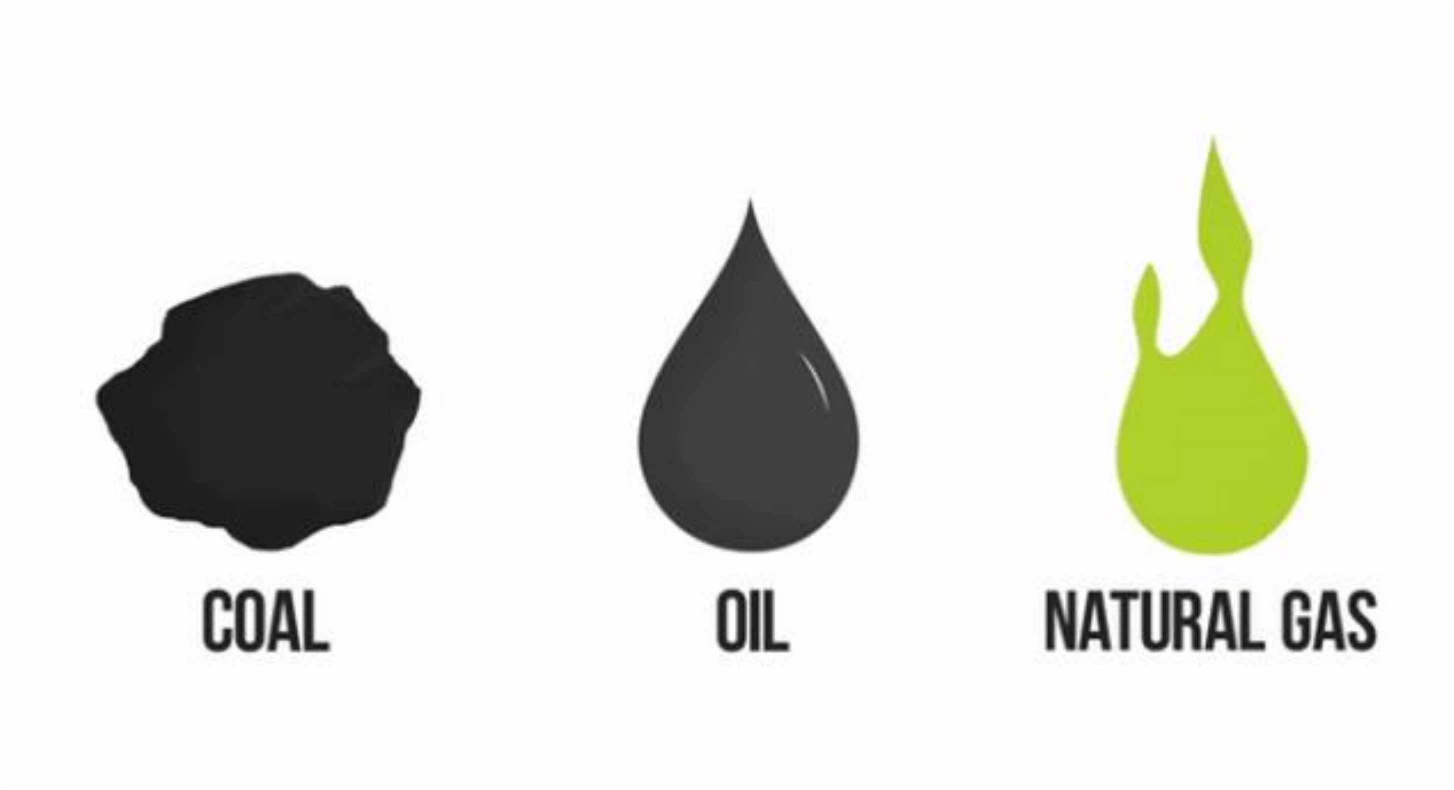
A comparative study of the legislative risk regulation of Norwegian petroleum and coal mining industry, and Russian coal mining industry



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Executive Summary

Regulating risk carries the potential of improving the safety of workers, protect the environment and prevent financial losses. Risk regulation has gained a lot of global interest these past decades. New equipment is developed to protect workers, new techniques are used in order to reduce the possibility of harming the environment and new methods of assessing risk are established. In other words, risk regulation is a very encompassing activity.

This thesis has examined the legislative risk regulation of three different industries: the Norwegian petroleum industry, the Norwegian coal mining industry, and the Russian coal mining industry. By choosing these specific industries it was possible to compare how legislative risk regulation is carried out across industries and national borders. Both the Norwegian petroleum industry and the Russian coal mining industry represents core industries for their respective countries. However, the coal mining industry is of less importance in Norway. This allowed for comparing the legislative risk regulation of one of the largest industries in Norway to one an industry of less significance. The comparison was carried out by scrutinizing the legal documents forming the legislative framework regulating risk for the three industries. The motivation for conducting this comparative analysis is to examine how each industry manages risk-related challenges. This allows for the regulators to learn from each other and adopt solutions used by others in order to regulate risk more efficiently.

This comparative analysis has focused on three criteria: the general characteristics of the legal documents, the use of enforced self-regulation as a regulatory strategy, and the use of safety management systems. The findings of this study are presented in the table below.

	General characteristics of regulations	**Enforced self-regulation**	**Safety management system**
Norwegian coal mining industry	Rather brief, heavy use of performance based requirements	Prominent use as regulatory strategy	Required by law
Norwegian petroleum industry	Extensive, encompasses large variety of operations and activities, heavy use of performance based requirements	Prominent use as regulatory strategy	Required by law and regulations
Russian coal mining industry	Extensive and specific, heavy use of prescriptive requirements	Very limited use	Required by law

The study shows there is a clear difference as to how Russian regulators regulates risk compared to the regulators of the Norwegian petroleum and coal mining industry. While the Norwegian legal regulation makes heavy use of performance based requirements, the Russian regulation uses prescriptive requirements. This has great impact on the extensiveness and specificity of the legal documents. As prescriptive requirements are more specific there is a greater need for more extensive legal documents. The use of prescriptive requirements also hampers the use of enforced self-regulation as a regulatory strategy. While the use of enforced self-regulation is prominent for the regulation of the Norwegian industries, the Russian legislative risk regulation makes very limited use of this regulatory strategy. The Russian use of this strategy is mainly encountered when examining requirements regarding the safety management system. The use of such a safety management system is also more prominent for the regulation of the Norwegian industries. However, this thesis concludes that compliance of the requirements regarding this management system is met by using the same standard for the Norwegian petroleum industry and the Russian coal mining industry.

The study also finds that there is a clear difference between the extensiveness of the regulations concerning the Norwegian coal mining industry and the Norwegian petroleum industry. While the regulation on Norwegian coal mining is very brief, the Norwegian petroleum industry is regulated by more comprehensive regulations. This is considered to be due to the sizes of the two industries. However, both industries are regulated by performance based requirements and by heavy use of enforced self-regulation.

Acknowledgement

I would like to take this opportunity to thank my supervisor professor Ove Njå. Thank you for suggesting writing about Norwegian and Russian legislative risk regulation. This has turned out to be a far more interesting topic than I first assumed. Also, thank you for giving me the opportunity to go to both St. Petersburg and Svalbard to write this thesis. Your guidance throughout the process of writing this thesis has been invaluable!

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1 Introduction

According to the International Labour Organization, over 7 600 people die each day from work-related accidents or diseases on a global scale (ILO (a), n.d.). Figure 1 and figure 2 shows the number of work-related fatalities in Norway and Russia respectively.

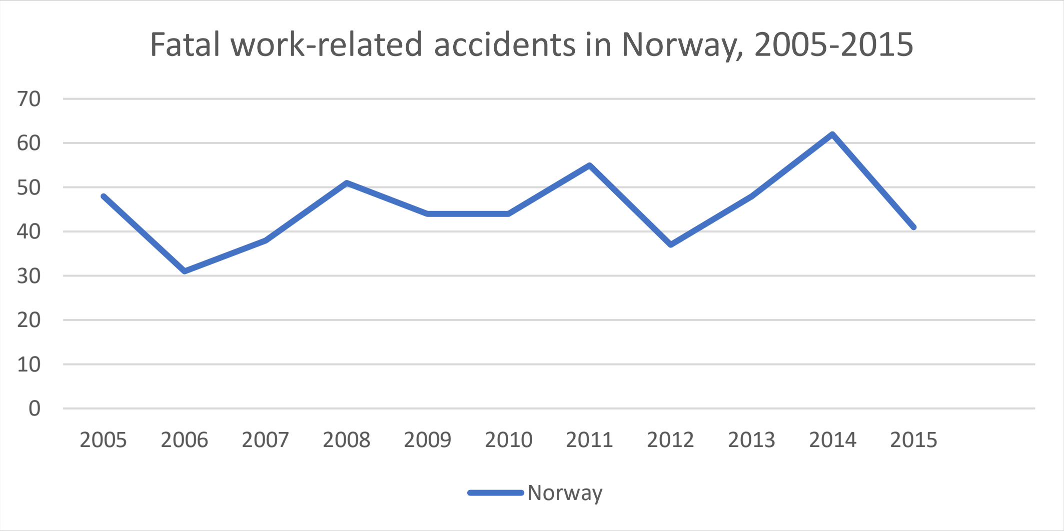

Figure 1: Work-related fatalities in Norway between 2005 and 2015 (ILO (b), n.d.)

Figure 2: Work-related fatalities in Russia between 2005 and 2016 (ILO (b), n.d.)

As seen from figure 1 and figure 2, these numbers are significant. It is therefore of great interest for the government, employers, employees and the general public to minimize these numbers. An effective tool in doing so is through legislative requirements regulating hazards and risks associated with industrial accidents.

legislative risk regulation aimed at reducing the risk related to industrial accidents requires constant attention and effort. Legislative risk regulation means the use of legal means in an effort to manage risks. As new and more complex technology is developed in order to solve new and more complex challenges, new risks arises, old risks are eliminated, and some risk remains. As a result, it is necessary to adapt how risks are regulated in order to attain a satisfactory level of safety. But it is not only new technology and their accompanying challenges that ensures the dynamic nature of legislative risk regulation. Competing organizational interests, political pressure and a general decreasing tolerance for accidents also affect how risk is regulated. As a result, several industries have experienced changes in regards to what is believed to be the best practice when regulating risk. This thesis will examine how legal risk regulation is carried for the Norwegian petroleum industry, the Norwegian coal mining industry, and the Russian coal mining industry.

1.1 Benefits of risk regulation

What makes risk regulation interesting is its great potential to provide safe working conditions and avoiding major industrial accidents. The legislative regulation of an industry provides different relevant actors a clear framework for what activities and operations are allowed and encouraged, as well as those deemed illegal or discouraged. This makes up the framework for which all activities aimed at reducing and controlling risks are based on. Regulating risk for an industry through legal measures is necessary when the actors operating within the industry is unable or unwilling to ensure a satisfying level of safety (Hood, Rothstein, & Bladwin, 2001).

What is considered a satisfying level of safety will vary among different relevant actors within each industry. Politicians, employers, employees and the general public may often disagree on what defines an acceptable level of risk is. This highlights the need for governmental involvement and necessitates a legal framework. Legislative risk regulation provides an opportunity to create a legal framework influenced by the different stakeholder’s’ attitude towards risk. The legal framework regulating an industry is often a result of competing interests, for which some will contradict the stakeholders' willingness to allocate resources towards reducing risk levels. Although several organizations state that safety is their number one priority, the organizations are at least as interested in making a profit while delivering their services (HASpod, 2014). However, since the government benefits from a safe *and* financially viable industry, it is often in their interest to develop a risk regulation regime that allows for organizations to make profits while ensuring satisfying levels of safety. This encourages the collaboration between the different relevant actors.

Legislative risk regulation may also function as a way of sharing information and knowledge amongst the actors. The regulators may function as a source of knowledge and competence available for the organizations, and assist them in complying with the regulatory requirements. Further, the organizations may be required to share relevant information concerning their safety related work with the regulators, as well as other organizations operating within the same industry. Some regulators also require the organizations to share this type of information with the general public. This allows for a dialogue between the authorities, employers, employees, and sometimes also the general public. How well this works in practice is highly dependent on the relationship between the different stakeholders and the balance of power (Engen O. A., et al., 2013). However, if the regulation of risk is not carried out in an effective manner, the consequences can be severe. This has been proven several times throughout history. For instance, the Ulyanovskaya Mine disaster (Russia) in 2007 killed more than 100 people, due to a methane gas explosion in an underground coal mine (Mineaccidents.com.au (b), n.d.). The Norwegian petroleum industry also experienced a horrific accident in 1980, when the platform Alexander Kielland capsized, killing 123 people (Smith-Solbakken & Dahle, 2018). Such disasters often lead to major reforms as to how risk is regulated (Engen O. A., et al., 2013). The ramification might be limited to an industry or a country, whilst others will have global repercussions. Disasters with a global impact on the regulation of risk is exemplified by the 9/11- terrorist attacks, where security systems proved to be inadequate and the need for better risk regulation proved necessary (Olsvik, 2015).

Even if those being regulated are complying with the regulations, it might not result in a satisfactory level of safety. There are several explanations as to why this might happen.

Among some of the most common is outdated prescriptive requirements unable to encompass new hazards and risks, or vague legal requirements that cause confusion as to how one is expected to comply (Engen O. A., et al., 2013). If the regulatory system proves inefficient it will be necessary to revise the requirements and the regulatory strategies used. Examining other regulatory regimes might provide the opportunity to learn how other regulated industries deals with similar challenges.

Regulating risk is complicated and is carried out at several different organisational levels, and by different actors. Risk regulation is an activity involving politicians, leaders of organizations, workers, the general public etc. These actors can be said to constitute a regulatory hierarchy in regards to their ability to influence the legal aspects of risk regulation (Engen et al, 2016, p.237). A simplified model of this hierarchy is shown in figure 3 (Leveson, 2011).

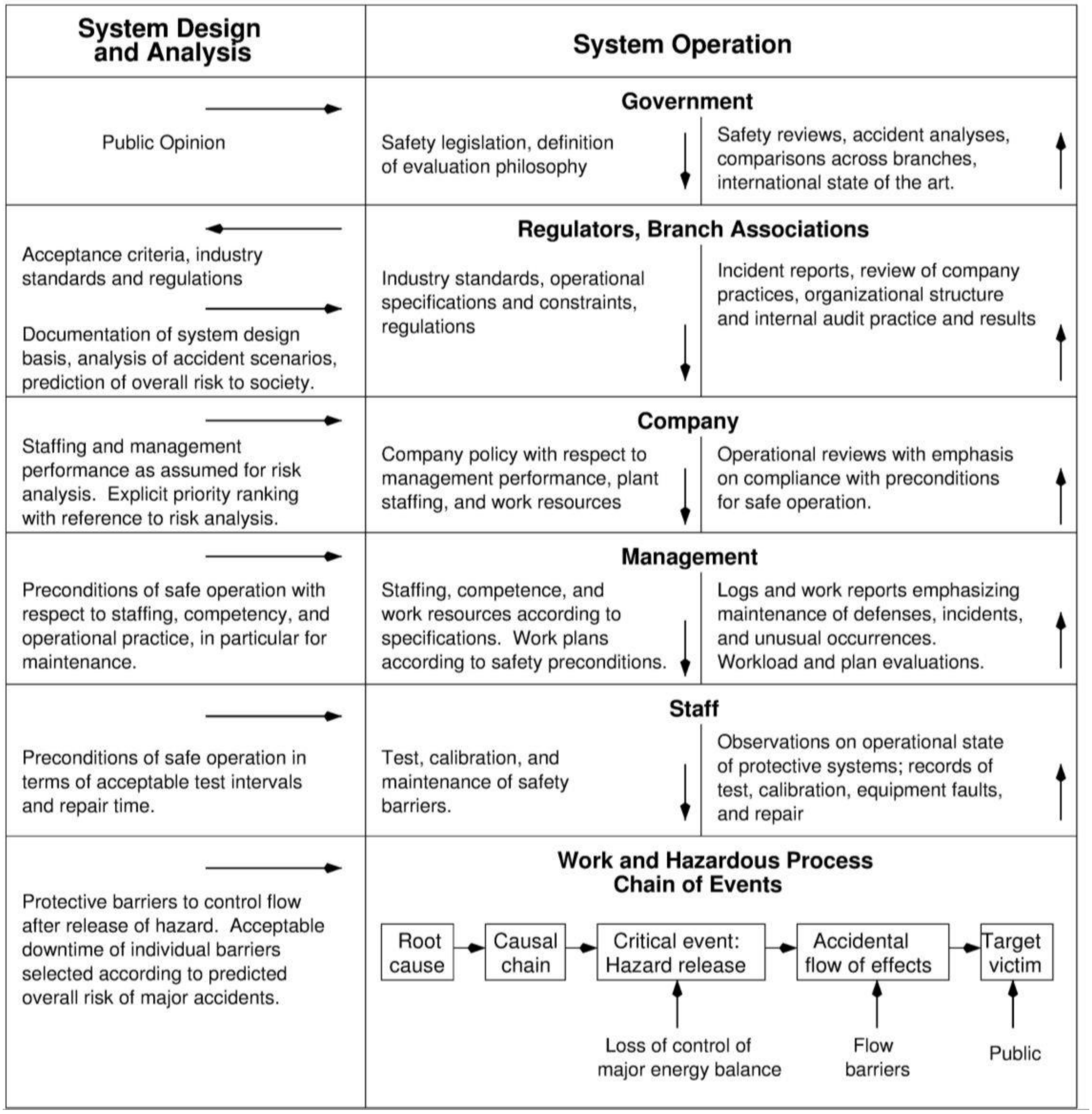

Figure 3: The Rasmussen/ Svedung model of risk management (Leveson, 2011)

The most obvious and well-known form of risk regulation is through legal requirements put forth by the government. As this study focus on the legal aspect of risk regulation, the attention will be given to the two upper parts of the hierarchal model: government and regulators. Further, this thesis will focus on the middle column. As government and regulators ultimately are responsible for developing and enforcing the regulations provided, it is considered natural to focus less on those subjected to the regulations.

Risk regulation regimes are dynamic, but the dynamic nature of risk regulation is not only determined by major accidents, like those mentioned previously. It may also be the result of a gradual shift towards better regulatory strategies that needs time to implement and manifest (Hood et al., 2001, p.168-170). Hence, risk regulation might be considered to be a dynamic system rather than a static framework. As risk regulation regimes are able evolve, it is important that it continues to improve and allow for safer working conditions, and does worsen the current safety levels. It is therefore important to be able to learn what other industries and countries do better than one self regarding risk regulation. This study will serve as an initial phase for learning how different countries and industries are legislatively regulated, with emphasis on similarities and differences between them.

1.2 Norwegian and Russian risk regulation

This thesis is a comparative study of how two different countries regulates the risk in their core industries. Legislative risk regulation of the Norwegian petroleum industry will be compared to legislative risk regulation for the Russian coal mining industry. In addition, the regulation of Norwegian coal mining industry will also be examined. This will allow for examining how an industry is regulated differently in two different countries, as well as if there is a difference as to how risk is regulated for different industries within the same country. It would also be natural to include Russian petroleum industry for this purpose, but to restrict the extent of the study, it has been decided to focus on the Russian coal mining industry. The general outline of the comparative study is illustrated by figure 4.

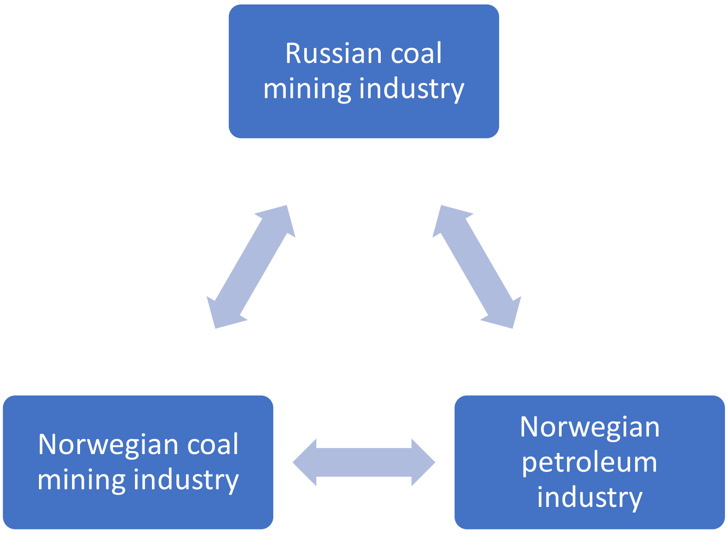

Figure 4: Comparison of risk regulation of different industries

The motivation for studying Norwegian and Russian risk regulating is a newly established collaboration between the Norwegian University of Stavanger and the Russian St. Petersburg Mining Institute. This will allow for both universities to share knowledge and competence, as well as strengthen international connections for both universities. The collaboration is established by University of Stavanger's Department of Risk, Economics and Planning and St. Petersburg Mining Institute's Department of Industrial Safety.

As risk regulation might be very dynamic, the regulatory regime may be experiencing constant change (Rasmussen, 1997). It is therefore of great interest to examine what works well for other countries and industries, as well as what aspects of their risk regulation proves challenging. Hopefully, this study will form a basis for further research on the legislative regulation of risk, and provide a possibility for industries and countries to learn from each other with the intent to ensure safer working conditions, and prevent major industrial accidents.

In order to obtain full insight as to how risk is regulated in practice it would be necessary to examine how all involved actors are regulated and how they comply with the imposed requirements. This would be a very extensive exercise and is deemed to comprehensive for this study. In order to delimit the scope of the study, only the legislative aspect of risk regulation will be examined. This will greatly reduce the workload, but will also lead to the loss of a holistic view of how risk regulation affects the work of ensuring acceptable levels of risk. As a consequence, the main emphasis will be relevant laws and legal regulations put forth by the regulators. It is however important to emphasise that risk regulation is much more than legal requirements and governmental supervision.

1.3 Why Russian coal mining and Norwegian coal mining and petroleum?

As mentioned, this study will focus on Russian coal mining industry, Norwegian petroleum industry and the Norwegian coal mining industry. Coal mining is a core industry in Russia. Similarly, petroleum constitutes a core industry in Norway. Major industries are considered interesting as these (often) are subjected to extensive regulation. Another interesting aspect of the industries is that they both carry the potential of major industrial accidents. Hence, it is considered very likely that the risk regulation of these industries is granted comprehensive attention by the government. In contrast to Russian coal mining industry and Norwegian petroleum industry, the Norwegian coal mining industry is a small industry. All coal mining activity in Norway is located on the archipelago Svalbard north of the Norwegian main land. As of June 2018, there was only one Russian and one Norwegian coal mining company producing coal in Norway. By including this small industry, it is possible to compare how two different countries regulates the same industry. If further allows for comparing how a country regulate different industries.

