatment be a new value proposition for the case company?

The first research question is providing answer how water treatment can create strategic advantage to the case company and if water treatment deliver value to the community or other stakeholders. New ways of water treatment can potentially also affect attitudes as well and thus reduce non-market influences

and improve the earning of social license. The business model canvassing method enables to analyse the existing way of value creating and it creates the framework for the analyses of how water treatment can improve the current business model of the case company. However, water treatment is typically considered as a cost structure in industry and thus is not usually invested in. Request of sustainability and technological development has increased, and it is driving business to the direction where water treatment and other sustainability factors need to be considered.

## 2. What are the effects of sustainability in the future for the case company?

The second research question analyses the sustainability aspects which can affect the future business of the case company. Determining these factors will enhance the business model design and they set the framework to the understanding of what kind of technology and method need to be considered that the new value proposition can be created. The emission limit values for water are set by the environmental agency and the government and thus the choice of the right water treatment technology is considered to be sufficient using these limit values and the emission values are thus concrete and clear. The second question also analyses the potential technological innovations that will become possible when water treatment requires investment because of emission values. In general, the choice of the water treatment technology is strongly based on cost and has not been exploited using innovations which can revolutionize the business model.

## 3. How focusing more sustainability and community through water treatment can bring new kind of value?

The third research question will analyse what kind of value generation and business opportunities a new way of water treatment can create. New way of water treatment can enable business model innovation (hereinafter BMI) which can affect the local community and even the entire mining industry. Thereby, the chosen method of water treatment sets the conditions for innovations; however, the third research question is also intended to build frameworks for such BMI in the mining industry.



All research questions are currently relevant and topical in the mining industry. Although the research questions constitute a broad topic in which mining and business theories must be combined and which are not common to combine, but the topic is narrowed to mine water topics forms a controlled entity. However, the issues are not entirely unique, as the same phenomenon can be seen in other companies, including the case company.

#### 1.4 Limitation of the Thesis

The thesis work phenomena are a relative extensive when considering the impacts of mine wastewater, and the depth understanding of the impacts will require a broader sample of interviews, and more time because interviews as well as making observations is time consuming and arranging for interviews has also been challenging due the covid-19 epidemic.

Combining theoretical knowledge also placed limitations, as knowledge of different theories of mining industry and business requires in-depth expertise in both subject areas. The business model and value proposition design method are not a frequently used in mining industry, and hence the combination of these methods requires creativity on the part of the author. The author also does not work for the company, leaving the observation within the company incomplete.

Used research methods set limitations for the thesis and the qualitative method will not form as comprehensive whole of the communities and stakeholders of the phenomena as quantitative methods.

## 1.5 Structure of the Thesis

The thesis work consists of five chapters. The basic information of the company is presented at the very beginning of the first chapter. The first chapter presents the motivation, background, objectives, and research questions of the thesis. Second chapter introduces the methodology, and methods that are used to carry out the thesis.

The third chapter forms an understanding of the emergence of the thesis phenomena in the mining industry. The third chapter also provides an insight into how mines are created and what is the life cycle of mine site, and thus deepen the understanding of what causes similar problems as in research questions.

The fourth chapter is the research section, where the theoretical background is utilized to study the case study and a proposal for a value proposition is designed based on theories and observations. The fifth chapter is the last chapter which contains the conclusions of the thesis.

## 2 RESEARCH DESIGN

The thesis work's methodological design is justified and explained in this chapter. The purpose of this chapter is to present the research approach and the data collection as well as the analysis methods used in the work.

### 2.1 Single Case Study

The single case study method was chosen as the research method of this thesis work with the qualitative research approach. Further, this thesis work can be referred to as a mixed research and development work. The single case method enables diverse exploration of the phenomenon of this thesis work and creates an entirety of the diversity of the research questions in the thesis work (Yin 2014, 16). One of the objectives of this thesis is to understand how water treatment can develop the mining business and understanding will concern necessary contextual conditions related to this case. The development of the value proposition and business model of this thesis is based on assumptions and case study is an effective method for building and testing business theories and ideas (Dul & Hak 2008, 17). Qualitative research utilizes flexible approach to data and analysis, and it enables to take a holistic approach to the thesis phenomena (Corbin & Strauss 2015, 9).

The thesis research design was built on following the principles of the case study. Research questions defined in this thesis support each other and the study propositions are pointed to develop the mining business to a more acceptable and sustainable direction through water treatment. Yin (2014) describes that case study research questions are appropriate in the form of "how" and "why" questions and the nature of research questions needs to be clarified precisely. In this thesis work the research questions can be seen as a relatively wide, but the topic is narrowed down to water treatment and its innovations. Thereby, because of this 'narrowing down' the units of analyses are defined, and they are related to entities which are influenced by water, such as local community. However, the case study method has been criticized to be a time-consuming method and because the result can be a massive unreadable

document (Yin 2014, 36). In this thesis work, the objectives and research strategy are designed as a clear path to avoid the mentioned problems and after all the most important strategy on case study methodology is to form rival explanations to findings (Yin 2014, 36).

Documents and literature played important role in this thesis, and they form the grounded theory of this thesis work. When the data is collected by variety of means it will be under constant comparison and when applying constant comparison, the data will break down into manageable pieces and the data is manageable even though there is lot of it (Corbin et al. 2015, 7). The data collection methods were based on the single case study data collection methods which are described in more detail in the next section.

## 2.2 Data Collection

This thesis work was using many different data sources and that is the one of the virtues of case study research. Generally, the qualitative method provides a lot of analyse methods for analyses and comparing data to form a theoretical basis for the thesis (Yin 2014, 37). The case study method itself has six sources of evidence which are supporting the fact that quality prepared case study supports its propositions as many sources as possible and multiple sources allow a researcher to understand the case more holistically (Yin 2014, 105). In this thesis the data will form the basis for understanding how the new way of water treatment can change the mining industry, and the meaning of collected data is to corroborate the value proposition.

The data collection has begun at the design stage and the amount of data is relatively big before the research part begin and the data collection has followed the four principles of the case study data collection where the first and most important part is to collect relevant data as much as possible from multiple sources. This principle will reinforce the case study's six sources of evidence and the principle is crucial because it will form the base for the case study research and creates reliability for research. (Yin 2014, 118-119.) The diversity of mining business and its development demand diverse sources to analysing

and developing the business. Diverse sources of this thesis consist of data from engineering, social and business which are different fields of science, but the case study method enables to use diverse sources as described and it establish validity and measuring to the findings and propositions. Thereby, the triangulation method is a crucial method to corroborate data from multiple sources and converge evidence. The data for this thesis has been gathered to a database which facilitate the processing of the amount of data and database method is the second principle of the case study data collection principles. Maintaining the chain of evidence will enable the increase the reliability of data and allows an understanding of the order of the data used during the case study. (Yin 2014, 123-128.) The fourth principle of the case study data collection is related to the use of modern electronic databases which are providing a considerable amount of data for the case study and to make the retrieval of data meaningful and efficiency it is critical to use different database search engines with appropriate words and time periods to improve the handling the broad array of electronic sources. (Yin 2014, 119.) The thesis also uses the author's empirical knowledge, as he works in the subject area and thus obtains the acquired data for the thesis. The author has also worked in water treatment issues related to mines for several years and has had discussions and visited several Finnish mining companies.

The data consist of documents, archival records, interviews, literatures, and observation. The Documentations and literatures provide stable and broad data use of this thesis and enable to create the theoretical framework. The direct observations and participant observations are adding the understanding of the thesis phenomena. Observations of the phenomena is a powerful data collection method due its possibility to serve another source of evidence in case study method and observations are seen crucial data collection method when the case is a real-world case. (Yin 2014, 113.) The interviews are organized as an unstructured interview with the research topic of the thesis work as the theme and thus the theme is pre-selected. The theme of the interview is recommended to be flexible, and the topics and questions should be such that allow the researcher to get better understanding of the phenomenon, on the one hand. On the other hand, if the interviewer is well acquainted with the

phenomenon, theme interview is not an effective data collection method. The interviewees were selected so that the phenomenon of this thesis is significantly related to their work or life. The interviews are conducted as an individual interview.

The theme interviews were used also as a data collection method, and interviews were conducted as thematic interviews towards the end of the thesis process. As the thesis progressed, a deeper view of the phenomena had emerged, which provided a quality assurance of the interviews and made it possible to make observations relevant to the thesis. The thematic interviews contained five predefined topics related to the phenomenon and pre-defined questions related to the topics, but the themes were more of a topic of discussion and selected so that there is not a single answer to the topic, and the predefined questions provided a clearer answer to the topics. Interviewees were individuals with long experience in the field of mining and with a holistic understanding of the social and environmental issues of the mining. Theme interviews were implemented in the end side of the thesis project, because thematic interview method require familiarization about the topics and knowledge of the phenomena, and thus the themes were chosen as appropriate (Puusniekka & Saaranen-Kauppinen 2006).

### 2.3 Data Analysis

Starting the data analysing from collected data was implemented by searching patterns and insights which are confirming the reliability of the thesis subject area and the analysed data will build the frameworks for this single case study (Yin 2014, 134). The data has been analysed and evaluated since the design of the case study and the data collection has been continuous through the thesis project. When analysing case study data during the thesis process, writer has started the analysis work as early as possible and to find out whether the data collected are relevant or have a significant impact on the study. Starting the analysing at an early stage will rise the quality of analysis, because the amount of data is usually large, and the timeline of the case study places limitations on

how the analysis will be performed. The early data analyses will enable to form and developing of the analytic strategy for this thesis and theoretical propositions will help to organize entire analysis work as well the explanations for the phenomenon (Yin 2014, 136). Although the theoretical propositions and insights will lead this case study, the writer's own empirical knowledge and empirical thinking is crucial to getting understanding of the thesis research objectives and the interpretation of the analysing results and for example the analytic strategy is using writer's own engineering background, and technical orientation when analysing technical documents and gained process engineering methods to analyse the technologies used in water treatment as well as the emission limits of environmental permits.

The thesis topic is manifold, and the diversity of mining business is crossing bounders from business, technical and social side and as well in political side. And because of manifold topic the analytic strategy of this case study is demanding multiple data sources and multiple methods of analyse. The triangulation will enable the comprehensive understanding of the thesis phenomena and mixing different methodologies will enhance the reliability of the thesis (Corbin et al. 2015, 347). The thesis work's collected data will be analysed orderly and using business model structure the data can be managed so that it can be used effectively at different stages of research phase. However, when the data consists of several different sources dealing with different styles of topics, the analysis of the thesis emphasizes finding connections that provide an understanding of the value creation being explored in the study. Managed data also enables understanding of how the value proposition can be create and frameworks for analysing the value proposition. However, there is a risk that some analysed data can be influenced by emotions because part of the data is information on social and political issues which can cause reactions, but the writer will have its self-awareness that he can recognize these kinds of situations. And sensitivity on the data analysing will enable gaining deep understanding of the phenomenon actors that are influenced by the mining business.

The thesis work's data generated by the interviews were examined openly, and the interviews provided a deeper understanding of the phenomena of the thesis.

The thematic interview method allowed observations to be made by different themes, and thus the observations could be used at different points in the research sections.



### 3 KEY CONCEPTS OF THIS THESIS

The third theory chapter focuses to achieving understanding of the key concepts of this thesis. The key concepts are used to form understanding of the thesis phenomena and thus create frameworks for defining answers to thesis work's research questions.

#### 3.1 Business Model Definition

Business model is widely used concept when researching business and it has been described as a story of how company will do its value creation and make its profits. Business model has many suggestions and Christensen, Clayton, Kagerman and Johnson (2008, 52) characterize business model as a wholeness where business model is formed through four elements customer value proposition (hereinafter CVP), profit formula, key resources, and key processes. Customer problems or needs are creating opportunity to deliver value which will solve customer problems or needs and the CVP is explanation of how the value proposition is created and how the value is finding its way to the customers. The design of the CVP is started from defining of the target customer and if the target customer is analysed deeply, analyse will enable customer insights. Target customer can have some specific problem or need which need to be satisfied. When CVP design is done the profit formula will define how the company itself gets its satisfaction and what are costs of value creation. Profit formula itself is consisting of four elements revenue model, cost structure, margin model and resource velocity. Formula of revenue model is defining the price and volume that the company achieve by using the business model and costs are explained in cost structure. Therefore, the margin model is an important part of the business model because it determines how much profit should be made on each transaction, and resource velocity explains the frequency of resource use and other assets at which expected profits can be achieved. Thereby, CVP needs human resources and other attributes that value can be delivered to the customer and key resources are defining key elements which are needed to create the value. To achieving key resources value

delivering, there is a need for key processes which are making value delivering possible and successful. After all, the business model is defining how the company do business and earn its revenue streams through specific activities and patterns (Amit & Zott 2010, 3).

Business model had been rationalized since Osterwalder et al. (2010) introduced the business model canvas. Visualization of a complex business model will strengthen the ability to observe and draw conclusions about company's way to value capturing and value creation, because many times it is challenging to explain business as understandable and simple to others. The nine-block business model of Osterwalder et al. (2010) is a concept which allows understandable describing and easy manipulation of business model, and it is widely used method when researching competitors or any organization for getting the understanding of how the company will capture, creates, and delivers value. Business model canvas method is seen as a key concept in this thesis due that it will provides understanding of market and market's needs, and it will define the role of the business's products or services when meeting market's needs. Rationalized business model of Osterwalder et al. (2010) is consisting of nine blocks, customer segments, value proposition, channels, customer relationships, revenue streams, key resources, key activities, key partnerships, and cost structure.

