

# MASTEROPPGAVE

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## Decisions and Sensemaking in The Uncertain Environment of Oil Industry

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Date: 08.06.2016

Pages: 78

## ***Abstract***

*This master thesis represents the end of a major in Master of Science in Energy Management. This thesis discusses what key actors in the context of what tools decision makers in oil companies uses in their investment decisions, and how these images are constructed. This thesis is based on qualitative approach in form of conversational interviews with three highly experienced informants from the petroleum industry. In addition to this, previous reports, articles and documents have been used to verify the primary data.*

*The main result of this study is that oil companies use rational, mathematical models in form of NPV, IRR and several others in their investment decisions. However, because of highly uncertain and complex environment of the industry, it becomes visible that rational tools do not provide a conclusive guide for investment decisions. As a result, decision makers have to ultimately rely on their own cognitive skill.*

## **Acknowledgement**

I would like to thank my supervisor June Borge Doornich at Bodø Graduate school of Business for great guidance and feedback during this semester. After each meeting, I had more motivations and ideas on how to solve challenges I faced through the process.

I also want to thank Kristian Støre and Anatoli Bourmistrov for great input and all my informants that took the time from their very hectic schedule for an interview. My interest for this topic has grown each interview I have had with informants.

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## Chapter 1

### 1.0 Introduction

The global energy market is experiencing one of the largest transformations in history. The unpredicted, rapid price fall of 60 percent between June 2014 and January 2015 was one of the largest of its kind during the past 30 years, ending a five- year era of high and stable global oil price around \$105 dollar per barrel. Although this sudden decline was driven by several reasons that imbalanced the global supply-demand marked, the rapid growth on unconventional oil in America and OPECs sudden shift in policy is believed to be the major factors. Because of the technological innovation of horizontal drilling combined with hydraulic fracking, the oil production in US has since 2008 increased by 80 percent, or four million barrel per day. At the same time, the country's oil imports have declined from 60 percent to 20 percent. This development from the world's largest oil consumer has directly led to today's oil price collapse (Baffes et el, 2015). One other major factor for this development is indeed the OPEC (Organization of the Petroleum Exporting countries), or rather Saudi Arabia's shifting policy. The Cartel, who has maintained the stability in the supply market for over 40 years, now seems suddenly unpredictable. Instead of cutting production to balance the market as they usually have done in previous oil price collapse, they have rather increased their production from their official quota of 30 million barrel per day to nearly 32 million barrel per day(Yager, 2015).

The startling aspect of this recent oil price collapse is that it came out of nowhere. There were no "credible" forecast before the collapse that predicted this development. In a Bloomberg article in late 2013 named "*most accurate oil price forecasts*" predicted an oil price of \$105 for the year, illustrating the unpredictability of these forecasts and of the market (Smith, 2013). One of the lowest forecasts was done by Edward Morse, the head of global commodity research, which predicted a price of \$75 as plausible (Platts, 2014).

International oil companies, which are closer to the industry and its activities, were also wrong as the rest and have suffered greatly for it. There are speculations that one of the major factors for our current oil price collapse is due to overinvestments from the oil and gas companies during 2013-2014. This overinvestment reached its peak in 2013 when the cumulative investment that year was approximately \$900 billion in exploration and

development (Nysveen and Islam, 2015). Most of these investments are considered today as highly “risky”, meaning that there are potential for loss. It seems that many oil companies have made their investment valuation based upon the assumption that the oil price would remain in a triple-digit number for the years to come. As the CEO of Chevron stated, “*there is a new reality in our business...where \$100 p/b is becoming the new \$20 p/b*” (Platts, 2014).

### ***1.1 Norwegian Perspective***

“*Norway’s oil industry is in a crisis now, we can’t deny it anymore*”, said Bente Nyland, director general of the Norwegian Petroleum Directorate. (Holter, 2016)

Norwegian petroleum industry, which has been a crucial driver for the country’s economic growth since the 1970s, has also been affected of the recent oil price collapse. The country, which is Western Europe’s biggest oil supplier, has announced major cuts for the second straight year. Investments in the Norwegian continental shelf in 2016 are estimated to drop by 10 percent, to \$15 billion, and will gradually fall to \$14.4 billion in 2008 (Holter, 2016). According to Norwegian Petroleum Directorate, there will not be an upturn in investment before 2019. This is a year later than predicted in 2014. Exploration expenditure in the country has also declined by 33 percent to \$2.7 billion in 2016, with 30 wells drilled compared to 56 in previous year. The development is predicted to continue next year, which again will lead to mid-term consequences (Holter, 2016).

Furthermore, with an oil price collapse of more than 70 percent since June 2014, over 30,000 people has been sacked in the industry and more than 200,000 workers are at risk (Wynne, 2016). Statoil, Norway’s largest company have already been reducing investment to shield their profits. Statoil announced that they were cutting capital expenditure by \$1 billion, to \$16 billion. The company also announced their strategy for improving efficiency with \$1.7 billion from 2016 an onwards, and a part of this achievement would be by cutting unnecessary labor. They announced that up to 1500 employees and 500 consultants could be sacked during 2016 (Exarheas, 2015).

Statoil has been much criticized by the public for their investment decisions during these recent years. It is especially their foreign investment in North America that have received attention in the media. Many experts believe that the company’s investment decisions



regarding this region has been poor and more planning and exploration was needed before these major decisions should have been made. The company has simply been willing to pay more for these projects than they were originally worth (Storeng, 2015).

### ***1.2 Dilemma and contribution***

There is an obvious dilemma in this context. Oil companies operate in a highly unpredictable and volatile environment where the price of oil constantly changing because of global events. Because of this, project investment decisions, which are typically long-term and counts for billions of NOK, becomes complex and uncertain. Any tools to make investment decision within this industry needs to take into account these factors. To determine investment decisions, oil companies today typically use rational tools in form of various financial analysis. Decision makers inside companies are expected to act rationally based on the financial feedbacks they receive from these tools. However, considering the uncertain industry environment and companies' limited available information about future events, it is easy to recognize the limitation of these tools as a basis of investment decisions. This naturally creates a challenge of how investment decisions are achieved in an uncertain environment such as in oil industry.

This study will cast a glimpse of how phenomena “management of uncertainty” are constructed by interacting with several informants and examine how they construct an image of this phenomenon. The phenomena are naturally not objective, but rather constructed by the subjective awareness and understanding. This study will give a perspective of how decisions inside companies in uncertain environment actually are realized.

### ***1.3 Purpose***

What becomes relevant in the context of uncertainty and complexity of the oil industry, is how informants are realizing investment decisions. The purpose of this thesis is therefore to explore investment decisions during management of uncertainty, and how images are constructed to give meaning and realize this phenomenon. To be able to explore my phenomena, the following statement will be foundation of my thesis:

*“What tools are used for investment decisions and how does decision makers make sense of investment during uncertainty?”*

### ***1.4 Structure***

This thesis will follow the basic formal requirement, and begins by presenting the theoretical frameworks for this thesis. I will first examine how risk and uncertainty are being viewed in the academic and practical world, and then present the rational choice theory with some investment valuation tools that are being used by most oil companies today. Further, I will look at the relevance of sensemaking in an uncertain environment.

Chapter three present the methodology in this thesis. I begin by presenting my philosophical approach, thus social constructionism. Then presenting qualitative process of gathering and analyzing my findings. Further, I will explain the process of analyzing findings. Finally, I will present the level of validity and reliability of findings.

I have in chapter four first presented the context of the uncertainty in the oil industry environment, and then presenting my empirical findings gathered from informants. I will give an overview of how informants construct images of the way investment decisions are achieved inside oil companies. Chapter five will present analysis where I discuss my empirical findings with theoretical framework, and finally come up with few concluding remarks.

## Chapter 2

### 2. Theoretical Framework

#### ***2.1 Introduction***

In this chapter, I will present a literature review of the relevant theoretical approaches of the topics' rational choice theory and Sensemaking theory. I will provide an overview of how contributors have defined the theories that are mentioned in this paper. I begin to examine how risk and uncertainty are described in the decision-making literature by academics and organizations. I will thereby refer to rational choice theory and few assumptions and the principle of this approach. Further, I will review how decision making and sensemaking are related to each other.

#### ***2.2 Complexity and uncertainty in decision***

Selecting alternative capital investment opportunities is one of the most difficult decisions a company has to make. Decision maker often have to choose to invest a large amount of money today in the hope of making a profit in the future. Oil companies often have to invest in exploration in order to make future long-term profits. Further, because of the complexity and uncertainty of each project, decision-makers will eventually make some mistakes along the way (Macmillan and Hons, 2000).

For each time a decision maker attempt to make a decision, there will be some sort of complexity linked to it. This complexity typically occur when decision-makers have several decision alternatives to choose from, and each has quite different consequences. In the case of the oil industry, a CEO could, for example, have the options of further appraising a well, focusing more on seismic examination, or starting with the actual exploration drilling. Uncertainty is certainly indeed in all sorts of decision-making. However, uncertainty normally tends to have a positive correlation with the consequence of decisions. This indicates that the higher the risk, the higher the uncertainty is (Macmillan and Hons, 2000).

Furthermore, one of the major reasons for many managers' failures in decision-making today is that they are attempting to solve, or rather fulfill several of their organizational goals with a single decision. This typically increases risk in most cases. Taking this into account, it is perhaps not that surprising that there is only a ten percent chance of major success in the

entrepreneur business, and the same applies to the oil drilling industry (Macmillan and Hons, 2000).

### ***2.2.1 Risk and uncertainty***

Risk and uncertainty are two factors that have always been a hot topic among scholars and others. Managers and other decision makers do still disagree at some level on exactly how to handle risk and uncertainty in a business environment. Some take an analytical approach while others show initiative in their thinking. To tackle this topic, I will first look at how investment decision makers interpret risk and uncertainty. Second, I will look at how decision-makers deal with this risk and uncertainty.

It is clear that risk and uncertainty exist in all kinds of investment decision-making. This assumption is well-deserved. If we absorb a realistic environment in an organization, risk and uncertainty represent a big part of the effective capital investment decision making (Macmillan and Hons, 2000).

There is evidence that the amount of risk and uncertainty adopted by the decision maker could affect the type of method he or she selects. It has also been proven that decision maker that explores different types of risk and uncertainty responds differently. However, there is unfortunately not enough compelling evidence today to conclude one way or the other (Macmillan and Hons, 2000). Furthermore, the decision-making literature does not provide us with a clear definition of risk and uncertainty. As Argote (1982) argues that *“There are almost as many definitions of risk and uncertainty as there are treatments on this subject.”* Yates (1992) also suggest that *“If we were to read ten different articles or books about risks, we should not be surprised to see risks described in ten different ways.”*

The table below illustrates how different authors in decision literature define risk and uncertainty. It clearly shows that there is are no clear definition of what exactly risk and uncertainty in the decision-making literature are. However, it does show that risk and uncertainty are indeed inherent with one another.

AUTHORS	TERM	CONCEPTUALISATION
1. Anderson <i>et al.</i> (1981)	Uncertainty	A situation in which one has no knowledge about which of several states of nature has occurred or will occur
2. Anderson <i>et al.</i> (1981)	Uncertainty	A situation in which one knows only the probability of which several possible states of nature has occurred or will occur
3. Anderson <i>et al.</i> (1981)	Risk	Same as (1)
4. Anderson <i>et al.</i> (1981)	Risk	Same as (2)
5. Humphreys and Berkley (1985)	Uncertainty	The inability to assert with certainty one or more of the following: (a) act-event sequences; (b) event-event sequences; (c) value of consequences; (d) appropriate decision process; (e) future preferences and actions; (f) one's ability to affect future events
6. Lathrop and Watson (1982)	Risk	Potential for deleterious consequences
7. Lathrop and Watson (1982)	Uncertainty	Lack of information available concerning what the impact of an event might be
8. MacCrimmon and Wehrung (1986)	Uncertainty	Exposure to the chance of loss in a choice situation
9. Harrison (1995)	Risk	A common state or condition in decision-making characterised by the possession of incomplete information regarding a probabilistic outcome.
10. Harrison (1995)	Uncertainty	An uncommon state of nature characterised by the absence of any information related to a desired outcome.
11. Spradlin (1997)	Risk	The possibility of an undesirable result

Figure 1. Conceptualization of risk and uncertainty (Lipshitz and Strauss,1997)

According to Lipshitz and Strauss (1997), uncertainty in the context of decision making will, in most cases prevent or delay decision. This statement highlights three fundamental features about decisions: (1) it is subjective, which means that different individuals could have different opinions in similar or identical situations, (2) no specific form of doubt is stated, and (3) it sees uncertainty as a form of its consequence on a decision.

Furthermore, there are also arguments that uncertainty often occur when routines are stopped because of certain doubts and uncertainties, while others argue that uncertainty takes place when there is competition amongst the alternatives the decision-maker has to choose from (Lipshitz and Strauss,1997). Feldman and March (1981) states further that the relationship between risk and uncertainty has drawn two contracting decision making models. On one side

we have consequential action that requires the decision-maker to look at their alternatives thoroughly, and at the consequences of these alternatives in order to make the best decision with “best” consequences for the organization. On the other side, we have obligatory action that requires quite different thinking. Here, the decision-maker has to study themselves and their surrounding environment and ask, “What is the most appropriate decision for me to take?” It is important to mention that in both models, coping with uncertainty are the most important aspects (Feldman and March, 1981).

As mentioned above, Feldman and March (1981) formulated the relationship between uncertainty and decision-making and between consequential and obligatory action. Since consequential action requires information about the alternatives and their possible outcomes, implementing this model will naturally create doubts regarding various alternatives. Implementing obligatory action, however, has other types of issues. This model require that the decision maker collects information and knowledge from the situation and also decides what he or she should do in that particular situation (Lipshitz and Strauss 1997).