1.4 Problem

As mentioned, the purpose of this study is to compare the legislative risk regulation of the Russian coal mining industry and the Norwegian petroleum and coal mining industry. The focus will be to uncover similarities and differences in way this is carried out. These shall be revealed through a comparative study.

The problem is as follows:

> ***"What similarities and differences are found in how legislative risk regulation is carried out for the Norwegian petroleum industry, the Norwegian coal mining industry and the Russian coal mining industry, and what practical implications does these have?"***

In order to answer the problem presented above relevant legislative documents will be examined. This includes laws and regulations regulating risk within each industry. Given the empirical basis of this study, this study will be based on a document analysis. The majority of all findings will be based on the legal documents, but will be complemented by scientific literature in order to better understand their implications.

As legislative risk regulation is very comprehensive, this thesis will focus on certain criteria that are believed to be of great importance when regulating risk. For instance, the use of prescriptive and performance based requirements will be special attention. Further, it is of interest to uncover to what degree enforced self-regulation is used as a regulatory strategy by the regulators. Requirements regarding safety management systems will also be studied. These criteria will be explained in chapter 3.

In an effort to make this study more manageable, it has been decided to exclude several interesting aspects regarding risk regulation. For instance, the involvement of employers and employees during the development of the regulations are not included in this thesis. Nor is the power distribution between regulators, employers and employees. How employers and employees comply to requirements put forth by regulators is also not examined. Hence, internal requirements and procedures established by organizations to self-regulate risks will not be given any attention. Industry standards, meant to comply with the regulations, are also not examined in this study. These are all important aspects of risk regulation and must be examined in order to obtain a complete overview of how risk regulation is carried out in practice. It is therefore not possible to draw conclusions about how well an industry is regulated by merely scrutinizing the legal requirements put forth by the government. However, the legislative framework put forth by the legal documents will be paramount to how an entire industry manages risks.

The study will be further delineated by focusing on key challenges for each industry. For the coal mining industry, the focus will be ventilation of underground mines, whereas drilling and well activities will be examined for the petroleum industry. These are challenges that has caused major industrial accidents in the past, and still poses a major risk today.

1.5 Structure of thesis

The next chapter will provide some insight into the industries examined in this thesis. The chapter will give the industries some national and international context regarding their past and future importance regarding finance and industrial safety. Next, chapter 3 will provide a theoretical basis used for answering the problem presented in chapter 1.4. Relevant theories regarding risk regulation will be presented to better understand the findings from the document analysis. The regulatory criteria given special attention in this study will also be explained. Chapter 4 will present the scientific methods used for carrying out the document analysis. In addition, a brief discussion on the strengths and weaknesses of the chosen methods will be presented. Chapter 5 presents the findings on how the different industries are regulated, followed by a presentation of the results and a discussion of these in chapter 6. Finally, the conclusions based on the analysis and the discussion will be presented in chapter 7.

2 Background

In order to give some insight into the industries being examined for this study, this chapter will provide some key facts about the Russian coal mining industry and the Norwegian coal mining and petroleum industry. The industries position in a global and national perspective will be presented in order to examine how important these industries are to the national and global energy market. Facts such as proven reserves, production, consumption and export will help compare the industries to each other. In addition, statistics on accidents will *indicate* the effectiveness of the regulatory regimes. However, assessing a risk regulation regime solely on statistics is obviously not an adequate assessment, given that risk is something that concerns future events. It does however give some insight as to how the regulatory regimes has performed in the past. It is also of interest to examine what types of hazards and risks each industry is facing.

2.1 Global coal mining industry

Coal is a fossil fuel that has been used by humans for thousands of years. Archaeological evidence indicates its use as far back as the Bronze Age, in Wales. The industrial revolution marked a turning point for the European coal mining industry. Coal was then used for iron production, powering steam engines and the production of chemicals. It is estimated that the coal production increased by 50% between 1700 and 1750, and another 100% between 1750 and 1800. As steam power made its mark on the industrialized Europe, the production of coal had increased by 500% by 1850 (Wilde, 2018).

Since then, coal production has almost exclusively increased. In 2016 the global coal production was approximately 3316 million tonnes, with around 90% of the total coal production being mined by the seven leading coal mining countries (China, USA, Australia, India, South Africa, Russia and Indonesia) (Kazanin & Rudakov, The Highlights of the Coal Industry Development Aimed at Achieving Sustainable Development Goals, 2018). Today, coal is primarily being used for generating electricity and heating. Coal may also be used to produce more than 130 chemical semi-products, which further allows for the production of more than 5000 other types of products and goods (Kazanin & Rudakov, The Highlights of the Coal Industry Development Aimed at Achieving Sustainable Development Goals, 2018). For instance, coal is used in the production of a wide range of chemical fertilizers, alloys, and the production of methanol and carbon monoxide. Today, coal covers 30% of the global energy consumption (World Energy Council, 2016).

Table 1 provides some key facts about the global coal industry (BP, 2017).

Global proven coal reserves	1,003,373 million ton
Global coal production	3,316 million ton
Global coal consumption	3,385 million ton

Table 1: Key facts for global coal industry

The coal industry directly employs more than 7 million people globally (Kazanin & Rudakov, 2018). Given that 90% of all coal was produced by seven leading countries, coal mining constitutes huge industries in a few number of countries. More than 50 countries produce coal commercially and coal is used commercially in more than 70 countries (The World Coal Institute, 2004). Coal is not subjected to international transportation to the same degree as oil and gas. This is partially shown by table 2 showing the world's leading coal producers and their respective coal consumption.

Country	**Production (mill. tonne)**	**Consumption (mill. Tonne)**
China	1,685.7	1,887.6
USA	364.8	358.4
Australia	299.3	43.8
India	288.5	411.9
Indonesia	255.7	62.7
Russia	192.8	87.3
South Africa	142.4	85.1
Total	3,299.2 (90%)	2,936.8 (79%)

Table 2: Leading coal producing countries and their coal consumption (BP, 2017)

There are two main techniques to extract coal from the ground: open cast mining and underground mining. Open cast mining is a technique used when the coal is found near the surface (thin overburden). The overburden is removed, and the coal is drilled and/ or fractured, and transported to a coal preparation plant or directly to where it is being used. The second technique is called underground mining. Underground mining means that the overburden is not removed, but the coal is reached by either going into or under the overburden. This method is often chosen when the cost of removing the overburden is higher than opting for an underground mine. Underground mines are more complicated and challenging compared to open cast mines. They require more specialized equipment, the extraction process is slower and there are numerous hazards that does not exist for open cast mining. As this thesis focus on underground mines, it is the regulation of risks associated with these types of mines that will be studied.

The following will give a brief presentation of some of the biggest hazards that are associated with underground mining. How these are handled will not be discussed at length, as managing these hazards involves technical equipment and often very advanced methods. Below is a list of some of the most prominent hazards faced when conducting underground coal mining. These hazards have caused major industrial accidents in the past and is still considered areas of importance to the mining industry today. The following list of hazards is not exhaustive, but includes the most significant hazards for the global mining industry.

Hazards associated with underground coal mining:

- Gas explosion
- Dust explosion
- Sudden rock, gas and/ or coal outburst
- Rockburst
- Breakthrough of water to the underground workings

Gas explosion

In practical terms, gas explosions mean methane gas explosions. Due to little or no natural ventilation in underground mines, there is an increased possibility of methane gas concentration build-up. Coal will, to a varying degree, contain methane gas. This gas is released when the coal is produced, and has the possibility to form an explosive atmosphere within the mine. If the concentration of a methane-air mixture is between 5-15% the mixture is flammable and has the potential cause an explosion if ignited. Methane gas is also an asphyxiant, but the concentration of methane must be much higher than the flammability levels in order to be suffocating. Hence, it is often the potential of an explosion that is considered most critical (Donoghue, 2004). The risk of methane gas explosion has existed as long as underground coal mines. Today the methane is detected using gas detectors and removed using ventilation systems. In 2006 a methane explosion, at a depth of 1030 meters below the surface, killed 23 miners in Poland. The mine was at the time closed due to high methane concentration, but miners were attempting to retrieve valuable equipment from a tunnel within the mine when the explosion occurred (Wikipedia, 2018a).

Dust explosion

As coal is being produced through crushing, grinding and pulverization, coal dust is also produced. This coal dust is combustible and has the potential to cause an explosion if suspended in air. If inhaled it may also cause respiratory problems for the miners. It is therefore of importance to ensure that the level of coal dust is kept at a safe level. One way of combating dangerous levels of coal dust is to spraying water on the coal being produced as well as mixing water mist with the air within the mine. A coal dust explosion killed 458 workers in 1963, when a tunnel in a mine in Fukuoka, Japan exploded (Nakao, n.d.).

Sudden outburst of gas, rock and coal

Sudden outburst is defined as a spontaneous ejection of gas, coal and rock. The severity of such outburst varies greatly, but has the potential to cause devastating accidents. Outbursts has the potential of filling the mine with an explosive gas mixture, as well as rock and coal hitting the workers within the mine. The associated gases are usually carbon dioxide, methane and/ or nitrogen, meaning that the workers might be exposed to an explosive and suffocating atmosphere (Underground Coal, n.d.). There are several factors determining the possibility of outburst, including stress regime, gas content and geological disturbances. Outburst may be prevented by controlling these factors, such as reducing the gas content of the coal (Lama & Bodziony, 1998). In 1991 three workers died of asphyxiation due to gas being released during an outburst in South Bulli Colliery, Australia (Mineaccidents.com.au (a), n.d.).

Rockburts

A rockburst is a spontaneous and violent fracture of rock, causing parts of the mine to collapse (Duo, Lu, Mu, & Gao, 2009). The collapsing rock mass has the potential of killing workers, damage equipment and harm the structural integrity of the rest of the mine. As for sudden outburst, the likelihood of rockburst is determined by several factors, the most crucial factor being the in-situ stresses of the formation being mined. Rockburst may be managed by determining these stresses and support the roof and walls of the mine accordingly. The use of pillars prevents gravity-induced rockfalls, while reducing the amount of seismic stress in the mine might prevent damaging walls as well as floors. Rockburst killed six workers as recent as April 2018 when the roof of a coal mine in Georgia collapsed (Reuters, 2018).

Breakthrough of water

If water enters an underground mine it can lead to catastrophic consequences. As some underground mines are stretches several hundred meters beneath the surface, a flooding of the mine could drown those located inside it. Water might enter the mine due to water from the surface reaching the mine or if aquifer enters the mine. In order to prevent the breakthrough of water it is important to keep maps that are up to date, find the aquifer using seismic, and design the mine so that surface water does not enter. In 1924 41 workers were killed when Milford mine in Minnesota, United States were filled with water from a nearby lake (Wikipedia, 2016).

The hazards mentioned above are especially important to take into account when dealing with underground coal mines. Reduced or missing natural ventilation, the possibility of collapsing roofs and the increased emergency escape time all make underground mining more hazardous compared to open cast mining. This is supported by accident statistics going back several decades.

2.2 Russian coal mining industry

Russia holds one of the largest proven coal reserves in the world. As of 2016 Russia had 145 billion ton coal, or approximately 14% of the proven global coal reserves, hence ranking third in the world, only after the United States and China (BP, 2017). The same year the Russian coal production amounted to 385,7 million ton (Kazanin & Rudakov, The Highlights of the Coal Industry Development Aimed at Achieving Sustainable Development Goals, 2018). The Russian coal consumption in 2016 was 197,5 million ton (Analytical Center for the Government of the Russian Federation, 2016). In 2012 coal made up 17,3% of the Russian total primary energy supply and 15,7% of all generated electricity (IEA, 2015). More than 62% of the coal consumption is used for generating electricity (IEA, 2015).

Most of Russia’s coal reserves and production is located in Siberia and the Far East (see figure 5) (IEA, 2015). Consequently, the coal must be transported great distances in order to reach the international market. Russia is the third largest coal exporter, behind Australia and Indonesia, meaning they play a paramount role within the global coal supply market (IEA, 2015). Hence, it is important that they are able to transport coal in an effective manner in order to be able to sell the coal for competitive prices. Coal transportation is mainly by carried out by trains, which is considered to be a bottleneck for the Russian coal export. Hence, Russian coal production is more sensitive to coal prices compared to other major coal producing countries (IEA, 2015). In 2013 Russia exported 143 million ton coal, of which 70% ended up in the Atlantic market (IEA, 2015). Russia is the largest external exporter of coal to the European Union (IEA, 2015). However, the majority of all coal produced is consumed domestically.

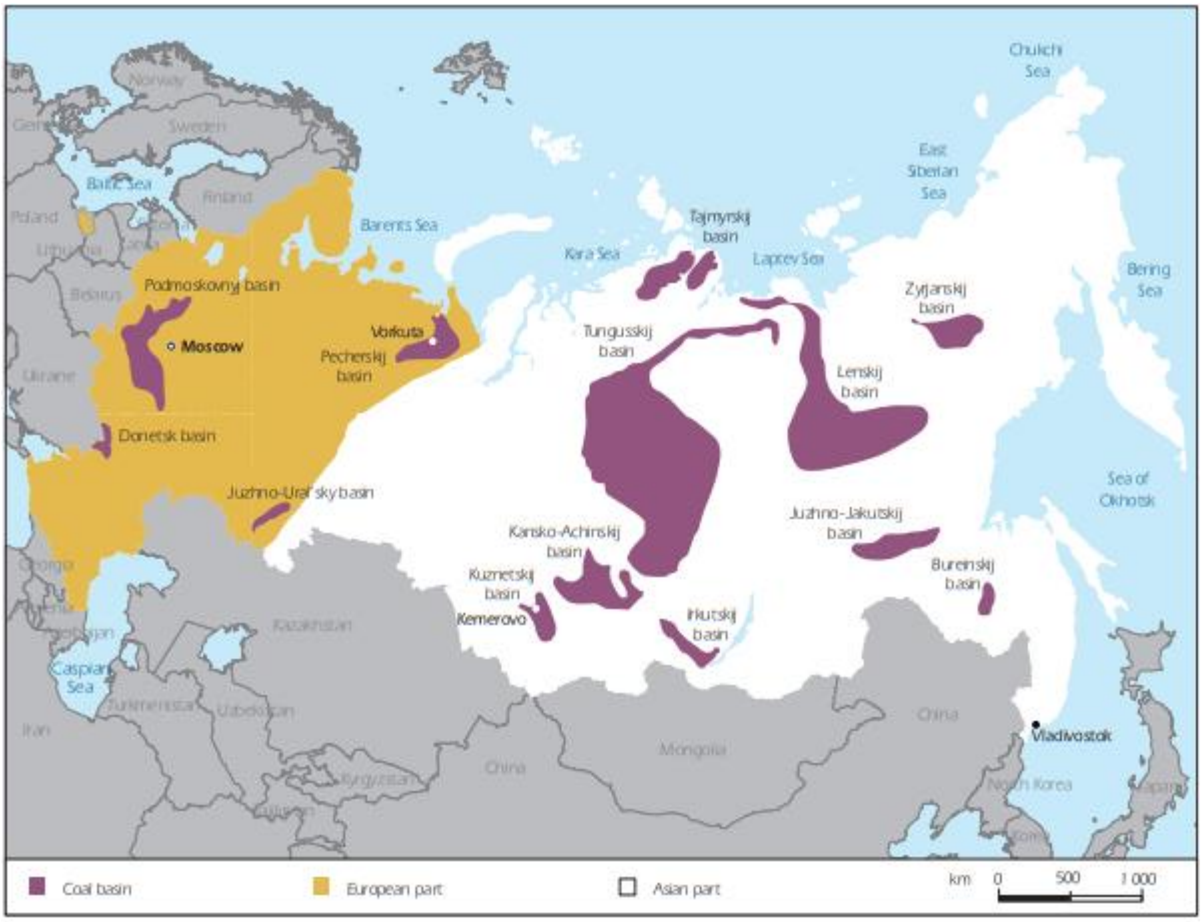

Figure 5: Location of Russian coal reserves, (IEA, 2015)

According to Kazanin & Rudakov (2018) more than 153,000 jobs are directly connected to the Russian coal industry (out of 64 million workers in Russia 2003 (Dudarev, Karanachev, & Odland, 2013)). Combined with the quantities produced, this means that the coal industry is of great importance for the Russian economy. This is for instance reflected by the research and development focusing on improving methods for producing coal in a safe and effective manner (Yuan, 2018).

Since the 1990's, Russian coal industry has been subjected to privatization. Up until then, the industry was state-owned and faced challenges such as the lack of modern mining equipment, exposure to the open market and a skilled workforce (IEA, 2015).Starting in the 90's, these challenges have been addressed, making today's Russian coal mining industry an important part of both the Russian and global energy sector.

Although the coal industry experienced a modernization during the 90's, the industry still faces some serious challenges regarding industrial safety (IEA, 2015). Between 2005 and 2016 there were recorded an average of 73 fatalities per year related to coal mining accidents (Kazanin & Rudakov, 2018). However, it is reported that the individual risk of an employee's death in the coal mining industry has decreased by a factor of 2.5 over the same period (Kazanin & Rudakov, 2018). As of 2016, the dominating cause of major industrial accidents in coal mines is due to methane gas explosions, accounting for 50% of all accidents. Kazanin & Rudakov (2018) also report that there are large variations in individual risk of death depending on what mine the employees work in. In 2007, the Ulyanovskaya Coal Mine had an individual risk of death of $9,1*10^{-3}$, whilst in 2016 the Severnaya Coal Mine had an individual risk of death of $1,7*10^{-3}$ (Kazanin & Rudakov, The Highlights of the Coal Industry Development Aimed at Achieving Sustainable Development Goals, 2018). It is important to mention that the former mine experienced an accident in 2007 killing 108 people, while an accident in the Severnaya Coal Mine in 2016 killed 36 people. Accident statistics for the Russian coal mining industry is given by figure 6.

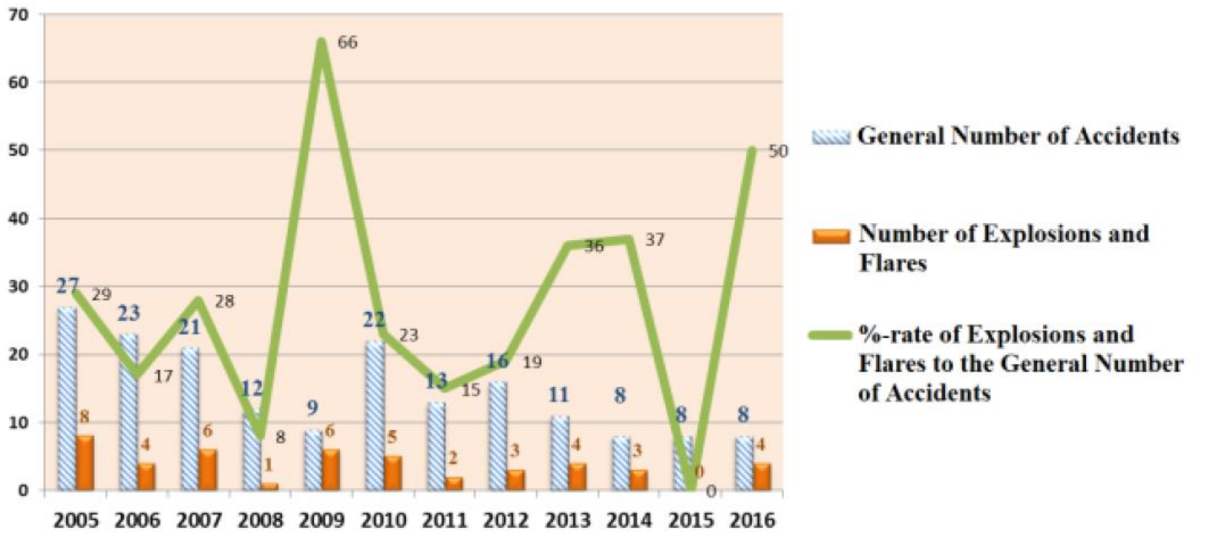

Figure 6: Accident statistics for Russian coal mining industry (Kazanin & Rudakov, 2018)

IEA (2015) reports that there were 0.48 fatal accidents per million ton produced coal in 2010. In 2012 there were reported 0.15 fatal accidents per million ton produced coal (Russia?) (IEA, 2015). Kazanin & Rudakov (2018) also mention that, despite the decreasing number of accidents and fatalities, the Russian numbers keeps exceeding those of the European Union.

According to IEA (2015), this is partially due to the lack of a skilled workforce in uninhabited areas, scarce investment in infrastructure and frequent shortage of modern mining equipment.

It is further worth mentioning that 109 out of 327 Russian coal mines are underground mines, constituting almost 30% of the total Russian coal production (Kazanin, 2012). As described in the previous sub-chapter, this greatly affect the what types of hazards the Russian coal mining industry faces. The fact that underground mining is more hazardous than open cast mining is illustrated by figure 7.

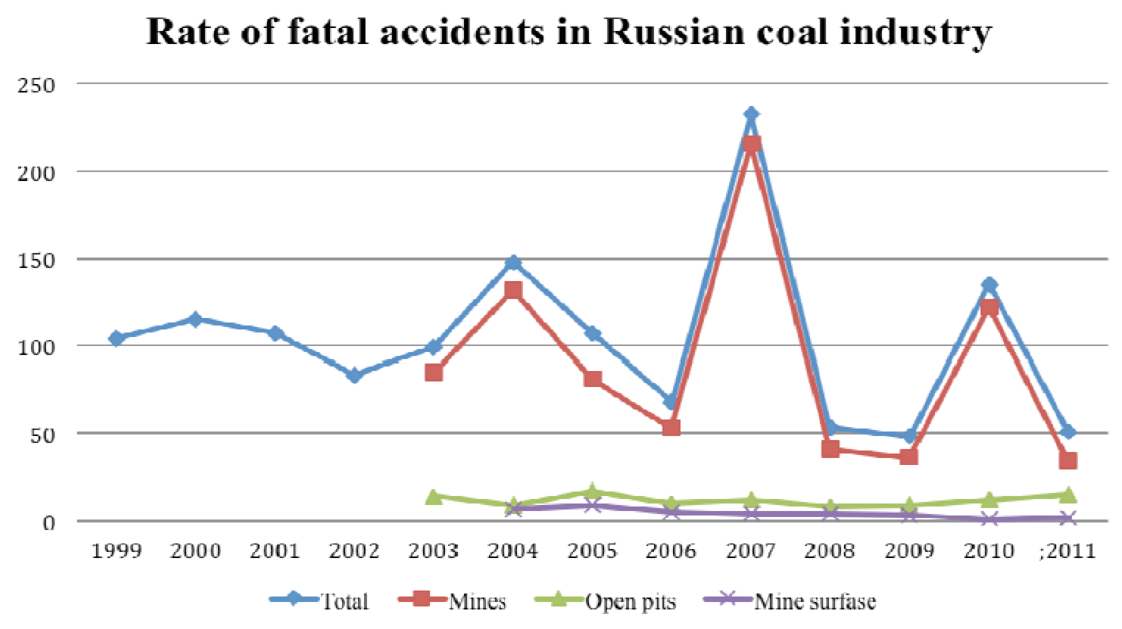

Figure 7: Rate of fatal accidents in Russian coal mining industry (Kazanin, 2012)

The increased fatality rates in 2004, 2007 and 2010 are due to a few numbers of accidents, killing 46 and 13 workers in 2004, 108 and 36 in 2007, and 66 workers in 2010 (Reuters, 2010). It should be mentioned that the statistics presented in figure 7 above does not mention if these fatalities are caused by any of the hazards listed in chapter 2.1, or diseases or other causes. However, it is safe to say that the Russian mining industry has the potential of lowering the number of fatalities.