Building a business model by canvas method starts from defining the actual customers or other groups which are the target of a design, and the first block is customer segments and customer segments block is explaining whom the value is created. Second block is value proposition. Value proposition will consist of the design of the value of products and services which are delivered to the customer, and it is explaining what the delivered value is. However, that the product or service reaches its awareness it needs channels, and the third block, channels, is explaining what the sales, communication, and distribution channels are used for delivering the value proposition to the customers. Fourth block is Customer relationships, and it describes what are the different types of relationships what the customers are expecting, and customer relationship block will explain answer of what kind of relationships are needed for retain and acquire customers. Fifth block is revenue streams which is generally explaining

the revenues of each customer segments and what is the price what customers are willing to pay. Nonetheless, even if the price of the product or service is appropriate, the value need to be delivered to the customers, and therefore it will need key resources for maintaining customer relationships and value offering. Sixth block, key resources provide answers of what kind of key resources are desired for the value proposition. After all, as Christensen et al. (2008, 4) characterize earlier that every company need key processes as well as key resources to deliver the value successfully. Key activities are seen relatively same as key processes and key activities are functions and activities for a business model to succeed. Eight block is key partnerships. The key partnerships form the network of the business model, and the key partners block explain the partners and suppliers who make the business model work. The last block is cost structure, and it describes the costs of using a business model and it allows form insight of whether a business model is relatively expensive and thus create a framework for developing other sections if needed. (Osterwalder et al. 2010, 17-45.) Figure 1 presents the visualized business model canvas.

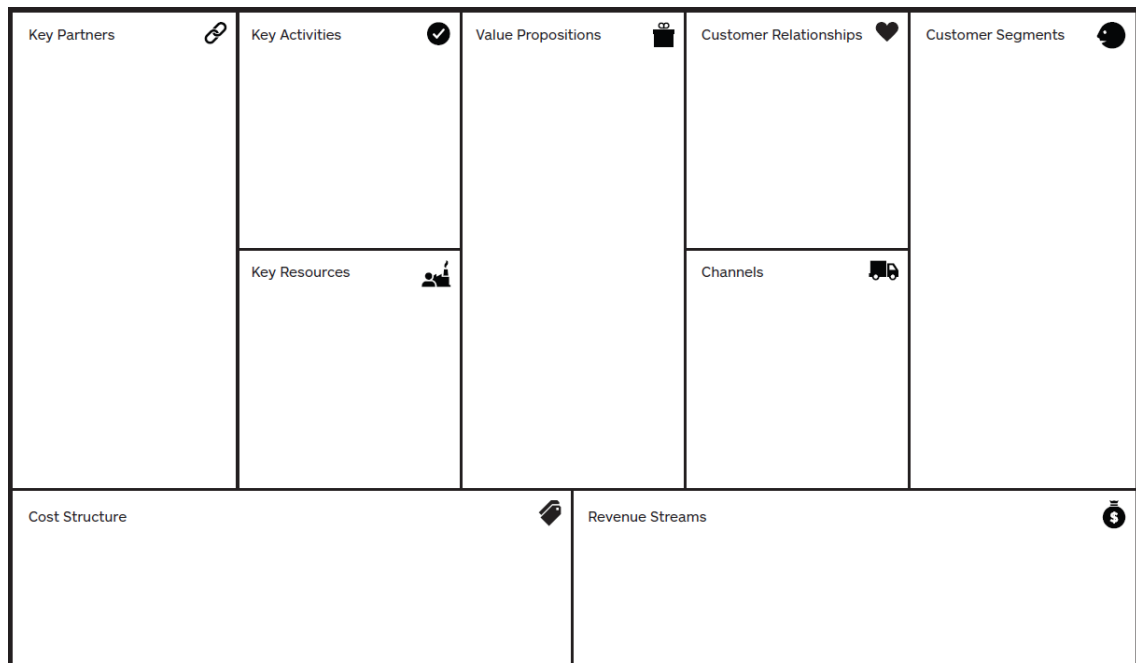


Figure 1. Business Model Canvas (Strategyzer AG 2021a)

### 3.2 Business Model Innovation

BMI is enabling the value rising due its capability to create competitive advantage from discovering new value creation opportunities by using metalevel activities (Mahadevan 2004, 1; Amit et al. 2010, 3). While the business model is creating understandable answers of value delivering, value capturing and value creating, the BMI is about creating new uniquely opportunities to make the business model more valuable. In generally, innovations are seen commonly as a new products or entire new business models, but innovations can be subtle, and innovation can be done in one block of the business model (Amit et al. 2010, 7; Evans et al. 2018, 404). BMI will become a topical issue when market conditions are causing value shrinkage due increasing competition and due that the customer needs are changed. Value shrinkage phenomena is key driver of BMI and in modern homogeneous business environment innovations are critical factors for the future functioning of the business model. (Mahadevan 2004, 3.)

Innovation in business can be creation of new markets or search for new opportunities in existing markets. Anyhow, innovations mean changes in the business model and therefore it is crucial to consider and analyse systematically the current business model before launching an innovation (Amit et al. 2010, 15). The business model definition by Osterwalder et al. (2010) provide effective method to analyse business model and their definition of business model is enabling easy manipulation, which is providing possible to change configuration of a single part of a business model and therefore it will create effective framework for the BMI. Innovating of some certain block of business model is not clearly defined as a BMI, but it has been determined that BMI is consisting at least two blocks of business model and this detention distinguish BMI from diversification (Evans et al. 2018, 411). But there is a clear path that BMI will always consists of manipulating at least two business model blocks, because the BMI framework consists of three core elements, which are target customers, value proposition, and value delivery system (Mahadevan 2004, 5).

### 3.3 Value Proposition Design

The value proposition of business model is the foundation for every successful business models. The aim of value proposition is identification how the product or service or combination of product and service are relieving customer's pain or needs. The definition of a value proposition can be explained most simply by the fact that the value proposition corresponds to why the customer buys your value. (Johnson, M. 2018, 29-30; Bernarda, Osterwalder, Pigneur & Smith, 2014, 15-20; Lanning & Michaels 2000, 46.)

The value proposition design has several different definitions, but it can be concluded that the intention is to understand what some defined customers want and how the value proposition is creating value that defined customers are ready to buy. However, value proposition is seen strategically significant because due the high competition between different providers mean that value proposition will distinguish competitors from each other's and if the design of the value proposition is successful other provider can deliver more value to the customer than other provider although the cost structure is the same for both (Lanning et al. 2000, 53). But while a value proposition is successfully designed, it cannot guarantee success alone because the success of a value proposition requires success of eight other blocks of the business model. (Osterwalder et al. 2010, 22-25.)

Johnson (2018, 30-35, 130) argues that the design formula of value proposition is consisting of two major concepts, identifying target customer's need or a job-to-be-done and offering, which is explaining what is the value that is solving the customer's problem or job-to-be-done. The need or job-to-be-done of a customer are defined through understanding of the circumstances where the need or job-to-be-done is. Circumstances are spaces where the specific need or job-to-be-done appears and to identifying this phenomenon the proactive and divergent thinking from outside a box is necessary. After all, it is crucial to determine exact customer group because the value proposition can be then designed properly and accurate. To reaching the insights by using proactive and divergent thinking can be done by separating value proposition design in three components, which are offering, access, and payment scheme. In

particular, the offering is analysing does the designed value offer satisfaction and are value's trade-offs desired. The aim of analyse is to get insights of can the product or service fulfil customer's needs or job-to-be-done. However, the access component is defining the right methods to discovering where the customer can get designed value and thus which channels are designed to use. Even if the offering and access are designed successfully, the purchase actions of designed value need to be defined as well and without knowing answers of how or when the value is paid, the value proposition will probability fail. The objective of payment scheme is to define how and when the value is paid by a customer. This design method will provide blueprint for value proposition, and it is done logically by dividing the value package proposal into different components and enhancing the thinking of internal matters with questions from the customer's point of view, as well as by settling in the customer's position, which are enabling insights and discoveries about the value proposition.

Another value proposition design method by Bernarda et al. (2014) characterizes value proposition as an integration of selected products or services that will create specific value for specific customer and value proposition distinguish companies even if they operate in the same market area. Thereby, there are similarities as in Johnson's (2018) definition of value proposition, but value proposition design method will differ from Bernarda et al. (2014) definition. Value proposition design characterize of Bernarda et al. (2014) can be seen more rationale and precisely due that it has been designed to use form the value proposition of the nine-block business model of Osterwalder et al. (2010) and the nine-block business model provide easy manipulation of single block, resulting in more manageable value proposition design.

The of value proposition design by Bernarda et al. (2014, 3-17) is starting from defining the target customer and its understanding. To achieving the defining of target customer and its understanding, the prototyping of value proposition has seen necessary and value proposition should be shaped enough times for gaining the understanding which allows to select the specific customer from high number of customers and to determine what specific needs or jobs the specific customer have. This method will require customer insights which are

forming ideas and thus create frame works for the early design of value proposition and due the fact that design can be time consuming, the design method includes a visual canvas to help understand the phenomenon more effectively Customer profile canvas is presented in figure 2. Customer profile is on the right side of the figure 2 and its customer jobs will define the certain needs which occur in their lives. To understanding the jobs of a customer it is crucial to think divergently and through exact defined customer's perspective. Jobs can be seen distinguished as three different types. Functional type of jobs are jobs with a specific problem that requires exact value proposition which will complete the functional job, this can be seen for example as a lack of certain knowledge to which the value proposition brings expertise. Social type of jobs is occurred when customer wants to gain social status and social job is for example when customer wants to wear a neat suit for work. The type of emotional jobs are jobs which are caused by customer emotional thinking and emotional jobs are occurred for example when customer wants to feel secure with his deposits.

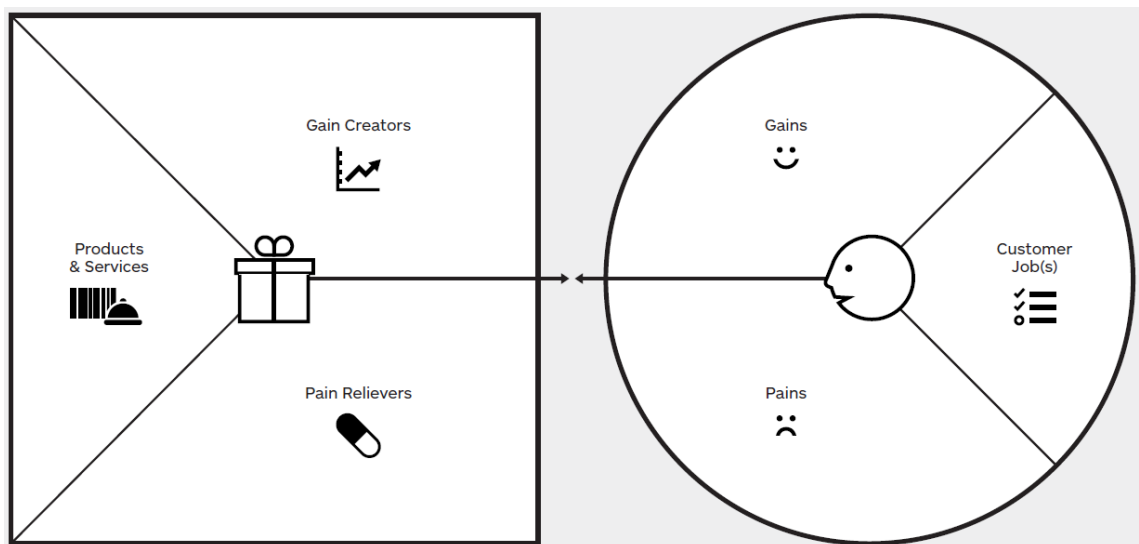


Figure 2. The Value Proposition Canvas (Strategyzer AG 2021b)

When customer jobs are defined an understanding of the diversity of jobs is also needed. Customer jobs has certain characteristics which can cause pains

which constitute from undesired outcomes and obstacles, these are described as pains in value proposition canvas (Figure 2.) Pains are the result of undesired results of customer jobs and pains are functional or emotional features that cause obstacles and risks to the defined customer. Obstacles and risks are features which make the customer jobs difficult or unpleasant and thus pains are creating framework for understanding of gains of the value proposition design. The gains are opposite features than pains and gains are characteristics what the customer is willing to have that the customers jobs can be accomplish. The gains are consequence from customers willingness to have certain outcomes or benefits which make the customer jobs accomplishment possible. After all, achieving understanding of customer's jobs and its gains and pains will form the basis for fulfilling the value map of value proposition canvas. Value map is on the left side of the figure 2. Although the customer profile is used to design value proposition, it will also create strategic novelty to understand certain customer and its characteristics. (Bernarda et al. 2014, 12-17, 54.)

Value map's products and services are the product, services or their combinations which make the designed value proposition possible and thus fulfil the customer jobs through achieving the tangible or intangible impact. However, products and services have relationship with the defined customer and thus they are fulling needs of specific customer group and therefore they do not rise value alone. Pain relievers will define how the products are alleviating customers pains and pain relievers can be seen as an outline how the exact customer pain is reduced by a products and services. Pain relievers affect some significant pain that is relevant, and in determining pain relievers, it is crucial to distinguish between the difference and significance of pain. When the products and services reliever customer's pain, they also create gain and gain creators explain how the gain is created. Gains can be seen as a combination of products and services and pain relivers, which achieve the desired outcome of a customer. (Bernarda et al. 2014, 29, 31, 33, 62.)