The most common factors in decision literature regarding risk and uncertainty are, (a) lack of information and other kinds of data (Thompson, 1967; Grandori, 1984; Smithson, 2008). (b) decision-makers could sometimes be indecisive regardless of the information because of the diverse opinions of others surrounding them, and, (c) that lack of information and incomplete understanding is not necessary the source of uncertainty. Decision-makers could have difficulty taking action regardless of whether they have perfectly understood the situation, but, however, are undifferentiated, for example, because of equally good or bad decision alternatives (March and Simon, cited in Macmillan and Homs, 2000).

### ***2.3. Rational theory approach***

The rational choice theory, also known as the choice theory or the rational action theory, is a theory which incorporates understanding and making a “rational choice” based on the fact that one has several options. According to Becker (1976), this theory was first acknowledged and developed by Gary Becker, the winner of the Nobel Memorial Prize in Economic Science. Elster (1989) later explained the basis of rational choice theory by stating that when people are faced with several options, they will most likely choose the option which they believe will give the best outcome. (Friedman, 1953) explains this further and states that the definition of rationality in this theory is that an individual considers his potential profit

compared to costs and reach a conclusion that maximizes personal gain. By this definition, an individual, or actor, knows the consequences of each potential option.

From an economic perspective, one should know the consequences of each potential option and understand the “probabilities” of its occurrence. It is expected that one will choose the option that give best-expected outcome. Furthermore, if an action alternative has several potential consequences, one must then sum the value of all the consequences and choose the consequence with the best utility value (Ogu, 2013).

Rational choice theory begins from the individual standpoint, meaning that although there are several assumptions regarding the individual and groups, individual interest is always the basis of the theory. This statement implies that ultimately, it is the individuals that make the final decision, and that they are mainly committed to their own interests. The theory has some assumption about individuals and their interaction with one another. It also creates processes that explain complexity regarding operation in collective society that I will present in later sections (Ogu, 2013).

### **Assumption of the rational choice theory**

There are several assumptions regarding this theory. I have presented below few of the most fundamental assumptions created by Abell (cited in Ogu, 2013).

- *Individuals*. Individuals make the final decision. Furthermore, it is assumed that individuals will always act rationally, be self-calculating and self-maximizing. Decisions originate from these three elements. From this overall assumption, four other assumptions emerge which will be explained below.
- *Optimality*. Individuals always attempt to optimize their performance. Optimality takes place when other potential alternatives are not preferred by the rational individual. However, this decision does not necessarily mean that the preferred action is the right one, rather that individuals make the best decision based on the surrounding circumstances.
- *Structures*. It is argued that the range of choice in situations with multiple courses of action differs from courses with a single action. Although this assumption could be interpreted as damaging to the theory, it is believed that individuals will eventually

find a way to optimize action. This means that rational choice theory may in some cases be inflicting and not achieve consensus and harmony in action.

- *Self-regarding interest.* An individual's action will always be based on his or her self-interest. This assumption is quite important. However, according to Abell (cited in Ogu, 2013), it is not as essential as action optimization. This is because of the biases that could occur, such as unselfishness, charity, and participation in activities that does not contribute to optimization. However, there are some claims that rationality could nevertheless be achieved in this situation, by suggesting that these activities that could be interpreted as "unselfish", could nevertheless ultimately be a tool of some form of self-interest. In other words, the intention behind this unselfish act would be to feel good about yourself and perhaps to raise you social position.
- *Rationality.* Although this comes last, this is the most essential assumption in the theory. All individuals will act according to what they believe to be most beneficial for them, and therefore will choose the option according to this.

### **Steps in the rational choice process**

Green (2002) has developed various steps in his so-called rational choice process, which he believes every decision should follow in order to be characterized as "rational". These are as following:

1. Define the problem and make assumption about their purposes.
2. Identify the weaknesses and restraints associated with each option.
3. Determine how you proceed and create a decision process that describes the outcomes of every possible alternative.
4. Analyze how the decision rules of several agents may be made in consistency with one another, thereby influencing the equilibrium of the model. These type of analyses typically involve mathematical methods.
5. Analyze how the equilibrium adjusts when changes happen in the surrounding environment. This could be quite complex and require substantial use of advanced mathematics.
6. See if the indications step five gives are consistent with real experiences.
7. Come to a conclusion.



### **Rational choice and collective action**

Although individuals in rational choice theory are characterized as “rational”, “self-calculating”, “self-interested”, and “self-maximizing”, it is still possible for them to participate in collective decisions or be motivated for common good. According to Olson (1965), there are three types of circumstances where an individual could exist in a group:

- *Privileged groups*. Members of these groups have an incentive to see that the best collective result is achieved, even if they have to take all the responsibility. It is assumed that collective good will be achieved, and members will most likely benefit more from collective maximizing good than they would have by acting alone.
- *Latent groups*. These are characterized by the fact that a member’s action or performance in the group does not have any significant influence on other members. Furthermore, because other members do acknowledge or react to their performance, they have to reason to “commit to the cause”. This is also called “free-riding”.
- *Intermediate groups*. A group where no single member has the incentive to provide the good themselves but does have enough members to “hide among the crowd.” In such groups, a collective good may, or may not be obtained. Collective good cannot be achieved without some guidelines.

### **Weaknesses**

Rational theory has received much criticism in recent years. Researchers have identified several assumptions in this approach that appear to contradict reality in many situations. Ogu (2013) mentions in his article few of the most important weaknesses:

- Challenges when organizations face uncertainty and have limited information regarding the current event. This could potentially cause difficulties in making a rational decision for individuals. Consequently, the individual may find other reasoning solutions when making decisions.
- People’s social interaction is quite complex and there may be other theoretical approaches that could give a better explanation of the process of decision-making.
- People’s action is often guided by their norms and actions. Once these take root, it may influence decisions by not questioning actions, but rather using them to seek social action.
- One of the most questionable assumptions of this approach is that every action people make is considered as rational, even in the case of self-sacrifice. In other words, all

forms of choices are included as rational in the model, including non-rational choices. It is therefore according to this theory not difficult to determine whether a choice is rational or not.

## ***2.4 Investment valuation methods***

### ***2.4.1 Net present Value***

Net present value (NPV) is the most common valuation method for investment projects inside companies, also oil and gas industry. This method presents several strengths, among others that oil projects are treated on equal basis and based on the same criteria as every other projects, meaning that one always end up with the best result regardless of what risk preferences from shareholders. The calculation and process of the method are very logical and gives an easy way to understand potential investment outcomes (Aasen, 2006).

An assumption of great importance in the model is that there is an overreaching goal or vision to maximize company's profit for interest group (shareholders, investors, partners). Based on this assumption, the companies want to invest in projects that are worth more than costs. In other words, if the value between the present value and costs are greater than zero, there will be an incentive for investment. However, if the difference were negative, then the company would naturally not invest (Ngo, 2012). The following formula present this connection:

$$NNV = -I + \sum_{t=1}^n \frac{K_t}{(1+r)^t}$$

Every investment project is as stated implemented if the net present value is higher than zero.

$$NNV > 0 \rightarrow \sum_{t=1}^n \frac{K_t}{(1+r)^t} > I$$

Where  $I$  is the investment cost  $t=0$ ,  $r$  is project rate of return,  $K_t$  is cash flow at time  $t$ , and  $n$  is project lifetime.

The method starts by estimating revenue and costs (in the cash flow) that will be generated during the project timeline. After this, one calculates the hurdle rate for the potential project, or cost of capital), which will again reflect the risk linked to the project and the opportunity cost. In case of high risk, this hurdle rate will naturally be higher. In the same way, in case of low-risk project, hurdle rate will be relatively lower (Ngo, 2012).

In many situations, it is more suitable to have the discount rate reflect the alternative cost of capital that is being invested. Most oil and gas companies today that use the net present value normally have a discount rate between 9-15 percent. However, there are also cases where higher discount rate is adopted to quantify risk and uncertainty. This method assumes that if the focus is exclusively on the cash flow, the picture of the profitability would naturally be more correct. Hence, one would be better to make investment decisions. These positive assumptions are enough reasons to make discounted cash flow among the most adopted method (Newendorp and Schuyler, 2000).

Despite these positive characteristics, there are also few weaknesses in the model that are not consistent with reality. One of them being the assumption that one has to make the assumption of implementing the investment project today, while one has other alternatives in reality. One other weakness is the assumption that we know every known input value, while in reality, this is not necessarily the case (Aasen, 2006)

#### ***2.4.2 Internal rate of return***

Internal rate of return (IRR) calculates the discounted rate where the present value of expected cash flow of a certain project is equal to the cash flows from a project. In other words, if the internal rate that gives NPV is equal to zero. The assumption is that one would accept the investment project that has a cost less than the project's rate of return (Ngo, 2012).

This method is very similar to the NPV as an analytical tool for investment projects. It is also based on the discounted cash flows, which again provides a measure of the project's profitability, given the data input used is accurate. However, the difference in this method is that you put the present value equal to zero, and solve the equation with regards to cost of capital. The basis of this method is thus to compare the project's capital cost and the internal rate of return one calculated with (Ngo, 2012).

$$NNV = -I + \frac{K_1}{1 + IRR} + \frac{2}{1 + IRR^2} + \dots + \frac{K_t}{1 + IRR^t} = 0$$

### 2.4.3 Other investment appraisal techniques

Other important techniques that petroleum companies currently use today are reviewed below (Arora, 2012). As we can see, there have not necessarily been significant changes in techniques during the recent past. Companies still mainly apply sophisticated techniques in their decision-making.

- *Payback Period.* This is defined as the period of time to recover the cost of investment, meaning when net revenue is equal to initial investment. This is as mentioned often between 9 and 15 years in the oil industry. Most oil companies normally prefer the payback period to be less than 5 years, but they will extend this in the case of long-term projects. In some cases, decision-makers are not interested in finding discounted cash flows when appraising investments, but rather want to know how long it will take until they start making a profit.
- *Discounted Cash flow.* This is a valuation method used to appraise the attractiveness of an investment. The method involves discounting all known future cash flows at an appropriate discount rate to find a present value of the involved asset. This present value will become the value of the asset. The discounted rate represents a nominal rate of return that has to take into account the inflation rate expectations in the market and the interest is estimated on the basis of the risk. In the case of unknown future cash flows, which occurs often, the method offers two discounted values: (1) estimated short-term cash flow, and (2) a (rest) value that represents the value of the project after the first period. There are several reasons for this. Discounting puts most of the weight and focus on the first cash flows, it is therefore, critical to have accurate estimates here. Also, it is easier to estimate short-term cash flows, while there are greater uncertainties after each passing year.
- *Sensitivity analysis.* This is used to predict how an independent variable will impact on a certain dependent variable under some presumptions. According to Newadorp (cited in Arora, 2012), companies that adopt NPV (Net Present Value) as their key profit indicator do this in combination with sensitivity analysis. Once the NPV for a certain

investment has been made, the sensitivity analysis is applied to see whether the investment would change given the variation in the analysis.

- *Decision Tree Analysis and Expected Monetary Value (EMV)*. This is the expected total weighted payouts linked to a decision. It combines estimated income with uncertainty in decision principles. The model encourages the decision-maker to accept the decision alternative that maximizes the EMV, given that all other factors are equal. According to Newendrop, (cited by Arora, 2012), the typical approach to illustrate EMV is by using a decision tree. This way, the decision-maker will be able to consider the all the angles before taking a course of action.
- *Portfolio Theory*. Investment portfolio theories aim to guide the decision-maker (investor) to allocate financial resources (capital assets) in an investment portfolio. This approach has a long-term goal but is independent of the daily market. By doing this, it aims to give investors a tool to predict the risk and uncertainty associated with investment. This approach is commonly used in the financial markets. Projects are preferred based on quantitative information on their input to companies' long-term goals, and also how they affect other projects in the portfolio.

### **Real option theory**

Real option theory is one of the most favored techniques in the decision analysis approach that has received significant attention in the recent years for investment decision-making, especially in foreign investments in the petroleum industry (Fan and Zhu, 2010; Henriques and Sadorsky, 2011;). This theory has been developed to highlight how oil companies can evaluate and compare decisions when considering investing in uncertain situations.

According to Fan and Zhu (2010), the first authors who introduced real option theory to investment decision-making literature were Myers and Tumbull (1977). In this analysis technique, decision-makers use marked hypotheses together with portfolio theory and trading strategies to foresee the financial future outcome, such as future cash flow (using the known information). Furthermore, this theory is used to understand the relationship between investment risk and uncertainty. Dixit and Pindyck (1994) suggest that in an environment with high uncertainty, the option of waiting comes more relevant, given that decisions are irreversible. Companies should perhaps not only act (invest) based on whether NPV (net

present value) is favorable or not. Hence, the option of waiting increases as uncertainty increases. The theory also argues that breaking large investments into a series of smaller decisions would reduce risks significantly.

Myers (1984) states that there are some weaknesses in traditional cash flow techniques in appraising investment decisions in an environment with high flexibility at managerial level. He also states that discounted cash flow analysis could fail as a strategic function, even if it is implemented properly. Therefore, managers often want to use an option approach to evaluate their investments. Some years later, Paddock et al. (1988 cited by Fan and Zhu, 2010) developed a real option model to find the optimal investment value for undeveloped offshore oil reserves. They discovered that there are three key advantages of using real option theory instead of cash flow method. First, it requires less data to function properly, which means fewer computation costs and less likelihood of error. Second, it provides an indication of the optimal timing for investing, and third, it provides a guideline for the optimal timing of investment. He believes that these are compelling enough reasons to use this approach for investment decisions.

However, the assumption of the negative relationship between uncertainties and investment has received some critique during later years. Sarkar (2000) states that the traditional option structure leaves some questions unanswered. In his studies, he illustrates that in certain situations, an increase in uncertainty could, on the contrary, increase the probability of investing when the value of possible success is significant.