2.3 Norwegian coal mining industry

The entire Norwegian coal mining industry is located on Spitsbergen, an island 960 km north of the Norwegian mainland (IEA, 2017).The production of coal dates back to 1900 and has, with the exception of World War 2, been continuous ever since (Spitsbergen Travel, n.d.). While Russia, in 2016, accounted for more than 11% of the world's coal production, the Norwegian coal production was significantly smaller. In 2016 the total coal production amounted to 1.2 million ton, or 0,033% of the global coal production (IEA, 2017). The majority is produced by the state-owned company Store Norske Spitsbergen Kulkompani. There is also a Russian state-owned company, Trust Artikugol, producing approximately 0,1 million ton per year (Wikipedia, 2018b). Both Trust Artikugol and Store Norske Spitsbergen Kulkompani only produce coal from underground mines.

The coal produced on Spitsbergen is mainly exported, but roughly 30,000 tons are used for generating electricity at Norway's only coal-fired power plant, located in Longyearbyen, Spitsbergen. The coal mined on Spitsbergen is considered to be of high quality and is heavily used by for making alloys. Since the island of Spitsbergen is located between 76° and 81° north the island is covered by pack ice, with the exception of the summer season. Hence, this is the only time of year export of coal is possible (IEA, 2017).

The coal mining activity on Spitsbergen has decreased significantly the past few years. Store Norske Spitsbergen Kulkompani have been forced to suspend their production from one of their two mines as of 2017, and is now only left with the mine Gruve 7 as their only producing mine. Also, Trust Artikugol's coal mine in Barentsburg is producing barley half the amount of coal compared to previous years.

It has proven unsuccessful to find any official accident statistics for the Norwegian coal mining industry. However, that does not mean the Norwegian coal industry has not experienced fatal accidents. A news article written by NRK states that 51 workers has died working in Norwegian coal mines between 1989 and 2005 (Mogård, 2005). The fatalities are spread by 24 separate accidents, where 45 out of the 51 people killed were working in Russian mines. One of the accidents, caused by an explosion, killed 23 workers in a Russian mine in 1997, marking one of the most severe mining catastrophes in Norwegian mining history. Another well-known mining accident is called the King's Bay Accident. In 1962 21 workers were killed due to an explosion in Ny-Ålesund. This was one of several accidents that hit the mine, which has claimed the lives of 71 people in the period 1948-1962. The political ramification due to these accidents brought down the government of former prime minister Einar Gerhardsen in 1963 (Wikipedia, 2017). The latest fatal accident occurred in 2013 when a Russian miner was killed in Barentsburg (Strøm, 2013).

It has not proven successful in finding any accident statistics comparing the Norwegian and Russian coal mining industry. it is therefore difficult to quantify the risk levels for the two countries. The Norwegian Labour Inspectorate Authority did not have any available statistics regarding fatalities in the Norwegian coal mining industry.

2.4 Global petroleum industry

Just like coal, petroleum has been used since ancient times. In the beginning, crude oil was used for heating, lighting and warfare (Wikipedia, 2018c). In more recent time it has allowed for the development of combustible engines, commercial aviation, production of plastic, as well as the generation of electricity (EIA, 2017).

Many consider 1858 to mark the beginning of the oil era, as James Miller drilled the first commercial oil well. However, the first large-scale oil production didn't start until 1901, when Lučić and Patillo struck oil in Beaumont, Texas (Wikipedia, 2018d). The commercialization of crude oil revolutionized the global energy market, and in 2016 crude oil covered 33% of the global energy consumption, while natural gas covered 24% (BP, 2017). With the addition of coal, more than 80% of the global energy consumption is covered by fossil fuels. As seen from figure 8, the use of oil and natural gas has increased since its commercial introduction in the beginning of the 20^{th} century.

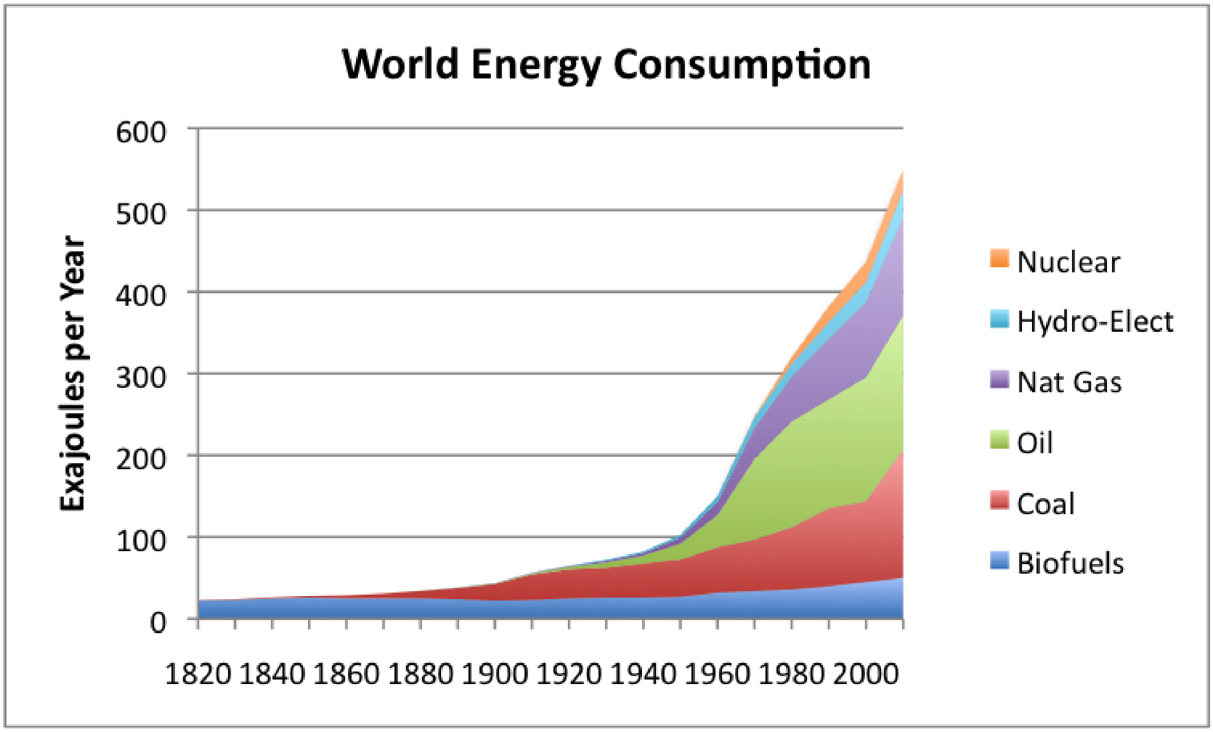

Figure 8: Global energy consumption (Tverberg, 2018)

Today, oil and natural gas is both produced and consumed all over the world. Table 3 presents some key facts about the global petroleum industry as of 2016, whereas table 4 lists the largest oil and gas producing countries in the world for December 2016.

	Oil (billion bbl)	Natural gas (billion Sm^3)
Proven reserves	1706.7	186,600
Production	33.6	3551.6
Consumption	35.2	3542.9

Table 3: Key numbers for global petroleum industry (BP, 2017)

Rank	Country	Production (Thousand Barrel/day)
1.	United States	12,123
2.	Russia	11,098
3.	Saudi Arabia	10,465
4.	Iraq	4,891
5.	Canada	4,859

Table 4: Oil and natural gas production Dec. 2016 (JODI, n.d.)

The petroleum industry has for several decades been responsible for creating millions of jobs around the world, pushing countries economic development and ensuring citizens' welfare. However, these benefits do have their price. Petroleum resources has been the root cause for several wars, like Chaco War in the 1930's, the Nigerian Civil War spanning from 1967 to 1970, and the Heglig War between Sudan and South-Sudan in 2012 (Wikipedia, 2018e). This goes to show just how important petroleum is for countries around the world.

The petroleum industry has also experienced several major industrial accidents. These accidents include blowouts, exploding oil refineries and sinking oil tankers. Not only may such accidents be fatal, but also has a great potential of causing serious damage to the natural environment. Especially offshore installations, such as producing platforms, pose a threat to the environment. Major oil spills reaching the ocean has proved devastating in the past. The Deepwater Horizon drilling rig explosion in the Gulf of Mexico in 2010, killed 11 workers and caused an oil spill of upwards of 4.2 million barrels over a period of 87 days (The New Orleans Sun, 2014). The oil spill endangered more than 400 species of wildlife and destroyed the fishing grounds for thousands of fishing vessels (CBS News, 2010). This specific accident had a huge impact on how the American petroleum industry regulated risk, leading to stricter requirements regarding safety equipment used when drilling offshore in America (Visser, 2011). The Deep Water Horizon also had ramifications outside of America. The Norwegian Petroleum Safety Agency (PSA) launched their own investigation in 2010 in order to learn as much as possible from the accident (Petroleumstilsynet, 2012).

The petroleum industry faces several challenges regarding major industrial accidents. As this thesis will focus on the drilling and well activities, the following will present associated challenges to these activities. Hence, hazards will mainly be related to formation fluid and equipment located on the seabed or downhole. The hazards will not be as diverse as those regarding underground coal mining.

The most serious hazard during drilling and well activities are the uncontrolled release of formation fluids, called a blowout. As mentioned, there has been numerous blowouts all over the world for as long as people have been drilling for, and producing, oil and gas. In the early oil era a blowout was a wishful sight, representing big financial gains. However, as technology improved, a blowout represented a serious danger to both workers and the environment. The largest blowout in history is called the Lakeview Gusher. This was the uncontrolled release of oil in Kern County, California, United States between 1910 to 1911, that over an 18-month period released over 9 million barrels of crude oil (Wikipedia, 2018f). This blowout did not lead to any fatalities. Also, the environmental impact was limited as the well was located on land. The most fatal blowout in history is said to be that of the Enchova Central off the coast of Rio de Janeiro, Brazil in 1988. The blowout, and the following evacuation and fire, killed 42 people (Oil Rig Disasters, n.d.).

A blowout may occur during the drilling phase, well testing, well completion, production phase or during well workover activities. In order to prevent blowouts from occurring, there has been developed several technical barriers that are widely used today. Blowout preventers, different types of valves and relief wells are some of the most common barriers used today.

2.5 Norwegian petroleum industry

For almost 50 years petroleum has been a crucial industry in Norway. The Ekofisk field was the first oil and gas field to start production in the Norwegian sector of the North Sea in 1971. Since then, the number of fields on the Norwegian Continental Shelf has increased to 107 (Ryggvik & Smith-Solbakken, 2018). As of March 2018, 66 fields are still active, extending from the Hod field in the southern part of the North Sea to the Goliat field in the Barents Sea. Figure 9 show the location of Norwegian oil fields.

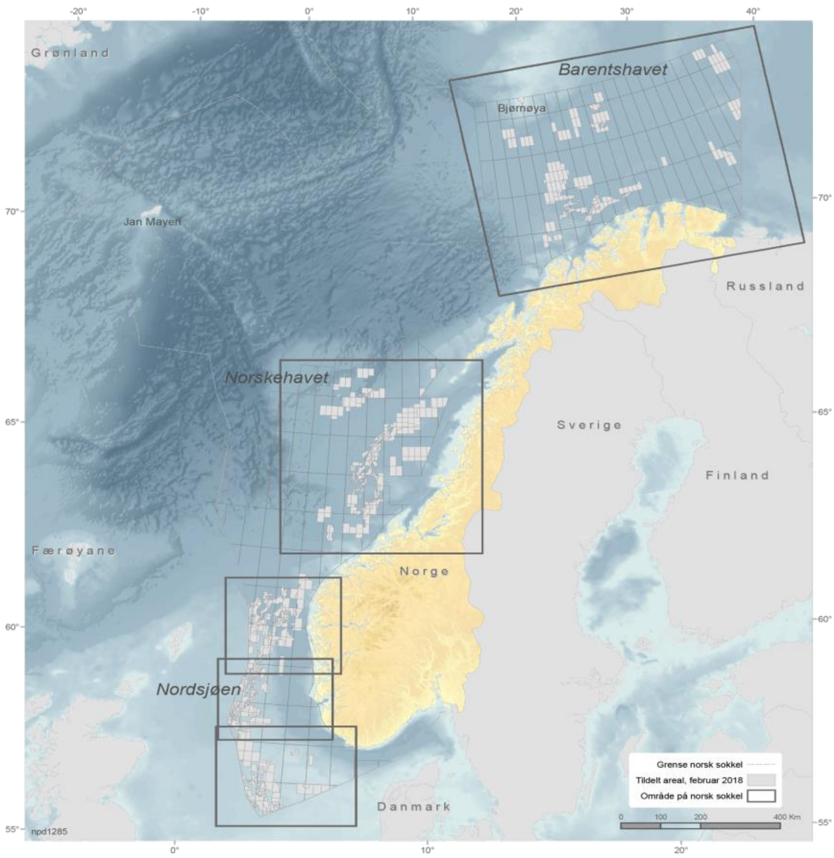

Figure 9: Norwegian oil and gas fields (Norsk Peroleum, 2018)

Figure 10 shows the production profile of the Norwegian petroleum industry since its beginning in 1971.

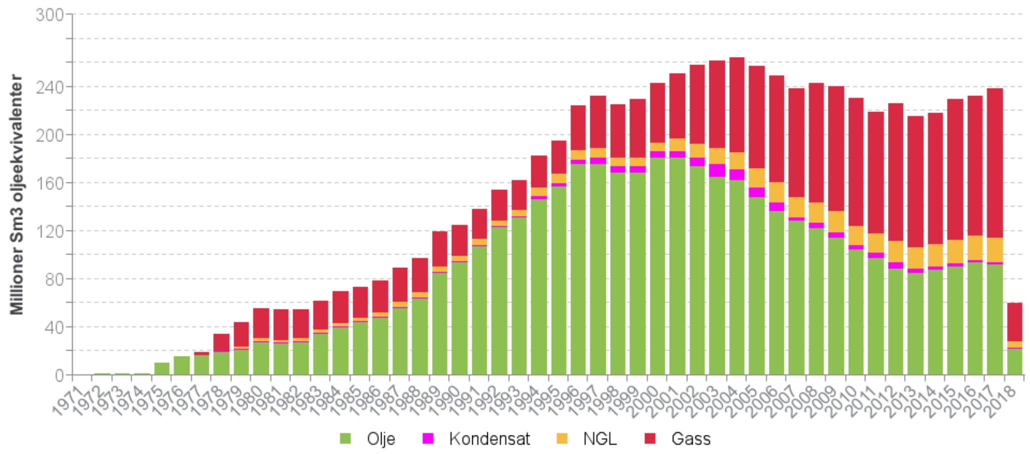

Figure 10: Production profile for Norwegian petroleum industry, green marks oil, purple condensate, yellow is natural gas liquids, and red is natural gas (Norsk Petroleum, 2018)

As of 2016, Norway ranks as the 15th largest producer of oil in the world with a yearly production of 94 million Sm^3 oil equivalents (Norsk Petroleum , 2018). The same year Norway produced a total of 117 million Sm^3 oil equivalents of gas, ranking as the world's 7th largest natural gas producer. Although Norwegian oil production only constituted 2% of the global crude oil production, Norway is a major natural gas exporter. In 2016, Norway was the third largest exporter of natural gas, covering 25% of the European Union's natural gas demand (Norsk Petroleum, 2018). Petroleum constitutes approximately 50% of the value of Norwegian export of goods, amounting to $55.2 billion in 2017 (Norsk Petroleum , 2018). As of 2017, more than 170,000, either directly or indirectly, are employed by the petroleum industry. This is approximately 6% of the Norwegian workforce (Norsk Petroleum, 2018).

Although proven reserves vary greatly as new fields are found or initial assessments are adjusted, Norway has a proven oil reserve of 6.6 billion barrels (ranking 21st) and a proven gas reserve of 1.856 trillion Sm^3 (ranking 15th) as of 2016 (BP, 2017).

As mentioned in chapter 2.4, the petroleum industry has experienced some major industrial accidents. Some of the most severe accidents has occurred on the Norwegian Continental Shelf. In 1980, the platform Alexander L. Kielland capsized killing 123 people, making it the second most fatal accident in the petroleum industry. The most fatal accident occurred off the coast the UK in 1988 when a gas leak on the Piper Alpha platform caught fire killing 167 people. Norway has not experienced any major blowouts as of June 2018.

Since the beginning of the Norwegian petroleum industry in 1967, 284 people have been killed. Table 5 shows how these fatalities are distributed among different types of offshore activities.

Activity	Number of fatalities	% of fatalities
Production facility	33	11.6%
Accommodation unit/ Flotel	123	43.3%
Mobile units	26	9.2%
Diving	14	4.9%
Helicopter	59	20.8%
Vessels	26	9.2%
Pipelaying vessels	2	0.7%
Shuttle tanker	1	0.4%
Total	284	100%

Table 5: Fatalities in Norwegian petroleum industry for different types of activities (Petroleumstilsynet, 2017)

As seen from table 5, the Alexander L. Kielland accident in 1980 constitutes almost half of all fatalities in Norwegian petroleum industry. Figure 11 shows how the fatal accident rate (FAR) has developed from the 1990 to 2017. The FAR-value is the number of fatalities per 100 million working hours and is often used to assess the risk of fatal accidents. This number does not only indicate the risk of major industrial accidents, but also includes the risk of minor fatal accidents that are not regarded as industrial accidents.

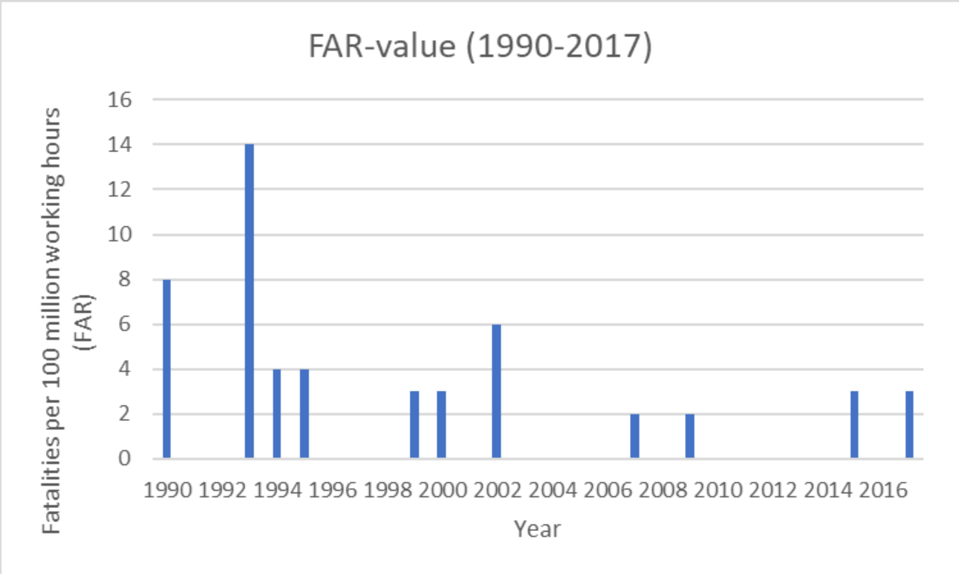

Figure 11: FAR-value for Norwegian petroleum industry (1990-2017) (Petroleumstilsynet, 2017)

As seen from figure 11, the FAR-value ranges from 0 to 14. Between 1990 and 2017 there has been 16 fatalities during more than 959 million working hours, yielding an average FAR-value of 1.7 (Petroleumstilsynet, 2017). However, if the period is split between 1990-1999 and 2000-2017, there is a significant difference. During the 90's the FAR-value was 3.3, but since the 00's the FAR-value has been reduced by more than one third, to 1.02 fatalities for every hundred million working hours. Although FAR-values does not give an accurate representation of the risk level for the Norwegian petroleum industry, it does provide a good indicator risk levels for working on the Norwegian Continental Shelf.

According to reports by the PSA, there has not been any major industrial accidents in the Norwegian petroleum industry since 1997 when a helicopter crashed killing 12 people. In 2016 there was another accident involving a helicopter transporting workers to an offshore installation that crashed. This accident is however not included in the PSA statistics.

3 Theory

The following chapter will form a theoretical basis for scrutinizing the legal documents forming the legal framework for risk regulation of the Norwegian petroleum iand coal mining industry and the Russian coal mining industry. It will also form a basis for the discussion of these findings in chapter 6. The theoretic field of risk regulation is vast. It is therefore necessary to focus on central parts of the existing literature in order to restrict the theoretical basis which this thesis will be based on. Consequently, several interesting similarities and differences as to how the industries are regulated will not be uncovered. The restriction of the theoretical basis for this thesis will however allow for a deeper, and more thorough examination of the legal documents. What is considered to be central aspects of legislative risk regulation is based on a rather extensive literature study, where leading authors in the field of regulation has been reviewed. These are authors that have often been referred to by scientific books and articles, and other master's and doctoral theses on the issue of risk regulation.

3.1 What is regulation

Baldwin & Cave (1999) list three different concepts regarding regulation. The first concept describes regulation as a specific set of commands. Regulation involves the development and enforcement of a binding set of rules being applied by a competent authority or regulator. Thinking of regulation as only a set of binding rules might be practical in some cases, but for other cases might be too simplistic. Hence, the second concept further expands the meaning of regulation to include all deliberate ways the state influences industrial and social behaviour. According to Baldwin & Cave (1999) this concept of regulation would encompass the so-called *command-based regimes*, as well as taxes or subsidies, and deployment of resources. The third concept described by Baldwin & Cave (1999, p.2) is said to be: "All forms of social control or influence". This concept includes all mechanisms affecting industrial or social behaviour. These might be intentional or unintentional, state-derived or from other sources. Hence, regulation can be regarded as all activities and interactions controlling or modifying the behaviour ranging from individuals to entire industry sectors. As this thesis focuses on legislative risk regulation, the first and second concept mentioned above is considered to be the most practical understanding of regulation.