After the fulfilling of customer profile and value map, the customers' expectations and pains will fit with designed pain relievers and gain creators, the value proposition has been successfully designed. However, the fit is



defined in three stages, and it is crucial to determine which fit the designed value proposition will make. If the value proposition canvas is fulfilling existing business model, the value proposition can be thus seen as a BMI which will create new revenue generation possibilities. Secondly the designed value proposition can be seen as a market fit if value proposition has evidence which testify the designed products or services profitable. Or value proposition will perform problem-solution fit, which comes into play when it is known that pains and gains are relevant, but there is no evidence of it. (Bernarda et al. 2014, 46-49.)

### 3.4 The Lifecycle of Mineral Exploration

Mining business has similarities and features, as with all other business models and business strategies. However, it has features and characteristics that distinguish mine design from other common businesses and therefore the business models of mining companies are unique. Mining is strongly tied to world market prices of minerals, and even the feasibility studies are pointing out that mine is not profitable, it does not rule out the possibility that the mine can be productive in the future.

The global economy is driving demand for raw materials, but there are still raw materials that will remain stable despite the economic downturn. After all, mining business itself has diverse business ecosystem which is vulnerable to economic effects. As the demand for raw materials produced by the mining industry increases, it creates a business opportunity. The mineral exploration is the very first stage of mining lifecycle and its objective is to discover as well as research mineral occurrences of certain area. The mineral exploration stage will locate where the mineral deposits are and finds out if the explored area have potential for mining activity. It is generally misunderstood that exploration is mining; however, exploration is a different matter practically and legally from mining. Exploration is researching samples from soils and bedrocks, which are providing the framework for mineral deposit analysis. In Finland area the safety and chemical agency is providing exploration takeover and the exploration

takeover will provide the permit for mineral exploration. Thereby, exploration takeover does not authorize mechanical excavation, drilling or other methods that modify nature and usage of these kind of methods requires a temporary mineral exploration permit. (Halдар 2013, 8; Kaiva.fi 2021; Tukes 2021a.)

After the exploration company has done takeover and received a mineral exploration permit, the mining life cycle has started. Exploration company's value is relatively small at the beginning of exploration and mineral deposit research project, but company has value which arises from the values of persons and equipment. The red dot 1 is presenting the value of exploration company in the beginning of the project in figure 3.

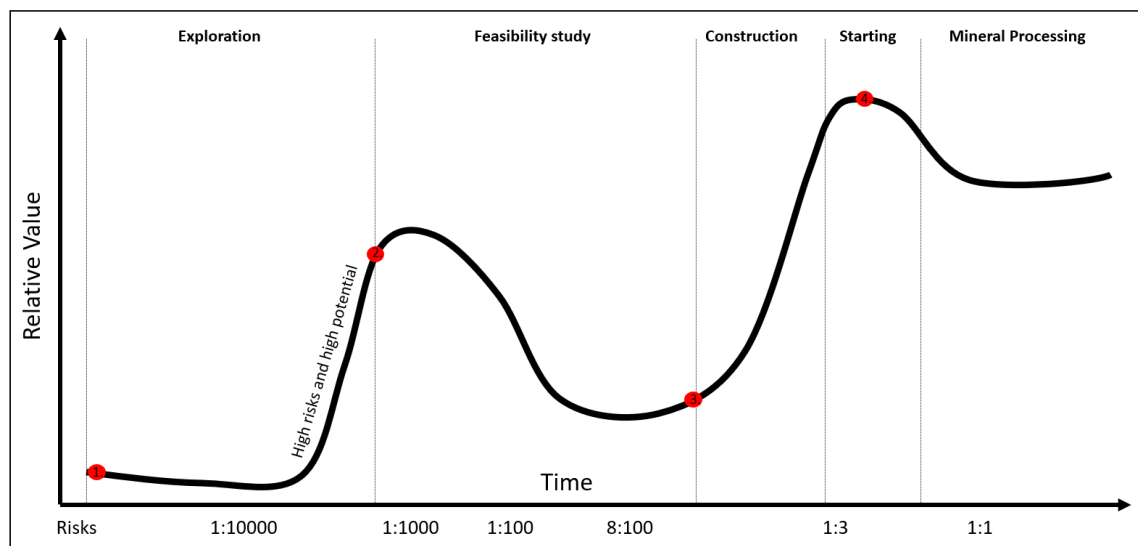


Figure 3. Life Cycle of Mineral Exploration (modified from Lindborg 2013, 2)

Mineral exploration is time consuming and therefore it is relatively expensive and risks for failing are significant. When the exploration is progressing and potential deposits are found from the explored area, it will cause speculation phase where the potential for high economic profits are possible, but at the same time the risks are high. The risks are described as relation of success and failure in figure 3. In the speculation phase, the risks are 1:1000, but the investment is crucial in the speculation phase so that wider exploration and research can continue, but the potential achieved in the exploration phase

allows investors a high financial return. After all, exploration and mining are different industries and commonly exploration companies will sell their takeover and exploration research for companies with the ability to develop the mining project, because exploration companies core businesses are exploration and research. Typically, takeover, exploration research and data are sold when company achieves the highest estimated relative value and in figure 3, the second dot is pointing where this happens on the mining life cycle curve. After this the formation of potential future mine site will begin. (Kaiva.fi. 2021; Lindborg 2012, 3.)

Although, the long and costly exploration stage is behind, the second stage will define the feasibility of the mine site, and in mining the changes of stages occur slowly due to the high amount of data and because of the licensing of environmental and other authorities (Lähde, J. 2021). Feasibility studies consist of three inner stages, which are the conceptual study, pre-feasibility study and feasibility study. Conceptual study is the first stage of the feasibility study project, and it evaluates whether the new opportunity be worth of effort. Evaluating is done through gathered data from exploration stage, but generally the data is not enough informative to giving the understanding is the new potential mine site profitable. The exploration data can give good results about the mineral deposits, thereby further drilling, analysing, and research are crucial for achieving confidential evaluation for the case. The early financial evaluations about resources such as process, flow diagram, and engineering are narrow, but they can be seen sufficient. After the case is evaluated by conceptual study and it justifies that it is worthwhile to pursue feasibility study further, the second stage of feasibility study can begin. The second stage of feasibility study is pre-feasibility study, and its objective is to justify is it profitable to go on final, third stage, feasibility study. When conceptual study can be seen as a superficial assessment, the pre-feasibility study is truly more comprehensive evaluation of the new potential mine site. Pre-feasibility stage identifies identify costs, risks, and backup data thus achieving the conceptual understanding how mine site can be built to produce. Nonetheless, the previous conceptual study and feasibility study will be done with fewer resources, and both studies will determine the deployment and structure of the final feasibility study because the

final feasibility study requires more resources and when a large number of resources are deployed, it is crucial that resources are pointed in right directions. Once the pre-feasibility study has shown direction for the feasibility study, the real contribution in evaluation and design for the potential mine site will begin. (Hickison & Owen 2015, 37-38, 57-58; Lindborg 2014.)

The final stage of feasibility study will form the required key activities and resources. The business model will find its frameworks through solid evidence and detailed engineering. Generally, the recommended feasibility study topics are listed in table 1.

Table 1. General Feasibility Study Topics

1.	Environment, health, safety, and quality assessments
2.	Financial and market analysis
3.	Geology and ore reserves
4.	Infrastructure and conditions
5.	Land use and property ownership
6.	Logistics
7.	Marketing
8.	Mining and metallurgy
9.	Permitting for mining and environment
10.	Process and refinery
11.	Risk and challenge analysis
12.	Social licensing
13.	Stakeholder management
14.	Sustainability and water scarcity
15.	The history of the deposit and area
16.	Water treatment and water management

Quantifying the mine site structure will contain various of determinants and establishments and when the risk for failure has still relatively big during feasibility study, the final feasibility will announce the judgement as early as possible will the new potential mine site be profitable to minimize loses. However, the success relation becomes better as the feasibility study progress. During the feasibility study process the engineering effort will rise and for achieving the holistic understanding of all feasibility topics the engineering effort

finishing percentage is around 20 %, and detailed engineers can be used to increase the accuracy of the cost structure of the construction phase. When feasibility study reaches its objectives and project is ready to start the mine site construction phase it requires investments. Figure 3 third red dot is pointing the paragraph where investments are needed, investments are often arranged by lowering the value of the share issue and old investors are motivated by a lower subscription price. Investments are critical to the completion of the construction phase. (Hickison et al. 2015, 71-72, 79; Lindborg 2014.) In general, the objectives and contents of the feasibility study can be seen in the table 2.

Table 2. Feasibility Study General Objectives and Contents

Study phase	Objectives	Contents
Conceptual study	Identify value creation frameworks and explore the possibility of creating new revenue streams.	Long-term cost structure forecasts and perceiving the outlining the overall picture of the business model.
Pre-feasibility study	Exploring strategic options and choosing a strategy. A strategy that maximizes value at an acceptable level of risk.	Long- and short-term cost structure forecasts and project optimization choices. Approval of capital and application for necessary permits.
Feasibility study	Creating an overall plan for the implementation of the project to meet the objectives set for the life cycle of the mine.	Design of used technology and infrastructure. Creating a business model.

After years of research work the mine site will reach the construction phase, which can be seen as a heart of the whole project. The risks for failure are still relatively big even the exploration and feasibility research has last long, but the risks are decreasing as the building phase progress. After all, feasibility stage has produced various of technical and economic plans which are implemented during construction phase and therefore the effort for construction phase is significant to make it success. Even the risks are managed the diversity of

construction phase will cause often issues which cannot be predicted, typical risks of construction phase are listed in table 3. Construction phase requires a wide range of expertise which mean that there are various of temporary key partners which are dominant players during construction phase and even they are temporary, their influence has long lasting effects. (Hickison et al. 2015, 539.)

Table 3. Typical Risks of Construction Phase

1.	Access to labour
2.	Authorization of work
3.	Automation and interface communication
4.	Availability of materials and equipment
5.	Delays in environmental and construction permits
6.	Inadequate plans
7.	Insufficient stakeholder management
8.	Lack of expertise
9.	Restriction of access
10.	Safety and health
11.	Social issues
12.	Sufficiency of energy and water
13.	Weather

When construction phase reaches its objectives and commissioning has implemented, the mining will move in the starting phase. The well implemented and documented construction stage will provide proper preparation for starting phase and therefore reduce risk level. Nonetheless, even everything is well prepared, and resources are optimized to work toward projects objectives, it can be generally state that in mining business the starting phase will decrease the company's relative value, because there is always unexpected risks or circumstances create unexpected problems that cannot be affected. The turnout point for effect of unexpected problems on the relative value can be seen in figure 3 fourth dot of the curve. The starting phase of mining business will differ from other business due its diversity, the starting phase involves various of different functions that must be made to work for the mine to start. Thereby, the starting phase have lot of pressure and expectations which will force to start the

mining as soon as possible, but the final 10 % of years of work are hardest due the fact that resources are exhausted by intensive project, and resources often strive for perfection which slow the progress towards the end. The objectives for the starting stage are clear and simple, but it requires active management from the mining company to key partners, leading to the achievement of the goals. Starting phase is always controlled by the owner and lack starting stage can cause serious production delays. (Hickison et al. 2015, 557; Lindborg 2014.)

After the starting stage reaches its objectives, the project is moving towards mineral processing stage, and the mining begins. However, the mine will have its acceptances which can be continuous during the first months or year, to ensure efficient production. Most parts of the business model have formed during feasibility study stage, and for example the value proposition design of the mining company can be seen designed fully when feasibility study determines the mining techniques and the grade of the deposit. But mineral processing stage requires new kind of business elements which will make the business model successful, and the importance of new reliable key partners and key activities are significant to ensure the success. Although resources and cost structures of the mineral processing phase are defined during feasibility study, it is sure that there are similar risks as shown in table 3, which can increase the estimated cost structure temporarily or permanently and, global mineral prices are affecting mining, making the mining industry even riskier. However, if the failure happens in the processing stage the mining project can return to the feasibility study stage. The typical business model canvas resulting from the mining project can be seen in Figure 4.