### **Alternative theories**

Previous research gives important awareness of the process of decision-making. The current theory, however, will give more attention to the rationality and decision-making at corporate level and to the more cognitive sensemaking behind decisions. Using this method will lead us towards finding the actual reasons for certain decisions in oil companies.

The purpose of this thesis is to build a new understanding of the various processes that are involved in decision-making, and the cognitive influence of the top management that are affecting the investment decisions. In this regard, I consider the Sensemaking theory to be an

appropriate approach, as it reveals how actors resolve problems during crisis in order to make logical sense by conserving a sense of coherence and consensus in the decision process.

## ***2.5 The sensemaking theory***

The sensemaking theory assumes that actors are experiencing a continuous stream of intangible situations with a high level of complexity and uniqueness (Weick 1995). The theory assumes that when different actors sense that an event will have some sort of consequence for the company, they will naturally ask themselves “what is the story here?” Furthermore, the actor will then try to solve the issue and bring some meaning to the situation by asking the question “now what should I do?” By doing this, actor will then build up meaning of what they have sensed in their environment (Obstfeld, cited in Doornich, 2014). Arthur (cited in Ancona 2012) further explains the process sensemaking by illustrating with an example from casino gambling.

*“How much do you play” you ask*

*“three billion”, the croupier replies*

*“who will be playing” you ask*

*“We won’t know until they show up”, he replies*

*“what are the rules”,*

*“These will emerge as the game unfolds”, says the croupier.*

*“what are the odds of winning?” you say*

*“We can’t say”, he says,*

*”Do you still want to play?”*

Sensemaking refers to the various phases or processes of understanding and meaning where individuals and teams try to reflect on different “realities” of events and create different subjective accounts (Weick, cited in Brown 2000). It is believed that social world is enacted by sensemaking, which has led to the creation of an organizational environment (Berger and Luckman, 1991). Sensemaking is the basis that creates the spoken explanation of our surroundings, and a feeling of “sense” appears when individuals act as if they share meanings with each other, and as a result, reach a consensus (Emerson, 1981). However, this illusion of sensemaking tends to exist even when an agreement is not fully achieved, meaning that the standpoints of some individuals within teams are neglected. This is because individuals often prefer to think that they share common viewpoints even if this is not the case (Gephart et al,

1990). Furthermore, given that companies are often hierarchical, individuals have different positions and responsibilities, some individuals are able to influence decisions more than others are. In other words, some individuals have more voice and authority in the company than others, so it is perhaps more appropriate in certain situations to describe sensemaking in organizations as a power effect rather than a tool for common sense and consensus (Brown, 2000).

### ***2.5.1 How does it work?***

Sensemaking is considered useful in several ways. Weick (1995) explains this by associating sensemaking with “mapping” ones environment. Creating a map could provide hope of awareness and courage to take action in an unexplored and unknown environment.

Furthermore, in case of teams, constructing a common map of “what is going on?” will also most likely guide them to take action. In an uncertain environment where individuals often are distressed and concerned about their actions, this process of mapmaking is essential to the sensemaking approach (Ancona, 2012).

As we attempt to study and “map” the unknown, we will be able to communicate and explain our current situation, come up with various explanation of our circumstance and eventually achieve a cognitive consensus and take action. Furthermore, as we explore our environment, we will gradually be able to abandon old map and develop a new that are more suitable to our understanding of reality (Ancona, 1012).

However, as Weick (1995) points out, it is important to understand that sensemaking is not concerned with finding “the correct map” or “correct answer”, but rather to try to create a common picture through available data, interpretation and communication. The purpose of sensemaking is to be able to take action when your surroundings have shifted. In other words, finding courage to act when the future is unclear.

The process of sensemaking in practice can be illustrated through a well-known story by Holub (1977, cited in Ancona 2012). According to the story, a unit of soldiers were deployed in the Swiss Alps for training. None of the soldiers inside the unit were familiar with the areas. Suddenly, one day during training a hard storm started out and it began to snow for several days and nights. Because of the clouds and blowing snow, it was very difficult to see



the road back to the camp, and at some point, the soldiers began to accept that they were lost. Realizing their situation and the possibility of different outcomes of this situation, panic and anxiousness started to spread amongst them. No one knew what to do. Suddenly, one soldier reached to his pocket and found a map that seemed to be of the area. They all started quickly to see and interpret the map together to figure out their location, and how they could get out. Together, they began eventually to plot a route home to their base.

They survived the storm and began to take action based on this old map. None of the soldiers was sure if the planned route was correct during the way back, so there were still some interpretation and sensemaking to be made along the way. There were some villagers in their path in one point that told them they were moving in the wrong direction and guided them the right path. Finally, as they came back to the camp, they realized they the map they have been using along the way to guide them, had been a map of another area. The moral of this story is, as Weick (1995) puts it, "*when you are tired, cold, hungry and scared, any old map will do*"

According to Ancona (2012), there are several reasons for why any map is considered applicable, or at least helpful during uncertainty. Firstly, a poor map could encourage act from leaders and other decision makers to reach their goals and ambition that otherwise could not have been possible if their perception of the situation were more objective and accurate. There are situations where accuracy would be harmful for decision making. In fact, the idea of accuracy constructs an image of the world where actions are constant and always predictable, instead of organizations with changing context. Secondly, any map that are able to harmonize and create activity are more critical than to pursue for accuracy that is not possible to achieve anyway. Finally, in a volatile environment, action can be better than accuracy (Ancona, 2012).

In brief, Weick (1995) believes that because of these arguments and more, plausibility are more suitable than accuracy in the process of sensemaking. Creating stories and mapping that could lead to explanation, discussion and action are more appealing than approaches that focus on getting best possible picture in a constantly changing reality.

### ***2.5.2 What hinder sensemaking?***

Because of the importance of sensemaking in organization that operates in uncertain and complex environment, there is still a phenomenon why this approach is not done properly, if done at all. According to Ancona (2012), the answer may be found in that sensemaking is typically desired in time of changing events that cause instant uncertainty. In these situations, the very instrument that is used to manage the event could disrupt sensemaking. In time of crisis and uncertainty, people are typically unsecure and vulnerable and wish for a clear direction and instructions. Therefore, it is most possible that they may go back to old habits and old maps, thus rely on old information.

Staw et al (cited in Ancona, 2012) was one of the first researchers that illustrated in their book how fear and threat can lead to rigidity. In case of threats, actors typically attempt to limit external factors that could affect their operation and decisions. Thus, they try to protect and maintain their status quo in the organization. This behavior is also described as the “deer in the headlight” syndrome. When a deer face car headlights in the middle of the road at night, they normally open their eyes widely go in such a state of shock that loose the ability to react in any way. Further, many organizations also sees threat as the time to remove outsiders that could “disrupt” their thinking process, and get back to old course of action. In other words, they want to go back to their “natural habitat”. However, as mentioned, it is in these situations sensemaking are critically needed (Ancona, 2012).

### ***2.5.3 Crisis management***

Crisis management occurs when an organization attempts to control, mitigate, prevent or resolve a crisis. One important part of this concept is to study various aspects of crisis and their occurrences. By this definition, crisis management means attempting to pre-plan a crisis (Gephart et al, 1990).

Mitroff (2005), identifies seven steps that he believes show the importance of inquiry sensemaking for organizations to overcome crisis. First, it is important before an inquiry performance to show an emotional picture of the crisis. Attending an inquiry will perhaps motivate and encourage managers in preparation for a crisis. Second, it is important to think critically when taking part in an inquiry. Conflicting facts will be presented that need to be challenged. This could, for example, be through interrogation. Asking as many relevant

questions as possible until one is satisfied with information. Third, it is important to use social and political skills in inquiries. By reviewing the relevant documents, managers are able to gain more knowledge on the social and political skills needed for managing crisis. Fourth, one must expect a high level of complexity and uncertainty in every event of crisis. There is potential for the learning about different aspects of crisis through inquiries. Fifth, inquiry testimony will often expose denial and disapproval among different actors within organizations, and also the consequences of this brings. This can be explained and clarified by the critical thinking of this process. Sixth, the need to modernize the organization in order to overcome the perception that certain parts of the organization can be changed without this affecting the organization as a whole. Finally, there is the importance of using the spiritual, qualitative way of life to build new meanings and goals after crisis (Mitroff, 2005).

#### ***2.5.4 Public inquiry***

Public inquiry is defined as hearings conducted by governments or organizations to assess the information presented. The purpose of this ceremonial face-to-face occasion is to investigate the causes and consequences of certain events that have impacted the organization. This method is typically used in time of uncertainty. Participants in public inquiries will seek to understand the important elements of certain events (Gephart, 1992).

#### **Narrative**

The most common way of understanding sensemaking is perhaps by thinking of the phenomenon as a narrative analysis, meaning that people act as story-telling individuals, where actors can interact and interpret details of experience. This is believed to be one of the key ways for actors to express themselves and give voice to their opinions (Riessman, cited in Gephart 1992).

Previous narrative public inquiry studies have focused greatly on people's narratives and understanding their way of story-telling in time of uncertain events. Narrative approach argue that actors typically focus on certain features of an event and downplaying other features that does not suit them. Thus, this process explores the substance of actors' stories and shows how stories are formed and the cultural elements that are used. Narrative analysis explains how individuals and organizations make sense of experience by attempting to interpret information and create meaning (Barry and Elmes, 1997).

Bruner (cited by Brown 2000) argues that the narrative approach helps us to find coherence and sufficiency. Narratives are often described as a tool to make sense of events, and to predict future potential organizational behavior by using own experiences and interpretation. By having this state of mind, people are able to “expect the unexpected”, which again enables us to understand, predict, and perhaps control unexpected events in our environment (Wilkins and Thompson, 1991)

### **Rhetorical analysis**

Rhetorical analysis is the art of communication. In other words, how people speak and understand (McCloskey, 1998). Rhetorical analysis highlights how stories are able to influence audiences’ interpretation in case of weak evidence. Rhetorical analysis accepts documents in organizations as a form of communication tool created to convince (or manipulate) the reader of their truthfulness rather than of the actual truth. From a narrative and rhetorical perspective, sensemaking is accepted as a process of creating various subjective explanations of presented information (Brown, 2000).

Studies of rhetorical analysis approach in public inquiry explore the possibilities of how secondary reports support the validity of social institutions. This approach sees inquiry report as a method created to persuade and convince others of questionable believes (Brown, 2000). Furthermore, this approach assumes that actors during public inquiry will embed their own interpretation in the reports. It argues that since reports are gathered from other texts, it need to be interpreted in relation to other texts (Brown, 2000).

### **2.6 Summary**

I have in this chapter, presented theories that have provided me the theoretical framework for this thesis. I have presented few theoretical descriptions about risk and uncertainty in a complex environment. Furthermore, I have presented rational choice theory and various investment valuation tools used by oil companies related to this theory. Finally, I have presented sensemaking theory to describe actors’ process of sensemaking in an uncertain and complex environment.

My goal is to give the reader an understanding of the terms and main concepts, since I see this as necessary for reader in order to be able to understand and interpret my findings and the discussion regarding this.

## Chapter3

### 3. Methodology

#### 3.1 Introduction

*“We are like dwarfs sitting on the shoulders of giants. We see more, and things that are more distant, than they did, not because our sight is superior or because we are taller than they, but because they raise us up..”.*

John of Salisbury

The purpose of this chapter is to present the research method used to collect data, analyze it, and draw valid and reliable conclusion. I will discuss the reason for choosing my philosophical position and arguments for qualitative and quantitative methods. Further, I will discuss the tools that are used for collecting and analyzing data. Finally, evaluate the data in term of ethical considerations, reliability and validity of the task will be presented.

To illustrate my problem statement, I have used both primary and secondary data in this thesis. The primary data is from interviews with informants that have much experience in the petroleum industry, and the secondary data comes from reports, news stories etc.

#### **What is methodology?**

A researcher tends to contribute to our knowledge about how reality is in both the small and large world and has to do this methodically. The word *method* comes from the Greek word *merhodo*, which means to follow a certain path towards a goal (Johannessen, et al, 2011). Methodology is about how to proceed in a certain situation in order to get full information, how to analyze data, and, how to interpret data. This method is also of significant importance in empirical science.

According to Hellevik (2002), methodology helps us to choose correctly. It gives us an overview of alternative methods and the consequences of certain choices. By looking at methodology, one can benefit from other researchers' previous experience, and therefore increase the chance of finding the desired results.

## ***3.2 Philosophical position***

### ***3.2.1 Ontology***

The theory of ontology refers to the philosophical assumption regarding reality. It has four main categories: realism, internal realism, nominalism, and relativism (Easterby-Smith et al, 2012). The difference between these is their perception of reality. In my thesis, I will use the relativism approach, which argues that truth in reality is a consensus between different viewpoints of different actors and that “truth” and facts depend entirely on the observer. The different viewpoints in this thesis are from informants I have interviewed. Relativism also argues that researcher must be aware that their knowledge could have an impact on what could be perceived as fact (Easterby-Smith et al., 2012).

Relativism argues further that before one can analyze and conclude a phenomenon, the researcher has to obtain an overall picture of the situation at hand. Therefore, I would like in this thesis to present an overall historic picture of the past oil price shocks and the impact this had on oil production and investment. I believe that relativism ontology will be a good base for me to begin my methodological approach.

### ***3.3.2 Epistemology***

Epistemology is how to acquire knowledge, meaning what we know about reality and how we can proceed in order to gain knowledge of society and people (Johannessen et al., 2011). Epistemology is divided into two approaches: positivism and social constructionism. It is often difficult to follow only one aspect of these two epistemological views since they are defined as stereotypes. On one side, positivism argues that knowledge is built on what we observe, and everything else is speculation. While constructionism states that there may be forces and structure behind a social life that one cannot observe (Johannessen et al., 2011). In this thesis, I have chosen epistemology in the form of social constructionism because I feel this will give me a better understanding of the complexity of my research topic.