Baldwin & Cave (1999) further distinguish between "red-light" and "green-light" concepts of regulation. The "red-light" concept regards regulation as activities restricting behaviour and prevents specific unwanted activities. Oppositely, the "green-light" concept focuses on how desired behaviour and activities are encouraged and facilitated. Although not mentioned by Baldwin & Cave (1999), it is believed that the legislative risk regulation of the three industries examined is based on both "red-light" and "green-light" concepts of regulation.

Koop & Lodge (2015) describes a remarkable lack of explicit definitions of the term regulation. The lack of a clear definition is often attributed to the term's different use in different scientific disciplines. Koop and Lodge (2015) mention lawyers, political scientists and economists to emphasise different types of disciplines who regards regulation according to Baldwin & Caves' (1999) two first concepts, as mentioned above. The last concept, regulation as all forms of social control or influence, is more interesting to social scientists. As a result, regulation is often talked about in very abstract terms due to the word's varied application by different scientific disciplines.

There are however, some widely used definitions across scientific disciplines (Koop & Lodge, 2015). For instance, Selznick's definition of regulation is often cited by other authors (as cited by Koop & Lodge (2015)): "Sustained and focused control exercised by a public agency over activities that are valued by the community". Black's definition of regulation is also commonly used: "the sustained and focused attempt to alter the behaviour of others according to defined standards and purposes with the intention of producing a broadly identified outcome or outcomes, which may involve mechanisms of standard-setting, information-gathering and behaviour modification" (Black, 2002, p.20). Black's definition is more detailed and includes three important components of regulation as described by Hood et al. (2001). Standard-setting means establishing requirements, goals and guidelines. Information-gathering is carried out by regulators in order to base regulatory activities on informed decisions. The information may be gathered through the regulator's own analyses or by requiring the organizations to provide it for them. Behaviour-modification is the regulators capability to change organizational or individual behaviour. Sanctions, rewards and guidance are all methods for encouraging desired behaviour.

But why is governmental regulation necessary? Baldwin & Cave (1999) lists 12 motives for a government to regulate. These are presented in table 6, but are not further explained as several of these are not associated with risk regulation. According to Baldwin & Cave (1999), often the need for regulation arises due to "market failures". If the market fails to produce the desired results or behaviour, the government might feel that it is necessary to intervene in order to obtain favourable results and market behaviour. This may include regulating an industry though legal means to ensure that organizations operating within the industry takes the necessary steps to ensure safe operations and activities.

Rationale	**Main aims of regulation**	**Example**
Monopolies and natural monopolies	Counter tendency to raise prices and lower input. Harness benefits of scale economies. Identify areas genuinely monopolistic	Utilities
Windfall profits	Transfer benefits of windfalls from firms to consumers or taxpayers	Firm discovers unusually cheap source of supply
Externalities	Compel producer or consumer to bear full costs of production	Pollution of river by factory
Information inadequacies	Inform consumer to allow market to operate	Pharmaceuticals. Food and drink labelling
Continuity and availability of service	Ensure socially desired level of essential service	Transport service to remote area
Anti-competitive and behaviour predatory pricing	Prevent anti-competitive behaviour	Below-cost pricing in transport
Public goods and moral hazard	Share costs where benefits of activity are shared but free-rider problems exist	Defence and security service. Health service
Unequal bargaining power	Protect vulnerable interests where market fail to do so	Health and safety at work
Scarcity and rationing	Public interest allocation of scarce commodities	Petrol shortage
Distribution justice and social policy	Distribute according to public interest. Prevent undesirable behaviour or results	Victim protection. Discrimination
Rationalization and coordination	Secure efficient production where transaction costs prevent market from	Disparate production in agriculture and fisheries

	obtaining network gains or efficiencies of scale	
Planning	Protect interests of future generations. Coordinate altruistic intentions	Environment

Table 6: Motives for governmental regulating. (Baldwin & Cave, 1999, p.17)

According to Breyer (1982) the motive for risk regulation may be explained by several of the rationales listed in table 6. For instance, externalities, information defects, and unequal bargaining power.

As mentioned previously, the concept of regulation can be regarded as more than set of commands. In order to encompass all behaviour-modifying activities Hood et al. (2001, p.9) use the term *risk regulation regime*. They define a risk regulation regime as: "the complex of institutional geography, rules, practice, and animating ideas that are associated with the regulation of a particular risk or hazard". Institutional geography is the governing body, which may range from international to local jurisdictions. Rules may vary in formality, ranging from unwritten norms to statutory codes (Hood, Rothstein, & Bladwin, 2001). The purpose of the rules may also vary from criminalizing certain activities to serve as motivation for desired behaviour or activities, in accordance with the "green-light" and "red-light" concepts of regulation. By practice and animating ideas Hood et al. (2001) regards all professional or cultural bias. Bias includes the reliance on professionals and lay people reporting risks and hazards, a bias toward command-and-control strategies or incentives, such as grants and taxes, and preferred policy instruments. Engen et al. (2013, p. 15) also considers a regulation regime to be more than just rules, and mechanisms for enforcing these. They also regard all actors and organs at different levels, as well as formal and informal mechanisms affecting the regime, to be a part of the regulation regime. This is in accordance with the third concept of regulation presented by Baldwin & Cave (1999). Hood et al. (2001) also considers the stability and consistency over time to characterize a regulatory regime, although a regime will be subjected to changes, and interactions between different elements within the regime is likely to occur.

Baldwin & Cave (1999) further explains how regulatory regimes arises and develops. According to them, there are several theories that are central in explaining the dynamics of risk regulation. These are categorized into two groups, depending on weather it is external or internal factors determining how the regulatory regime is formed and shaped (Baldwin, Cave, & Lodge, 2012). The reason for presenting these theories are to illustrate the main differences and tensions that is often considered when explaining regulatory systems. The brief presentations are meant to give an insight to the variety of existing theories, and give a sense of what limitations and possibilities each theory provides. All theories presented below encompasses several other theories, meaning there are different theories that falls in under those presented. Among those that are shaped by external conditions are public interest theory, interest group theory and opinion responsive theory. Institutional theory, however, focuses on the internal factor's impact on the regulatory regime. These theories apply both to governments and private organizations operating within the industry being regulated.

Public interest theory centres around the idea that those who regulate do so in pursuit of public interest. The purpose of regulation is therefore to achieve certain results as desired by the general public. A prerequisite for this to function effectively is that there exists a high level of trust between the regulators and the public. Further, the regulators have to be impartial experts within the area being regulated. The public interest theory has however, met some criticism. Firstly, it has proved difficult agreeing upon what the interest of the public is (Sunnhordvik & Svela, 2013). This often lead to practical and political challenges, and it undermines the entire theory if this is not agreed upon. Another challenge is ensuring that the regulators are neutral and that they objectively act in the public's best interest. This fact greatly affects the trust between the public and the regulators. Further, the theory underestimates the internal conflicts between groups, and how economic and political power may affect the regulatory regime (Sunnhordvik & Svela, 2013).

Interest group theory focus on the relationship between interest groups, and the relationship between interest groups and the government, and how regulatory developments are a result of these relationships (Baldwin & Cave, Undertanding Regulation, 1999). Hence, private financial interests often act as an important driving force for governmental regulation. A regulatory system may also be the result of the state's negotiation between interest groups, businesses and other actors. Therefore, regulatory systems are seen as results of power struggles. The theory is criticized for not taking into account the effect of established institutions, ideas and world views, and their effect on the regulatory systems (Sunnhordvik & Svela, 2013).

Opinion responsive theory centres around how regulators, being either governments or private organizations, reacts and adapts to the public opinion. The opinion of the public may be uncovered through polls or how much media coverage and public debate a story gets (Engen O. A., et al., 2013). It may however, prove difficult to separate the influence of the public opinion from the economic interests of the government or private organizations.

Institutional theory focuses on how institutional structures and organization, as well as social processes shapes the regulatory systems (Baldwin, Cave, & Lodge, 2012). This theory concerns the internal driving forces that give rise to and further develops the regulatory regimes. This theory has been of great importance the latest years (Engen O. A., et al., 2013). Within this theory there are large differences within the institutional approach. Some focus on inter-institutional relationships, whilst others focuses on the internal processes within an institution. One of the challenges regarding institutional theory is how to find a balance between institutional explanations and other explanations affecting the regulatory system (Sunnhordvik & Svela, 2013).

3.2 Regulatory Strategies

There are multiple ways the government can facilitate or restrict certain activities. For example, regulators can sanction unwanted behaviour or reward desired behaviour. It is important that the regulatory strategy suits its purpose in order to regulate the activity as efficiently as possible. As mentioned in chapter 3.1, regulation may be considered all mechanisms deliberately or unintentionally affecting behaviour. Hence, a company may be regulated by its competitors or employees, as well as the government. The following paragraphs will focus on those regulatory strategies commonly applied by the regulators, meaning governmental agencies given authority by the state to establish and enforce requirements for which organizations are subjected to.

Baldwin, Cave & Lodge (2012) describes seven regulatory strategies that are considered relevant for risk regulation.

Command and control is a strategy where requirements are sanctioned if not complied with. This type of regulation allows to prohibit certain forms of behaviour and demand desired behaviour. The strength of such a strategy is that it is non-compliance is punished by different sanctions (see chapter 3.3.4). It states what kind of behaviour is acceptable, and what is not. But command and control runs the risk of creating a system that lacks flexibility and opposes innovation (Baldwin, Cave, & Lodge, 2012). It may also lead to a system that is unable to adjust to new challenges, opportunities and technology. The strategy is also criticised for being reactive rather than proactive, which is considered to be negative (Bekkeheien, 2015).

Incentive-based regimes means employing economic incentives to affect an industry's behaviour. This strategy allows for negative or positive taxation of a company, with the intention of steering a company towards what is considered positive behaviour. Baldwin, Cave & Lodge (2012) considers this a way of avoiding the more restrictive and rule-bound strategy of command and control. The use of incentives gives a company more freedom while at the same time reduces the need for governmental involvement. The incentives may punish undesired activities or reward positive behaviour. However, such a strategy often requires a complex system of rules, causing a less flexible regulatory system than first intended.

Disclosure regulation forces actors to share critical information about their products and activities, and prohibits them from sharing misleading or false information. This strategy does not regulate the production process, taxation or allowed levels of output. Critical information could for example mean information about price, composition and quality of a product the organization is selling, and is most effective when the actors are dependent on a good reputation. Hence, the consumer can make an informed decision whether the production process and the finished product is acceptable. It is therefore important that the consumer is able to understand the information disclosed. Consumers may also not respond to the information as anticipated. For instance, price may be more important than the social concern regarding a product than what was first expected. Disclosure regulation may also apply to safety related information. If actors are required to share this type of information with other actors within the same industry, it allows for actors to learn from each other's mistakes. This may be carried out by making investigation reports public. Further, sharing of safety related information also allows for others to learn what an organization does better then themselves and adapt aspects of how they operate in regards to safety.

Direct action is a regulatory strategy where the government use their own resources to achieve results. For example, the government can buy equipment and rent this to actors. This is an alternative to forcing companies to purchase such equipment themselves through legal requirements. For smaller companies this might be the only way they can afford using different types of expensive equipment. Baldwin, Cave and & Lodge (2012) notes that this strategy might be very optimistic. Even if there is an available solution to a problem, it is not certain that actors will make use of these solutions. This strategy also means that the government will be heavily involved, and what actors are offered to rent equipment might also be unfair.

Rights and liabilities holds actors responsible for their behaviour. For example, by giving the public the right to fresh air, actors are held responsible for what gases they release into the atmosphere. Hence, potential polluters will be deterred by the cost of violating the publics rights. A challenge arising when applying such a strategy is determining the cost of violating the rights of others. A company valued at much less than the cost of violating these rights will possibly run the risk of going bankrupt. For larger companies the same fines might be considered unproblematic and again, the company would not be deterred by a *relatively* small fine. It is therefore important that the courts are able to fine the companies in such a way that it motivates the companies to not violate any rights and promote positive behaviour. This strategy is considered very effective for ensuring a safe working environment.

Public compensation or *social insurance schemes* encourage good behaviour be rewarding actors that can show good track records. For instance, the insurance premiums are lower for customers who has a history of no accidents or insurance claims, compared to customers who have had insurance claims in the past. By complying to legal requirements over longer periods, the organization will gain more trust from the regulators. This is of course considered positive, and will strengthen a mutually constructive relationship between the organization and the regulators.

Self-regulation is by Hood et al. (1999) considered to be a substitute for command & control, or to be a form of self-administered command & control. An example of self-regulation is an organization developing internal rules which they manage and enforce themselves. This strategy is often applied in order to avoid heavy regulation and legislative control by the regulators.

3.2.1 Enforced self-regulation

As enforced self-regulation is known to be a cornerstone in Norwegian risk regulation of the petroleum industry, it will be presented in greater extent than the other aforementioned strategies. Karlsen & Lindøe (2006) describes the concept of enforced self-regulation as a regulatory strategy where parts of the regulatory process are delegated to the actors themselves. This may be considered as self-regulation carried out under terms given by the regulators. Hence, the actor, or the organizations, are not free to self-regulate as they wish, but must do so following the directions provided by the regulators. What regulatory responsibility is being delegated might differ due to the size of the organization, activities carried out by the organization or what industry the organization is operating in.

There are several benefits of applying enforced self-regulation as a regulatory strategy for a sector or industry. The regulators delegate part of their supervisory responsibility to the organization allowing the regulators to save resources. Hence, a competent authority without the resources to enforce the requirements put forth in a satisfying way may apply this regulatory strategy forcing the organization to carry out some of their responsibility. Another attraction of the enforced self-regulation strategy is that the organization typically will be more familiar with the operations and work carried out at their facilities. As a result, inspections carried out may involve highly trained inspectors from the organization with more detailed knowledge about the facilities and operations as opposed to external inspectors (Baldwin & Cave, 1999). Further, it is also easier to introduce new internal rules and regulatory systems within an organization, as these do not have to await industry-wide agreement on what new requirements require or entail (Baldwin & Cave, 1999). New firm-specific rules and regulatory systems may be adopted quickly and efficiently as these are designed specifically for the organization. Enforced self-regulation can also lead to more specific rules than requirements meant for an entire industry. This is considered advantageous as different organization operating in the same industry might carry out different work and operate different facilities. Hence, requirements intended to regulate all these different organizations are often vague or very specific as it tries to cover all operations and activities within the industry. According to Baldwin & Cave (1999), enforced self-regulation leads to organizations taking more responsibility for their own operations and activities causing them to be more committed to complying with their own regulatory system. This is considered as an advantage, as complying with externally imposed requirements often leads to less commitment by the organization. As the internal rules and regulatory systems established as a result of enforced self-regulation often are more precise and less complex, the enforcement of these are often more effective (Baldwin & Cave, 1999).

Despite the mentioned benefits, enforced self-regulation also has its shortcomings. For instance, in order to ensure safe operations and activities at all organizations, the might have to approve all organization-specific rules and regulatory systems (this is not the case for all industries and regulators). Often these rules have to be put in context to the operations and activities carried out by the respective organization in order to fully comprehend their function and implication. This requires the regulators to have detail-knowledge about the organization, hence often making the assessment of the rules' effectiveness complicated (Baldwin & Cave, 1999). In this regard, it is less complicated and time-consuming for the competent authority to apply a regulatory strategy where they only have to deal with one set of industry-wide requirements. Further, in order to establish firm-specific rules the organization has to possess the necessary knowledge and competence in order to be able to establish and enforce them. If organizations are unable to do so, the fundamental basis for enforced self-regulation falls apart. When the competent authority has approved the specific rules set by an organization, they have to ensure that the organization enforces them. Ensuring compliance with internal rules will require the competent authority to supervise the implementation and enforcement of these. As mentioned, this often requires knowledge about the regulatory systems being inspected. This might be contrary to when an inspection where the competent authority evaluates compliance identically for all organizations, when an entire industry is regulated by the same requirements. Enforced self-regulation ensures that rules are firm-specific and it is therefore possible to avoid complex and far too specific requirements that shall apply to all organizations and cover all possible contexts (Baldwin & Cave, 1999). When each organization creates their own rules, one makes sure that the rules are tailored to the organization and its activities.

3.2.2 Safety Management System

As safety management systems are described differently by different legal documents, standards, and organizations, the safety management systems as described by one the most commonly used standards will be presented. This standard is called OHSAS 18001:2007. The reason for presenting the use and structure of safety management systems according to this standard is that it is one the most common ways of complying with legal requirements requiring these types of management systems. This will however be a normative description of safety management systems, as their actual design and structure are not examined. However, these management systems often must be certified in order to be recognized by the regulators as complying with the requirements. Hence, it is most likely that the safety management system described by OHSAS 18001:2007 is very similar to those used by the organizations.

The safety management system presented by OHSAS 18001:2007 applies the "plan-do-check-act"-methodology (PDCA-methodology). The use of the PDCA-methodology entails that the management system requires a continuous effort in order to improve the established management system, and consequently the safety levels at the work place. According to a guideline on how to establish a safety management system, the ILO-OSH 2001, the PDCA-methodology is as follows:

• ***Plan**: establish the objectives and processes necessary to deliver results in accordance with the organization's OH&S policy.*
• ***Do**: implement the processes.*
• ***Check**: monitor and measure processes against OH&S policy, objectives, legal and other requirements, and report the results.*
• ***Act**: take actions to continually improve OH&S performance.*

The safety management system presented by OHSAS 18001:2007 categorizes the management systems according to the PDCA-model, but also includes "Policy" as a category on its own. The policy should ensure that the management system is appropriate to the size and nature of activities carried out by the organization. Further, the policy should allocate responsibility, accountability and authority regarding the safety related work, as well as stating that the employer has the overall responsibility for the management system. The policy should also state that the management system shall ensure compliance with legal and internal safety related requirements. The policy should also commit the organization to improve the safety of the work place.

“Planning” focuses on how hazard identification and risk assessments shall be carried out, and what these shall include. OHSAS 18001:2007 emphasise that the elimination of hazards and risks are preferred over substitution. Further, substitution is preferred over isolating the hazard or risk, followed by altering how the employees work in regards to the hazard. Lastly is protecting the workers using personal protective equipment. “Planning” also includes developing internal rules, as well as ensuring compliance with legally binding requirements.

“Do” encompasses the allocation of resources. It further defines the roles of those involved in the safety related work, as well as assigns responsibility, accountability and authority of those involved. As a further extension of the allocation of responsibility and roles, is the creation of efficient communication lines. It shall further ensure that the employees’ competence, awareness and training is satisfactory. All necessary documentation in regards to the safety related work shall also be described. “Do” shall also ensure that operational control, and satisfying emergency preparedness and response.

“Check” includes measuring and monitoring performance, as well as evaluating compliance to internal requirements. Further, it encompasses incident investigations, examining nonconformity and shall ensure that corrective and preventive actions are carried out. “Check” shall also involve internal audits. In general, this phase shall ensure that those measures being taken are functioning as intended and shall uncover areas where new measures are necessary.

“Act” ensures that the safety management system is reviewed by top management. The safety management system should be assessed, and if this assessment concludes that the management system can be improved, these improvements shall be implemented.

The standard does not provide any detailed outlines of what a safety management system should include. This is due to the fact that a safety management system should be designed based on the size of the organisation and their activities and operations. As a result, it is difficult to provide a more detailed description of the requirement put forth by OHSAS 180001:2007.

3.2.3 Prescriptive and performance based requirements

The types of requirements provided by a legislative regulatory regime will often be affected by the applied regulatory strategies (Sunnhordvik & Svela, 2013). They exemplify this by stating that direct control often is considered to be the antithesis to self-regulation. Direct control often leads to rigid regulation, whilst self-regulation often allows for more flexible regulatory systems. The type of requirements used may have a huge impact on, for example, required competence among those being regulated, resources necessary for ensuring compliance and how regulators ensure compliance. Fintland & Braut (2012) distinguishes between four types of requirements: prescriptive requirements, performance based requirements, management- and responsibility requirements, and procedural requirements. This thesis will mainly focus on the two former types of requirements: prescriptive and performance based requirements.

In regards to risk regulation, prescriptive requirements determine *how* a certain level of safety shall be achieved (Lassagne, Pang, & Vieira, 2001). Hence, those who must comply with the requirements are left with no choice as to how to attain this level of safety. Further, compliance may be assessed directly by comparing the applied solution to the solution stipulated by the requirements. This type of requirements is also called compliance-based requirements (IAEA, 2018) or deterministic requirements. Prescriptive requirements are in some cases easier to comply with as they explicitly express what is acceptable and requires no extensive assessment in order to ensure compliance (May, 2007). Further, compliance is easy to ensure by regulators, as a checklist often is sufficient. Prescriptive requirements are often technical and detailed, and as mentioned, does not allow those complying with the requirements to deviate from the specified requirement. By setting very specific and detailed requirements there might be a need to regularly revise the legal documents. If not, the requirements might not allow the use of new and innovating solutions that could attain the desired level of safety in a more effective way. But regularly updating the requirements would cause those subjected to it to change their existing solutions. This type of regulation has also been criticized for limiting innovation. Olsvik (2015) cites Wilpert (2008, p. 373) who lists several drawbacks experienced when applying prescriptive requirements:

- "Inundation of regulations, proliferation of regulatory requirements"
- "Increase of conflict relations and distrust between regulator and regulated"
- "Information asymmetries between regulated and regulator since regulated is closer to emerging problems"
- "Increased de-motivation and tendency to unreflective compliance with rules"
- "Reduced learning for all parties involved"
- "Inflexibility due to lengthy rule making processes"
- "Increase of operational responsibility for the regulator with potential liabilities."

Performance-based requirements, rather than specifying *how* to attain a certain level of safety, specifies *what* level of safety that shall be achieved. In doing so, those trying to comply with the regulation are often free to determine what solution that best suits them. They are however responsible for ensuring compliance. Performance based requirements emphasises the desired result rather than the exact procedures in achieve it, leaving it to those subjected to the requirements to determine how to achieve these goals (May, 2007). This type of regulation allows for using new technology and innovative solutions. As opposed to prescriptive requirements, the performance based requirements do not apply a "one size fit all" approach (Engen O. A., et al., 2013). This means that the flexible performance based requirements allow for different organizations to apply different solutions in order to comply with the same requirement. In addition, this flexibility often reduces the need for revising the legal documents as often as when using prescriptive requirements. As for prescriptive requirements, performance based requirements are also subjected to criticism. The use of performance based requirements means that those trying to ensure compliance must possess knowledge and competence to be able to abide to them. If the requirements are very encompassing and vague there might also arise confusion and uncertainty as to what the regulators are trying to achieve, and what really is required by those subjected to the requirements. Regulators might also have to assess the whole system being regulated in order ensure that the desired level of safety is attained.