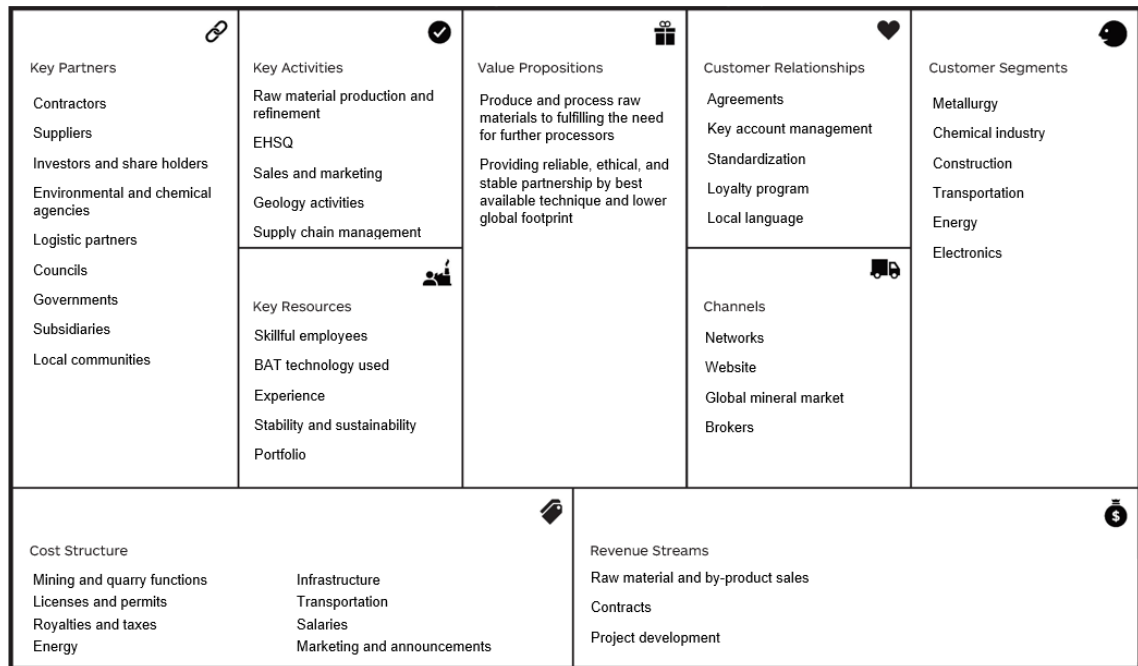


Figure 4. Typical Business Model Canvas of Mining Company

After all, the establishment of a mine is not done by a certain method or frameworks, because every mine environment and its features are unique, and most of the mining projects are difficult for reasons, because mine sites are often in the area where there is no infrastructure. The mining project will require investments and time because the exploration, feasibility, and implementation of the mine site are time consuming and relative expensive, but the positive impact of the mine establishing can be that it will bring wealth for the surrounding civilization. (Baird 2021.)

### 3.5 Social License and Sustainability in Mining

The term social license can be seen misleading because it is not an actual license or permit. A social license is a combination of political and social agreements obtained from local communities, local country, and governments to avoid delays or protests caused by rules, bureaucracy, and regulations, or other non-market influences. The issue of social licensing often arises when criticizing the environmental or social impact of mining or due to changes caused by the mining area. Nongovernmental organizations (hereinafter NGO) are often connected to social license, and they have been seen as active



claimants of social licensing. NGO's can be group of active local peoples, who are concerned about environmental changes caused by mine or other groups or individuals with different ideology which, however, has manifested itself in the effects of the mine. The changes can be for example infrastructural, economical or changes in basic needs such as water or energy distribution. (Bullock & Mernitz 2018, 271-272.)

The social license importance can be seen crucial in the mining business, and in the 2020s the digitalization has revolutionized the social license due to the easy sharing of information and at the same time the ease of finding members and supporters of the group's objectives. Even the mining project has achieved its objectives during feasibility study and gained environmental and mining permits, the lack social license can cause delays or even stop the project permanently. NGO's reclamations for example from lack water treatment or high noises, may cause additional work, and thus delay the starting phase of the mining project. Nonetheless, the power of digitalization often attracts media attention, which will have serious consequences that may affect the appearance and attitudes of the whole mining industry. Therefore, obtaining a social license must be a major investment and it requires continuous development, as the social license is valid for the time being.

Sustainability is strongly tied to social licensing and mining. For achieving the social license, the sustainability must be demonstrated successfully to project stakeholders and NGO's and demonstrating must be continuous through whole mining life cycle, because the sustainability is valid for the time being as is the social license. Nevertheless, for sustainability to be understood and thus achieved, sustainability measurements are essential. The most important measure is the financial sustainability, where the main objective is positive financial impacts on environmental, social, and political factors. After all, when mining is always temporary, it is important that the estimated life cycle is made clear and that the positive financial impact of the mine is thus temporary for its stakeholders. Financial impacts are thus providing primary impacts to its key resources and key partners, but secondary the financial impacts are providing economic growth for other operators who are in some way affected by the economic impact of the mine. Other operators can be suppliers or soft goods

providers, who are delivering value to the mine. Other measurement is the environment, and to achieving the understanding of environmental impacts, it is crucial to understand how the mining ecosystem will affect on its surrounding nature and its diversity. The environmental permit set the maximum emission and other environmental impacts limits to the mine site, but many times NGOs are seeing maximum limits low, which makes it difficult to obtain a social license. Environmental impacts are understood as a whole, and impacts are seen from above from a long-term perspective so that their impacts can be fully understood. Nature has strong bounds to local community and therefore it also partly creates social sustainability and filling needs of community. (Bullock et al. 2018, 271-272.)

The sustainability has many roles in mining business, and it requires clear and formal governance structures, which lacks corruption and treats environmental permits fairly. Framework for successful sustainability is, however, the mining company's own policy, transparency, and fairness, which are the values that make up the company's value map, enabling value to be delivered to those who need it, as in any business.

### 3.5.1 Communities and Stakeholders in Mining

Mining is always affecting strongly in its surrounding environment and people; the impacts are often multidimensional and complicated. Impacts affect communities and stakeholders as a mine performs its activities. There are not clearly distinguish between terms community and stakeholder, and stakeholder can be the community, but generally distinguish can be done by understanding that stakeholders are those who are the right holders, who therefore can affect the mining and local communities are for example, indigenous people who are not able to affect the mining. Stakeholder can be individual or group, which the mining affect or individual or group which is affecting in mining. Thereby, the neglect of community needs hampers the earning of social license, and thus their effect can be emphasized. The term local community is used in mining to

define communities which are near of the mine site and thus affected by a mining company's activities. (Freeman 1984, 46; Evan & Kemp 2011, 1675.)

The importance of social sustainability has emphasized, and increased social pressure engage the company, and governments to develop and manage impacts of the mining continuously. The impacts on the community are presented in figure 5. Although the impacts can be economical and thus create wealth for its surrounding community, there are impacts which can be seen even dramatically and unchanging impacts. The impacts are relevant to address and recognize fully the cultural and contextual impacts that might affect on community. After all, the impacts should not be treated by collective, which distorts the assessment of indirect effects. Impacts are dynamic and they are of a different nature. The nature of impacts is changing through the life cycle of a mine, and thus the early impact recognizing is crucial for maintaining the social license. Each stage requires engagement of communities and stakeholders, and the first relationships are formed before the first stage, exploration, will begin, because exploration requires reporting and consultation of local community. The mining project engages in dialogue throughout the life cycle to build inter-community relations, but while the initial stages of a mining project have significant impacts, the turning point is the construction phase, where the mining area causes various impacts on its surrounding environment. Well managed dialogue between communities will build frameworks for engagement and relationship building and enables successful construction stage community dialogue, as community development is paramount at that level. The objective of dialogue is to achieve positive outcomes for communities from, and to gain acceptance for future environmental, social, and economic changes. (Evan et al. 2011, 1681-1682.) Acceptance is built through activities where communities are informed about the changes which, however, also requires an understanding of people's needs, which means that dialogue must go through a process in which these needs are understood and facilitated, after all, relationships are formed as a process that activates both parties, not as individual activities.



Figure 5. Impacts on the Community (Evan et al. 2011, 1680)

Social acceptance of mining is strongly committed to the local community and other stakeholders, which subjects can be seen more as a cost structure in mining. Nevertheless, a successful mining life cycle requires the successful design and implementation of community and stakeholder commitments, which also allows for social acceptance by several other actors, such as government and public authorities, who demand ethics and sustainable mining throughout their life cycle. Today's successful mining companies strive for ethics and transparency in their operations, as the modern trend leads mining in this direction and thus also directs key partners to work with responsible mining companies.

### 3.6 Water Considerations in Mining

Water is used for a wide variety of applications in the mining industry, and due to its high-water consumption, water is primarily surface water that has been pre-treated for its intended use. Water is mainly used for mineral processing, washing and hydrometallurgical use, but there are other uses that may depend on the location of the mining site, and therefore the use may be, for example, the use of boiler and drinking water. After all, the mining method, infrastructure, and ore type determines the water aspects, and if the mining area is in a groundwater body, the amount of water can be considered a problem as it causes energy consumption due the dewatering and other activities and thus increases the cost structure of the business model. Mining activities will however dispose water constantly and therefore the high amount of unwanted water can be seen as a problem, because the water cannot be discharged without water treatment. Wastewater treatment prevents the environmental damage of dissolved and solids left in the water from mining activities.

The usage and dispose of water will change the surrounding environments hydrological and topographical circumstances and the use of water is essential in mining. The changes are the results of a water contaminants and because of water abstraction, which reduces the amount of surface water. Nonetheless, due to the crucial role of water, water management has been seen as necessary in the mining industry, and many emission values are determined by water, which means that water must also be treated to achieve emission values and thus water treatment can be seen as one of the cornerstones of the mining industry. (Lottermoser 2010, 119.) The environmental permit will define the maximum emission values for the mine site and environmental permits are temporary and managed and processed by the environmental authority and the regional state administrative agency (Tukes 2021b). The aim of the environmental permit is to protect the environment by limiting emissions from mine operations, and there are no common emission limits to suit each mine, and therefore emission limits are set on a case-by-case basis to protect the environment more effectively. After all, mining will require various of other permits as well, which can be seen as important from environmental and social point of view.

The water is managed in each stage of the life cycle, but the mineral processing stage will require biggest effort for water management, because the usage rates are then highest. Figure 6 shows typical sources of contaminated water in mine site in mineral processing stage. Water contamination is generated through combination of chemicals and microbiological processes, and the typical sources of contaminated water in mining are listed in table 4. (Barley, Brown, & Wood, 2002, 3, 5.)

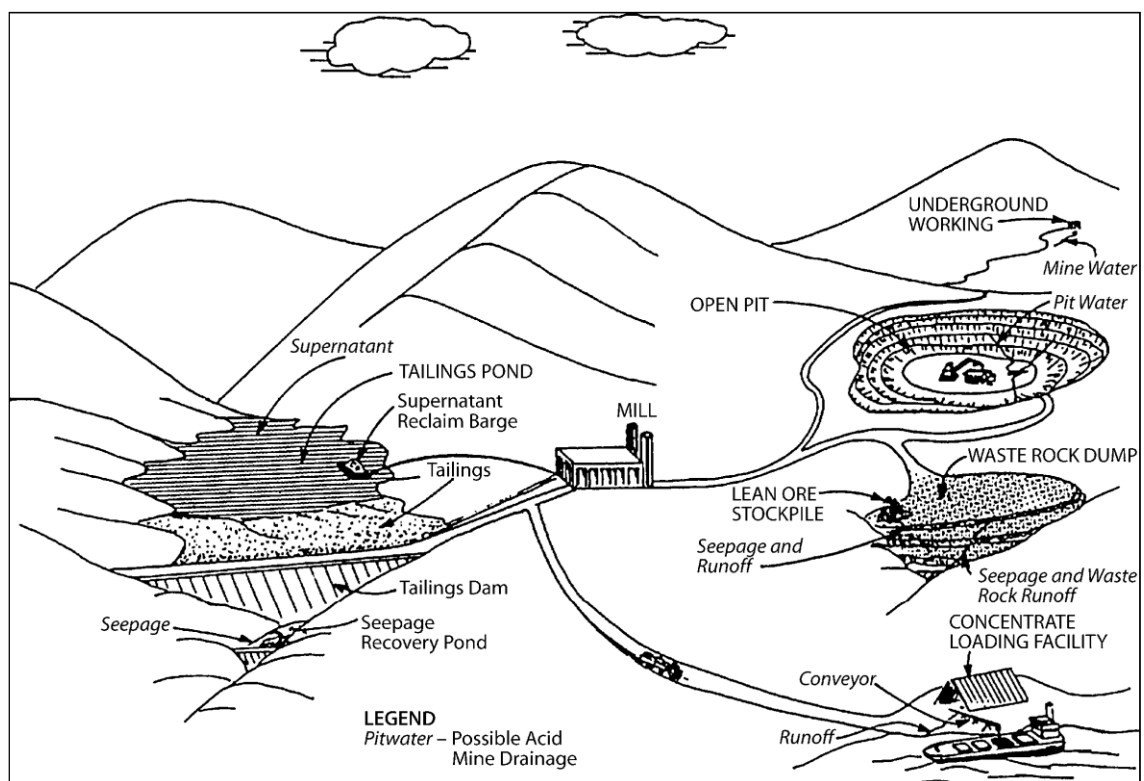


Figure 6. Sources of Contaminated Water in a Mine Site (Lottermoser 2010, 123)

Table 4. Sources of Contaminated Water

1.	Dewatering from underground
2.	Dewatering from open pit
3.	Side and waste rock dumping
4.	Tailings
5.	Ore storage
6.	Ore heap leaching

Contaminated waters are often acidic because the sulfuric acids in the stones are dissolved in water with oxygen, the concentration of metals, and the *pH* will change dramatically result of this reaction, but there are many objective factors which determine the influence of the reaction, and the contaminated water generation is mine specific. In general, water treatment can be seen in line with general practice, but there are problems in mining with technology, awareness and regulations that reduce the social licensing and profitability of mines. (Barley et al. 2002, 3, 9.) Thereby, every mine requires continuous monitoring, and regular reporting of water throughout the life cycle, which can raise awareness for the development of water treatment, and thus increase the operational reliability and profitability of the mine.