The purpose of this thesis is to focus on what tools that are used for investment decisions, and how managers make sense of investment decisions in time of uncertainty. I have assumed that decision behavior is based on more elements than numbers and calculations alone. Because of this assumption, it was logical for me to choose a qualitative approach.

There is a great focus on individuals and individual behavior during my collection and interpretation of data findings. This is also something that a constructionist approach recognizes. Further, according to Easterby-Smith et al (2012), ontology in the form of relativism and constructionism in the form of epistemology are theories that could be combined together, which further led me to choose these approaches.

### ***3.4 Research design***

Research design is generally about organizing different research activities. This includes, among others, the process of collecting desired data. By employing good research design, a researcher will most likely be able to gain a better “flow” in their activities, and hence, be more efficient. In other words, research design refers to the choices of what should be observed and the process of how this should be done. (Esterby-Smith et al, 2012).

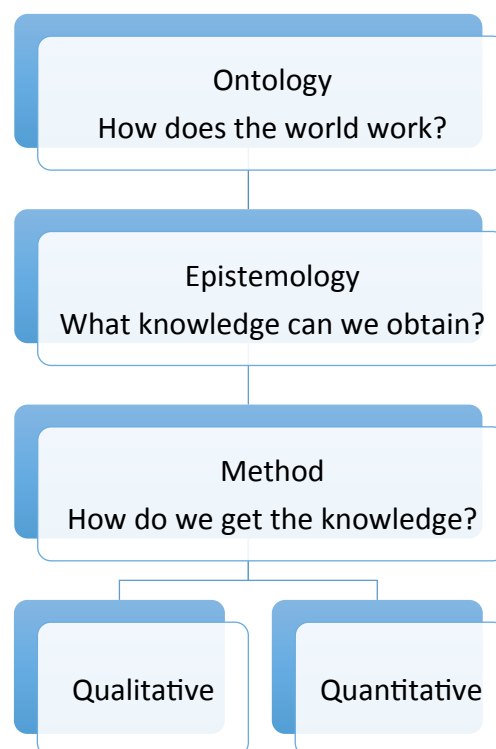


Figure 2: Qualitative and quantitative methods (Easterby- Smith et al, 2012)

Naturally, the problem statement and phenomena determine the choice of method. The method is dependent on whether the researcher wants to test existing theories or develop their own. The literature identifies two approaches in methodology: qualitative and quantitative



methods. The main difference between these two approaches, in short, is the difference in the techniques of collecting, analyzing and interpreting the data (Easterby-smith et al, 2012).

The qualitative-oriented method is a method of generating knowledge by investigating what influences a certain experience had on those who experienced it, also how it can be interpreted and understood by others actors. The quantitative method is typically presented as a contrasting approach, which has a focus on numbers and what is measurable (Johannessen et al, 2011).

### ***3.5 Design choice***

My topic choice and the basis of my problem statement were prepared early in the process with the support of my professor and supervisor June Borge Doornich. The purpose of my thesis has always been to find out more about limitation and challenges in times of uncertainty, such as the uncertainty regarding the oil price shocks. However, as I further investigated this topic, I began to grasp the extent of this topic, and gradually set my focus mainly on the investment decision behavior oil companies.

In the basis of this statement, it was natural to use a qualitative approach in this thesis, in the form of semi-structured interviews to understand the phenomena of management uncertainty in the oil industry. A qualitative approach resulted in a much better closer participation of informants, which again helped achieve a deeper and more extensive understanding of my problem statement.

I also recognize that my awareness of the surrounding environment, in terms of my values and existence, could have an influence on the research procedure, and also the sampling and interpretation of data. I recognize the importance of this topic, and that it should be studied in most professional way, by interviewing informants that have vast experience and knowledge at managerial level within the petroleum industry. I recognize further that this thesis could be beneficial for other researchers as well, which motivates me to produce a high-quality thesis. I have used various existing scientific reports and articles on this topic.

I will in this thesis use a case study approach in the research design. Although I am fully aware that there are many other approaches a researcher can chose, such as cross-sectional

studies, longitudinal study, quasi-experiment, experiment, ground theory and others (Johannessen et al., 2011).

### ***3.6 Case study***

One of the main strengths of conducting a case study approach is that the researcher can collect a significant amount of data from very few units or sources in a certain amount of time (Thagaard., 2013). Considering that I have three expert interviews, this was the main reason for my choice of case study.

Yin (2013) states that a case approach is preferable when “*how*” or “*why*” questions is answered and when the researcher has little control over situations, and when the focus of the particular phenomenon is in the real world, which is the case in this study. I have to thoroughly study the “*how*” and “*why*” in the phenomena and term of the process of investment decision making behavior. In addition, I have to create an understanding of how uncertainties such as oil price shocks affect oil companies’ investment decisions. I therefore believe that the problem statement fits within Yin’s central criteria (Yin, 2013).

The findings should be interpreted in the light of already existing theories. Based on the findings, the case study will play an important role in whether to maintain the existing theory, to develop it, or to establish new theories. By performing a case study, it will be both possible and interesting to observe how the various informants consider sensemaking in investment decisions that are made in oil companies.

### ***3.7 Data collection***

At the very beginning of my data collection, I found that the best way to do this process was by searching through previous research that had a similar topic to my thesis. This was to get a better understanding of the topic and of what to do next, and further, to be able to distinguish between relevant and irrelevant data.

Social constructionism studies are typically quite complex and require many variables and factors that play an important role in finding answers. By using a case study approach, the researcher is able to collect various rich data to make the research more credible, and also to present the problem statement in the best possible way.

To achieve this, I used data gathering tools form of both *primary and secondary data*. Primary data is defined as new data that is collected directly by the researcher, while secondary data is already-existing data (Easterby-Smith et al., 2012). Primary data is as mentioned, collected through expert interviews with highly experienced people from the oil industry. Because of geographical distance, my interviews were conducted through telephone. At first, I considered Skype or similar communication tools, but because of some technical difficulties, I decided not to proceed with this. However, I believe that telephone interviewing was sufficient to collect the information I required.

The choice of informants was based on strategic selection. The criteria were that at least two of my informants had experience from project and strategic analysis. I feel that I achieved this since all three of my informants have had, or still have key positions in the oil industry. They are very much familiar with what factors that there is that determines investment decisions.

During my first interview, I noticed that some of my questions did not seem to obtain the deeper answers I was looking for, and I therefore had to, on several occasions, rephrase my questions or ask spontaneous questions as we moved further into the interview. I also reminded myself, both during the interview and after, that the “unsaid” could be as revealing and important as what was said by the informants.

Interviews were audio recorded, and then transcribed. The purpose for using a sound recorder was to save time by not having to take notes, and so I could fully concentrate during the actual interview. Another advantage of audio recording was because of the encoding after. One could easily search for words or phrases in the interviews and use them in my empirical chapter. Furthermore, in order to ensure that all my questions were answered accordingly, I also took notes during my interviews. This also helped me to detect new potential findings that had been raised during the interview.

I also find it important to mention that during the interview, informants at times touched on topics such as companies advanced mathematical, valuation models that I, with my educational background did not always comprehended the concept at first. However, in these situations, informants presented practical examples to ensure that I understood the overall image of the concept.

In order to avoid misinterpretation and improve the quality of the interview, the transcription was done “word-for-word”. However, a researcher must also be critical of his transcription since human error could occur during this process. To avoid this issue, I listened to the interview once more to see if the transcript was in line with what actually was said.

### ***3.7.1 Semi-structured interviews***

There are two different approaches for conducting interviews, semi- structured and unstructured interview. As mentioned, these has been conducted a semi-structured interview in this study. I first made an interview guide with few different questions, or rather topics that I would discuss with informants during the interview. By doing this, informant could interpret the questions in their own way and perception of reality and sensemaking of what was important to address in the topic. Furthermore, I felt that this interview approach gave the flexibility to create new question and topics during the actual interview.

This interviewing approach gave me the opportunity to better understand the reality of sensemaking in decision making, and to rethink my problem statement. This is because this study involved building knowledge about a context I had no comprehensive knowledge of from previously. I knew to some extend that oil companies use various financial models, but my knowledge around final decisions making and analytical tools was limited at the beginning phase. However, I began shortly to comprehend the context and was able to study the problem statement at a higher, more complex level.

Although semi-structures interview offer great contribution when collecting data, I have also acknowledged that there could be some weaknesses to this approach. I have recognized that the interaction between interviewer and informant could have some potential disruption. Interviews are normally characterized as unpredictable, which again could lead to challenging issues regarding ethical or methodological. In order to deal with this issue, I have taken a reflexive thinking during the interviews (Alvesson and Skøldberg, 2009).

### ***3.7.2 Reflexivity***

According to Alvesson and Skøldberg (2009), the concept of reflexivity is typically introduced in qualitative research as in this thesis and is accepted as a method in which the

researcher has the opportunity to validate their findings. Reflexivity refers to the recognition of the researchers' self-perception and research relationship. This concept argues that interviewers value perception, presence etc., and this could affect research decisions, such as interpreting data and writing the conclusion. Therefore, the whole research process requires reflection. Reflexivity is about having an open mind during the interviews, and being aware that both the interviewer and respondent are involved in the process.

I have recognized this in this thesis and have reflected on my research by examining my relationship with my informants and also examined how this relationship dynamic could affect my informant's responses to the questions. Furthermore, this approach has allowed me to be more vigilant in my thinking and always be expect so sort of disruption of compromise in research method or ethics (Alvesson and Skoldberg, 2009).

### ***3.7.3 Documents***

When I refer to secondary data in this thesis, this is data that I have collected which already exists in the form of articles, annual reports, and public governmental data. This kind of data is usually available to the public and is used to provide a historical perspective and understanding. This is quite useful to obtain a foundation for the research. One of the biggest pros of using secondary data is that, compared to using primary data it is much less time consuming. The secondary data I collected was from several scientific databases, such as Google Scholar, ScienceDirect and Scopus. There are significant amount of published reports about historical oil price shocks which as been very relevant and helpful for getting insights an grasp the context of the complexity and uncertainty regarding the oil price.

Whilst preparing this thesis, I have also contacted governmental and non-governmental companies and departments whilst collecting my secondary data. Unfortunately, most of them did not voluntarily provide me with the historical data I needed. Some claimed that the data I requested was not available for public viewing while others stated that the data did not exist in their database.

### ***3.8 Data analysis and findings***

The purpose of the analysis process is to organize all the collected data and identify a possible connection between the data. After my interviews, I transcribed them and created a word document in which I recorded my findings according to the topics discussed. This gave me a better overview of my findings and was very helpful in the analysis process. This analysis method is also used by Jacobsen (2005), as we can see from the figure below.

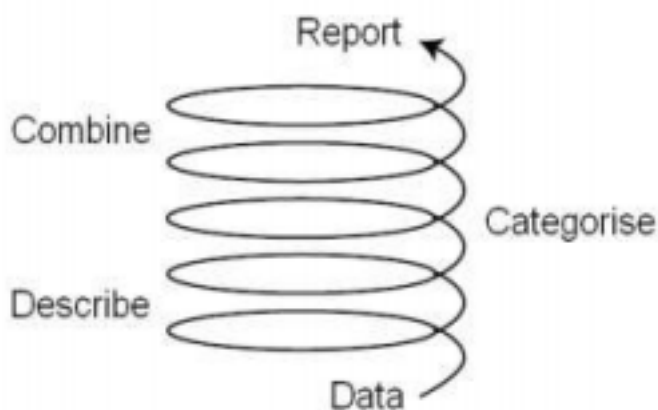


Figure 3; Dana analysis (Jacobsen, 2005)

According to Glaser and Strauss (1967), a researcher should use a “constant comparison model” to analyze gathered data. This means coding and analyzing at the same time. They created the following four steps:

1. Compare findings that fit with each category.

Data will be encoded in categories. As the number of categories increases, there will be several different categories; those that the researcher self-constructs, and those that contain specific statements from informants. When the data is analyzed several times, the researcher will see that there are several ways of understanding the topic, and should then start to create memos. During this process, it is important to be aware of the choices that are made.

2. Integrate categories and decide where they belong.

This process begins by reviewing the memos and evaluations that are produced in the first step of the process. After the data is collected on the basis of theory, the theory can be used in the analysis to create new knowledge.

3. Refine new theory

4. Creating new theory

The purpose of this study is not to develop new theory, but rather to gain a better insight into problem statement. Therefore, it is natural for me to disregard steps 3 and 4.

The data that is generated through this process is then inserted into a narrative analysis. The narrative is a story, where the researcher can, during the analysis, vary between being a so-called “story-finder” looking for stories during the interview, or be a “story-creator” who creates a story by putting together many events (Johannessen 2011). The analysis will then become a coherent story and is organized to describe what the researcher wants to explore. Thus, the encoding process will be the basis of the storyline and theory. Although his process has several advantages, the main purpose here is so that researcher can detect important elements that they would not have found otherwise (Johannessen, 2011).

### ***3.9 Validity and reliability***

#### ***3.9.1 Validity***

Validity in qualitative research concerns whether the researchers have measured what they actually intended to measure. Within validity, we can distinguish between internal and external validity. Internal validity focuses on whether the research findings are consistent with reality, and external validity focuses on how well the results of the study can be transferred to other cases. Although my intention with this thesis has not been to generalize findings to other cases, I strongly believe that my findings could be transferred to other cases as well in the same context of uncertainty.

I attempt in my study to raise the validity by using several different sources. I may have conducted relatively few interviews, however, the interviews were with informants that have much experience and much knowledge of the energy industry. Therefore, I am confident that

the information provided by them is valid. I have also had the opportunity to discuss my problem statement with several other people who work in the energy industry.