Olsvik (2015) regards prescriptive and performance based requirements to both mark extremes on a scale when considering "space for action". In this regard, space for action means to what degree those subjected to the regulation are allowed to choose *how* to comply with the requirements put forth. On one end, prescriptive requirements allow for no space for action, while on the opposite end of the scale, performance-based regulation allows for a large space for action. The scale is illustrated in figure 12 from Olsvik (2015).

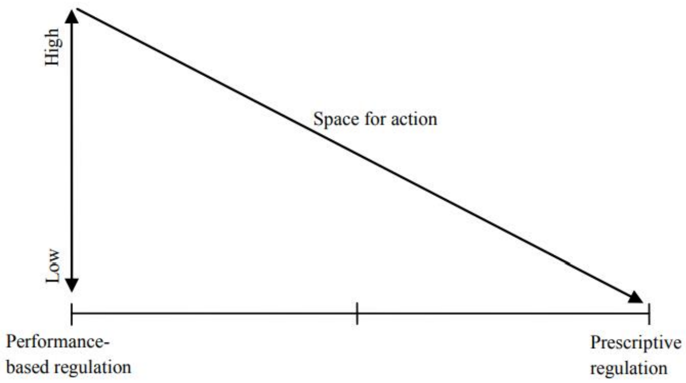

Figure 12: Space for action for prescriptive and performance-based regulation (Olsvik, 2015)

Olsvik (2015) emphasises that this scale is merely a theoretical scale, where the two extremes are considered "ideal types". In reality, requirements will exist somewhere between the two endpoints.

May (2007) presents a table comparing prescriptive, system-based and performance based requirements, providing an overview of the differences between the types of requirements. The table is rendered in table 7 below, as a summary of the two types of requirements. System-based regulation is not included, as this will not be further examined in this thesis.

	Prescriptive regulation	Performance based regulation
Regulatory foci	Prescribed actions	Results or outcome
Compliance determination	Adherence to prescribed actions	Achievement of desired goals
Nature of rules and standards	Particularistic and detailed specifications	Goal-oriented outcome specifications
Basis for achieving regulatory goals	Adherence to prescriptions presumed to meet goals	Regulatory goals are embedded in the results orientation

Table 7: Prescriptive and performance based requirements (May, 2007)

3.2.4 Sanctions

Sanctions are a very important tool for enforcing requirements as it strongly influences regulatory success or failure (Baldwin & Cave, 1999). When requirements are not complied with the regulators enforcing them may choose to sanction the offenders. As seen in figure 13 there are several ways of sanctioning an organization or individual that doesn't comply with the requirements put forth. These range from dialogue to revocation of an organization's license (if the organization has been granted a license).

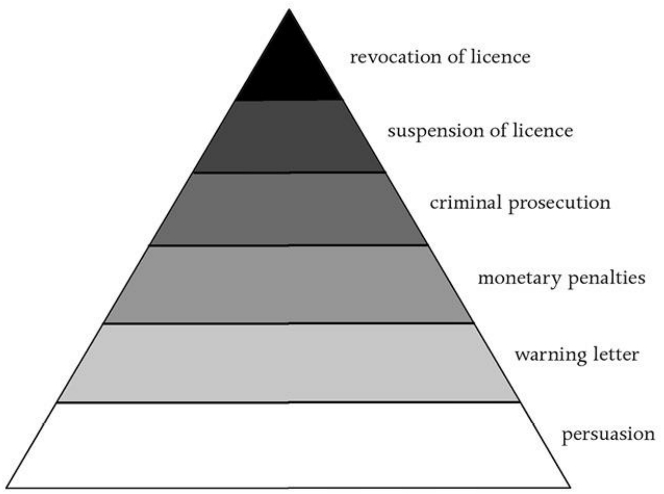

Figure 13: Sanction pyramid (Ayres & Braithwaite, 1995)

According to Baldwin & Cave (1999) there are different strategies of enforcing legal regulation. They mention two sub-strategies of ensuring compliance: persuasive and insistent approaches. The persuasive strategy is more accommodating than the insistent approach, aiming at educating and coax offenders into compliance. The insistent approach is less flexible where the regulators draw clear lines as to what behaviour is tolerated. Baldwin & Cave (1999) says that there is often a cultural difference as to how countries enforce regulations. The mention the American system to be more adversarial and deterrence-based compared to the British system of enforcement, which is more persuasive and compliance-based. However, national enforcement strategies may be heterogenous, meaning regulators of an industry enforce their regulations differently than regulators of a different industry. The enforcement strategy is also said to be affected by the requirements put forth by the regulations. If an insistent approach is applied the requirements put forth by the regulations are often prescriptive. Or conversely, if the requirements are prescriptive, an insistent approach might be more effective than a compliance-oriented or persuasive approach. Moreover, as performance based requirements are less specific and less precise, the need for guidance and dialogue between the regulators and the those being regulated might be necessary, calling for a persuasive approach.

4 Method

This chapter will present the scientific methods used in order to answer the problem presented in chapter 1.4. The strengths and weaknesses of these methods will also be presented. Further, the literary sources, their validity and reliability will also be discussed.

4.1 Existing studies

There has not been found any studies or other scientific work comparing the legislative risk regulation of Norwegian petroleum and coal mining industry, and Russian coal mining industry. However, several studies regarding the risk regulation of Norwegian petroleum industry exist. These do however not entirely cover the criteria examined by this thesis. Existing literature covers the use of enforced self-regulation, the use of performance based requirements and the enforcement of the regulations. Scientific work on the safety management systems have not been found. What concerns the Norwegian coal mining industry the existing literature is very scarce. There has not been found any work on the risk regulation of this industry. Furthermore, research on Russian legislative risk regulation of the Russian coal mining industry has not been found either. It is suspected that most of this type of research is written in Russian using the Cyrillic alphabet, making it challenging to find these studies.

Although the research on legislative risk regulation is limited, other sources cover different important aspects of risk regulation has been found. These have for instance formed the basis for chapter 3.

4.2 Scientific method

The problem of this thesis, as presented in chapter 1.4 is as follows:

> ***"What similarities and differences are found in how legislative risk regulation is carried out for the Norwegian petroleum industry, the Norwegian coal mining industry and the Russian coal mining industry, and what practical implications does these have?"***

In order to answer this problem a comparative study will be conducted. This comparative study will mainly involve analysing the legal documents regulating risks for each industry. Initially, all documents will be examined in order to find specific criteria that are considered interesting, either because these criteria are similar for two or more industries, or if they represent contradictions for how the two other industries are regulated. The criteria have also been chosen based on what the theoretical basis, presented in chapter 3, considers important in regard to legislative risk regulation. Once the criteria that shall form the basis for the comparative study has been selected, the legal documents will be scrutinized once again with emphasis on the chosen criteria. The number of criteria forming the basis for the comparative study will be restricted in order to limit the extent of this thesis and allow for a more thorough study of the criteria chosen.

This thesis will compare the legal risk regulation of Norwegian petroleum industry, Norwegian coal mining industry and Russian coal mining industry. Hence, this will be a comparative study based on a document analysis of the legal framework regulating the risk of the aforementioned industries. A comparative study based on document analysis might be qualitative or quantitative, or a combination of the two. This thesis will be a qualitative comparative study. This is a result of the empirical basis being comprised of different qualitative legal documents.

Due to the lack of literature on Russian regulation it has been decided that the empirical findings shall be based solely on the legal documents. There is a lot of literature concerning risk regulation regarding Norwegian petroleum industry. However, this literature has not been carefully studied as this would make the Norwegian risk regulation a benchmark when studying the Russian legal documents. Instead, the Norwegian legislative documents have been scrutinized in parallel with the Russian documents. As there is very little existing research concerning Norwegian risk regulation of the coal mining industry this has not been a concern when focusing on Norwegian and Russian coal mining regulations. Although existing articles and other literature has not been given much focus, they have been looked into in order to make sure that important elements of risk regulation have been included in this thesis.

The focus of this thesis has been the legislative documents, such as acts and regulations. Different guidelines to the regulations scrutinized is not included as part of the empirical findings. This is due to the fact that these guidelines are not legally binding, so that including these would be outside the scope of this thesis. Those guidelines available have however been examined for the purpose of ensuring that the requirements put forth by the regulations are correctly understood.

4.3 Sources

All laws and regulations are considered to be primary sources. These form most of the empirical basis for this thesis. However, some guidelines to the regulations regulating the Norwegian petroleum industry has been examined. These guidelines are developed by the PSA and is an elaboration of how the requirements put forth by the regulations are to be understood. These types of sources are secondary sources.

The Norwegian legal documents scrutinized has been selected based on what the regulators of each industry considers important legal documents for regulating risk. The key laws and regulations concerning the Norwegian petroleum industry is listed by the PSA on their webpage. Other regulations have been examined, but is not considered to be as important for regulating risk as those listed by the PSA. For the Norwegian coal mining industry, the Directorate for Mineral Management have also made a list of the most important laws and regulations regulating mining activities in general. Not all of these legal documents are applicable to Svalbard, and not all are concerning with regulating risk. These legal documents have therefore not been included as part of the empirical basis. In addition to the relevant documents presented by the Directorate for Mineral Management, the Regulation for Coal Mines on Svalbard and the Regulation on Industrial Safety have been examined. These regulations have been found by carefully searching Lovdata.no, a website that has made all Norwegian laws and regulations available online. Regarding the Russian legislation on risk regulation for the coal mining industry, all documents scrutinized has been provided by Professor Marat Rudakov from St. Petersburg Mining Institute. He is working at the Department of Industrial Safety, and has great experience within his field. It has proved difficult to either finding or accessing other Russian legal documents. This is mainly due to the challenges posed by the language barrier, but also the fact that most regulations available online are blocked by a paywall. However, the legal documents examined for all industries are believed to give a representative view of how the three industries are regulated regarding risk. The documents are believed to encompass most of the legislative risk regulation of each industry.

Constitutions and other laws that does not have any clear and direct impact on the risk regulation of the industries are not examined. This is done in an effort to reduce the number of documents, for which some are quite comprehensive and extensive.

Regulations will be given more attention than laws and conventions. This is due to regulations having a greater impact on how an industry is regulated regarding industry-specific risks and hazards. These regulations will however be within the scope of the laws examined, and it is therefore important that both the laws and regulations within the scope of the laws, are scrutinized. Certain laws are included when examining the regulation of both the Norwegian industries as these laws are believed to emphasise the similarities of how these industries are regulated. Also, an ILO convention is included as this is believed to form a common legal framework regulating the Norwegian and Russian coal mining industry.

4.4 Validity and reliability

The validity of each legal document is determined by reading the scope of each law and regulations. If the scope of the law is considered to regulate risk for one or more of the examined industries, the legal document is deemed valid and relevant. As mentioned in chapter 1, not all legal documents regulating risk for each industry are included. For instance, laws and regulations concerning hygiene, disease, electricity or radiation are not included as part of the empirical basis. Instead, the regulation of *industry-specific* risks is considered to be of interest.

The reliability of the legal documents scrutinized is not considered to be an issue. Official legal documents are by principal reliable as these has major implications for everyone subjected to them. However, the reliability might be weakened when official Russian legal documents are translated to from Russian to English using Google Translate. Although this programme has proven very effective and useful, some words and abbreviations has not been translated correctly. This exemplified by article 32 of the Russian regulation Order No. 550:

> *"The personnel of the mine and the personnel of other organizations should be instructed in industrial safety and familiarized with the submarine. Instruction on industrial safety and familiarization with the submarine is carried out according to the program approved by the head of the coal mining organization."*

The word “submarine” is in this article correctly translated to “emergency response plan”. The reason for this erroneous translation is that “emergency response plan” in the Russian version of the regulation is written by the use of the abbreviation “пла” (PLA). After some research it turns out that PLA also is a Russian abbreviation for “Nuclear submarine”. However, this is not considered to affect the reliability of the document itself, but rather the flawed translation of the document. This is not considered to be a major issue, as single articles of the regulation are not given a lot of attention. Instead, the articles are seen in context to their chapter. Thus, if an article makes mention of submarines, or other vehicles not commonly associated with coal mining, it is *assumed* that the translation of the article is incorrect.

When deciding on what sources to apply to the theoretical basis, it has been determined to restrict the number of sources. As there are different scientific perspective applicable when discussing risk regulation, it has been determined to focus on the most acknowledged and widely recognizes authors within the field of risk regulation.

4.5 Strengths and weaknesses of scientific approach

The author of this thesis has studied the petroleum engineering for several years and know most of the equipment and terminology used in the industry. However, the author has no experience or knowledge about the coal mining industry. It is therefore reasonable to believe that the regulations regarding the petroleum industry is easier to understand, and it will be easier to see each requirement in context with other requirements.

It should also be noted that the author of this thesis has no experience reading and interpreting legal documents. This might be an issue if the requirements are very functional, as these types of requirements may be open for interpretation. If the requirements concerning the coal mining industry is prescriptive and very specific this might also prove challenging. The lack of training and experience in understanding legal documents is not deemed very crucial in regards to the findings of this study. It is however important to reflect upon the fact that this might affect how the documents are analysed. More importantly, this will also influence the discussion of the findings.

Hence, the lack of experience in reading and complying to laws and regulation might result in a reduced understanding of what the requirements put forth by the regulations entail. The impact of this has not been further reflected upon, and no effort has been made to eliminate this potential weakness. In order to eliminate the impact of the potential reduced understanding of the legal documents, it would be necessary to uncover how personnel complying to the requirements interpret them, and not least what the regulators specifically are trying to achieve.

The fact that this study only focuses on a few criteria when comparing the risk regulation of the three industries will greatly affect the results. By limiting the number of criteria, the extent of the study becomes more manageable. However, it is believed that several interesting similarities and differences of the legislative risk regulations of the different industries will not be uncovered. For instance, it would be of interest to examine the stipulated relationship between the regulators, employers and the employees according to the legal documents, and whether there is any correlation between this relationship and the use of prescriptive and performance based requirements, and enforced self-regulation.

The results and conclusions of this study would most likely be strengthened by quantitative accident statistics. This would probably give the results and conclusions more scientific weight. However, with the exception of the Norwegian petroleum industry, this type of statistics has proven difficult to obtain. It is possible to find numbers on fatalities or number of accidents, but not a more detailed cause of each accident. However, detailed accident statistics would not be enough to compare the effectiveness of the legislative risk regulation, as this is merely a framework for regulating risk. It does not include the regulators, employers and employees attitude towards risk, how the legal requirements are enforced in practice, and it is possible that several accidents go unrecorded.

5 Analysis

The legal risk regulation of the different industries will be compared based on a few selected criteria. These criteria are chosen based on what is considered of interest of the legislation for one or several of the industries, or might be considered interesting as they are deemed important as to how risk regulation is carried out. For instance, the use of prescriptive and performance based requirements is considered important as it has a major impact in regards to compliance and enforcement of the requirements. Some of the other criteria examined will be closely linked to the type of requirements put forth by the regulations, such as level of detail or specificity of the requirements, and the extensiveness of the legal documents. The use of enforced self-regulation will also be given special attention as it is considered an important regulatory strategy that has major implications for how both the organization and the regulators manages issues regarding risk. Lastly, requirements regarding safety management systems will be examined.

5.1 ILO conventions

The International Labour Organization (ILO) is a tripartite United Nations agency with 187 member states (ILO, 2018a). The agency develops policies, sets labour standards and promote fundamental principles and rights to assure decent working conditions. ILO was created as a part of the Treaty of Versailles in 1919 and has since then consisted of representatives from governments, workers and employers. In 1946 ILO became a specialized agency of the UN. Today ILO provides an international legal framework through conventions developed by governments, workers and employers, which is ratified voluntarily by member states. This legal framework is not enforced by ILO or any other agency, meaning inability to comply with the ratified conventions does not result in any sanctions. However, the conventions developed are meant to be incorporated into national law, making each national government responsible for enforcing the conventions they have ratified. As of April 2018, ILO has developed 189 conventions and 6 protocols (ILO, 2018b). The conventions deal with several challenges affecting the workers. For instance, there are conventions concerning forced labour, child labour, discrimination and minimum wages. The reason ratified conventions are of interest when examining two different countries' legislation on risk regulation is that the conventions form identical legal frameworks for each country. However, the strategy of meeting the requirements set forth by the conventions might differ.

A study from 2007 compared the occupational fatality rates of countries that have ratified ILO's conventions on occupational health and safety (OSH) related matters and countries that haven't (Wilson, et al., 2007). The study showed that countries that haven't ratified these conventions generally had higher occupational fatality rates, and concluded that the ratified conventions had a positive impact on occupational health and safety.

If a member state chooses to ratify a convention they must document its implementation. In general, every five years the government must report what steps that has been taken in law and practice to apply the convention into their legislation (ILO, 2018c). For fundamental conventions and governance conventions, a report must be submitted every three years. These reports are reviewed by the Committee of Experts which evaluates the member state's incorporation of the convention into the national legislation.

Out of the 189 conventions and 6 protocols, only two are aimed specifically towards the mining industry. C045 prohibits women to work underground, meaning they are not allowed to work in underground coal mines, and C176 covers the health and safety in mines. There are no conventions specifically covering the petroleum industry. The Russian Federation has been a member state of ILO since 1954 (ILO, 2018d). Russia has ratified 75 conventions and 1 protocol. Among these are C045 (ratified in 1961) and C176 (ratified in 2013). Norway has been a member state since 1919, and as of April 2018 Norway has ratified 110 conventions and 3 protocols. Norway has not ratified C045, but ratified C176 in 1999 (ILO, 2018e).

5.1.1 C176

C176 on health and safety in mines forms a legislative framework for occupational health and safety for mining operations and activities (ILO, 2018f). C176 aims to ensure safe working conditions in both underground and open cast mines extracting minerals. C176 calls for the supervision of OSH in the mines, inspections of the mine by regulators and their power to suspend mining activities on health and safety grounds. The convention also states that the employer is responsible for ensuring safe operations and activities. Employers are for example responsible for eliminating or minimizing risks under their control, prepare emergency plans and ensure that workers has adequate training regarding occupational health and safety. The employer is also responsible for providing regular health surveillance of workers exposed to health hazards specific to mining activities. Further, the rights and duties of workers working in mines are described in C176. The requirements put forth by the convention is considered to be performance based, and does not include any articles or requirements considered to promote enforced self-regulation. Further, there are no requirements stating that the organizations must establish a safety management system.

5.2 Risk regulation of Norwegian petroleum industry

The Norwegian petroleum industry is regulated through several laws and regulations. According to the Norwegian Petroleum Safety Authority (PSA) some of the most central laws regulating risk in the petroleum industry are the Petroleum Act, the Working Environment Act, and the Fire and Explosion Prevention Act (PSA, 2018). The Fire and Explosion Prevention Act will not be examined for this study in an effort to reduce the number of laws scrutinized. In addition, the two former acts are considered to be of greater importance when regulating risk in the petroleum industry.

There are also five key regulations concerning safety in the petroleum industry, named the HSE-regulations by the PSA: The Framework Regulation, the Management Regulation, the Facilities Regulation, the Activities Regulation, and the Technical and Operational Regulation. The latter regulation will not be examined as this only concerns onshore facilities. The PSA have also developed guidelines for these key regulations. Although the guidelines to the regulations is not included in the list of documents examined below, they have been used to ensure that different requirements are correctly understood. It is important to note that these guidelines are not legally binding. They do however elaborate the requirements put forth by the regulations and often suggest what standards to apply in order to comply with the regulations. This sub-chapter will however focus on the two acts and four regulations listed in table 8 below.

Name of document	Type of document	Field/ Area	Language
The Petroleum Act	Act	Petroleum, general	English
The Working Environment Act	Act	Occupational health and safety and working environment	English
Framework Regulation	Regulation	Petroleum, safety	English
Management Regulation	Regulation	Petroleum, safety	English
Facilities Regulation	Regulation	Petroleum, safety	English
Activities Regulation	Regulation	Petroleum, safety	English
Regulation on Internal Control	Regulation	Internal Control (safety)	Norwegian

Table 8:Legal basis for Norwegian petroleum Industry

5.2.1 Laws

5.2.1.1 The Petroleum Act

The Petroleum Act's scope is to regulate the exploration and extraction of petroleum on the Norwegian continental shelf. The act gives the Norwegian government monopoly on assigning organizations exploration and production licenses. What is considered of interest in regard to this study, is chapter 9 of the act, named "*Special requirements to safety*". Article 9-1, on safety, states: "*The petroleum activities shall be conducted in such manner as to enable a high level of safety to be maintained and further developed in accordance with the technological development*". This specific article does not place the responsibility regarding safety onto the organization, but does however require the activities to be carried out in a prudent manner. The chapter further requires that the operators and all other participants at all times maintain efficient emergency preparedness regarding OSH and major industrial accidents. It also includes a requirement stating that the operator, or licensee, shall initiate and maintain security measures in order to avoid deliberate attacks towards their facilities.

Further, the chapter requires the operator to suspend all activities in the event of an accident, in order to ensure safe operations. The chapter also requires the licensee to provide necessary safety documentation to the Ministry of Petroleum and Energy.

The Petroleum Act constitutes the framework for safety in the Norwegian petroleum industry (PSA, 2017). The act regulates the Norwegian government's management of Norwegian petroleum resources. The most central mean of ensuring governmental control and management of the Norwegian petroleum resources on the Norwegian continental shelf is the licensing system. A license allows for organizations to explore, recover and/ or transport petroleum under certain terms. The Petroleum Act further describe the responsibility of the authorities and the organizations who have been awarded a license. One of these responsibilities are concerning the safety of their activities and operations. The act requires the licensees to establish and maintain an emergency preparedness, establish safety zones around and above facilities and to possess the necessary competence and knowledge to ensure work is carried out in a prudent manner. The act further allows the Ministry of Petroleum and Energy to order others to make their contingency resources available.

5.2.1.2 The Working Environment Act

The second act deemed relevant to this study is the Norwegian Working Environment Act. The Working Environment Act is fairly comprehensive, consisting of more than 27,000 words, 18 chapters and 184 articles. The scope of the Act is to ensure safe working conditions, prevent discrimination against employees and to ensure a sound working environment.