## 4 DELIVERING VALUE THROUGH WATER

### 4.1 The Current Value Creation of Sotkamo Silver Oy

The principle of successful business is based on value creation, and the Sotkamo Silver business model has unique features which are ensuring the innovations and new kind of developing. In general, this phenomenon can be seen as an unusual in the mining industry and thus it enables the creation of strategic novelty. Traditional mining company's business model will not guarantee value or benefits to the community, but Sotkamo Silver value creation emphasizes sustainable and responsible operations, which are strongly related to community. (Dunbar et al. 2019, 264). The value proposition of Sotkamo Silver enables the mitigating the non-market influences of future changes, and it will give strategical advantages, but when the value proposition is strongly based on sustainability, responsibility, and value creation for communities as well as customer segments, the value proposition requires regular developing and activities that the gain creators and pain relievers remain functional, because the mining business is living in time of change. When the social license is valid for the time being and the goals of sustainable development change, the development of a value proposition and business model is required, so Sotkamo Silver business model regularly requires new proposals and implementations to make value creation possible in the future. However, with the core business being mining and processing, value propositions to shareholders and investors must also be considered, as they enable the entire business and thus revenue streams must remain on target for the business to continue. Afterall, the effective and efficient management is efficient and effective management is one of the most important issues for a mining company, and once it is functional, it can also be possible to design new types of value propositions (Baird 2021). Some of the value propositions for sustainable development and the local community may increase the cost structure and require careful examination and reflection on whether they are necessary and can achieve the objectives. Generally, rising cost structures reduce revenue streams and thus reduce the economic benefits to shareholders



and investors, and when the mining industry is relative risk business sector, and thus additional cost structures are often desired to be kept to a minimum.

The business model of Sotkamo Silver in figure 7 consists of several different sort of key partners, which require multiple key activates which allows key partners functionality, and because company’s own resources are relatively small key partners are crucial for performing mining activities for the company. Outsourced mining activities include operation, logistics and mining. Thereby, the key partnership requires commitment, and usually commitment is done by creating a fixed-term contracts to ensure commitment, but contracts also create large cost structures. The physical assets of the key resources are forming the foundations for human resources and key partners, because without physical assets the concentrate production is not possible, and physical assets require specific key activities to make this combination work. The combination of key partners, key activities and key resources requires continuous development, especially when mining industry is living in a time of change, and for example, in a permit decision in December 2020 the regional government requires the limit value for total nitrogen in water to be lowered (Aluehallintovirasto, 2020, 305). These kinds of challenges create need for technical insights, but with right key partner choice the challenge can be managed and thus successfully solve.

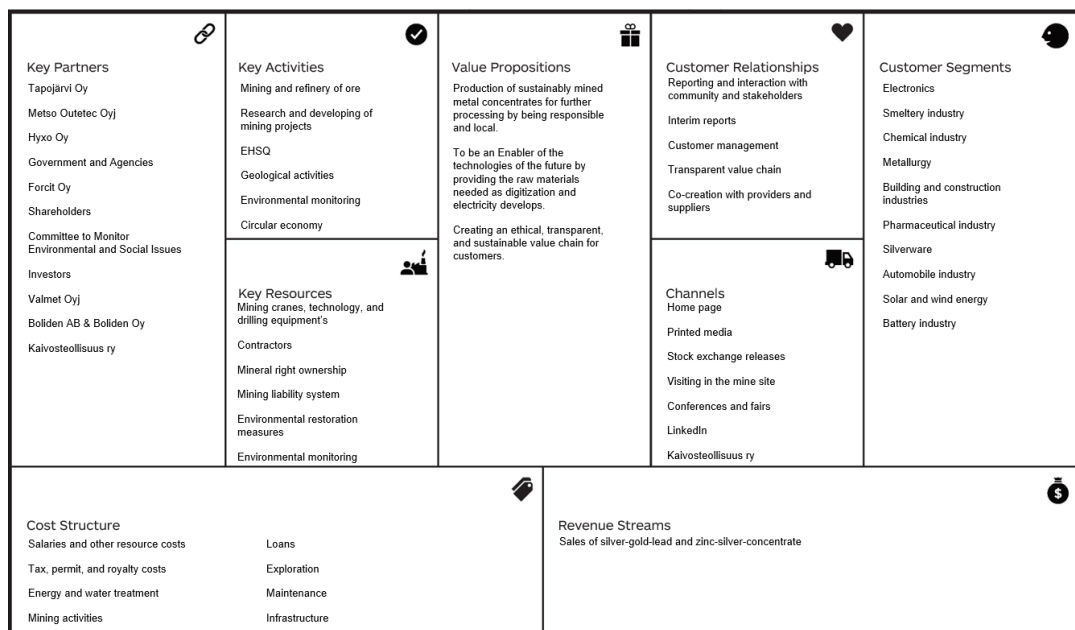


Figure 7. Business Model Canvas of Sotkamo Silver Oy

Sotkamo Silver core mission and values, discovering, mining and metal delivering, while being responsible and local, creates differentiating customer relationships which distinguishes it from the usual customer relationships maintained by mining companies. The common value creation of a traditional mining company can be seen in figure 8. Sotkamo Silver customer relationships supports value creation by providing utilization to the community and stakeholders, and proper relationships with communities and stakeholders can help achieve an understanding of their needs, which can be used to maintain a social license. However, the core values of the company will create effort for these kind of customer relationships building, and they can be seen crucial for maintaining the social license and achieving the objectives set by core values (Sotkamo Silver AB Strategy 2021-2025 2020, 6). The social license can be used to measure about how the well the company's relationships are performing, and the co-creation with providers and suppliers, is effective way to develop the relationships between community and stakeholders, because the social license is valid for the time being, and social license achievement can be improved with technological and social insights (Dunbar et al. 2019, 263). The co-creation customer relationship with providers and suppliers enables the wider value delivering and capturing, by providing engineering, and technological knowledge on both sides. Co-creation relationship with suppliers and providers contains a lot of intangible value, which can be challenge to measure, but long relationships have formed affective trust that creates new kinds of problem-solving skills for key resources, by transferring tacit information between both actors. After all, the generation of revenue stream can be simplified describe as a formula of production capacity and price element driven by world market prices, and the production capacity can be affected by company, but the company is not able to influence world market prices. Production and its capacity are strongly tied to technical entities, where the key activities are performing important role, by enabling the key resources performance and creation of the value proposition, but the customer relationships of the company have characteristics which are creating new kind of developing possibilities by providing access to new technologies and knowledge, which can create new key activities and thus improve the

performance of key resources, and finally enable the rise of the production capacity.

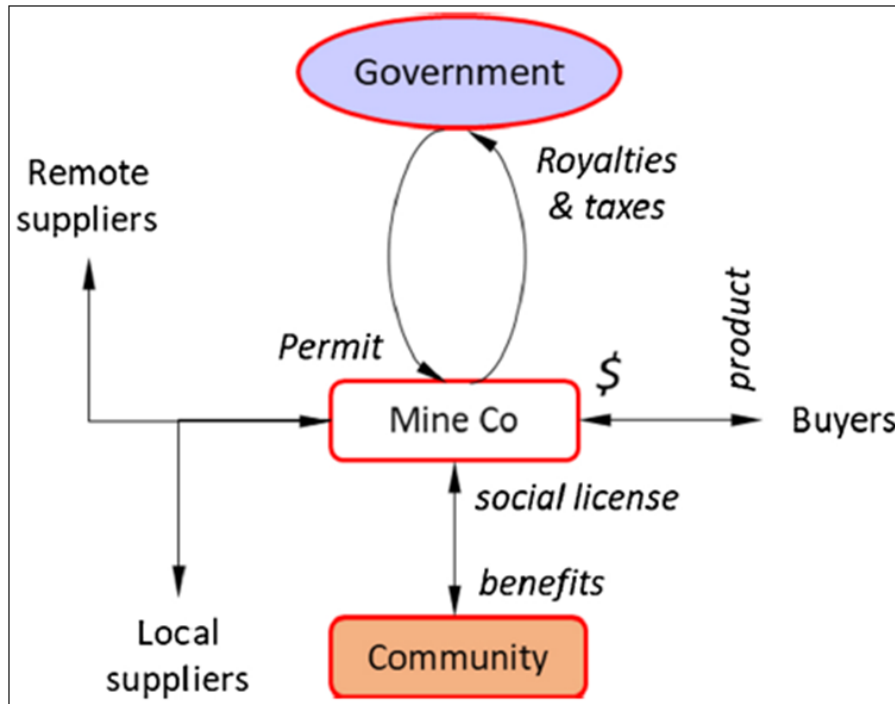


Figure 8. Traditional Value Creation of a Mining Company (Dunbar et al. 2019, 264)

The social license and responsible value chain have been made transparent, and the channels are delivering information about the company's financial, environmental, and social functions to the customers and stakeholders. The transparentness of the company creates strategic advantage by witnessing the mining operation is highly responsible and local. In time of change of mining, this strategic choice will create frameworks for reliable and stable relationships with customers and key partners and at the same time the company is a trendsetter in the modern mining industry. Although the value creation process of Sotkamo Silver can be seen similar as many other businesses, the mining industry have myriad challenges with environmental, technical matters which create unique characteristics to the business model of a mining company, but the business model requires constant developing from mentioned reasons. The development of the business model and the creation of

new value propositions are subject to constant development pressures, which create challenges for the company, but the functionality of Sotkamo Silver business model show that the challenges can be met with the right key partners, key activities, and customer relationship actions. After all, while the global market prices and ore content of the mine rise the risks of the business, also the social, environmental, and technological matters will rise the risk even more, which are forming the mining business extremely risky business.

#### 4.2 The Water Usage in the Mine Site

The Sotkamo Silver mine site uses water mainly for ore enrichment, and secondarily water is consumed for human needs, but its share of water total consumption is not significant. The raw water is taken from Tipasjärvi, which is lake near mine site. However, the refinery uses mainly recycled water which, due to its circulation, can be reused in the enrichment process, which reduces the water consumption. The water circulation process can be seen in figure 9.

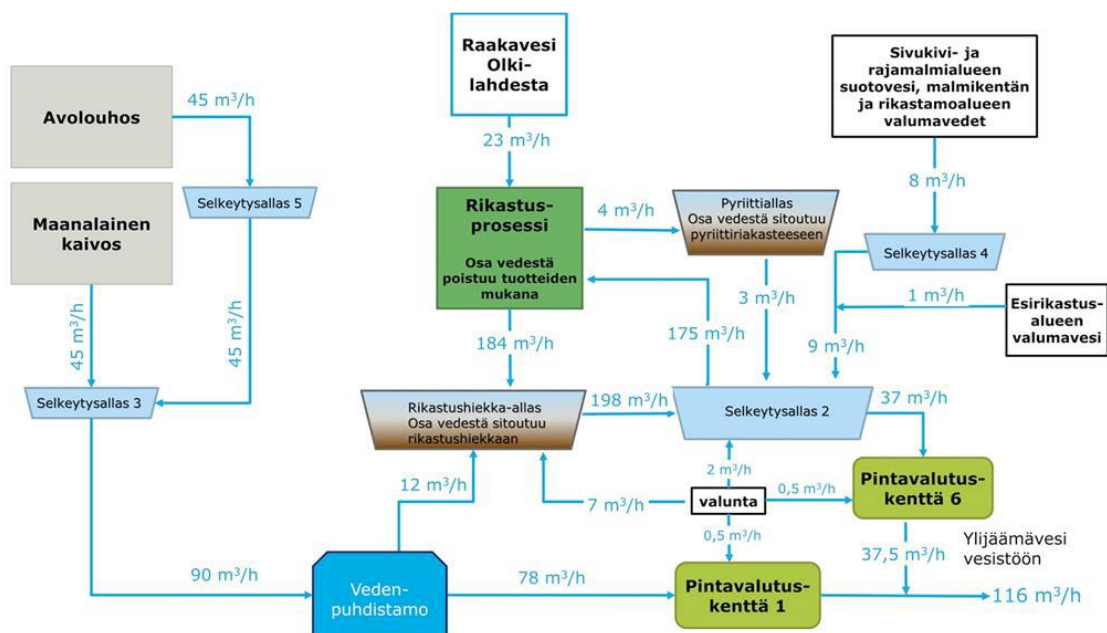


Figure 9. Water Circulation Process (Aluehallintovirasto 2020, 30)

The mining wastewater is treated before it is released to the water shed by removing dissolved ingredients from the water. The current water treatment process is consisting chemical precipitation by coagulant, flocculant, natrium hydroxide for pH adjustment and polymer, and after the precipitation the solids are separated by lamella and sand filter methods. The water quality is measured by using automatic pH, temperature, and total dissolved solids instruments. The current capacity of water treatment plant is 127  $m^3/h$ . The mine site wastewater causes mainly effect to near Hietanen watershed.

#### 4.2.1 Mine Wastewater

The mine's wastewater at the Sotkamo Silver mine comes mainly from the refinery and dewatering from an underground mine and open pit mine. Refinery effluents consist of chemical residues that would not otherwise evaporate or dissolve in the refinery process, and wastes consisting of ore minerals that are not mined, and small residues of various minerals called tailings. In addition, mine consist various of other emitters which are causing emission to air, which are, for example, carbon dioxide and carbon monoxide. The explosives used in mining cause nitrogen emission, which dissolve in the dewatering waters of an underground mine, and discharge wastewater are mainly consisting of nitrogen compounds of explosives and dissolved metals from tailing (Aluehallintovirasto, 2020, 202). The current emission limits set by environmental authorities can be seen in the table 5.