### ***3.9.2 Reliability***

Reliability is related to the accuracy of the research findings, which kind of data can be used, the way data is collected, and how it is processed (Johannessen et al, 2011). As mentioned earlier, all my interviews were transcribed, this significantly increases the likelihood that all the information was correct. However, coming back to reflexive thinking, one weakness of the reliability of the qualitative data is if the researcher and informant have different views on the topic. This could mislead the researcher when interpreting responses from informants. Because of this risk of possible misinterpretation or findings, I have in my empirical chapter used quotation to avoid occurrence of this issue. This is to present the reader of what informants have responded during interviews and give further assurance them of the studies reliability.

One other thing that can strengthen the reliability is how the interview guide and questions are build. It is important to ensure that questions in the interview guide are not leading questions nor are structured questions. Researchers should, therefore, put themselves in their respondents' situation to get an impression of the questions that could be interpreted as leading. If, for a different reason, there is the necessity to test the data reliability, one can retest this under identical conditions. If the results turn out to be the same, then they are likely to be highly reliable. Because of my limited timeline, I have unfortunately not had the opportunity to conduct a new case with identical conditions. Furthermore, it is nearly impossible to conduct identical qualitative cases. This would be more suitable for a quantitative study.

### ***3.10 Ethical considerations***

Ethics is one of the most important things to consider when conducting a research study. The researcher has to take responsibility for carrying out the survey in accordance with the scientific guidelines and limitations. I believe that I have had a strong focus on ethical principles and have not violated any rules. I have been honest and open with all my interviewees and have taken their wishes into account, during and after the interviews. I have



also been aware to not thrust my informants and persuade them to answer any questions that they were not comfortable with.

One of the focuses before, and during the expert interviews was to not interrogate the informants, but rather gather the necessary information needed for your research through a “normal conversation”. Furthermore, every interview must have the informants consent before recording, and every respondent has the right to ask for confidentiality or anonymity if they wish so (Johannessen et al, 2011). One of my informants wished to remain anonymous, and one other was also not completely sure about sharing his experience and personal knowledge about of the industry and publically. Because of this and more, I have decided to make all my informants anonymous.

## Chapter 4

### 4. Empirical Findings

#### *4.1 Introduction*

This chapter starts with an introduction of the context, which is the uncertainty and complexity in the oil industry. I will first give an overview of some factors of supply and demand in the oil industry, and then give a historical view of the geopolitical and financial events that have influenced the oil shock.

I will then present the empirical data based on its relevance to my problem statement. As mentioned in the introduction to my thesis, the purpose of my study is to explore what decision tools are used in oil companies' investment decisions. Due to content limitations, I will refer to my findings to give an overall view of what it indicates.

Finally, I will present what informants consider as the key factors behind investment decisions in oil companies. Further, I will present a constructed view of corporate issues regarding industry uncertainty and investment decisions. Data will be presented via citations and text. I believe this to be a good way to present a rich and meaningful perspective of what empirical data suggests.

#### *4.2 Context*

Crude oil, or “black gold”, is one of the most precious products in the world. Its price development influences the entire global economy. This means that if reliable oil price prediction were achievable, the global economy forecast would as a consequence be significantly improved. However, because of the volatility in this industry, this has not yet been possible to achieve. The recent oil price shock in 2014 emerged within a few months and had an overwhelming impact on the global economy. There were only a handful of analysts that predicted outcome similar to this (Eder et al, 2015).

The price of crude oil can be affected by events that could potentially disrupt the supply flow. Historically, there have been mainly due to geopolitical or economic events. These events normally have lead to global uncertainty regarding supply and demand of a commodity, which again have caused price volatility. I will in this section give further illustration of this.

## **Demand**

Rapid economic and industrial growth by non-OECD (The Organisation for Economic and Cooperation and Development) countries in recent years has changed the pattern of demand. According to the Energy Information Administration (EIA), oil demand from non-OECD countries increased from 2000 to 2010 by more than 40 percent, while oil consumption in OECD countries experienced a steady decline. The largest growth in oil consumption was in China, India, and Saudi Arabia. China, world's most populated country, has today become the largest oil importer in the world, and together with other major non-OECD countries will play even a bigger role than earlier in the years to come (Bajpai, 2015). The country's total oil consumption is expected to increase by nearly three million barrels per day in 2020 compared to 2012 (Cunningham, 2015).

## **Supply**

The Organization of the Petroleum Exporting Countries (OPEC), with its 12 member nations has for several decades been the largest supplier of conventional oil. They have controlled the market and determined prices by the boosting of the reduced level of production. According to IEA estimates, the OPECs have 1206 billion barrels of oil reserves, which accounts for 81% of the world's crude oil. Saudi Arabia and Venezuela alone account for almost half of this volume (Bajpai, 2015). Although their power have weakened at some degree in recent years due to development of unconventional oil, OPEC's every activity is observed closely observed by governments, oil companies, and other stakeholders continue to play a major role. Geopolitical events have a great impact on OPEC policies. Several of the organizations' member nations are politically unstable or have political disputes with the West. And some have experienced sanctions by the Western world. This has triggered several supply disruptions in the past (Cunningham, 2015).

## **Oil Price**

As IS (Islamic state) forces were advancing towards the gates of Baghdad and Damascus in 2014, potentially disrupting major suppliers of crude oil, there were few people in the energy industry that suspected oil price shock. Despite many unpredicted events in the world, such as the Arab spring and the American energy renaissance, the oil price had been relatively stable for several years. This is mainly since the supply disruption from several OPEC members that

gave the opportunity for shale oil production in US to grow without any significant global imbalance (Bordoff and Losz, 2015).

However, because of OPEC's policy change and rapid increase in North American production, the global market experienced an oversupply of oil in the third quarter of 2014. The decrease in price first began after the liberation of Libya which caused supply resumption from the country, and continued to decrease even after the supply disruption few months later. The situation also accelerated dramatically when Saudi Arabia, the most influential member of OPEC, refused to cut production levels and kept production at a high level of 32 million barrels per day (Bordoff and Losz, 2015).

To understand the context of unpredictability and volatility of the oil industry and oil price, I will now briefly present few historical geopolitical and economical events that have caused oil price shocks.

#### ***4.2.1. Historical overview***

Most of the world's conventional oil resources today are located in regions with great instability and that have caused disruption in supply at some point in history. The oil industry has experienced several price shocks during these past decades as a result of major geopolitical or financial events. Geopolitical events include the Arab oil embargo in 1973-74, the Iranian revolution in 1978, the Iran-Iraq war at the beginning of 1990s, and the Gulf war. Global financial events include the Asian crisis in 1996, and the famous global financial collapse in 2008 (EIA, 2002).

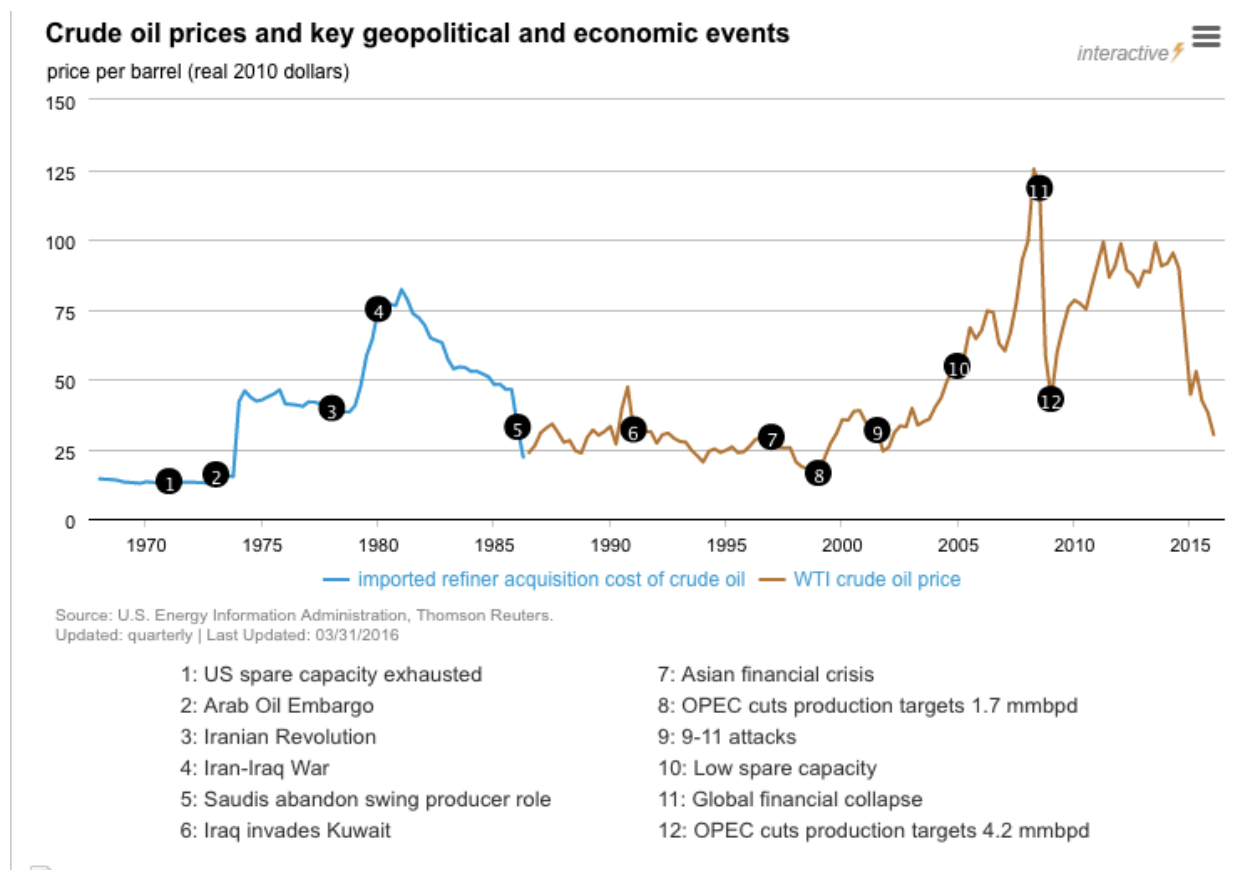


Figure: 4 Oil crude and key geopolitical and economic events. (EIA, 2016)

#### 4.2.1.1 Political

##### The Iranian revolution 1978-1979

The Iranian revolution began in 1978 and resulted in a supply reduction of 3.9 million barrels per day of conventional oil exported from the country, between the years 1978 to 1981. This was in a time where world supplies appear to be very sensitive to every changing even.

Although other OPEC members covered most of this shortage, the global market was still quite unstable. Further, the Iran-Iraq war began shortly after the revolution in 1980, and led several Gulf countries to reduce their output. This naturally had an impact on the cartel as an organization. The cumulative production level from the cartel dropped nearly 7 million barrel per day during this period (EIA, 2002).

This high oil price cost made exploration and development in non-OPEC countries, which had been too expensive to develop earlier, more profitable. Development in areas such as the North Sea, Mexican Gulf, and Alaska began during this period contributed significantly to

world demand. By 1985, production from these regions accounted for 69 percent of global production, an increase of nearly 50 percent from 1978. OPEC reacted to this production development and tried to defend its \$34 per barrel price by reducing production level further. At the same time, the U.S. began to increase its crude oil imports from non-OPEC countries such as Norway (EIA, 2002).

### **The Gulf War 1990-1991**

Iraq's invasion of Kuwait caused the third global oil shock in 17 years. During this period, the United Nations (U.N.) approved the blocking of all oil supplies from both countries. This led again to the fear of an oil shortage similar to the previous crisis in 1979. Between July and August 1990, the oil price jumped from \$16 per barrel to over \$28 per barrel and escalated further to \$36 per barrel in September that year. The price gradually began to drop again in October 1990, when the U.N. approved the use of military force against Iraq. The so-called oil crisis lasted no more than two months (EIA, 2002).

Supply shortage from these two countries combined, which was about 4.3 million barrels per day, tested the modern petroleum market. The market had experienced few great changes since the oil crises in 1978-79 and oil had become a more important global commodity. Therefore, it seemed beneficial for nations from both supply and demand side attempted to keep the market balanced (EIA, 2002).

<b>Date</b>	<b>Event</b>	<b>World Supply Disruption</b>	<b>Recession Date</b>
<b>November 1978</b>	Iranian Revolution	8.9%	January 1980
<b>October 1990</b>	Iran-Iraq War	7.2%	July 1981
<b>August 1990</b>	Persian Gulf War	8.8%	July 1990

Figure: 5. The main military conflicts in the Middle East that have affected the global oil supplies (Baghirov and Rodzko, 2014)

#### ***4.2.2.2 Economic***

##### **The Asian financial crisis 1997-1998**

The Asian financial crisis began in 1997 and was a short period of crisis that affected at first the Asian continent, but gradually began to induce fear of a global economic crash. The crisis originated in Thailand in 1997, but later spread to other Southeast Asian countries, such as Singapore, South Korea, Hong Kong, and Japan. This uncertain situation naturally affected investments in most of these countries, and other developing countries, which led to economic recession in large part of this regions (Olowe, 2010).

The oil price maintained a relatively stable price at \$15-20 dollar per barrel during the first half of the 1990s. But began to decline rapidly in 1997, to a price as low as \$8 dollar per barrel towards the end of 1990s. This price collapse was different from the 1986 supply crisis, where commodity demand was the key factor (Bordoff and Losz, 2015).

Before the crisis, the demand for oil was strong and increasing, mainly due to the rapid economic growth in the Asian Pacific countries and the growing industrialization of countries in that region. As a consequence, the demand for oil in this region, especially in China, naturally increased. During the same period, several countries inside OPEC were disregarding their original quotas and increased their production significantly. Iraq, increased production from 0.6 million barrels per day in 1996, to 2.1 million in 1998. Non-OPEC countries contributed 3.7 million barrels per day to the global market between 1993 and 1998 (Bordoff and Losz, 2015).