What is considered to be of relevance to this study is article 3-1 of the Working Environment Act. This article (item 1 and 2) requires the employer to establish a safety management system (SMS). This system shall ensure employees' health and safety, and the protection of the environment. This management system shall also facilitate the participation of employees and their representatives. The scope and function of the SMS are specified by eight points in Article 3-1 item 2:

> *Systematic health, environment and safety work entails that the employer shall:*
>
> *a)* *establish goals for health, environment and safety,*

b) have an overall view of the undertaking's organisation, including how responsibility, tasks and authority for work on health, environment and safety is distributed,

c) make a survey of hazards and problems and, on this basis, assess risk factors in the undertaking, prepare plans and implement measures in order to reduce the risks,

d) during planning and implementation of changes in the undertaking, assess whether the working environment will be in compliance with the requirements of this Act, and implement the necessary measures,

e) implement routines in order to detect, rectify and prevent contraventions of requirements laid down in or pursuant to this Act,

f) ensure systematic prevention and follow-up of absence due to sickness,

g) ensure continuous control of the working environment and the employees' health when necessitated by risk factors in the undertaking, cf. (c),

h) conduct systematic supervision and review of the systematic work on health, environment and safety in order to ensure that it functions as intended.

According to the article, the safety management system does not differentiate between occupational health and safety, and industrial safety. The requirements regarding the SMS are considered to be performance based. The requirements leave the employer a large space of action, due to the requirements formulation. How the employer chooses to comply may differ as long as the attained level of safety satisfies the regulators.

5.3.1 Regulations

As mentioned, this study will focus on the general design of the legislation, the required safety management system and to what degree enforced self-regulation is applied as a regulatory strategy. Risk regulation of drilling and well activities will be used as an example in order to gain some insight into what types of requirements are put forth and how detailed these are. Instead of structuring the findings according to the regulations, the findings will be presented according to each criterion. Hence, the general design of the regulations will be presented, followed by the regulation's requirements regarding a safety management system. Next, the use of enforced self-regulation as a regulatory strategy will be presented.

5.3.1.1 General design of regulation

Combined, the four key regulations are made up of almost 39,000 words, with the Management Regulation being the shortest with 6,709 words, and the Activity Regulation being the longest with 12,459 words. Combined the regulations put forth 295 articles divided by 55 chapters. The key regulations regulating risk for the Norwegian petroleum industry are based on some very defining principles. According to the PSA the regulations are risk based (PSA, 2018a). Risk based regulation means focusing on activities and operations where the potential of harm is the greatest. Hence, ensuring compliance with requirements that are not of great importance in regards to safety is not given that much attention by the PSA. Instead, resources are allocated where risk is highest and needs to be managed. Further, the requirements put forth by the four key regulations are performance based. They do not specify *how* to achieve the required level of safety, but do state *what* level of safety that is considered acceptable. As the regulations uses performance based requirements, the acceptable level of safety is not explicitly mentioned in any way. There are no quantitative goals given, merely vague indications of what is considered satisfying levels of safety. Even though the majority of requirements are performance based, there are some use of prescriptive requirements. For instance, requirements regarding diving activities are prescriptive. Section 94 of the Activity Regulation states that divers are not allowed to spend more than 14 days at depths deeper than 180 meters. This requirement does not specify any goals to be achieved, but rather a measure to ensure the safety of the divers.

In addition, the regulations also recommend the use of industry recognized standards. Adopting these as a mean for complying with the regulation is considered sufficient by the PSA. However, if other solutions than those proposed by the standards are applied, the responsible party must document that the level of safety attained is at least as high compared to level of safety attained by adopting the solutions presented by the standards.

5.3.1.2 Safety management system

According to article 1 of the Framework Regulation, the scope of the regulation is to:

a) promote high standards for health, safety and the environment in activities covered by these regulations,

b) achieve systematic implementation of measures to comply with requirements and achieve the goals laid down in the working environment and safety legislation,

c) further develop and improve the health, safety and environmental level.

Regarding item b), it is natural that the requirement regarding a safety management system is presented in this regulation. None of the regulations uses the term "safety management system", just "management system". This is since a safety management system may be incorporated into other management systems. Hence, there is no need to establish a separate management system that only comprises safety related activities, as stated by the Management Regulation's guideline. The requirement regarding a safety management system is mainly described by article 17 of the Management Regulation:

> *"The responsible party shall establish, follow up and further develop a management system designed to ensure compliance with requirements in the health, safety and environment legislation.*
> *The licensee and owner of an onshore facility shall establish, follow up and further develop a management system to ensure compliance with requirements in the health, safety and environment legislation directed toward licensees and owners of onshore facilities.*
> *The employees shall contribute in the establishment, follow-up and further development of management systems."*

This requirement applies to the scope of several acts: the Petroleum Act, the Pollution Control Act, the Fire and Explosion Protection Act and the Working Environment Act. The requirement states that all responsible parties carrying out operations offshore or onshore must establish, follow up and further develop a safety management system. This is also stipulated in article 18 of the Framework Regulation, stating that the responsible party (licensee) must ensure that the entrepreneurs and suppliers possesses the necessary competence in order to comply with requirements regarding health, safety and environment. The management system shall also allow for the participation of employees or their representatives when establishing and developing the management system. The participation of employees and their representatives is also required by article 13 of the Framework Regulation.

The management system described in the Framework Regulation's article 17 is further specified by the Management Regulation's article 6 on "Management of the Health, Safety and the Environment", stating that:

> *The responsible party shall ensure that the management of health, safety and the environment comprises the activities, resources, processes and organisation necessary to ensure prudent activities and continuous improvement, cf. Section 17 of the Framework Regulations.*
>
> *Responsibility and authority shall be unambiguously defined and coordinated at all times.*
>
> *The necessary governing documents shall be prepared, and the necessary reporting lines shall be established.*

According to this regulation's guideline, the management system shall include

a) setting goals, strategies and requirements,
b) planning and execution,
c) handling nonconformities,
d) measurement and assessment,
e) further development and improvement,

These bullet points all matches the requirements put forth by the standard OHSAS 18001:2007.

Although there are limited explicit requirements regarding a safety management system, several requirements will indirectly determine the functions and use of the management system. For instance, article 17 of the Management Regulation, on risk analyses and emergency preparedness analyses, determines how risks shall be analysed and used as a basis for the decision-making process. All requirements regarding the management system are performance based, and provide little information on how to ensure compliance. However, article 67 of the Framework Regulation specifies that the management system must be approved by the PSA. According to the PSA, a requirement is considered met if those regulated applies an industry recognized standard. Hence, the OHSAS 18001:2007 is sufficient to ensure compliance.

To summarize, the performance based regulations does not provide any detailed requirements regarding a safety management system. The safety management system, as presented by the four key regulations, allows for a management system that incorporates several aspects of the operations carried out offshore. For example, the management system could include health and safety, industrial safety, environment and energy, and information technology. The regulations also require the employees, or their representatives, to participate in the establishing, following-up and further development of the management system.

5.3.1.3 Enforced self-regulation

The PSA states that enforced self-regulation is a very important regulatory strategy for ensuring safe operations in the Norwegian petroleum industry (PSA, 2017). The use of enforced self-regulation is found in several laws and regulations. The Regulation on Internal Control are of special interest when examining the use of enforced self-regulation. This regulation defines internal control as systematic measures meant to ensure that the organization's activities are planned, organized, executed, secured and maintained according to requirements put forth by legislation regarding safety. Article 4 of the Internal Control Regulation states: "*Those responsible for the organization shall ensure that internal control is implemented and exercised, and is carried out in cooperation with the employees and their representatives*". This is one of the clearest example of the use of enforced self-regulation regarding the petroleum industry.

The key regulations on HSE in the petroleum industry also require the responsible parties to self-regulate. As already mentioned, the required safety management system is a method applied by the PSA in order to ensure self-regulation. The key regulations are unambiguous regarding who is responsible for attaining a satisfying level of safety. According to article 7 of the Framework Regulation, all participating parties are responsible for complying with the regulations. The operators are also responsible for ensuring that those carrying out work on their behalf complies with the requirements regarding safety. Article 2 for all the three remaining key regulations refers to this article when assigning responsibility regarding safe operations. The PSA regards the use of enforced self-regulation as a cornerstone for the regulation of the Norwegian petroleum industry (Brundtland, 2016). This cornerstone might be considered a result of another important principle: The competent authority is not able to micromanage the industry. This is due to the lack of resources, as well as it would undermine the operators sense of responsibility regarding safety (Brundtland, 2016). According to the PSA: "those who owns the risk also owns the responsibility of managing it".

5.3.1.4 Drilling and well activities

Drilling and well activities are mainly regulated through nine articles of the Activity Regulation and seven articles of the Facility Regulation. The seven articles of the Facility Regulation, found in chapter 8, concerning drilling and well activities are solely aimed at safety during these operations. For instance, the articles put forth requirements regarding well barriers, well control equipment, drilling fluid system and wellheads. Although aimed at technical systems and equipment, the requirements are performance based, and therefore not very specific. As an example, article 51 of the Facilities Regulation, on the drilling fluid system, states:

> *The drilling fluid system shall be designed such that it mixes, stores, circulates and cleans a sufficient volume of drilling fluid with necessary properties to safeguard the drilling fluid's drilling and barrier functions.*
> *The high pressure section of the drilling fluid system with associated systems shall also have the capacity and working pressure to be able to control the well pressure at all times.*

This is a clear example of the use of performance based requirements. The requirement does not specify how to attain a certain level of safety, but rather what level of safety to attain. While the Facility regulation focuses on the technical systems and equipment, the Activities Regulation concerns the drilling *process* and well *activities*. Chapter 15 of the regulation, named "Drilling and well activities", requires the preparation of a well programme before drilling commences. This programme shall include all planned drilling activities and what equipment that will be used during each operation. The chapter further explains how the responsible party must establish a well plan for a relief well on two different locations. Drilling a relief well is a safety barrier used to gain control over a well experiencing the uncontrolled release of formation fluids, a so-called blowout. A relief well is only one of several barriers required when drilling and/ or carrying out other well activities. Specifically what barriers, and how many, are required is not explicitly mentioned. Besides relief wells, the responsible party must ensure access to capping equipment, if this is considered a good measure in a well control incident. Other more obvious barriers, such as blow out preventers (BOP) are not explicitly mentioned, neither in the Activity Regulation or in the Facility Regulation. A BOP is an obvious barrier used by the entire industry and it is considered challenging to safely produce oil and gas from an offshore well without using a BOP. Even though BOPs are not mentioned as a required technical barrier, the Activity Regulation requires BOPs and other pressure control equipment to be maintained and tested regularly, and undergo a complete overhaul and recertification every five years. This indicates that the use of a BOP is considered a natural part of the technical barrier system used.

When regulating risks related to drilling and well activities, the use of barrier systems is prominent. Both the Activity Regulation and the Facility Regulation puts forth requirements regarding well barriers through performance based requirements. The Facility Regulation states the required functions of the barrier system, such as preventing any outflux of formation fluid to the environment. The Activity Regulation focuses on the assurance of functionality, such as barrier independence, and requires the performance of the barrier system to be verifiable. The Activity Regulation forbids any well activities if a barrier fails, unless those activities are related to restoring the barrier’s functionality. Some general principles regarding barrier systems are described in article 5 of the Management Regulation. An excerpt of the article is rendered below:

Barriers shall be established that at all times can

- *Identify conditions that can lead to failures, hazard and accident situations*
- *Reduce the possibility of failures, hazard and accident situations occurring and developing,*
- *Limit possible harm and inconveniences*

Where more than one barrier is necessary, there shall be sufficient independence between the barriers.

Although the Activity and the Facility regulation explicitly mentions drilling and well activities, both the Framework Regulation and Management Regulation put forth requirements for these types of activities and operations. The framework regulation requires the responsible party to notify the PSA when they start the planning phase of an exploration well, how this planning shall be organized, managed and carried out. The PSA also requires the responsible party to document the required competence necessary to carry out the operations. Article 25 of the Management Regulation requires the operator to obtain an approval from the PSA before commencing exploration drilling activities. The Framework Regulation and Management Regulation has a stronger focus on documentation, planning and personnel's competence and training, and may in that regard be considered more of organizational barriers. The Facilities Regulation and the Activities Regulation on the other hand, focuses more on the establishment and maintenance of a technical barrier system.

The legal requirements regarding risk regulation of drilling and well activities for the Norwegian petroleum industry are presented by the use of performance based requirements. This leads to fewer, but more encompassing requirements. As seen for the rest of the regulations, drilling and well activates are also subjected to enforced self-regulation. The operators are responsible for ensuring safe operations, but the PSA reserves the right to approve all associated activities planned and even the equipment to be used during drilling.

5.3 Risk regulation of Norwegian coal mining industry

According to the Directorate for Mineral Management, the most central laws and regulations regarding Norwegian coal mining are those listed in table 9. The table also include the Svalbard Act, as this has proven to have major implications for how the coal mining on Svalbard is regulated. The number of regulations deemed relevant for the Norwegian coal mining industry is significantly lower than the number of regulations regarded as important to the Norwegian petroleum industry.

Name of document	Type of document	Field/ Area	Language
The Svalbard Act	Law	Legislative framework for Svalbard	Norwegian
Working Environment Act	Law	Occupational health and safety and working environment	English
Regulation on Industrial Safety	Regulation	Industrial Safety	Norwegian
Regulation for Coal Mines on Svalbard	Regulation	Industrial Safety/ Coal mining	Norwegian

Table 9:Legal documents used for studying legislative risk regulation of Norwegian coal mining industry

As for risk regulation of drilling and well activities for the Norwegian petroleum industry, the ventilation of underground mines will be given special attention when examining the legal documents for Norwegian coal mining industry.

5.3.1 Laws

5.3.1.1 The Svalbard Act

The fact that all coal mining activities in Norway is located on the archipelago Svalbard has proven very important for the risk regulation of the industry. The Svalbard Act of 1925 is of great importance regarding the coal mining industry on Svalbard. Article 2 of this act states that besides private law, criminal law and Norwegian legislation regarding the administration of justice, Norwegian law does not apply on Svalbard (with some exceptions). However, article 3 of the same act states that laws and regulations regarding labour protection and labour disputes applies to Svalbard (such as the Working Environment Act) unless the law specifically states otherwise. These two articles have proven to complicate the research regarding laws and regulations applicable to the coal mines of Svalbard. For instance, the Regulation on Internal Control, stating that every company is required to conduct internal revisions in order to ensure safe working conditions, explicitly states that the regulation does not apply to Svalbard. Furthermore, the Regulation on Health and Safety in Explosive Atmospheres *does* apply to Svalbard, with the exception of all coal mines. Hence, it has proved challenging to get an overview over which laws and regulations apply to the coal mines on Svalbard, and just as important, which laws and regulations does not. The reason several laws and regulations does not apply is likely due to the international status Svalbard is given by the Svalbard Act. However, this could not be confirmed by the Labour Inspectorate, as this would require proceedings according to the Public Administration Act, which takes a long time. The Chief Mining Inspector of Svalbard from the Directorate for Mineral Management could not confirm this as well.

The ratification of ILO conventions further complicates this matter. As stated earlier, the ILO conventions Norway has ratified shall serve as a framework for, and be incorporated into, the Norwegian legislation. Some of the principles described in ILO C176 are found in the Working Environment Act and some more specific are found in the Regulation of Coal Mines on Svalbard. However, several parts of the convention that is aimed specifically towards the mining industry is neither found in any of these. They are however found in regulations such as the Regulation on Safety, Health and Working Environment for Rock Work. This regulation is considered to be more comprehensive, and imposes stricter requirements for mining underground and open-cast mines.

To summarize, given that Norwegian law, in general, does not apply to Svalbard the work of examining the legal basis for coal mining in Norway is more complicated than examining the legislation regarding mining on the Norwegian mainland. The reason for exempting Svalbard for most laws and regulations is not uncovered, but it may relate to the fact that other countries that has signed what is called the Svalbard Treaty shall be able to trade, conduct industrial activities and mining activities *unhindered*. The signatories are however subjected to Norwegian law.

5.3.1.2 The Working Environment Act

The Working Environment Act is already presented in chapter 5.2.1.2 for the Norwegian petroleum industry. The act makes no specific mention of coal mines. Therefore, there will be no further presentation of the act in this sub-chapter. The interesting parts of the act was the description of the required management system through the use of performance based requirements.

5.3.2 Regulations

5.3.2.1 Regulation on Industrial Safety

The Regulation on Industrial Safety is, along with the Regulation on Coal Mines on Svalbard, one of the most central regulations regulating risk of the Norwegian coal mining industry. The regulation is relatively brief, with less than 2000 words and 25 articles. The scope of the regulation is to ensure that organizations possess the necessary competence and equipment in order to responsibly and efficiently limit the consequences of an unwanted incident with regards to health, safety, environment and material assets. This regulation is included as part of the empirical basis as it has a major impact on how the coal mining industry is forced to self-regulate, and how the organization has to assess the risks associated with their coal mines.

The Regulation on Industrial Safety states that all organizations with more than 40 employees working within predetermined industries shall develop a system to protect their workers against industrial accidents. The list of defined sectors consists of 38 industries and includes organizations extracting oil and gas, producing clothes, mining coal and companies producing chemicals. Hence, this regulation is also applicable to the petroleum industry. The regulation is authorized by the Working Environment Act and is enforced by the Ministry of Justice and Public Security. The role of inspector has been delegated to the Norwegian Industrial Safety Organization (NSO). NSO is an independent organization funded by a levy paid by organizations subjected to the Regulation on Industrial Safety (NSO, n.d.).

The regulation requires the organizations to appoint an industrial safety leader that shall be responsible for the administrative tasks regarding industrial safety. This leader shall have the necessary authority and resources to fulfil his or her tasks in a responsible manner. The regulation also requires organizations subjected to it to keep records of incidents and accidents. These records shall be revised at least once every year, and if necessary the organization must dimension their industrial safety activities to accommodate any significant changes. Moreover, the regulation requires the organization to establish an emergency preparedness plan as well as ensure employees are provided with personal protective equipment. Based on the organizations risk assessments, the organization is required to obtain all necessary emergency preparedness equipment in order to handle accidents

The regulation requires organizations who may experience accidents with the possibility of serious harm to people or the environment to establish a *reinforced* industrial protection. This applies to the coal mining industry, meaning they must establish a rescue team. The tasks of the rescue team depend on the hazards identified by the organization, but is not fully disclosed in the regulation. However, securing the accident scene, first aid, firefighting and handling dangerous chemicals are some of the tasks mentioned. For instance, a coal mining company might experience serious harm to employees or a fire, and must therefore have competent personnel with regards to first aid and firefighting.

The requirements put forth by the regulation are all performance based. The only exception is requirements regarding number of yearly exercises and required documentation. The regulation makes no mention of a safety management system (although several of the requirements will dictate the functions of the management system). However, the regulation further makes the organization responsible for the safety concerning their activities, and is thus another way of ensuring that the organization self-regulates.

5.3.2.2 Regulation for the Coal Mines on Svalbard

As the Regulation for the Coal Mines on Svalbard are considered to be the most central legislative document regulating the coal mining industry in Norway, this regulation will be given the most attention. The Regulation for the Coal Mines on Svalbard is the only regulation specifically aimed at Norwegian coal mines. The regulation does not cover open cast coal mines as these do not exist in Norway. The scope of the regulation is safety regarding mining activities, and does not include financial or other administrative matters. The regulation is only valid for underground coal mines on Svalbard. Unlike the HSE-regulations for the Norwegian petroleum industry, there is no guideline for the Regulation for the Coal Mines on Svalbard.

5.3.2.3 General characteristics of regulation

Like the Norwegian Regulation on Industrial Safety, the Regulation for the Coal Mines on Svalbard is a very brief document, with less than 2800 words, 21 chapters and 72 articles. The regulation combines the use of prescriptive and performance based requirements. However, the use of performance based requirements are the most prominent, and prescriptive requirements are restricted to levels of methane, oxygen and carbon dioxide within the mine, dimensions and design of ladders, and when to inspect the mine.

What is considered interesting, is the classification of the coal mines. This shall be done by the Labour Inspectorate, who classifies the mines according to the gas hazard. A Norwegian coal mine is classified based on the concentration of methane gas in the mine. Three classes are used:

- Class 1: mines where there has never been detected the presence of methane gas, even without ventilation (considered to be small gas hazard)
- Class 2: mines where the maximum detected methane gas concentration is below 1,0% during ventilation, or where the return air of the mine contains less than 0,3% methane (considered to be average gas hazard)
- Class 3: mines where the methane gas concentration has been measured to be above 1,0% during ventilation, or where the return air of the mine contains more than 0,3% methane

If the gas concentration limits of the current class are exceeded, the organization has to immediately notify the Labour Inspectorate. If the concentration of methane gas concentration exceeds 1,5%, all activities within the mine shall cease and all personnel must evacuate. This classification system is only used when deciding where to establish safety zones for the use of non-explosion proof vehicles and machines, and is therefore decided by the Labour Inspectorate.

5.3.2.4 Safety management system

Article 8 of the regulation requires the coal mining company to establish a management system used for assessing the working environment and implementing necessary measures if needed. The system shall also be able to assess the health and safety of employees. Further, the system shall include necessary instructions for activities that involves increased risk for the health and safety of the employees. Lastly, the management system shall be maintained and controlled by the organization. The requirements regarding a safety management system is less specific than the required management system according to article 3-1 of the Working Environment Act. The regulation does not put forth any more specified requirements than those listed above. Hence, the most detailed requirements regarding a safety management system is found in the Working Environment Act article 3-1 item 2.

5.3.2.5 Enforced self-regulation

Chapter 19 of the regulation puts forth several requirements that may be deemed to be in accordance with enforced self-regulation. For instance, the organization must keep track of all workers within the mine at all times and ensure that the mine is inspected at least once every shift. The inspection shall for instance include the measuring of methane gas concentration, inspection of the ventilation system and the physical state of the walls and roof of the mine. Moreover, the required safety management system is also a clear example of enforced self-regulation. However, the regulation does not explicitly state that the employer is responsible for safety related aspects of the mining operations, as opposed to the HSE-regulations for the petroleum industry. This responsibility is however given to the employer through the Working Environment Act as well as the Regulation on Industrial Safety.

Chapter 5 requires that a mining engineer is responsible for the daily operations of the mine. This person shall be responsible that all technical operations are conducted in a prudent manner. The responsible mining engineer shall hold a master's degree in mining engineering and must possess sufficient experience from mining operations.

Although there are some requirements of the Regulation for the Coal Mines on Svalbard ensuring self-regulation, the most decisive requirements are put forth by the Working Environment Act. For instance, article 3-1 requiring the safety management system.