Table 5. Emission Limits (Aluehallintovirasto 2020, 260)

<b>Substance</b>	<b>Limit</b>	<b>Unit</b>
Arsenic	0,10	<i>mg/l</i>
Lead	0,05	<i>mg/l</i>
Zinc	0,20	<i>mg/l</i>
Antimony	0,20	<i>mg/l</i>
Aluminium	0,50	<i>mg/l</i>
Mercury, dissolved	5,00	<i>µg/l</i>
Cadmium, dissolved	10,00	<i>µg/l</i>
Sulphate	1000,00	<i>mg/l</i>
pH	6,00-9,50	
Total nitrogen content	12400,00	<i>kg</i>
Total nitrogen content from 2023	7000,00	<i>kg</i>
Total phosphorus	40,00	<i>kg</i>

The emission limits have been updated in December 2020 in application for the expansion of the Sotkamo Silver mine. Emission values can be seen as relatively the same as before, but for total nitrogen, limits have been set to reduce total nitrogen by about 43 percent (Aluehallintovirasto 2013, 22; Aluehallintovirasto 2020, 260). The change of total nitrogen value poses

challenges and requires investment in nitrogen removal methods. Nitrogen emissions can be effectively reduced with the right type of water treatment process.

#### 4.2.2 Environmental impacts of wastewater

The mine site is located around 40 kilometres southeast from the nearest town, and the surrounding nature of the mine site is mainly wilderness and forests. The treated discharge water is discharge to nearby watershed. Watershed quality is monitored constantly, and main impact causers are phosphor and dissolved nitrogen, which are result of the mining activities of Sotkamo Silver (Aluehallintovirasto 2020, 139). Phosphor and dissolved nitrogen emissions to watershed can cause eutrophication and effects on aquatic organisms, and thus affect the entire watershed ecosystem. Other substances are also released into watershed at low concentrations and their predicted no-effect concentration value does not exceed the concentration value of the harmful value. Other substances are cadmium, aluminium, zinc, antimony, arsenic, mercury, lead, nickel, and silver. Physical impacts on watershed include variations in water level, and small infrastructure changes, which are which consist mainly of ditches caused by pipelines. Sotkamo Silver own mine wastewater treatment plant ensures that the water treatment is adequate, and the discharge water is treated in accordance with the emission limits. The current water treatment plant also provides a strategic advantage to the company, by providing opportunity to be trendsetter and improve company's own appearance.

Wastewater impacts on environment have also caused concerns from community and efforts have been made to minimize concerns through proper information and communication. After all, the mining wastewater always have source of risk. Risks are anticipated by plans, which are also required by law, but there is always the possibility of wastewater hazards. However, wastewater emergencies can be small, which can be resolved quickly by the company's own methods, but in any case, exceptions must always be reported, and failure to provide information and communication will result indirect sanctions but also

indirect sanctions. Direct sanctions come from public authorities and major stakeholders and often have financial consequences, but indirect sanctions can include loss of social license or deterioration of a company's appearance, and the costs of indirect sanctions are difficult to measure or estimate. Nonetheless, the mine site of Sotkamo Silver does not locate in a groundwater area, which reduces risks, but although in general the location of the mine is thus good and raw water can be took from near by watershed, the environmental impacts are managed responsibly, which is the company's core values (Sotkamo Silver AB Strategy 2021-2025 2020, 7; Kekkonen, Karjalainen, Lehtinen & Viitasalo 2017, 26; Aluehallintovirasto 2020, 115). Responsibility frameworks are built from anticipation, scenario creation, planning and implementation. Responsibility frameworks consist of anticipation, scenario creation, planning and implementation. The impacts also consider the measures required by the closure stage to restore and landscape nature in the best possible way.

#### 4.2.3 Social Impacts of Mine Wastewater

The wastewater of the mining is strictly linked to the human rights, but generally the mine wastewater treatment is good level in Finland and in the company. Water is essential for human well-being, wealth and environmental protection, and water has deeper impacts on people, such as education and cultural aspects which are negatively influenced with lack of water treatment (Collins & Woodley 2013, 161). Mining has a transformative impact on the environment and society, indirectly causing social change for communities and stakeholders. The law requires in Finland mining companies to conduct an environmental impact assessment, which emphasizes social impact assessment and aims to determine the effects of mining on the environment and people (ELY Centre. 2017).

The Sotkamo Silver mine site is in area where there are not many permanent residents, but the area has many leisure homes. The affect area of the mine site can be seen in the figure 10. The nearby area is also in recreational use, and wastewater as well as the mining area thus also have indirect effects on



recreational use. (Kekkonen et al. 2017, 50) The mine site infrastructure creates pain points for community by limiting opportunities for hobbies by using land for mining, and the water can be seen as an imitating actor as well by causing land use restrictions due to pipelines and the location of the discharge pipe. Emissions into water bodies can reduce the opportunities for activities in watershed, as well as cause concern for leisure residents.

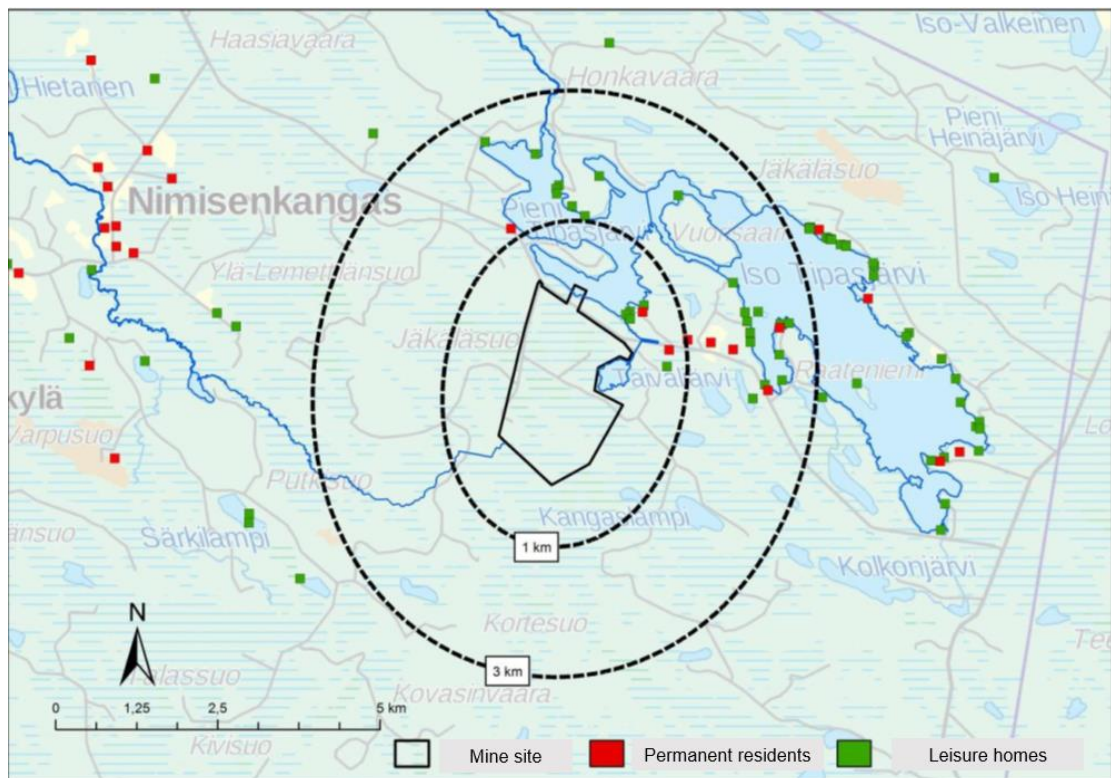


Figure 10. Affect Area of the Mine Site (Kekkonen et al. 2017, 50)

As previously mentioned, the mine wastewater causes concerns among the local community and stakeholders. This can be seen as a natural reaction, but the negative reputation of the mine's wastewater is highlighted in the discussion and news coverage, but Sotkamo Silver has successfully delivered value to the local community and the social permit has thus been earned. The communication with the community creates foundations for understanding of the social impacts of wastewaters, and it is crucial to involve the local community in mine-related communication activities.

The social impacts of mining wastewater are largely indirect to different people, and the complexity of the impacts can be broadly defined by the impacts experienced by stakeholders and the community that cause needs or pain to stakeholders and the community that affect mining operation. After all, water can only be treated cleanly, used responsibly and the effects of water treatment are similar for different stakeholders and the community, but the sustainable development of water management also create opportunities to treat water in new innovative ways that can also create social impacts.

#### 4.3 Identification of Community and Stakeholders Influenced by Water

The environmental and social impacts of mine wastewater touch several community members and stakeholders indirectly. The deep analyse of each member of the local community, and stakeholder is challenging due to their large number, but the identification provide understanding for their needs, or pains. The needs or pains create possibility to create value proposition, which can create new revenue generation opportunities and business possibilities for the company. After all, the impact of wastewater has similarities for communities and stakeholders, so a broad identification of these groups is warranted. The identification has looked at the groups that are affected by mining wastewater either environmentally or socially. The analysis has highlighted groups that have the potential to influence the mine's social license and acceptability as well as the company's appearance.

The Identified groups, individuals, and organizational have been selected on the basis that they have some potential to influence mining, either directly or indirectly. The definition of influencers who can affect the achievement of the company are defined as a stakeholders and communities, and even the identification is done by using broad view, the analyse will create frameworks for recognizing, and responding the needs and pains of the stakeholders and communities (Freeman 1984, 25; Agle, Mitchell & Wood 1997, 853). The identified groups, individuals, and organizational can be seen in table 6.

Table 6. Identification of Community and Stakeholders Influenced by Water

<b>Group</b>	<b>Definition</b>	<b>Bases</b>	<b>Relationships</b>	<b>Interests</b>
Government and agencies	Government agencies and supervisory authorities	Organizational	Reporting, monitoring of the impact of mining activities and notifications	Respect for the use of resources, sustainability, compliance with laws and regulations
Journals and media	Communication channels	Groups	Interviews, press releases and publicly	Economic effects, political effects, and nature conservation
Leisure home users and outdoor enthusiast	Persons for whom the area has been significant due to possessions or hobbies	Individual	Information, communication, and transparency	Concerns about watersheds, nature impacts and impact of the mining infrastructure
Local community and landowners	People living nearby and former and current landowners in or near the mining area	Individual and groups	Information, communication, and transparency	Concerns about watersheds and nature, impact of mining infrastructure and social influences
NGO's	Organized non-profit groups and registered groups with goals related to the mine	Groups and Individuals	Communication, and information	Environmental impacts, social impacts, and social relationships
Other mining companies	Mining companies operating near Sotkamo Silver	Organizational	Common objectives, information sharing, communication	Access to technology, intangible benefits
Key partners	Networks that make the business model work	Organizational, groups and individuals	Create an opportunity for both to do business by performing multiple functions	Economic benefits, social relationships, business development

The qualitative broad view of stakeholders and communities in table 6, who are influenced by water create understanding of the phenomena diversity, but every actor has similarities that create same kind of needs and pains for value proposition design. However, the possibilities for actors to influence the operation of the mine are very different, and thus the company's relationship with different actors is also different, but on the other hand, most communities and stakeholders can be influenced through water, which is creating new kind of business opportunities.

Agle et al. (1997) presented frameworks for analysing the typology of stakeholders by using three core attributes, power, legitimacy, and urgency. The power in stakeholder analysing typology is the demining factor in several activities and businesses, and the power is variable transitory, but the control of power does not mean that it should be exercised, and the holder of power does not necessarily understand the magnitude of power. The legitimacy is a more variable than power, and legitimacy is based on a general understanding of the norms, beliefs, definitions, and values that an entity performs. Urgency describes the urgency of stakeholder claims, or impacts, and thus identifies those stakeholders who require an immediate response. As previous mentioned, it is possible to create impacts by water to community and stakeholders, and the typology analyse of stakeholders provide larger understanding of the phenomena. The understanding of the typology of community and stakeholders, provide frameworks to observe the effects of new kind of value proposition. The figure 11 typology analyse will track stakeholders, and community typology.