OPEC decided to lift the quotas and increased production level at their meeting in Jakarta in 1997. This decision was mainly made because of the assumption of continued economic development in the Asian countries that would require further demand. Further, it was also because of the belief that other non-OPEC countries were producing more than their original quotes, thus attempting to gain global market share (Bordoff and Losz, 2015). OPEC was clearly unaware of the pending Asian economic development and was not concerned about unpredictable events that would change the market circumstances, such as oversupply that would lead to oil price shock. OPEC increased its production at almost the same time as Asian demand was started declining. The Thai currency collapsed in July 1997, spreading panic through the entire Asian market, and putting a short term end to the demand. As a

consequence, the oil price decreased by 50 percent between October 1997 to December 1998 (Bordoff and Losz, 2015) .

The price recovered swiftly again after the two-year crisis and tripled to approximately \$30 between 1999 and 2000. As a result of this crisis and the unnecessary challenges it brought due to speculations, oil supply countries, including OPEC, agreed to restrain their production level to a certain extent to avoid similar events in the future (Bordoff and Losz, 2015).

### **The financial crisis 2008-2009**

After many years of low oil prices and under-investment in production, the emerging economy of China and other countries at the beginning of the 2000s overwhelmed the oil market. Supply was struggling to keep up with demand, and the price was reaching new heights year after year, reaching \$147 in July 2008 (Bordoff and Losz, 2014). The financial crisis in 2008 and a fall in demand then caused a sharp decrease in oil prices to a low point of \$30 per barrel at the end of 2008, causing an instant panic throughout the entire Western market, and other markets as well (Bordoff and Losz, 2015).

However, the oil industry recovered relatively quickly from this crisis. Price of oil started to increase again shortly after the crisis, and ultimately increased to over \$100 per barrel per day and remained stable until recent crisis (Bordoff and Losz, 2015).

This quick rebound of the industry was due to several events that eventually led to an increase in price. The main reasons were due to a quick demand upturn from non- OECD countries. OPEC members decided in 2008 to cut their production level by 4.2 million barrels per day to maintain global balance. Despite that the cartel reduced their production by 2.4 million, which is approximately 60 percent of what they originally promised, it still had a significant impact on the market (Bordoff and Losz, 2015).

### **4.2.3. 2014 crisis**

After the Arab oil embargo in 1973, the power in oil supply changed from the U.S. to OPEC, and to Saudi Arabia in particular, and the cartel has controlled the global market since then. Today, there are only few members in this organization that have the spare capacity to balance production levels in the case of supply disruption from other members (EIA, 2002).



OPEC has, for decades, “balanced” the market in the case of supply surplus by cutting their production level. However, in 2014, Saudi Arabia announced that the organization would not attempt to stabilize the market by cutting production levels, but rather let it balance itself with low oil prices (Spano, 2016).

*“The American oil revolution of the past few years has been one of the most geopolitically consequential events in the global oil market in decades”*

*(Bordoff and Losz, 2015)*

One of the main causes that directly lead to our new oil price crisis is the unexpected rapid growth of the U.S. tight oil production. Horizontal drilling technology combined with hydraulic fracturing has become a blessing for the American oil and gas industry. This technology was at first used in natural gas production, but later was also implemented for production of unconventional oil. This has increased the country’s production level by 80 percent (four million barrel per day) during the past ten years. Due to this development, U.S oil imports has fallen by nearly 40 percent, to a level of 19 million barrels per day in 2014. Furthermore, the country has projected that average level of imports in 2025 will be 14 million barrels per day less than was projected few years back (Bordoff and Losz, 2015).

This American production development has been one of the biggest geopolitical events that has significantly changed the global supply and demand market in several ways. First, it has weakened OPEC’s capacity to control the supply market. Secondly, this oversupply development has the potential to weaken the oil price for many years to come, which will be beneficial for oil-demanding countries such as China, India and Japan. Finally, this current low oil price will also have a global environmental impact. The rising demand in oil and the low oil price will in the short term outdo other more harmful alternative subsidies. However, it will also make renewable energy recourse alternatives non-profitable, which is not beneficial for environment (Bordoff and Losz, 2015).

#### 4.2.4. Recent oil drop: different or similar?

Although this sudden fall in oil prices is significant, there *have* been other similar events during the past three decades. As we can see from the figure below, the industry has experienced five other major episodes of oil price decline that have shocked the world. Oil price in all five situations decreased at minimum 30 percent over a seven month period. The first oil crisis was in 1985-86 when OPEC began to shift their production policy. The other four situations after this were the U.S. financial crisis (1990-91 and 2001), the Asian Crisis (1997-98), and the financial crisis (2008-2009) which was mainly driven by a decline in global demand (Baffes et al, 2015).

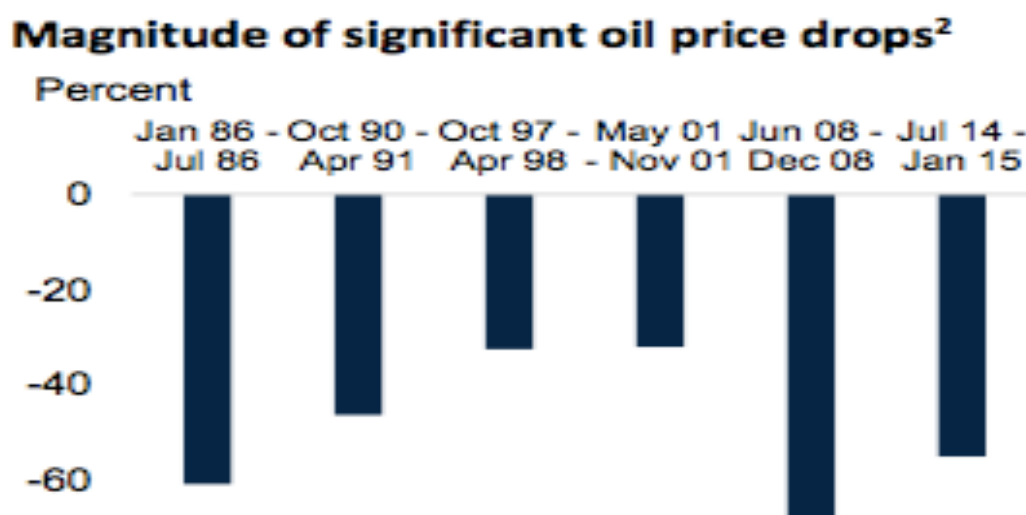


Figure 6: oil price drop effects (Baffes et al, 2015)

Although there have been five oil price shocks during the past three decades, the current crisis we are experiencing has most similarities with the aggressive increase in oil production from the North Sea and the Gulf of Mexico in the 1980s which lead to the 1985-86 crisis. Both crises began with an aggressive increase in supply from non-OPEC countries (mainly the U.S.) and another aggressive reaction by OPEC countries to abandon their policy and increase production to push out competition (Baffes et al, 2015).

The unconventional oil and gas extracting technology has been available for many years, and due to four years of high oil prices, non-OPEC countries such as U.S, Canada and Russia began extracting unconventional resources. However, the sudden drop in the oil price between 2014 and 2015 had a devastating impact on the whole petroleum sector, especially for these

non-OPEC countries. Looking back to the 1970s, we can see similar scenario. The high oil price in 1970s and 1980s made expensive technologies, such as offshore technology, very profitable for the U.S. (The Mexican Gulf) and Norway (The North Sea). In fact, the combined production from these regions added \$6 million day per day to the global market, which is approximately the same volume of unconventional resources that were added to the market in 2014 (Baffes et al, 2015).

One other major similarity is the OPEC countries' decision to abandon price targeting. After the oil price peaked in 1979, OPEC decided to reduce oil production in order to control the high price. They gradually continued reducing their production over the next six years, from 30 million barrels per day in 1979 to 16 million barrels per day in 1985. This significant cut in supply reduced the oil price by 20 percent. OPEC later began to slightly increase its production again to 18 million barrels per day (by the end of 1985). This change in policy was one of the main reasons for the oil collapse that lasted almost two decades (Baffes et al, 2015).

In comparison, there are several differences between our current oil price shock and other crisis such as 2008 crisis. For example, the decline in the oil price in the current crisis has been more severe than other commodity prices in the market. Whereas the price of all commodities in 2008-09 declined relatively at the same rate. Second, market signals also indicate that today's crisis has been driven by several factors (U.S. unconventional recourses, OPEC policy etc), while the 2008-09 and most other crisis was due to weakening in demand that led to an oil drop price and global uncertainty (Baffes et al. 2015)

### ***4.3 Tools for decisions***

Informants constructed tools for investment decision-making with various images. Furthermore, they seem to obtain the same image of investment decision tools, which tend to be sophisticated, mathematical tools. Most oil companies today operate as any other business and try to maximize profit for their owners. However, they also tend to recognize the limitation of these financial valuation tools, and tend to move from these tools to a qualitative approach when it comes final decision making process.

### 4.3.1 Tools

*“Investment appraisal is extremely complex. There are so many uncertain factors that could go wrong, including what one believes about the oil price, what you think about the required return, what you think about the production profile, which option exists.”*

(Informant II)

Projects in international oil companies are characterized by large investments with high uncertainty. Uncertainties regarding factors such as product volume, investment costs, scheduling, and not least the price of oil that could change at any moment. Considering these factors, a considerable planning is needed in order to conduct a thorough assessment of risks in the project. Various potential alternative outcomes and risks need to be documented and analyzed to provide evidence and guide management decisions.

Oil companies seems to have evolved significantly since earlier historical oil price shocks, and have learned a great deal about their market fluctuations. This has naturally helped improve valuation models and become to a certain extent, more reliable in their projections than before. Informant II explained that

*“We have become much better with analyzing and forecasting today than we were in 1985-86. This is because we have much more data, many more tools, and a much better insight than we had before.”*

To value investment decisions, oil companies today still use standard economic methods as any other profit-focused company. This is mainly because as typical projects in any industry, oil projects have a major form of investment over a long period of time, then a long period of income-generating production that relies on the market, and finally the project ends. This is very similar to general industrial investment analysis. Informant II explains:

*“...Net present value (NPV), internal rate of return (IRR) and different types of key KPIs (key performance indicators) are the most common and widespread methods in the industry to measure the profitability of various decisions.”*

In addition, most oil companies also apply a “risk-adjusted cash flow” formula and discount everything with the same interest rate. This means that if there are any annual loss risks, one

can attribute this probability of loss directly to the cash flow, and adjust the fraction line instead of the yield. Sensitivity or decision-tree analysis also gives an indication of what happens with the NPV in case of unpredictable events, such as, for example, an oil price shock. This is because companies recognize the complexity and volatility of the industry, and attempt to be as flexible as possible in their planning and decision-making. Informant III explained,

*“It is important to recognize that the industry is a cyclical industry. I have been in this industry for 40 years, and I have been through four or five upturns and downturns, and it usually happens every five-six years. When you are in this business, you must be able to understand that there are cyclical activities”.*

#### **4.3.2 Decision-makers**

*“It is not possible to measure risk and uncertainty. It is not something you can do. You can analyze and attend, and maybe describe, but not measure,”* (Informant II).

It is clear that when oil companies are considering major investments, primarily offshore investments, which are typically worth tens of billions, a considerable amount of planning is needed, in order to try to conduct a thorough valuation of what is risk and what is not. They carry out a thorough valuation of their potential decision, considering all “thinkable” outcomes. However, the valuations are based on the current available data knowledge. Thus, there will always be some level of uncertainty linked to the valuation models. Informants construct the image that ultimately, it is up to top management to generate a qualitative valuation based on current, available knowledge. Informant III explains, *“The final responsibility and decision rests with the top management of the company.”*

Informant II explains further,

*“...everything management does is based on their “gut feeling” and the input they receive. Nobody gives you the answer and says what you should do. There are people that give you a significant amount of documents which contain many calculations and recommendations, then it is up to the management to make a decision based on their interpretation.”*

However, there were some conflicting opinions amongst the informants about the significance of top managements' influence on investment decisions. One informant, which have great experience from the industry and have been personal adviser for Statoil executive management for several years, believes that despite the fact that top management have the final saying, they will eventually come to a consensus based on the concrete information that is provided to them from these analytical tools. As Informant I explains:

*“After all the valuations are made and presented, top management will essentially come to a crystal-clear conclusion. In the case of uncertainty, top management will understand whether to act one way or the other.”*

Informants expressed further the importance of team decisions when considering major investments in oil companies. They imply that decisions are not made by individuals, but rather by top management teams where each member possess vast experience in the industry, and who are familiar with major changes and crisis in the industry. The provided information is assessed and interpreted by the company's management team, and they try to come to a consensus as regards the “right” alternative for the company.

Furthermore, in case of consideration of investment where certain details regarding the project are missing, It is important that for management not to proceed with the project unless all the details are available. This is because it is the top management team that holds the “money -bag”, and it is they that hold be held accountable in case of unwanted outcomes, as will be presented in next section. They must therefore ensure that all information received from lower level management is correct and accurate.

### **4.3.3 Strategy**

A company's strategy is one of the main elements that could influence investment decisions. When considering a investment option, managers must often discern whether the possible investment decisions are in accordance with their strategic visions and goals. Companies will not invest in projects if it is not in accord to their long-term strategy. Furthermore, companies have to see the availability of the necessary resources that are required to carry out the project. Informant II explains,

*“Even if you come across a project that is very profitable in Indonesia producing shoes, you will not go for it. So strategy will determine what you do...and it will be a*

*well thought-out approach to what we are good at, what we have expertise in etc.. and other factors as well that obviously influence what decision you end up taking.”*

Another element to consider is the possible synergy effects which occur as a consequence of the company's investment decisions. Companies that have several similar projects should consider the possibility of integrating parts of the project. By doing this, the company can achieve lower costs on individual projects and increase the value of all projects. Such additional proves to be very valuable as new technologies and field discoveries have led to optimal production levels being higher than initially planned production. Informant III mentions the Ormen Lange project, which he was an important part of.