5.3.2.6 Ventilation

Chapter 16 of the Regulation for Coal Mines on Svalbard regulates ventilation systems of the underground mines. As mentioned in chapter 2, the ventilation system is necessary in order to prevent the accumulation of methane gas within the mine. Chapter 16 contains seven articles regulating the design, functionality and maintenance of the ventilation systems. The chapter combines the use of performance based and prescriptive requirements. The prescriptive requirements are exclusively related to gas concentration levels. For instance, the mine shall be evacuated if the methane concentration exceeds 1.5%, and all power supply shall be cut off for all equipment if the methane concentration exceeds 1.0%.

The ventilation system shall be able to dilute explosive gas, such that the explosive component of the gas is less than 1.0%. The system shall also be able to ensure that the concentration of oxygen is more than 19% as well as the concentration of carbon dioxide is below 0.5%. This requirement specifically states the required functions of the ventilation system, but does not put forth any requirements as to how the ventilation system shall be designed. Another requirement regarding the ventilation of the mine is that the organization must develop a documentable system for the operation, maintenance and supervision of the system. In addition, the organization must produce maps showing the air flow of each ventilation district.

The requirements regarding the ventilation system are not very comprehensive or encompassing. They are performance based, like most of the requirements put forth by the regulation, and do require detailed knowledge about ventilation systems of underground mines in order to be able to comply. This required knowledge is reinforced by the fact that the regulation does not have a guideline referring to standards that are considered to comply with the regulations by the regulators.

5.4 Russian risk regulation of coal mining industry

To examine the legislative risk regulation of the Russian coal mining industry three central documents has been scrutinized. These documents have been recommended by professor Rudakov from the St. Petersburg Mining Institute.

Name of document	Type of document	Field/ Area	Language
Labour Code	Legal code	Occupational health and safety and working environment	Russian (Unofficial English edition available)
Zakon 116-FL: On industrial safety of hazardous production facilities	Federal law	Industrial safety	English
Rostechnadzor Order No. 550	Regulation	Industrial safety: “Safety rules in coal mines”	Russian

Table 10: Russian legal documents scrutinized

As seen from table 10, both the Labour Code and Rostechnadzor Order No. 550 is written in Russian. Hence, it has been necessary to translate these using Google Translate. The use of this program has been discussed in chapter 4. With a few exceptions, using this program to translate the Russian documents into English has proven quite effective. Hence, there has not been any major language barriers.

This sub-chapter will start by presenting the findings from the Labour Code and Zakon 116-FL. Next, the findings from the regulation Rostechnadzor Order No. 550 will be presented. As mentioned, the main emphasis will be on the regulation, as this document is believed to have the largest impact on the industry-specific legislative risk regulation of the Russian coal mining industry.

5.4.1 Laws

5.4.1.1 Labour Code

The Russian equivalent of the Norwegian Working Environment Act, the Labour Code, has been included as part of the legal documents scrutinized in this sub-chapter. Although included as part of the empirical basis, the labour code has not been examined as carefully as the other documents listed in table 11.

The Russian Labour Code is an extensive document consisting of 169 pages and close to 91,000 words, making it the most extensive document scrutinized in this thesis. The size of the document may be due to the fact that it is a legal *code*. A legal code is a legislative system trying to cover a complete system of laws within a given legal area (Mervartová, 2011), such as a criminal code or a civil code. The Labour Code consist of six parts, 16 sections, 62 chapters and 424 articles. Although the entire document has been examined, special attention has been given to Section X named "Labour Protection", which is considered to be the most important section regarding occupational health and safety (OSH).

What is considered of special interest concerning the Labour Code is its mention of an OSH management system. Article 212 of Section X of the Labour Code specifies the responsibility the employer holds regarding ensuring safe working conditions and labour protection. The article further requires the employer to establish and operate a functioning OSH management system. An OSH management system is according to the Labour Code, described as:

> "*The OSH management system is a complex of interrelated and interacting elements that establish the policy and objectives in the field of labor protection for a particular employer and procedures for achieving these goals. The standard provision on the OSH management system is approved by the federal executive body, which exercises the functions of developing state policy and regulatory and legal regulation in the world of work, taking into account the opinion of the Russian tripartite commission for regulating social and labor relations*"

Specific requirements regarding the OSH management system is not further put forth by the Labour Code. However, as stated above, it is the federal executive body regulating the Russian mining industry that shall provide provisions as to how the management system shall function and be operated. Section X of the Labour Code further requires the employer to develop internal rules and instructions ensuring the safety of the workers. The employees and their representatives shall be included in this process. Internal rules, instructions and procedures are considered to constitute a central part of the OSH management system. Requiring the organization to develop internal rules and instructions is also a clear example of enforced self-regulation. Several requirements put forth by the standard OHSAS 18001:2007 are also put forth by the Labour Code, but the requirements from the Labour Code are not explicitly mentioned to constitute a part of the OSH management system. As for the majority of the requirements put forth by the Labour Code, requirements regarding the OSH management system are performance based. Besides the requirements that are considered to indirectly concern the OSH management system, there is very little use of apparent enforced self-regulation with regards to occupational health and safety.

5.4.1.2 Zakon 116-FL

Zakon 116-FL: "On industrial safety of hazardous production facilities" (hereafter called 116-FL) regulates the industrial safety of production facilities deemed hazardous. 116-FL is a shorter document compared to the Labour Code, with 48 pages and 11,000 words divided into three chapters and 18 articles, as well as two attachments. The scope of the law is to prevent major industrial accidents that might occur at production facilities where the potential of major accidents is considered to be significant. It regards the entire life-cycle of an industrial production facility, from planning to decommissioning. What is considered to be a hazardous production facility encompasses a wide range of facilities, ranging from nuclear powerplants, facilities producing certain chemicals, gas stations and elevators. In order to better describe the hazard associated with the different types of production facilities, the law applies four different hazard classes. These are termed class 1 through class 4, where class 1 is considered the most hazardous (see table 11). What class a production facility belongs to is specified in an attachment of 116-FL.

Hazard class	**Hazard**	**Example**
Class 1	Extremely high hazard	Facilities storing chemical weapons
Class 2	High hazard	Pipes Transporting natural gas with pressure exceeding 1.2 MPa
Class 3	Average hazard	Elevator
Class 4	Low hazard	Facility storing 0.1-2 ton high-toxic substances

Table 11:Hazard classification according to 116-FL

As seen from table 11 the associated hazard to each production facility is based on a qualitative scale. 116-FL does not further explain what "extremely high hazard" entails or what this assessment is based on. What hazard class a production facility falls under is predetermined and is only related to the production facility itself or the activities/ operations carried out at the facility. It is the regulators that determines what hazard class a facility belongs to. For some cases the level of production or storage may determine the hazard class.

For instance, an elevator belongs to hazard class 3 regardless of design, layout or its use, whilst a chemical plant producing sulfur dioxide is a hazard class 1 if producing more than 2500 ton/ year or hazard class 4 if production is between 5 and 25 ton/ year. Hazard classes are of great importance in two regards: determining how governmental supervision shall be carried out, and weather an industrial safety management system is required.

Regarding underground coal mines, the hazard class is determined by what hazards are associated with the mine. According to Attachment 2 of 116-FL, an underground coal mine falls under hazard class 1 if at least one of the following hazards can be identified:

- Gas and (or) dust explosions
- Rock, gas and (or) dust sudden outburst
- Rockburst
- Breakthrough of water to the underground workings

As these are hazards associated with all underground coal mines, all underground coal mines are classified as hazard class 1. For open cast mines the classification depends on the volume of mined rock per year. Open cast mines are classified by the following criteria:

- Class 2: more than 1,000,000 m^3 per year
- Class 3: open 100,000-1,000,000 m^3 per year
- Class 4: less than 100,000 m^3 per year

As mentioned, the fact that all underground coal mines fall under hazard class 1 has two important implications for how they are regulated. The first consequence being the requirement of an industrial safety management system, the second being how governmental supervision is carried out.

Hazardous production facilities belonging to hazard class 1 or 2 are required to establish and ensure the functioning of an industrial safety management system. According to 116-FL's article 11 item 4, this management system shall ensure:

"identification of objectives and tasks of the organizations operating hazardous production facilities in the field of industrial safety, informing the public about these objectives and tasks;
identification, analysis and forecast of accident risk at hazardous production facilities and threats related to such accidents;
planning and implementation of actions on accidents risk reduction at hazardous production facilities including during execution of works or rendering services at hazardous production facilities by the external organizations or individual enterpreneurs;
work coordination on prevention of accidents and incidents at hazardous production facilities;
execution of industrial control for meeting industrial safety requirements;
safety of technical devices test use at hazardous production facilities in accordance with item 3 of Article 7 of the present Federal Law;
timely update of measures on accidents risk reduction at hazardous production facilities;
participation of the employees of the organizations operating hazardous production facilities in development and implementation of measures on accidents risk reduction at hazardous production facilities;
information support of exercising activity in the field of industrial safety."

As seen above, the industrial safety management system shall fill many roles and serve many functions. The management system shall ensure that hazards associated with the production facility are identified, their associated risks are analysed and assessed, as well as implementing actions for managing these risks. The participation of employees operating hazardous production facilities shall also be included in the effort to reduce risks. The government requires documentation about the established industrial safety management system.

How the organization shall be able meet the requirement stating the need for an industrial safety management system is not specified in 116-FL. Hence, this is a performance based requirement. The law does however state that the Russian government shall establish requirements regarding documentation concerning the safety management system. These requirements have not been uncovered, and therefore not further examined. These requirements may provide more details as to the intended function and the scope of the management system.

Although supervision is not one of the criteria given special attention in this thesis, the supervisory strategy used by the Russian regulators concerning the coal mining industry is considered interesting. There are three types of inspections carried out by the Russian regulators concerning major industrial accidents. The first form of inspection is those that are planned. According to 116-FL, planned inspections shall not be carried out more than once a year for class 1 and 2 hazardous production facilities. The second type of inspections are those that are not planned. These are often carried out if there are special concerns regarding a hazardous production facility. For example, after an accident or based on concern or reports of non-compliance with legal requirements. The third type of inspection is of major importance for the underground coal mines. Since underground coal mines are classified as hazard class 1 industrial production facilities they are subjected to a regime of permanent governmental control. This means that an inspector sent by the government may be present at the mine at any given time. 116-FL refers to Federal Law 294-FL "On the protection of legal entities and individual entrepreneurs" for the establishment of permanent state control. Permanent state control is described in article 13 item 1 of 294-FL, rendered below:

> *"In regard of legal entities and individual entrepreneurs operating high-risk facilities and exercising technological processes whereat which may pose a threat of infliction of harm to citizens' life and health, to the environment, to the ensuring the security of the state, and to the state and municipal property, as well as a threat of occurrence of natural and man-made emergencies the permanent state control (supervision) mode is established that provides for an opportunity for empowered officials of state control (supervision) bodies to continually stay at high-risk facilities and to implement control measures over safety status as well as the status of ensuring safety at such facilities."*

Hence, the regulators may establish permanent supervision of underground coal mines. What is also of interest, is that 294-FL allows for state officials to implement necessary safety measures to ensure safe operations. Whether this means halting mining activities deemed dangerous or impose minor safety measures that has minimal impact on the overall operations, has not been uncovered.

116-FL also specifies that production facilities of hazard class 1 or 2 carrying out mining activities must establish auxiliary mining-rescue teams. These teams form an emergency response that are to respond to any accidents within the open cast or underground mine. According to the law, the formation of these teams, as well as their specific tasks, are further specified in other regulations, without mentioning any specific regulations.

The requirements put forth by 116-FL are performance based. The law encompasses a wide range of hazardous production facilities, and its only focus is industrial safety. Hence, OSH is not mentioned in by the law.

5.4.2 Regulations

5.4.2.1 Rostechnadzor Order No. 550

The most central document regulating risk of the Russian underground mining industry is called Rostechnadzor Order No. 550 of November 19, 2013
"*On the Approval of Federal Norms and Rules in the Field of Industrial Safety" Safety Rules in Coal Mines*" (hereafter called Order No. 550). The regulation put forth very industry-specific requirements that are directly aimed at the Russian coal mining industry. The regulation has been translated from Russian to English using Google Translate. All findings are taken from the translated version.

5.4.2.2 General design of regulation

Order No. 550 is developed within the scope of 116-FL and regulates the underground mining activities in Russian. The scope of the regulation is to ensure safe operations and to prevent major industrial accidents. The regulation consists of 63 chapters and a total of 515 articles. Further, the document consists of 69 pages, with more than 44,000 words. Due to the extent of the regulation, not all chapters have been examined as thoroughly as others. However, the chapter regarding ventilation has been given special attention. The extent of the regulation is mainly due to the use of very specific prescriptive requirements. For instance, chapter 46 of Order No. 550 regulates the use of electrical wiring through 15 articles. This is more than twice the number of articles regulating the ventilation of Norwegian underground coal mines. Article 419 illustrates how detailed *some* of the requirements of the regulation are: "*For telephone and dispatch communication lines, it is necessary to use mine telephone cables with copper conductors and fiber. For local communication lines, flexible control cables are allowed in the faces*". Despite the heavy use of prescriptive requirements, some of the requirements are performance based. These are typically focusing on emergency preparedness and general management of the mine. In addition, requirements regarding fire safety are also performance based. Chapter 60, on fire safety and fire protection, consists of three articles. Article 473 states: "*Fire protection of a mine must be designed and constructed in such a way as to prevent the possibility of a fire, and in case of its occurrence, to ensure effective localization and extinguishing of the fire in its initial stage*". This requirement allows for the organization to choose freely how to ensure compliance.

As the requirements are very specific and detail oriented, most of the articles put forth by Order No. 550 are difficult to understand. This is mainly due to the use of technical terminology making it challenging to understand what the articles states/ requires. Therefore, to fully understand the requirements, it is necessary to possess in-depth knowledge about the mining industry and the equipment being used. This is illustrated by article 356 stating: "*Lifting and traction cargo lines of VC and B grades are used for human and cargo handling equipment and the rest are not lower than grade 1*". The regulation does not explain what VC, B grades or grade I is, making this requirement very difficult to understand. Another example is provided by article 245:

> *245. The radii of curvature of tracks and transfer curves in newly introduced mine workings for a track of 600 mm should be not less than 12 m, and for a track of 900 mm - not less than 20 m.*
> *On the interface of mine workings that are not intended for locomotive hauling, a radius of at least 4 times the largest rigid base of the rolling stock is allowed.*

The radius of curvature of railways with a track of 600 mm in the existing mine workings should not be less than 8 m, and for tracks with a track of 900 mm - less than 12 m.

The practical implication of this requirement is difficult to fully understand without experience from, or expertise within the coal industry. Whether article 245 is a requirement that has huge implication for the mining company, or if this is the only reasonable solution regarding railway tracks is not known. For instance, it is possible that these requirements are necessary in order to use common standardized equipment and machinery.

5.4.2.3 Safety management system

Order No. 550 does not put forth any requirements regarding a management system. Hence, all requirements regarding a safety management system is put forth by the Labour Code (regarding occupational health and safety) and 116-FL (regarding industrial safety).

5.4.2.4 Enforced self-regulation

Order No. 550 does not explicitly state that the employer is responsible for ensuring safe operations and working conditions. Nor does Order No. 550 does not appear to delegate any of the regulators responsibility or tasks to the organization. In other words, there is no apparent use of enforced self-regulation as a regulatory strategy. There are very few requirements forcing the organization to establish internal procedures or internal rules. These few requirements concern the establishment of procedures regarding emergency evacuation and procedures for rescuing workers within the mine in case of an accident. However, requirements that ensures that the organization self-regulates might be put forth by other federal laws and regulations that has not been examined for this study. However, based on Order No. 550 it is safe to say that enforced self-regulation is not a key regulatory strategy being applied by the Russian regulators. It is not considered an issue that the terminology used in the regulation makes the requirements challenging to understand. This terminology is mainly related to equipment and operations, and is thus not considered to be used for requirements regarding enforced self-regulation.

5.4.2.5 Order No. 550 on ventilation

Order No.550 provides 39 articles regulating the ventilation of underground coal mines. These requirements encompass the air quality and temperature within the mine, devices used for ventilation, how to operate and maintain them, as well as where to place them. These articles are very specific and detailed, especially compared to the requirements for ventilation stipulated in the Norwegian Regulation for Coal Mines on Svalbard. All the 39 requirements are prescriptive.

While the Norwegian regulation requires a ventilation system that is able to ensure an oxygen concentration of 19%, the Order No. 550 requires the ventilation system to ensure an oxygen concentration of 20%. The methane levels shall, as for the Norwegian coal mines, be kept under 1.0%. The maximum allowable concentration of carbon dioxide is identical for Norwegian and Russian coal mines, at 0.5%.

The specificity of the requirements is exemplified by article 24 of the Order No. 550. This article refers to Attachment 6 of the regulation, providing a table stating maximum allowable air speeds within the mine. The table is rendered in table 12.

Mine workings, ventilation devices	Maximum air speed , m / s
Ventilation wells	Not limited
Trunks and ventilation wells with lifting equipment designed only for lifting people in emergency cases, ventilation ducts	15
Trunks designed only for the descent and lifting of goods	12
Tube-type crossings and bridge-type bridges	10
Trunks for the descent and lifting of people and goods, cuts, the main haulage and ventilation drifts, capital and panel bremsbergs and slopes	8
All other mining workings carried out on coal and rock	6
In lavas and dead-end mine workings	4

Table 12: Maximum allowable air speed for ventilation system

This table does not provide any useful information unless one is familiar with the terminology used in the mining industry. This is representative for most of the requirements put forth by the regulation.

The requirements also refer to another regulation named Rostechnadzor Order No. 637 “Instruction for the compilation of ventilation plans for coal mines”. It has proved unsuccessful in obtaining this regulation, but it is meant to provide requirements on how the coal mining organization develops ventilation plans for their mines. Unfortunately, any specific requirements of the regulation have not been possible to examine.

Order No. 550 also refers to another regulation, called Order No. 704, regulating mine air composition, determination of gas content and the establishment of categories of mines for methane and carbon monoxide. Order No. 704 have not been further examined. The regulation of how underground coal mine shall be ventilated further exemplifies how specific and detailed most of the requirements put forth by Order No. 550 are.

6 Results and discussion

The following chapter will provide a discussion regarding the findings from the previous chapter. The discussion will be structured according to the criteria used when scrutinizing the legal frameworks regulating risk for each industry. Thereafter, a more general comparison of the industries will be presented.

It is believed that the documents analysed in chapter 5 encompasses the most important legal documents regulating risk for the industries examined. It is therefore considered that these documents provide a very good basis for assessing the criteria used for the comparison of the different industries.

6.1 General characteristics of legal documents

For the purpose of this thesis, the general design of the documents means the extent of the legal documents, the specificity of the requirements and the use of prescriptive and performance based requirements. In general, there is a clear link between the extensiveness, specificity and the types of requirements used for each legal document. However, there are exceptions. The general characteristics has been examined for all documents, but with special attention to the regulation of drilling and well activities for the Norwegian petroleum industry and ventilation of the Norwegian and Russian coal mining industry.

The reason these characteristics of the legal documents has been given attention, is that they are believed to have a big impact on how the industries are regulated. Especially the use of prescriptive and performance based requirements are considered to greatly affect how risks are regulated. Further, it is believed that the extensiveness and specificity of the legal documents are closely linked to the use of prescriptive or performance based requirements.

The number of words and number of pages for each legal document has been provided in order to give an idea of how extensive each document is. This is believed to be relevant as it speaks to how extensive the legal framework for each industry is. The number of articles is not considered as important as these often vary in length, and each article may contain several items. For instance, article 7-2 of the Norwegian Working Environment Act contains seven different items, each putting forth a requirement. The total number or requirements are therefore more interesting than the number of articles. However, it has proven difficult to count the number of requirements as many of the items from each article moderates or restricts the implication of other requirements, and does not put forth a requirement itself. Comparing the regulations, it is clear that there is a connection between the extensiveness of the regulation and the use of prescriptive and performance based requirements. This is especially apparent when comparing the regulation of Norwegian and Russian coal mining industry. While the Regulation for Coal Mines on Svalbard, which makes use of performance based requirements, consists of 2800 words, the Russian Order No. 550 consists of 44,000 words and makes heavy use of prescriptive requirements. However, comparing the regulations concerning Norwegian petroleum industry with the regulation on Russian underground coal mining industry this clear connection becomes less obvious. This is due to the fact that risks regarding the Norwegian petroleum industry is regulated by four key regulations, which combined consists of 39,000 words. These key HSE-regulations are more encompassing than Order No.550, which is considered to be the reason for the regulations' extensiveness. More encompassing means that the HSE-regulations regulates a wider range of activities compared to Order No. 550. Therefore, it is not possible to say that legal documents who uses prescriptive requirements are exclusively more extensive than legal documents using performance based requirements, but there is a clear correlation.

Comparing the general characteristics of the legal documents regulating drilling and well activities for the Norwegian petroleum industry and ventilation of underground coal mines for the Norwegian coal mining industry, there are not that many differences. Both are similar in regards to the use of performance based requirements, and as a result, the specificity of these are considered to be similar. The requirements regulating the ventilation of coal mines do apply some prescriptive requirements regarding acceptable methane-, oxygen- and carbon dioxide concentrations. There are no requirements regulating drilling and well activities that are deemed prescriptive. The regulation of the two industries do differ in regards to the number of requirements related to drilling and well activities, and ventilation of coal mines. Both the Facilities Regulation and the Activities Regulation put forth requirements regarding drilling and well activities. The requirements put forth by the Activities Regulation are considered to be more technical than those regulating ventilation of coal mines. That is, these requirements focus on the functions of specific equipment, which no requirements for the ventilation of coal mines does. The total number of articles regulating drilling and well activities is also twice that of the articles concerning ventilation of coal mines.

When comparing the general characteristics of the legislative risk regulation of the Norwegian and Russian coal mining industry, there are some fundamental differences. The Russian regulation Order No. 550 regulates the ventilation of underground coal mines through 39 articles. This is almost six times the number of articles regulating the ventilation of Norwegian underground coal mines, which only puts forth seven. The number of articles is a direct consequence of the use of prescriptive and performance based requirements. While the Norwegian Regulation for the Coal Mines on Svalbard applies performance based requirements, the Russian regulation makes use of prescriptive requirements. The fact that the Russian requirements regarding ventilation are more specific makes them more challenging to understand for lay people. The terminology and the use of numerical values means that the persons trying to comply with the regulation must possess great knowledge and competence regarding ventilation of underground coal mines. Whereas performance based requirements might lead to confusion as to what solutions is required in order to comply, the prescriptive requirements of Order No. 550 pose a challenge when trying to understand what solutions is stipulated by the requirements. This is mainly due to industry-specific terminology, heavy use of abbreviations and numerical values. However, as the regulation is intended for industry professionals, the specificity of the requirements is not considered to be problematic. Regarding similarities between the how risk is regulated for the two coal mining industries, one must look at the laws rather than the regulations. The Russian Labour Code and 116-FL, and the Norwegian Working Environment Act all apply performance based requirements. However, it is worth noticing that while the Norwegian Working Environment Act covers both OSH and industrial safety, the Labour Code and 116-FL makes clear distinctions between the two. The Labour Code only concerns OSH, while 116-FL only concerns industrial safety. Both legal frameworks are considered to correspond with ILO C176. However, as this shall create a common legal basis for how both industries are regulated, it was expected that there would be more similarities than differences for how risk is regulated through the use of legal requirements. A possible explanation is that the requirements stipulated in C176 are performance based. Hence, if these are "translated" into prescriptive requirements for the Russian legal documents their resemblance to the Norwegian performance based requirements might become less obvious. There are however no requirements put forth by either country that are considered to contradict the requirements put forth by C176.