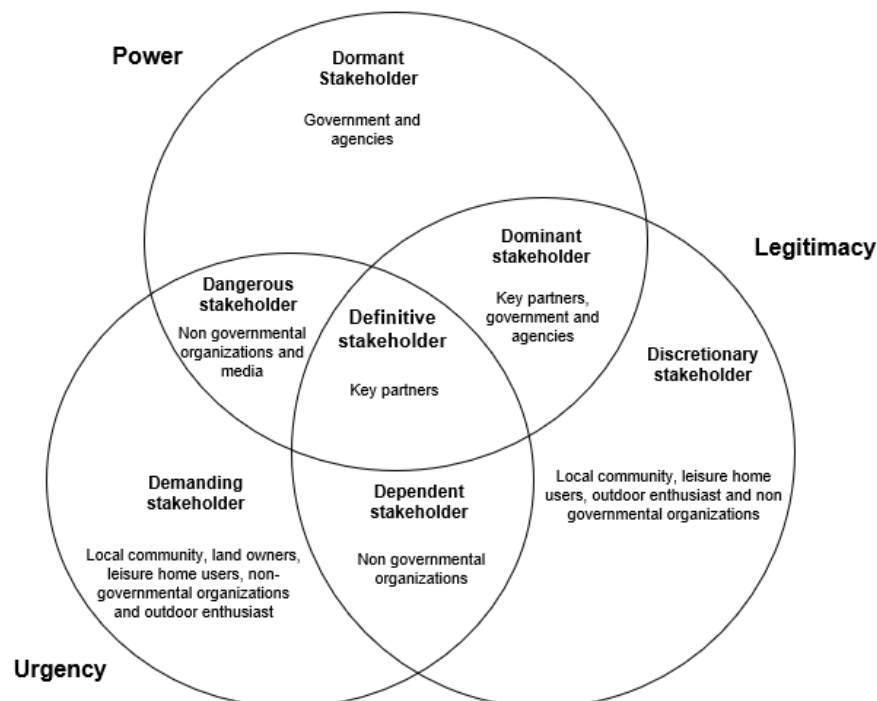


Figure 11. Community and Stakeholder Typology Analyse (modified from Agle et al. 1997, 874)

The power is the main attribute for dormant stakeholders, and naturally the government, and agencies possess power. However, government and agencies can be seen as a dominant stakeholder as well, due the power to enable or discontinue mining, but the power will remain unused if the mining activity meets the set requirements for water. However, the government and agencies are not the definitive stakeholder, because the key partners are those who provide the continuity of the business model and mining. Key partners have every attribute, and their requirements are always urgent because their actions have a direct impact on the company, but due the legitimacy the relationship is trustful. The lack of legitimacy is dangerous, and the dangerous stakeholders may lack legitimacy when pursuing their own objectives. The NGO are a wide variety of groups, and their activity is a non-profit, and they can be seen as a depended stakeholder as well, and their existence is dependent on the mining industry, and the relationship is based on reciprocity value exchange. However, the NGO's can be seen also as demanding stakeholders, who has various of claims about the company, but their power attribute is not big enough to influence the mining operation, but their claims are seen often urgent, and claims require urgent responses, but some NGO's can have high legitimacy and they can be defined as a discretionary stakeholder, but they do not have any claims or requirements regarding to the company. The discretionary and demanding stakeholders are emphasized when considering the social impacts of mine wastewater, but still power attributes of both is insufficient to influence the operation of the mine.

Each of the community, and stakeholders are valuable for some way, and the differences presented in the analysis will provide understanding that if the phenomena are causing impacts on some stakeholder, the power, legitimacy, and urgency may be a limiting factor in meeting the stakeholder claim. However, the CSR and ethical practices require that mining also consider stakeholders who have claims and their attributes impose constraints on the presentation and achievement of claims. However, there are always different kind of people in every group who have own opinion, and will, which will challenge the identification, because each one wants to be considered in some way. In generally, the types of people in a group can be divided in three

classes, those who do not accept the mine, those who accept the mine and those who are not sure about is the mine impact positive or negative. (Baird 2021.)

#### 4.4 Needs and Pains Caused by Mine Wastewater

The mine wastewater causes indirect and direct impacts to communities and stakeholders, which can be generally described as an environmental and social matters, these matters are creating the phenomena's new value proposition possibility. However, the diversity of community stakeholders creates challenges in measuring specific pain or need for a single actor, but the proven common effects of mine wastewater are similar and allowing the identification of common needs or pain to design a new value proposition, but some quantitative methods are possible to use for understanding the local communities or stakeholders, but the use of quantitative methods is relative slow and expensive (Baird 2021; Lähde 2021).

The prejudice of mining is creating the foundations for the pains in generally, and the common reason of prejudices according to wastewater has been born mine exploration stage is often incorrectly associated with the mineral processing stage, and in the mineral exploration stage, the formation of mine effluent compared to the mineral processing stage is negligible (MOT 2012; Sauli 2018). Emission from mine wastewaters is a major concern of the phenomena, and the concerns are also relevant. The lack of information can be seen as one of the core characteristics of the concern, and the mining appearance is built on assumptions that give rise to increased concerns about mining wastewater. The wastewater treatment is regulated by law and decisions about it are public, but often understanding of these documents may require special expertise as well as an understanding of water treatment, which will rise the need of information and communication. The miss of comprehensible information will lead to the uncertainty and pain, but the digitalisation has created easy access to knowledge, and therefore the digitalisation will create possibilities to improve the appearance of the company, and new ways to

improve the communication and information about the water treatment and wastewater impacts. The concerns, lack of comprehensible information, and communication can be seen as social matters, which are relative difficult to measure by economic benefits, but the social license importance will emphasize these needs and pain.

Emission to watersheds cause eutrophication and changes in the ecosystem of aquatic organisms, and the direct impacts on the watershed turn impacts to the community and stakeholders. Such impacts reduce the attractiveness of the area, and thus affect to leisure activities and tourism. But the mining district does not include a significant tourism business, but the watershed area has some fishing activity. Mining waters also affect fisheries, and thus fishing significantly, and nitrogen emissions from the mine have a significant impact on the eutrophication of the watershed. However, in the in the environmental permit decision related to the expand the mine on 7 December 2020, the regional government agency states that nitrogen emissions must be halved from 2023 onwards. The leisure home users, nearby and outdoor enthusiasts are directly affected by mining wastewater, and they have same kind of needs as other actors, which can be described as a concern for the environment, but also as a but also concerns for health effects.

The described needs and pains are also causing the jobs what need to be done, and in this thesis, the mining wastewater phenomena is diverse, and it is relative challenging to measure the social impacts narrowly, but the mining wastewater impact has similarities on every actor, and thus it creates a comprehensible whole of needs and pain of the community and stakeholders. The jobs that need to be done are formed through the concerns and direct impacts of the mining wastewater. The water treatment is often not highlighted in the debate around the mines, and the resulting gap creates the job need to be done. The gaining trust of responsible wastewater treatment is a job that need to be done, and it is strongly associated with access to comprehensible information about the current water treatment, and mining wastewater impacts. Therefore, the job that need to be done is the achievement of awareness and trust in the ways in which a company treats water before it is discharged into watershed.

#### 4.5 Prototyping of Possibilities

The pains, needs, and jobs need to be done of community and stakeholders create challenges to the company, but there are also possibilities for new kind of business opportunities and revenue generation by a new way of water treatment. Accordingly, the decision of the Regional State Administrative Agency in December 2020 regarding the reduction of nitrogen concentrations will also create additional pressure for the development of new ways of water treatment.

The achieved understanding of the job that need to be done of community and stakeholders enable possibility to launch new kind of ways and means of communicating, by using new channels and outside of the box thinking. Often, the way the industry communicates is fundamental to the engineer, and thus gaining the trust of communities and stakeholders can be limited because the information is incomprehensible or information about mine wastewater treatment is complex and difficult to internalize (Baird 2021). However, even the water treatment enables company to impact community and stakeholders, the new way of water treatment requires new way of communicating and information that the awareness can be achieved in line with objectives. The communicating and information can be boosted by digitalization, which provide new kind of social license measuring possibilities for the company, and the digitalization will enable to think differently about how the value is created (Rogers 2016, 4).

The new way of water treatment can be combined with the reduction of nitrogen concentrations in water by using the technologies which enable the further development of innovations. Cost structure of the new technologies are high, and it is therefore justified to use future nitrogen reduction challenge to implement the new value proposition, as it will also allow the emission limit values to be exceeded in the future. However, new technologies required innovative perspective about how the impact to community and stakeholder can be achieved. The company have access to new water treatment technologies through its key partners, but the new technology does not in itself guarantee the



value proposition, and the new technology can be defined more as a tool that enable the positive impacts to the community and stakeholder.

The potential water treatment method for nitrogen reduction from mine wastewater is moving bed biofilm reactor (hereinafter MBBR) process, where nitrogen can be reduced by using bacterial mass, which is growing inside the moving bed, which is practically made up of solid plastic pieces, which will grow the internal surface area due the modular structural of piece (Juholin 2019). The MBBR process is not in use in mining in Finland, but in the future, its use may become more common, because it is possible that in the future there is a general desire to reduce nitrogen emissions in watersheds, but the mine wastewater temperature is relatively low, and the temperature of mine wastewater can be +1 °C in the wintertime, and the low temperature requires heating, which will grow the energy consumption, and waste heat can thus be generated, which is financially unprofitable (Juholin 2021).

The waste heat of MBBR process create possibilities to use waste heat as a framework for further innovations. The waste heat can be used for example growing plants or vegetables, such as poinsettias or tomatoes, which will enable the possibility to gain positive impacts and reactions from community and stakeholder by creating unusual and innovative way of water treatment. Alternative use of waste heat can also create a new and highly influential speculation that, combined with the opportunities brought by digitalisation, such as the use of new channels, can create new ways of measuring and earning social license. However, the establishment of new water treatment process will require comprehensive and understandable information about how the new water treatment process will create gain and relief pains of the community, and stakeholder, but the new MBBR water treatment method and the use of waste heat for grow poinsettias can create disruptive innovation which will revolutionize the company's appearance and allows for a new kind of attention.

The creation of value proposition of new way of water treatment is possible for the company, and the effect of the value can shape the concerns and prejudices of community and stakeholders. After all, the additional possibilities of the new value proposition are interesting, as it enables company to be a

trendsetter of the Finnish mining industry, but the continuous development of technology will create new possibilities in the future, because many mines in the world has been used for example energy production, which was not possible due the uninterrupted technology in the past (Baird 2021).

## 4.6 Value Proposition Design

The value proposition design method by Bernarda et al. (2014) provides frameworks for the value proposition design which enable the value proposition design for the new way of water treatment. The value proposition design principles and definition are described in chapter 3.3.

### 4.6.1 Customer Profile

Customers of the new way of water treatment are the community and stakeholders who are influenced due the generation of mine wastewater. The customer profile will define the customers pains, needs and jobs from the previous chapters. The customer profile canvas in Figure 12 will visualize the structure of the customer profile.

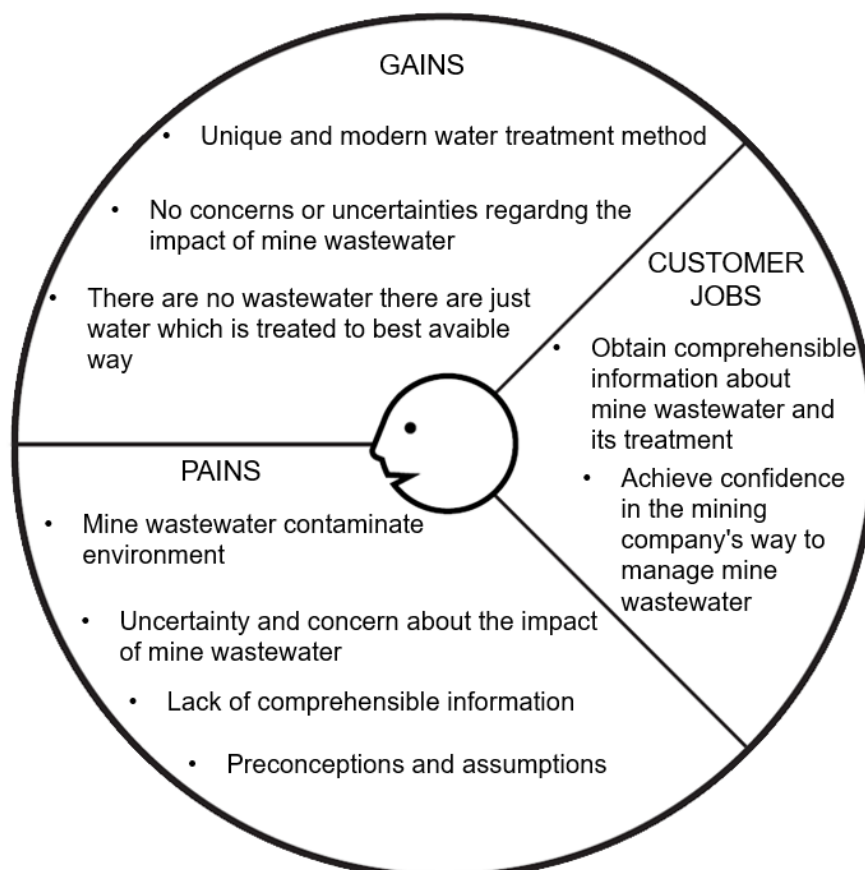


Figure 12. The Customer Profile Canvas

The customer profile canvas in figure 12 is giving the broad view of community and stakeholders pains, gains and jobs that need to be done. Each issue has similarities as several issues are related to social needs or pain. The technology is not the core of the customer profile, and it is obvious because water treatment technology requires special knowledge, and it can be said that technology is not attracting attention either, but technology is seen more as an enabler of value proposition. The information and advertising are crucial for the value proposition formula, because without proper information and advertising, the value proposition will not get enough attention and the social impact may be diluted. Caution and care must be taken in providing information, as the effects of such value proposition can also be negative, or it has a very short impact to customers, and in generally, the information aim is to convince people that the current mining project is necessary and responsible (Baird 2021).

#### 4.6.2 The Value Mapping

The value is brought through water treatment and its further innovation possibilities which create value for the community and stakeholders who are influenced by mine wastewater. The designed value proposition features are mapped and visualized in the figure 13.