“Our original plan was to build a plant for gas coming from Ormen Lange in the Norwegian Sea, and on the coast. However, during the planning, we also thought that this could be a hub in the future so that we would not just process gas from this field, but other fields in the Norwegian Sea as well, thus gaining better synergy effects...now they have built two other fields, and their gas will be brought to the Ormen Lange facility, and the capacity will increase. It has become a strategic infrastructure and better than what we could see for ourselves when we built the plant in 2004.”

#### **4.4 Luck**

*“You can as well ask a monkey where it (oil price) will stop, or throw a dart,”*

Torbjørn Kjus, DNB markets.

Informants' constructs an image that are more or less identical when it comes to factor of luck in invest decisions. As every industry with high uncertainty, there is a certain degree of luck that influences the outcome of every investment. This is something that that will always exist in in investment. Theoretically, top managers inside companies are expected to detect and consider every aspect of investment, even the elements that are impossible to detect. Informant II explained,

*“There are known knowns, the known unknowns, the unknown unknowns etc. There are so many things that could go wrong.”*

This comment implies the difficulty of investment decisions in this sector. It is impossible to address every potential outcome of a decision. Therefore, one has to in many situations rely on the factor of luck. Luck has become especially important in time of crisis when there are great short-term uncertainties where companies could lose great deal of investments. Furthermore, informants imply that because of the unpredictability of the market, where uncertain events rarely are similar, luck could be considered as better than having experience and knowledge from the industry. Informant II explains further,

*“One can make a good decision (on paper) and get a bad outcome. Not everyone understands that. You may have done a really good job and have made a correct decision, but had a bad outcome. If you lose and go bankrupt and everyone laughs at you. Or you could have made a terrible decision that everybody should have laughed off, but then you got lucky and pulled the lottery ticket. Then everybody declares you a genius.”*

#### **4.4.1 Project failure**

To obtain a contextual perspective on the constructed image of luck, I will present few examples of project failures from the industry that have resulted in significant loss of investment. Informants mention Statoil’s project failures, thus I will present their failures as illustration.

According to informant II, the whole series of poor investment decisions could be traced back to the Mongstad scandal in 1987-88, which was one of the first over-budget projects in Norwegian history. As a result of miscalculation and other external events, the project had a budget excess of 7 billion NOK, or approximately 95 percent of the original budget. This eventually led to the resignation of Arve Johnsen, the CEO of the company at that time.

*“...It was a lot of money back then, and they had not estimated the cost correctly. So of course, the top managers had to go,”* (Informant III).

As a result of this scandal and the weakened oil price at the time, the newly appointed CEO, Harald Norvik, saw the for serious changes in the company’s corporate structure, and a more efficient business strategy. This was naturally to avoid similar setbacks in the future.



There have been many other projects that have experienced budget overrun since the Mongstad project. During the last 14 years alone, Norwegian petroleum projects have spent a total of more than 200 billion NOK. The cumulative miscalculation is approximately 16.6 percent. There are cases where certain projects have been miscalculated by more than 100 percent (Taraldsen, 2015).

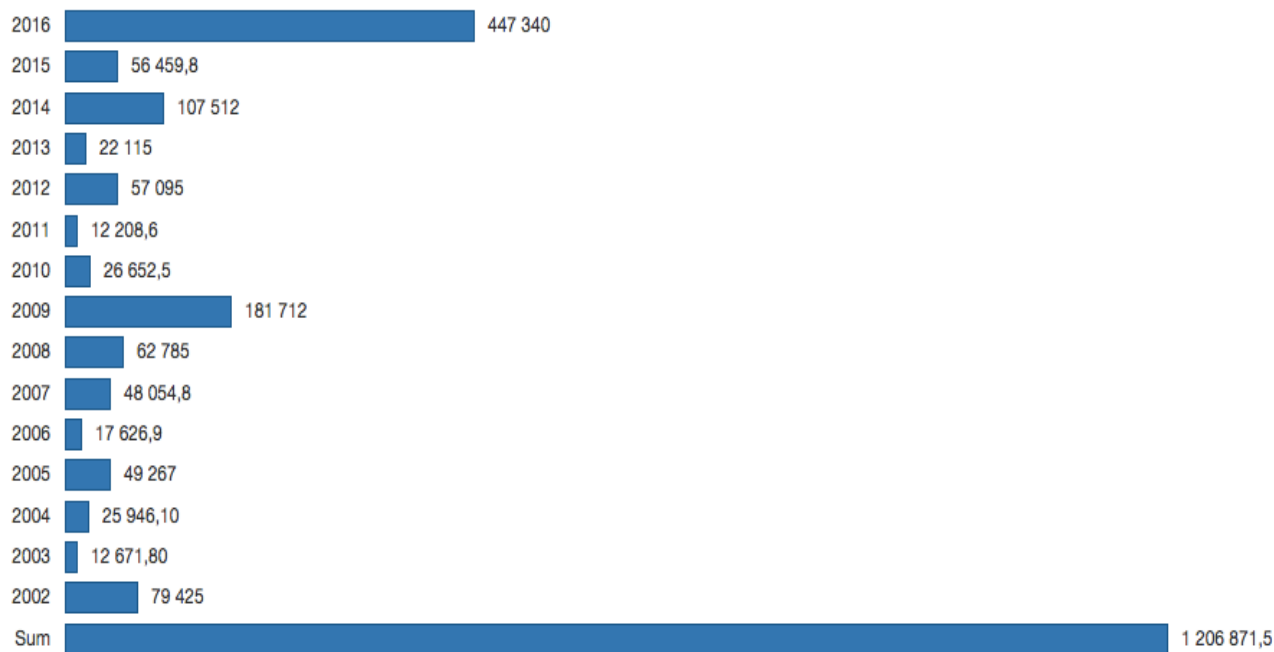


Figure: 7. Project overrun: in millions on the Norwegian continental shelf (Taraldsen, 2015)

One recent Statoil investment decision that has received attention is the company's investments in North America. The company invested heavily in three geographical areas in the U.S. between 2008 and 2011 and continued to buy after this period. This was in a period when the price of oil was much higher than today and there were no credible indication of any significant change. So when the oil price began to decrease in 2014, the company suffered heavily. Last year, the write-offs from the company's international operation were 42.7 billion NOK.

Many analysts in Norway claim that Statoil has paid more for field development in this region than they would have initially paid in Norway (Storeng, 2015). This opinion is also shared by informants I, who describes these investments as simply unplanned. In case of major investment decisions such as this, more thorough planning and calculation is needed before any further action.

However, Informant II constructs a different image and describes these major losses of investment as an *unfortunate* outcome that occurred as a consequence of imbalance in supply and demand in the market.

*“...if anyone goes and buys a stock and loses 50 percent of that stock because of something. Was it foolish to buy the stock? As an economist you should say that if the stock were priced in a market with that price, then it was a fair deal when you bought it. This regards other things as well. What happened in US is that we experienced a sharp drop in gas price. Against what many thought would happen. Because it suddenly turned out that there was oversupply of gas in the country. Then you naturally got a price drop. And you were unlucky and bought before the price drop”.*

#### **4.5 Summary**

Investment appraisal in oil companies is quite complex and there are many “known” and “unknown” uncertainties linked to each decision. When it comes to investment appraisal decisions, companies normally use standard appraisal tools similar to other industries. This reason for this is that as other companies, the companies has to make profit for the company shareholders and try to maintain an image of control and supervision of their investment decisions.

On the other hand, informants also construct an image towards a qualitative approach. More precise, towards a sensemaking approach. They realize the high level of complexity and unpredictability of the industry, and decision-makers’ own realizations and interpretations of information which they receive the lower management. However, regarding the importance of managers’ own sensemaking, informants seem to constructing images that are conflicting. They also agreed to a certain degree on the importance of the “luck” factor in the outcome of their decisions. They seem to construct images of this topic based on their own viewpoints. In other words, they seem to select facts based on their own perception on reality.

## Chapter 5

### 5. Analysis and discussion

#### *5.0 Introduction*

This chapter presents the analysis part of the thesis. I will here analyze empirical data presented in chapter four which I gathered through expert interviews with informants that have had key positions in investment projects, and through comprehensive collection of secondary published data. The objective of this chapter is to explore what tools decision makers use for investment decisions and how managers make sense of investment decisions.

In this chapter, two main findings of the study are presented. At first, it is shown that investment decisions are based on premises of rational choice theory. Second, that investment decision during management of uncertainty is based on sensemaking process. I will here present typical procedures and influences regarding investment decision making inside oil companies. Thus, I will discuss the factor of luck in investment outcomes, decision making inside teams and public inquiry.

Statoil's investment decisions were often mentioned in term of bad long-term business planning within the oil industry. The company's foreign investments decisions in North America have specially received great deal of attention in the media. The company had no way of knowing how the market would react in the way it did when they made that decisions. Given the existing information about the market development at the time, it was reasonable to make the decision of expanding. However, given the high level of uncertainty that exists within the oil industry, negative future need to be considered. Without thorough planning for adverse market conditions, it would be impossible to make successful long-term decisions.

Statoil investment behavior were based on the assumption that the oil price would remain at a three-digit level, and therefor thought they made a good decision by entering the North American market and invested quite heavily for several years. But what they did not anticipate was the rapid drop of oil price in 2014 that occurred because of several geopolitical reasons. Instead of having a situation where supply was lower than demand, which would have been positive for the company, the market had an opposite reaction, where petroleum prices were driven down. This event suddenly made a decision that was considered as good to begin with, to a bad one.

Informants implied how decisions like those made by Statoil can cause long-term challenges which companies are forced to manage. These bad decisions not only cause difficulties in the function surrounding the bad decision, companies would also face future decisions such as layoffs, which they may otherwise would not have if the earlier situations had been different. For instance, if Statoil had not made the costly investments as they did, they may have had more capital reserves to handle the oil crisis better. The situation with Statoil also hinted at another key finding that becomes evident when analyzing my data. Because of the complex and uncertain industry environment, decisions that may be characterized as “simple” and “uncomplicated”, becomes suddenly more critical in this industry. The long-term effects of decisions cannot be ignored.

### ***5.1 Rational tools for invest decisions***

As presented in previous chapter, regardless of the market uncertainty, the most common valuation method in oil companies today is the net present value (NPV) and internal rate of return (IRR). This is at some level understandable since, as informants imply, investment projects in the oil industry are considered as any other projects in other industries.

As presented in chapter two, there are several reasons why these methods are so popular among oil companies, or rather companies in general, one of them being that projects are treated equally and there are same criteria for choosing between them. This method is expected to give an “acceptable” accuracy and have a very logical process, which makes it easy to understand and explain results from analysis to investors. It is based on the presumption to maximize shareholder’s financial assets. In other words, oil companies, or rather shareholders, wish to invest in the project with higher potential profit over costs. This presumption of the model fits rather perfectly for most oil companies in the world, as they are profit-focus companies.

These analytical tools are as mentioned very useful when presenting future potential costs and profits to company’s various interest groups. Most importantly, shareholders, who are the backbone of the company, would naturally want to know if their interests are safeguarded. By using these easily understandable methods, it will further assure them that their common vision and goal are in line with company investment strategy.

Based on these presumptions, we can argue that this method is based on rational choice theory. As introduced in the literature review, rational choice theory sees actors as fundamentally rational in their decisions and actions regarding the process of decision making. Companies and top managers are considered to have the complete information about their alternatives and consequences. And because of these assumptions, it is natural to think that decisions are made at a company's corporate level, rather than individual level. Assuming that a company operates as "privileged" group where all company members have a common goal and strive to achieve best possible investment outcome.

As proposed in chapter two, the decision making process from a rational choice perspective, and goes through certain steps that eventually defines such action as rational. The fourth step of this process is to determine how to make best decision between various potential alternatives. In this situation, effective analyses of complex mathematical models are implemented. Mathematical models are often the basis of investment tools oil companies' use today to appraise their investment decisions. Models such as net present value (NPV) and internal rate of return (IRR), which is the most common investment appraisal models in the industry can be considered as such tools.

However, the answer one gets from net present value calculation is not necessarily always reliable. It is only correct if the assumption your analysis is based upon is accurate, and whether other factors affects influence your environment or not. Considering the complexity and high uncertainty associated with accuracy the oil industry, it is not surprising that this method has received some negative and recent criticism.

Although these models are simple to understand and implement, they have some weaknesses that is not consistent with reality. One of them being that is does not take into account managers' flexibility to change previous decisions and take into account unexpected marked change. In figure 9, I have summarized the most significant weaknesses with net present value and discounted cash flow.

Assumptions in the discounted cash flow models	Actual Context
Decisions taken now, cash flow is locked in the future	Uncertainty variables in future income and expenses. All decisions are not taken “today,” since some can be postponed to later when the uncertainty is less.
Project’s “mini company” and is independent from the whole company	Network effects, diversification, relationships and synergy makes companies operate with a portfolio of projects and their cash flows. Sometimes a project cannot be treated without comparing others.
When a project is initiated, it is only passively controlled	Projects are usually actively managed throughout their lifetime.
Future cash flows are easily determined and deterministic	It is difficult to estimate future cash flows because they are usually random and risky by nature.
A project’s discount rate is used as the opportunity cost of capital, and is proportional to the non-diversifiable risk	There are many factors that lead to risk in the project, and some are diversifiable across multiple projects or over some period of time.
All risks are considered through hurdle rate.	Company and project risks may change over the life of the project.
All factors that may affect project outcomes and investor value are reflected in the models through NPV and IRR	Because of the complexity of external factors, it is difficult if not impossible to quantify all the factors and consider them in the cash flow. Events that are not taken into account can be significant and have strategic value.
Unknown, intangible and immeasurable factors are valued at “zero”	Many of these factors may have strategic value.