Several of the differences for how ventilation of coal mines is regulated in Russia and Norway regarding the general characteristics of the legal documents is also found when comparing how drilling and well activities are regulated for the Norwegian petroleum industry and Russian coal mining industry. This is due to the fact that legal documents regulating Norwegian petroleum and coal mining industry share several characteristics. The regulation of the drilling and well activities and the Russian regulation of ventilation of underground coal mines are considered similar in regards to the number of requirements put forth for each industry. As mentioned above, the reason why the Norwegian petroleum industry is subjected to a large number of legal requirements is thought to be related to the number of organizations and the variety of activities being regulated. This is supported by the fact that drilling and well activities are regulated by only 15 articles, whereas the ventilation of Russian underground coal mines is regulated by 39 articles. The use of prescriptive and performance based requirements also differs greatly. While the Russian regulation uses prescriptive requirements, the Norwegian petroleum industry is subjected to a large number of performance based requirements.

It is argued that the use of performance based requirements will influence the risk assessments carried out by the organization. As prescriptive requirements determine what level of safety that shall be attained, the organization must comply with these requirements in order to obtain this level. Hence, the need for carrying out risk assessments is reduced compared to when performance based requirements are used. Performance based requirements specify *what* level of safety that shall be achieved, but does not indicate *how*. Therefore, the organization might have to carry out several risk assessments in order to determine whether the required level of safety is achieved or not.

To summarize, the extensiveness of the legal documents is closely linked to the use of prescriptive or performance based requirements, and the specificity of these. The use of prescriptive requirements will result in a need for the requirements to be more specific, thus making the number of requirements greater. Hence, the legal documents will be more extensive compared to those that to a greater extent uses performance based requirements. However, performance based requirements may be vague and therefore complicate the efforts of complying. Further, the Order No. 550 heavily applies industry-specific terminology. This is considered natural as the requirements are very specific and detailed. However, a result is that it is challenging to understand what requirement is being put forth by each article. In order to comply one obviously has to understand what the articles requires the organizations to do. As a result, those complying must possess great knowledge about the coal mining industry. This also goes for the Norwegian petroleum and coal mining industry, but for a different reason. The requirements put forth by these regulations are easier to understand, but knowing how to comply might be more difficult. That is, in order to understand what solutions will meet the requirements, one has to know what level of safety is being obtained by different solutions. Hence, both prescriptive and performance based requirements put forth for each industry requires competent and knowledgeable personnel. Finally, the use of prescriptive and performance based requirements is thought to affect to what degree the organizations are required to carry out risk assessments.

6.2 Enforced self-regulation

The Norwegian petroleum and coal mining industry, and the Russian coal mining industry are, of varying degree, regulated through the use of enforced self-regulation. For instance, requiring the organizations to establish and operate a safety management system is considered to be a method of ensuring that the organizations self-regulate. As seen in chapter 5, all industries examined in this thesis is required to have a safety management system. Further, the fact that the legal documents states that the organization is responsible for the safety of their operations is not considered to be encompassed by enforced self-regulation. To make the organization accountable is instead considered to be a strategy to ensure that the organizations comply with the legal requirements, and have a legal basis for sanctioning those who do not.

The use of enforced self-regulation is prominent, both for the Norwegian petroleum industry and the Norwegian coal mining industry. However, the number of requirements requiring self-regulation for the petroleum industry is larger compared to the Norwegian coal mining industry. A natural explanation would be the extent of the legal documents and the number of requirements put forth by them, compared to the legal documents concerning the Norwegian coal mining industry. Another explanation might be that the PSA has a strong focus on their use of enforced self-regulation, and considers it to be an important and useful regulatory strategy. Regardless as to why, the regulations concerning the Norwegian petroleum industry gives the use of enforced self-regulation more focus compared to the regulations for the Norwegian coal mining industry.

Enforced self-regulation is not as prominent when scrutinizing the Russian legal documents. The Labour code requires the organization to establish internal rules and instructions. Further, both the Labour Code and 116-FL do require the organizations to make use of a management system. These management systems are clearly distinguished as the Labour Code concerns OSH and 116-FL concerns industrial safety. However, there are no clear examples of enforced self-regulation found in the regulation Order No. 550. Still, some of the requirements put forth by this regulation might indirectly require the organization to self-regulate. But since this has not been uncovered, it is believed that this regulatory strategy is not applied for regulations specifically aimed at underground coal mines. The lacking use of enforced self-regulation means that the regulators takes greater responsibility for the safety of the underground coal mining industry (Engen O. A., et al., 2013).

By scrutinizing the legal documents regulating the risk of each industry it is argued that the Norwegian petroleum industry is the industry subjected to heaviest use of enforced self-regulation. The Norwegian coal mining industry is also subjected to this regulatory strategy to a great extent. However, either due to the fewer requirements regulating the industry, or the regulators conscious decision to limit its use, the legal documents regulating the Norwegian coal mining industry does not apply this strategy to the same extent as the legal documents concerning the petroleum industry. Lastly, the Russian coal mining industry is not required to self-regulated to the same extent as the aforementioned industries. It feels natural to include the fact that Russian underground coal mines may be subjected to permanent governmental supervision. This might undermine the use of enforced self-regulation, and might even be considered to contradict the use of this regulatory strategy.

In order to try to explain why the use of enforced self-regulation differs across countries and industries of the same country, it might be useful to examine the legal document’s use of prescriptive and performance based requirements. As mentioned, Norwegian coal mining industry and petroleum industry is mainly regulated through the use of performance based requirements, whilst the Russian coal mining industry is mainly regulated using prescriptive requirements. It is argued that there is a strong connection between the use of performance based requirements and the use of enforced self-regulation. As prescriptive requirements leave the organizations with a much smaller space for action (according to figure 12) there is less room for the organization to self-regulation. A possible consequence might therefore be that the Russian regulators will find it more difficult or more challenging to make use of enforced self-regulation as a regulatory strategy. On the other hand, performance based requirements give the organizations the opportunity to choose how to comply. This makes the organization responsible for achieving acceptable levels of safety. As a result, it is considered more natural that the regulators require the organizations to self-regulate as a mean of ensuring compliance.

The enforcement of prescriptive and performance based requirements might also affect the use of enforced self-regulation. As the enforcement of prescriptive requirements often are compliance oriented, an organization that self-regulates might make the enforcement of the prescriptive requirements more complicated. Self-regulation might force the regulators to assess entire systems, either technical or organizational, rather than the compliance of single, specific requirements. In other words, it is believed that the introduction of enforced self-regulation will force the regulators to assess compliance using a more holistic perspective. When enforcing performance based requirements, the regulators often assess the results achieved, rather than the compliance of single requirements. Hence, the use of enforced self-regulation will not complicate the enforcement of requirements to the same degree as when enforcing prescriptive requirements by ensuring compliance.

Enforced self-regulation is believed to have several advantages. For instance, the use of enforced self-regulation might improve the level of ownership each organization feels regarding safety for their own operations and activities. Further, the fact that the organizations possesses more in-depth knowledge about their safety related work compared to the regulators also makes it seem reasonable to give them the responsibility and opportunity to more freely manage their safety levels. This allows for a more effective use of resources and a better understanding of what measures are required in order to attain the acceptable safety levels. Alternatively, this responsibility would lie with the regulators who would be required to have detailed knowledge about all operations, activities, procedures and equipment for each organization. This would also call for a compliance oriented supervision, rather than a result oriented approach. Hence, it could be argued that enforced self-regulation allows for the use of result oriented enforcement. It may also be argued that the organizations have more to gain from preventing accidents than the regulators. A major industrial accident will cause huge financial losses as the organization must halt their operations in order to normalize the situation. Their reputation might also be weakened, which will have several negative implications. This all indicates that the use of enforced self-regulation will contribute to a higher level of safety for the organizations as it motivates (or forces) the organizations to give attention to the safety levels regarding their operations. Another advantage of making use of enforced self-regulation is that it could reduce the workload of the regulators. The regulators can transfer some of their tasks and duties to the organizations through the use of legal requirements. This allows for the regulators to use their resources on other matters that might be deemed more important.

However, if the organization subjected to enforced self-regulation lacks the necessary knowledge and competence in order to self-regulation, this regulatory strategy will not be as effective. It also requires that the regulators are able to assess the level of safety based on a more holistic perspective as opposed to a compliance oriented enforcement where a requirement is either complied with or not. Hence, it could be argued the regulators also must possess the competence required to assess the overall safety of the organization and their activities.

To summarize, the use of enforced self-regulation is prominent for both the Norwegian industries. The use of performance based requirements allows for, and encourages, the use of this regulatory strategy. Enforced self-regulation can be very efficient in ensuring acceptable levels of safety. This will however require that the organization possesses the necessary knowledge and competence, allowing them to implement the correct measures in order to ensure satisfying levels of safety. The Russian coal mining industry however is not subjected to the same degree of enforced self-regulation. This may be due to the use of prescriptive requirements hampering the regulatory strategy's effectiveness.

6.3 Safety Management System

Legal requirements regarding a safety management system is found for all industries. In general, these requirements are mainly put forth by the laws, rather than the regulations. However, there are requirements regarding the safety management system (SMS) found in the Norwegian regulations, concerning both the petroleum and the coal mining industry. For the Russian coal mining industry all requirements regarding a SMS is put forth by the Labour Code and 116-FL. In general, all requirements put forth for the three different industries regarding a safety management system are performance based. This makes sense as organizations differ in size, the nature of their operations and activities will vary, and they will have differing safety cultures. Hence, different organizations will have different needs that are met by different safety management systems. Hence, by putting forth detailed prescriptive requirements along with a "one-size-fits-all"-philosophy, the regulators would force certain organizations to operate a SMS that is less efficient compared to a SMS tailored to their needs. Consequently, it is considered reasonable to give each organization the freedom to develop their own safety management system, and thus ensure that it meets each organization's needs. It is therefore arguably more practical using performance based requirements rather than prescriptive requirements regarding safety management systems.

As mentioned in chapter 3, there are several recognized standards that are developed in order to comply with requirements regarding the safety management system. Just like the required safety management systems described by the legal documents, these standards are not very specific. OHSAS 18001: 2007 arguments that this is due to the same reasons mentioned above: different organizations will require different managements systems that meet their specific needs. However, the OHSAS 18001:2007 is far more specific regarding the requirements of the SMS than any legal documents scrutinized in this thesis.

It is difficult to determine whether the requirements regarding a SMS is stricter for the Norwegian petroleum industry compared to the Norwegian coal mining industry. What makes it seem like the requirements are stricter for the petroleum industry is the fact that the HSE regulation's requirements regarding the SMS are more comprehensive and exhaustive compared to the required SMS for the coal mining industry. However, this is by itself not a definitive proof that the safety management system is given more focus for the petroleum industry.

Chapter 5.3.2.1 mentions that the Regulation on Internal Control specifically does not apply to Svalbard, thus not the Norwegian coal mining industry. As this regulation concerns labour protection the regulation should be valid on Svalbard according to the Svalbard Act article 3. As this regulation makes additional requirements regarding the SMS, it is considered odd that the coal mining industry is exempt of this regulation. The explanation might be Svalbard's international status, meaning that the presences of other nations makes this regulation difficult to enforce. However, this has not been further examined.

It is also of interest that the Norwegian legislation does not differ between OSH and industrial safety. Consequently, the SMS must cover both areas. The practical implication of using a SMS concerning both OSH and industrial safety is not further examined. However, the PSA approves a management system that includes safety, quality, energy etc. In addition, the SMS described by OHSAS 18001:2007 are compatible with standards concerning other management systems, further indicating that the combination of several management systems is advantageous.

Both the Russian Labour Code and the Federal Law Zakon 116-FL puts forth requirements concerning a safety management system. As opposed to the Norwegian requirements regarding a SMS, the Russian legislation makes a clear distinction between OSH and industrial safety. An OSH management system is required by the Labour Code and an industrial safety management system is required by Federal Law 116-FL. However, according to professor Rudakov, it is not unusual to combine these two management systems. Furthermore, the fact that the organizations operating within the Russian coal mining industry are obligated to establish, maintain and further develop a safety management system might be considered a contradiction to the otherwise lacking use of enforced self-regulation.

Regarding ILO C176, there are no explicit mention of a safety management system. However, the convention does put forth some requirements that are considered to be central functions of the described safety management system by both the Norwegian and Russian regulations on underground coal mining. There are no requirements regarding the management system described by the legal documents that contradicts any of the requirements put forth by the ILO C176. Oppositely, there are no requirements put forth by the ILO C176 with implications to the management system that contradicts the requirements put forth by the legal documents. Hence, with respect to the safety management system, there are consistency between the requirements with implications to the management system put forth by the ILO C176 and the requirements put forth by the legal documents regulating the coal mining industry in Norway and Russia.

Both Norwegian and Russian regulators consider the certification of a management system according to industry recognized standards to comply with their requirements. According to professor Rudakov, standards like OHSAS 18001:2007 are considered to comply with the Russian requirements regarding the management system. This means if a coal mining organization is certified according to this standard, the regulators considers the requirements to be met. PSA also considers the requirements regarding a safety management system met when OHSAS 18001:2007 is applied. Unfortunately, it has not been possible to uncover if this standard is considered to comply with the legal requirements of a SMS regarding the Norwegian coal mining industry. If the regulators of the Norwegian coal mining industry consider the standard to comply with their requirements, this would mean that all three industries are able to subscribe to the same standard in order to ensure compliance. This would mean that the requirements regarding a safety management system are the same for all industries examined in this thesis, just formulated differently. However, if the organizations choose to not make use of standards, it is uncertain whether the same safety management system would comply with the requirements for all three industries. That being said, there has not been uncovered any contradicting requirements when comparing the required SMS. The biggest difference is the specificity of the requirements, which is thought to be not very different.

How compliance is ensured, the practical implication of, and the use of the SMS has not been examined in this thesis. This, in combination with performance based requirements, has made it challenging to understand what is required in order to comply with the legislation regarding the SMS. This might indicate that if an organization chooses not to apply an industry standard to ensure compliance, the organization must possess a significant level of knowledge and competence regarding SMSs. Alternatively, the regulators must guide and assist the organizations. The PSA describes themselves as watchdogs and guides, meaning they are willing to help organizations who are trying to comply with the legislation (Midttun, 2016). There has not been found any documents stating that the regulators of Norwegian and Russian coal mining industry fill the same role.

6.4 Comparing the industries

The following will summarize the comparison of the industries according to figure 13.

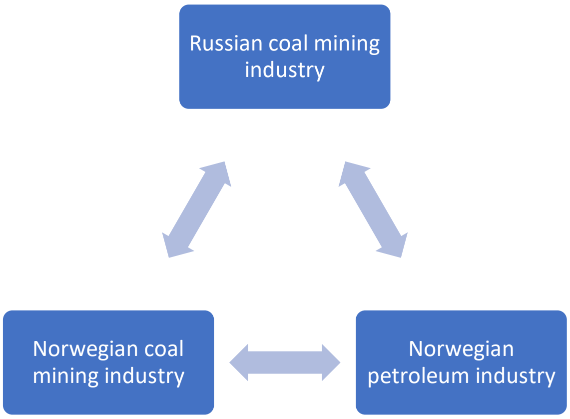

Figure 14: Comparison of the three industries examined

There are more similarities than differences regarding the legislative risk regulation of the Norwegian petroleum industry and the Norwegian coal mining industry. The biggest difference is considered to be the extent of the legal documents. The petroleum industry is regulated by four key regulations that are all mainly using performance based requirements. The regulation concerning Norwegian coal mining industry however is relatively brief, and does not put forth as many requirements. Hence, there are more requirements regulating the petroleum industry than the coal mining industry. This might relate to the number of organizations and their different types of activities being regulated by the legal documents concerning the petroleum industry. As different operations and activities faces different hazards and risks, this might call for a legal framework that is able to encompass all of them. Hence, the fact that the legislation for the petroleum industry is more extensive than for the coal mining industry is considered natural. Further, both industries are mainly regulated using performance based requirements. There has not been uncovered any major differences regarding the use of enforced self-regulation. Both industries are subjected to requirements ensuring that organizations self-regulate. As mentioned above, the PSA considers this regulatory strategy to be of great importance when regulating risk in the petroleum industry. Further, both industries are required to use a safety management system and the requirements regarding this system are very similar. This is mainly due to the Norwegian Working Environment Act putting forth the most deciding requirements. There are also some requirements put forth by two of the key HSE-regulations for the petroleum industry.

Legislative risk regulation of the Norwegian petroleum industry and the Russian coal mining industry are carried out quite differently. The main similarity is considered to be the requirements regarding the safety management system. Organizations of both industries may comply to requirements concerning the SMS by using the standard OHSAS 18001: 2007. Further, the number of requirements regulating the Norwegian petroleum industry and the Russian coal mining industry are similar. The reason for the approximate equal number of requirements are for different reasons. When only considering the drilling and well activities, and the ventilation of underground coal mines, the number of requirements vary greatly. 39 prescriptive articles regulate the ventilation of Russian underground coal mines, whereas 15 articles regulate the drilling and well activities for the Norwegian petroleum industry. This indicates that the use of prescriptive requirements in general requires a more extensive legal document as opposed to using performance based requirements. Further, the use of enforced self-regulation as a regulatory strategy varies greatly between the two industries. The Norwegian petroleum industry is subjected to enforced self-regulation to a great extent, whereas the use of this strategy is very restricted regarding the Russian coal mining industry. Whereas both Norwegian laws and regulations regulating the petroleum industry forces the organizations to self-regulated, it is only the Russian Labour Code and 116-FL that makes use of this strategy when putting forth requirements concerning a safety management system. The Russian regulation Order No. 550 does not include enforced self-regulation as a regulatory strategy.

The two industries examined for this thesis that are believed to have the biggest differences as to how they are regulated is the Norwegian and the Russian coal mining industry. This is considered to be surprising as it was thought that the ILO C176 would lead to the legislative risk regulation of the two industries to be more similar. However, there has not been uncovered any legal requirements for either the Norwegian or the Russian coal mining industry that are contradictory to the requirements put forth by the convention. Apart from similar requirements regarding a safety management system, there are not any clear similarities when considering the criteria examined for this thesis. The regulations vary in their extent, use of prescriptive and performance based requirements, and use of enforced self-regulation. Regarding the Russian Order No. 550 and the Norwegian Regulation for Coal Mines on Svalbard, although sharing similar scope, Order No. 550 consists of almost 16 times as many words as the Norwegian regulation, which is probably the most striking difference. This is related to both the heavy use of prescriptive requirements and the specificity of the requirements put forth by Order No. 550. The different use of enforced self-regulation are very similar as to when comparing the Norwegian petroleum industry and the Russian coal mining industry. That is, the Norwegian regulations applies this strategy to a great extent, while the Russian regulations does not, apart from some requirements concerning the safety management system and a few requiring the organization to establish internal rules and instructions.

7 Conclusion

This chapter will summarize the findings from chapter 6. The comparison of the three industries examined are presented in table 13.

	General characteristics of regulations	**Enforced self-regulation**	**Safety management system**
Norwegian coal mining industry	Rather brief, heavy use of performance based requirements	Prominent use as regulatory strategy	Required by law
Norwegian petroleum industry	Extensive, encompasses large variety of operations and activities, heavy use of performance based requirements	Prominent use as regulatory strategy	Required by law and regulations
Russian coal mining industry	Extensive and specific, heavy use of prescriptive requirements	Very limited use	Required by law

Table 13: Comparative table for risk regulation of the different industries

The criteria examined in this thesis is considered to be closely linked. It is mainly the use of prescriptive or performance based requirements that affect the other criteria examined. Although being careful as to not generalize all legal documents based on those few that are examined for this thesis, the use of prescriptive requirements leads to more extensive and specific legal documents. It further hampers the use of enforced self-regulation as a regulatory strategy. The reason why combining prescriptive requirements and enforced self-regulation is considered challenging is the fact that prescriptive requirements leaves those subjected to them (to a varying degree) unable to decide *how* to comply with them. Hence, the space for action, and possibility to self-regulate, is limited. Another consequence is that the use of prescriptive requirements leads to compliance oriented supervision. Further, regulating risk through the use prescriptive requirements means that the regulators takes a greater responsibility regarding safety compared to when using performance based requirements.

The use of performance based requirements almost represents an opposite when concerning the criteria examined in this thesis. Solely based on the legal documents examined, performance based requirements reduce the legal documents' extensiveness, and the number of requirements are reduced. The requirements are also less specific compared to the prescriptive requirements. However, the extensiveness of the legal documents is not only related to the use of prescriptive and performance based requirements. The Norwegian legal documents regulating the petroleum industry are noticeably more extensive than the regulations concerning the Norwegian coal mining industry. This is due to the regulations of the petroleum industry covers a wider range of activities and operations than the Regulation for the Coal Mines on Svalbard.

It is also considered natural to combine the use of performance based requirements and enforced self-regulation. As the requirements leaves the organization with a large "space for action", it makes sense that the regulators make the organizations responsible for the safety regarding their operations and activities. Hence, the regulators are less responsible for ensuring an acceptable level of safety compared to when using prescriptive requirements. This is the case for the two Norwegian industries examined in this thesis. The legal documents are very clear when making the organizations accountable for any safety related aspects of their operations. The performance based requirements regarding a safety management system is also considered to be a clear example of enforced self-regulation. Further, the use of performance based requirements calls for a result oriented supervision. Result oriented supervision asserts compliance to the legal requirements by assessing whether the required level of safety is attained or not, rather than focusing on the compliance of single requirements.

It is also argued that the risk assessments carried out by the organizations are affected by the use of prescriptive and performance based requirements. By using prescriptive requirements, the organizations can more easily ensure acceptable levels of safety by simply adopting the solutions stipulated by the legal requirements. Performance based requirements on the other hand will require the organizations to carry out risk assessments in order for them to ensure that the desired level of safety is attained.

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