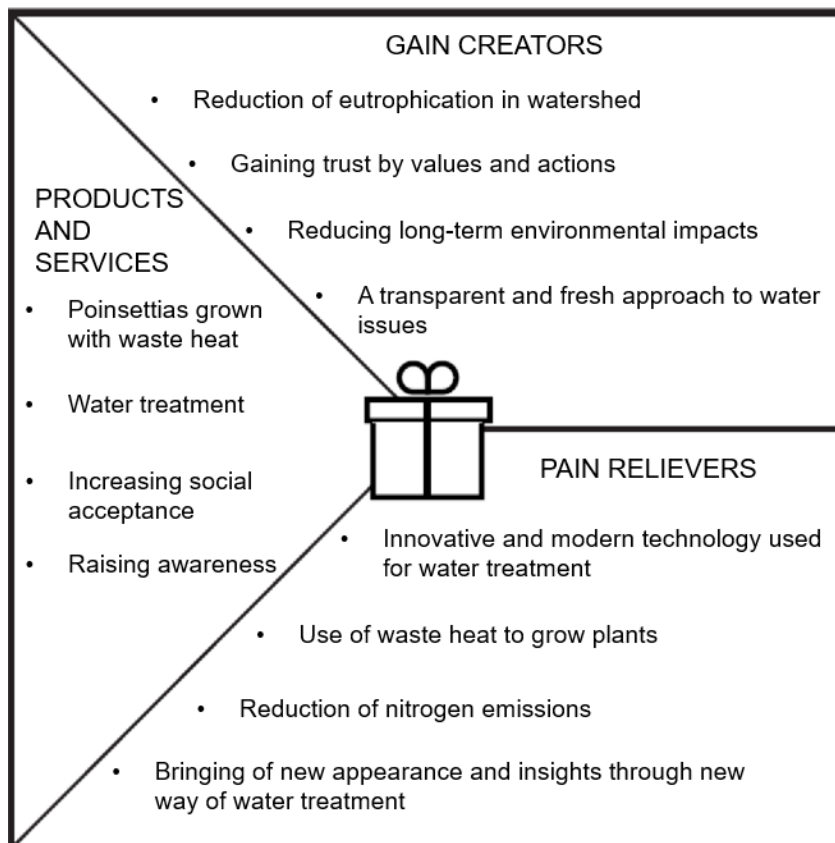


Figure 13. The Value Map

The value map is consisting of the value, which is created to the community and stakeholders, and as previously mentioned the values created through water emphasizes social impacts, but the values can be seen as a diverse, and the same sentence in the figure 13 value map applies to several other sentences in the figure 12 customer profile canvas, which can be seen as effective. The poinsettias grown with waste heat are not seen as concrete value creator, but the new appearance they create will cause positive effects on communities and

stakeholders. After all, the value creating is possible if each value of figure 13 are brought together, but as the social license is valid for the time being, such value creating need to be further developed in the future. But it is difficult to influence customers emotions without experience, but with suitable mining infrastructure planning there will be a chance to create experiences for visitors to the mine (Lähde 2021). However, the creation of experience must already be taken in account into feasibility study stage, where the mining infrastructure is implemented, and in the subsequent stages it is difficult to modify the infrastructure afterwards.

#### 4.6.3 Fit of the New Value Proposition

The identified pains, needs and jobs to be done presented a relevant possibility for the new values which are formed through water treatment. However, the phenomena require further developing and more holistic value creation that the customers' pains, needs and jobs can be fully filled, because the phenomena can be seen similarities with other mining social issues than mine wastewater also.

The value map addresses problem-solution fit for the company, by delivering new and fresh values for the community and stakeholders who are influenced by mine wastewater. However, the value proposition does not answer in every issue of the customers, because preconceptions, and assumptions require more diverse changes of the whole mining industry which are not possible to create by a one single company. However, the designed value proposition will create framework for the further processing of social license and will enable the implementation of similar innovation projects also in the future. The fit of the customer profile canvas and value map is visualized in figure 14.

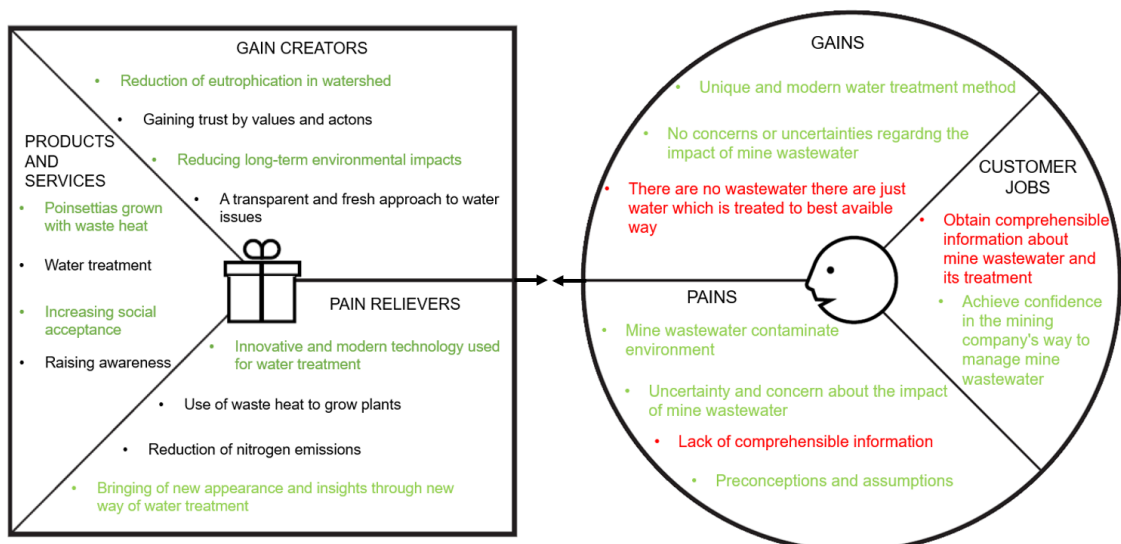


Figure 14. Value Proposition Fit

The fulfilled customers' gains, pains and jobs are highlighted in green, and ignored issues are highlighted red in the figure 14 on the right-side customer profile canvas. The ignored issues require further development and can potentially be addressed in part through digitalization using new channels and the creation of new types of fresh content that can influence the customer awareness and thus positively influence, for example, the prejudices and assumptions. After all, many issues can be positively impacted by creative and improved water treatment, but customer profile canvas issues generally emphasize indirect social impacts, while direct fit for purpose effects, for example, can affect nearby mining area users and property owners. Figure 14 left side value map fit for purpose affairs are highlighted green, and it confirms that the new way of water treatment produces positive social impacts.

The value proposition reach topics that often come to the fore in discussions about mining wastewater, and on the other hand, the rising trend in sustainable development may also lead to a phenomenon in the future where mining companies compete for social acceptance with water or environmental innovations and by value propositions. It can also be stated that development work such as this value proposition design can lead to a vantage where the Sotkamo Silver can be a trendsetter of the Finnish mining industry, and the value capturing is possible.

The designed value proposition will create new possibilities for the company, and if the company will invest on MBBR process, due to the increase in total nitrogen limitation, the further development of waste heat creates strategical novelty for the company. The using of new water treatment method also points out that the case company acts responsibly in water matters, but it is crucial to understand that the responsibility in mining is an issue that extends beyond the mining company, and the responsibility is not the sole control of the mining company, but when the company acts responsibly, it enables joint value creation with other responsible partners (Lähde 2021).

The new value proposition also creates a multiple fit and may, for example, attract the attention of investors and other actors. However, full testing of the value proposition requires the implementation and execution of the value



proposition, as it ultimately depends on customers' decisions as to whether the value promise works (Bernarda et al. 2014, 52).

## 5 CONCLUSIONS

The mining business has the same characteristics as any other business, but the challenges caused by global mineral prices, mine wastewater and with other environmental, and social issues are factors that make the mining business unique and risky. However, mining is necessary for the civilization to work as desired. The mining business can be one of the locomotives of Finnish economy in the future, but the risks and prejudices constitute barriers to domestic mining investors, and junior mining companies. Sotkamo Silver transparency, and desire for development can be seen as a relatively rare feature when considering a mining company. The designed value proposition, delivering value through water, is an unusual way to create value to unusual customers in mining, but such innovations can also lead to unusual results, such as achieving a social license more effectively and reducing environmental emission. Nonetheless, the traditional mining company's business model does not guarantee value to the community or stakeholders, and the traditional mining business model is no longer fit for the purpose, and the future mining business requires new kind of value propositions and business models that create unusual value. However, there is no simple formula for value creation for community or stakeholder, but the value creation should be sustainable, where the delivered value is educational or other comparable value that will have long lasting effects to the community or the whole nation (Baird 2021).

The results of the thesis are useful for the company, and in general the phenomena are topical in the entire Finnish mining industry, and therefore the results can be seen useful for the entire mining industry in general. The mining industry is an engineering-based industry where business is often viewed from a technical point of view, where observations such as the thesis work are not emphasized, but the growing demand for sustainability creates need for new perspectives and observations, and the topic can therefore be considered relevant. This thesis gives the reader brief insights into the phenomenon, and to achieve a more comprehensible and holistic whole on the phenomena, further research is required. Further research should examine in more detail the direct and indirect social impacts of the mining industry to gain understanding of how to design and guarantee value proposition for communities and stakeholders to

achieve the company's objectives and reduce the non-market influence. The fully achieved understanding of the social impacts of the mining industry will lead the researcher to form frameworks for new kind of value proposition designs for the mining industry in the future. The results of further research can improve the competitiveness of the Finnish mining industry and create strategical novelty for the Finnish economy and thus also enables and promotes the Finnish export industry by providing sustainable produced domestic raw materials.

A variety of references were used in the work, and consisting of a wide range of disciplines, such as engineering, social sciences, and economics, which create reliability to the thesis, however the reliability of the thesis would have been enhanced by a broader interview sample. Afterall, the diverse theoretical part created an understandable view of the phenomenon, and with the topic narrowed down to mine waters, the extent of the phenomenon remained under control. The author of the work also achieved insights into and understanding of himself that will improve his future working and business development skills. Overall, the thesis is a unique entity that combines modern business research frameworks and the mining theories, which are not commonly seen integrated when considering mining companies and, therefore the thesis work also brings new ways and winds to the whole mining industry. Even though the required water treatment or other similar measures which are not the core businesses of the mining company and are often seen as cost structures, but further innovation from these subjects can also allow for indirect benefits or revenue streams for the company.

The thesis work provides answers issues concerning for business development of the mining industry in general and even though the thesis work has a case company, other mining companies have similar issues and areas for development as well. The author of the thesis has gained understanding that the social license of mining is valid for the time being and maintain requires continuous business development proposals and innovations that the mine can maintain its social acceptance. Although the ethics of the mining business is under constant review, the mining industry also ensures the production of raw materials needed for sustainable development and is therefore an essential

industry in the future, and this thesis provides value proposition design basics that enable sustainable and responsible mining industry in the future. After all, the surveillance, and licensing in Finland is generally well maintained, but the design of the mines should also consider possible other innovation opportunities that can be made at the mine during the mining area or at the end of the life cycle. In this way, a framework can be created for other actors as well, and an understanding can be gained of how the business model of a mining company can guarantee value to community or stakeholder. The sustainability also requires development of the mining laws and the regulation of mining permits because the life cycle of a mine is one sustainability and responsibility factor, and the life cycle of the mine must be long enough that the economic impacts of the mine are long-lasting.

The mining company's business model is formed during the feasibility study, and often development ideas or social innovations such as thesis are designed when the mine site is in processing stage. The new ways of value creation in mining require business model developing at the very beginning of the mining project, and that will enable the social license achieving of social acceptance. Responsibility is often perceived as an individual act, and a set of shared practices, values and attitudes that will characterize a company, but the responsible mining require a business model that allows variations of social and environmental trends over time and allows new value propositions to be made from the beginning of the mining life cycle.

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APPENDICES

Appendix 1. Thematic Interview Guide.

## Thematic Interview Guide.

## 1. RESPONSIBLE MINING INDUSTRY, CURRENT VALUE CREATION

- What do you think are the key responsibility issues in mining?
- Can information through different channels affect to concerns, prejudices or attitudes caused by an existing mine or a future mine?
- Do you think that in the future there would be competition in matters of responsibility between mining companies?

## 2. ACHIEVING SOCIAL ACCEPTANCE BY BUSINESS MODEL INNOVATIONS

- What kind of methods have you seen used to obtain a social license?
- Could the use of new channels make social acceptance more effective?

## 3. MEASURING AND MONITORING OF SOCIAL ACCEPTANCE

- Do you think that using new channels and innovations could influence general perceptions or attitudes towards the mining industry?
- What types of innovations could increase the acceptability of the mining industry and improve its appearance?

### 3. MEASURING AND MONITORING OF SOCIAL ACCEPTANCE

- Do you think that using new channels and innovations could influence general perceptions or attitudes towards the mining industry?
- What types of innovations could increase the acceptability of the mining industry and improve its appearance?
- Could social media or virtual reality create transparency in the mining industry?

### 5. WATER TREATMENT

- How do you see the role of water treatment in the mining industry?
- Does the EIA report provide comprehensible information on the effects of mine wastewater?
- Are the social impacts of mine wastewater being assessed to a sufficient extent?
- Do you think that the water treatment can be a new value proposition of a mining company?