Figure: 8 Difference between Cash flow assumption and actual context

According to informants, it appears that most oil companies have at some level recognized these weaknesses in the NPV and IRR model, and therefore attempt to measure this risk and uncertainty behind investment decisions by adjusting the risk in cash flow and discount this with same interest rate. Oil companies also partially use real option method in a form of sensitivity analysis and decision tree analysis. As two of my informants highlighted, oil companies test each of their variables against the “what-ifs”, including any changes in oil price or reserves, instead of using the original projections.

Furthermore, as mentioned in previous chapter, these mathematical models typically require significant amount of data that needs to be analyzed in order to give a *rational interpretation* about current situation, and give a solid prediction about the future. But as informants imply, these models have improved with time. Companies today have much more data available than

in previous crisis, which again improve the calculation and prediction of various investment decisions. Hence, this could create a feeling of control and perhaps would make it easier for top managers to determine investment decisions.

One other benefit top managers could have using these rational tools is perhaps in case of investment failure. If a project happens to fail, as they occasionally do, top managers would have a quite “valid” explanation and justification of their decision, as they believe they acted rationally on the basis of these analytical tools.

## ***5.2 Limitation of rational thinking***

Considering the various uncertain non-linear of factors that could influence decision making, it is easy to recognize the limitations of rationality. As mentioned in chapter two, rationality has problems dealing with inadequate information and uncertain environments. This may mean that a company’s ability to act rational is limited by the strength of the mathematical or economic analysis. Also, the more complex and alternatives a decision have, the greater the restriction on making a fully rational decision. This may lead to difficulties when making rational choices, and the clarification of rational choices. Because of this, it is interesting to see that despite these various sophisticated analytical methods, top managers are the ones that ultimately make the final investment decision. This is where other theories, such as the Sensemaking Theory becomes interesting.

Furthermore, when decision makers try to make objective decisions based on these valuation tools that assume long-term applicability and accuracy of key factors, they run into challenges when these factors naturally evolve or change in some other way. Because of these potential changes, plausibility becomes more relevant than accuracy when decision makers are forced to make decisions that impact business operations over long term.

I have summarized below some differences in key elements of rational choice theory and plausibility assumption in sensemaking theory

Element	Rational choice assumption	Plausibility assumption
Approach	Rationality	Plausibility
Environment	Stable and predictable	Unforeseen and Unexpected
Reasoning	Objectivity	Cognition
Question-answers	Accuracy and persistence	Vaguenes and muddiness

Figure: 9 Comparing key elements in rational choice and plausibility theory

### 5.3 Sensemaking

As introduced in the literature review, sensemaking is based on the assumption that people often encounter a stream of information and attempts to understand unexpected events. In other words, sensemaking is about finding plausible understanding of your unpredictable surroundings by gathering information, action, and then delineating from original plan, depending how credible the information gathered was. Sensemaking often occur when we experience high uncertainty and ambiguity, meaning that sensemaking gets triggered when we experience an unexpected event, such as crisis. The key function of sensemaking is about mapping the “unknown” world, since there exists certain events where the only way to understand you surrounding is attempting to explain the unknown.



As mentioned earlier, the oil industry is quite unpredictable and uncertain in many aspects. Because of various geopolitical and economical events, oil price are constantly changing and there are really no way of knowing next week’s oil price, and certainly not long-term price, which again indicates the complexity of every investment decision within the company.

Firstly, a typical characteristic of investment in any industry is the importance of the factor of luck, and the oil industry is not an exception. Rather, luck plays perhaps a greater role in the oil industry. This becomes evident from the data, as two of my informants implied that in order to succeed in this business, the factor of luck is sometimes, or rather most of times,



more important to have than business skill or knowledge. In other words, every investment decision is a gamble.

Considering Statoil's major investment losses in North America, informants are not harmonized with the way executive management of the company made sense of the investment decisions at the time. It seems that they approach different reality of this particular decision. One informant implies that these decisions were absolutely sensible and correct, and that this unwanted outcome we have today was simply because of several *unlucky* geopolitical events that was not possible to predict at the time decision was made. Another informant implies that these decisions were poor. They should have used more time to consider every, and it was certainly not thoroughly planned, as it should have been done. Their different statements in this matter are quite interesting, since both of informants have great deal of knowledge and experience from the industry.

By referring to the literature review from chapter two, it becomes clear that informants' opinions are not in harmony with rational choice theory, but rather with the sensemaking theory. Informants seem to be constructing different perceptions of reality, hence the industry environment for legitimizing investment decisions. Consequently, they seem to get different sensemaking of the company's decision. This way of grasping reality of decisions appears in both Weick and Ancona.

#### ***5.4 Decision teams***

As mentioned in chapter four, informants reveal that there are a team of top managers in oil companies that makes the final investment decision to go one way or the other. They are provided with significant amount of information about different alternatives and scenarios from lower management level which they have to interpret and ultimately conclude. The purpose of this team decision process is naturally to get different viewpoints from members with great deal of knowledge from the industry. It is believed that by management meetings, they will build a platform for communication where they eventually will reach a "common ground" and come to a consensus of what are best decisions to make. This is also a description of sensemaking Ancona makes.

However, although informants claim that this process improves investment decisions for the company, they also acknowledge the fact that provided information are limited and there are no “real” or certain knowledge about future occurrences. Thus, there are no “right” answer or strategy of how to act. They simply have to create an image of the reality they are living in, by using the available resources they currently possess. This acknowledgement is coherent with the image of sensemaking created by Weick.

Furthermore, as shown in previous section when Statoil’s investment decisions in North America was discussed, different actors normally have different opinions of what could be called a good decisions and what is not. Despite that each member have much knowledge of the industry and experienced several oil crisis during their time, it is important to recognize that these decisions team members have their own approach when it comes to interpreting data and create their own image of what decisions serves the company best. This could naturally cause consensus disruption amongst the top managers in the company.

However, as illustrated in the Holub’s poem from the soldier training camp in Swiss alps in chapter two, sensemaking becomes indeed most important to achieve in these uncertain situations, when the road ahead are blurry and full of *surprises*. The executive team members will have to create a common strategy or so-called “story-map” about their current situation through data gathering, interpretation, communication and action. It is also important to recognize that new information about the market will emerge along the way that will perhaps influence previous decisions.

In addition, in an uncertain and complex environment such as our industry, it is perhaps better for top managers to not have the feeling of confident and control when mapping their environment and make decisions. If decision makers portrayed a picture of their reality that was more “objective” and constant, meaning that if they believed every event or crisis was exactly as the previous ones, they would naturally follow the same old strategy and fail. This is perhaps the case in the Mongstad scandal, where the CEO, Arve Johnsen and several other board members was forced to resign because of their poor investment judgment.

### ***5.5 Public Inquiry***

One other factor that is important to present within the component of sensemaking is public inquiry, which is considered very important in the decision making process for oil companies, especially in time of uncertainty. In our case, this becomes relevant in two ways. Firstly, informants reveal that it is the lower management that uses mathematical models and creates alternatives and scenarios of potential decisions. After various calculations and projections, they present this data to top management with comments regarding each alternative. In this process, it is not unthinkable to argue that there could be potential for lower management giving their voice during this narrative and rhetorical presentation of the information they provide to the top management. This could disrupt, or rather mislead top managers sensemaking of the provided data and could eventually decide on one decision that they perhaps would not have been deciding if the data was presented differently. In this aspect, we can argue that lower management could have more to say in investment decisions than previously assumed, and could perhaps be called the real decision makers.

Secondly, one other way public inquiry could play a role in decision making is the process of interpretation and sensemaking amongst top managers and their individual significance. Because of their individuality and different level of experience and knowledge of their environment, they will naturally think differently about potential investment decisions. Thus, it will be difficult to come to a consensus of what is best investment alternative to make for the company. In this case, it is *not* impossible to assume that some members inside the top management team will give their voice and attempt to influence other members' opinions by using their social skill of story- telling in communication. Furthermore, there are naturally senior members inside the team that have higher voice than certain others have, and will be able to "heard" much easier. Senior members that have experiences many uncertain industry crises would perhaps be quicker able to "make sense" of the situations and create map (strategy) than others, and be able to influence other members sensemaking. As Ancona mentions in chapter two, this is one of the main reasons of sensemaking failure. In an environment of high uncertainty, events are rarely similar to one another. For example, as presented in chapter four, every previous oil price shocks we have experienced seem to have occurred because of different factors. Trying to create a common map based on previous events, and try to convince in order to come to a decisions consensus could be very harmful for sensemaking.

### ***5.6 Never learn***

As pointed out in chapter five, the image of realizing effective sensemaking in oil companies in time of crisis and uncertainty is not always achievable. My informants implied that oil companies, or rather top management, never learn from previous crisis and previous mistakes. Informant describes most oil company's investment behavior as a "sheep flock". In case of an uncertain event, as current crisis, they tend to reach out to past experience and react as they normally have done in previous events. Meaning that they invest heavily in good times, and cut heavily in bad times. This image constructed is quite descriptive and could perhaps explain oil companies continue investment failures. Further, it is coherent with Ancora's explanation of the limitation of leadership's sensemaking in uncertain times and crisis.

## Chapter 6

### 6. Conclusion

The purpose of this study was to explore what tools are for investment decisions in oil companies, and how decision makers make sense of investment decisions during uncertainty. The thesis proposes two main findings in relations to the problem investigated.

- i. Oil companies today use rational tools in their investment decisions.
- ii. Investment decisions are ultimately decided by top managements interpretation and sensemaking.

Decision- making processes within the oil industry are difficult, especially in terms of what investment decisions should be made. Companies seem to rely heavily on rational tools in their valuation of investment decisions. There are significant amount of data that are gathered and inserted into sophisticated mathematical valuation model to determine each possible outcome of potential decision. Further, top managers are expected to make a rational decision based on these models. They are considered to have complete information about their industry environment, and therefore, foresee the outcome of their decisions.

What has become clear in this study is that these rational tools alone are not sufficient enough. Because of the highly uncertain and complex industry, where any global events, such as geopolitical or economical could occur at any time that would disturb the global oil supply and demand balance, oil price shock, these valuation tools can only be taken so far before they reach their limitation.

The research uncovered further how principle of sensemaking impact decision making process, particularly in term of plausibility. The outcome of investment decision is partially, if not fully, more dependent on luck than industry knowledge and experience. Therefore, when interpreting data, top management are compelled to use sensemaking process and attempt to come up with plausible understanding and meanings from available information and knowledge they have about the industry environment. This finding lead to the assumption that calculated accuracy from these rational investment valuations methods meet their limitation

during uncertainty, as oil companies are not able to forecast the ongoing flow of unpredictable and unforeseen events that may determine the outcome of an investment.

Rational tools oil companies' use will give indications of various future outcomes, but will certainly not give any conclusive information. Investment decisions are therefore to some level based on top managers own sensemaking of information, which again leads to the possibility of decisions that could be interpreted as irrational and ill-conceived by others. Thus, we can argue that because of the limitation these rational methods, they can in a way be considered as a "tool for failure".

I feel that this study has been very interesting approach for exploring how sensemaking develops and becomes relevant in the context of investment decision in the highly unpredictable and complex oil industry. By examining how informants construct the reality of this, I feel that managers or other decision makers that operate under uncertainty could benefit from this study, as this study implicate that management under uncertainty demand more than only rational analytical tools, they should therefore me more conscious of their own way of making sense of their current situation. Furthermore, I feel that this topic I have studied have potential for further exploration. It would be interesting to use similar theoretical framework for investigating same problem statement in other industries. Although I believe, based on my interpretation of data that we would draw same conclusion in similar contexts.

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## Appendix

### Appendix 1

#### Interview Guide

Ranch Zangana

Master of Science student at Nord University

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*Er det greit at jeg tar opp denne samtalen?*

*Er det greit at jeg nevner deg i oppgaven?*

*Navn*

*Lydopptak*

*Konfidensialitet*

Problem statement

*“What tools are used for investment decisions and how does decision makers make sense of investment during uncertainty?”*

*Norsk: Hvilke verktøy brukes for investeringsbeslutninger og hvordan beslutningstakere “skaper mening” til sine beslutninger.*

*Og i forbindelse med det..*

Tema/spørsmål

1. Hvordan måler ledelsen i oljeselskaper risiko og usikkerhet i prosjekter, og hvordan blir disse faktorene beregnet for i investeringsbeslutninger?
2. Hvilket andre faktorer er det som påvirker beslutninger, ut over tradisjonell Finansielle analyser?
  - Vi vet allerede at «hard data brukes i investeringsbeslutninger. Dette har vi allerede god kjennskap til. Men jeg synes det er spennende å vite hva annet som påvirker en beslutning, fremfor tall. Kan det være leders erfaringer? kan det være tidligere

erfaringer i markedet? eller erfaringer i lignende prosjekter? Historiske hendelser i markedet, i lignende prosjekter?

- Hva med politisk, reguleringer, skattelover osv..

3. Prissjokk, og dets påvirkning investeringer-> Hvordan prissjokk begrenser beslutningsmodeller ved investering.

- Jeg vil gjerne finne ut hvordan dagens prissjokk begrenser beslutningsmodeller ved investeringer. Siden beslutninger må tas raskt, kan det kanskje være en begrensning med å hente inn all data og tall og kanskje disse typer tall blir for magert under prissjokk. Tar man i betraktning historisk erfaring.? Hva skjedde ved tidligere prisfall?, lærte man noe da som man tar i betraktning i dag? Da blir eventuelt dagens beslutninger tatt ut fra tidligere erfaringer, fremfor analytiske metoder.
- Hva når beslutninger skal/må tas raskt?

4. Hvordan beslutninger for Statoil skiller seg mellom investering i Norge og I utlandet?

Selv om et marked I utlandet er mer lønnsomt enn et norsk prosjekt, satser man kanskje hjemme. Dette for at Statoil har forpliktelser og dermed press på seg til å et samfunnsansvar hjemme.

- Hva med Statoil investeringer?. Disse har fått mye kritikk i media, og de har tapt masse penger på disse beslutningene.