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Crisis and Security Management

MSC Thesis

Organizational failures of foresight and Unawareness of Warning Signals prior to the Deepwater Horizon Oil Spill in 2010

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Abstract

Unawareness of warning signals can have crucial consequences for oil and gas (O&G) industries. The sense making stage is situated in the incubation period, where failure of foresight can lead to the unawareness of potentially hazardous situations. This thesis seeks to gain knowledge on the factors that contributed to O&G industries being unaware of warning signals preceding industrial crises. The following research question has been used: What are the factors that contribute to offshore oil and gas (O&G) industries being unaware of warning signals preceding industrial crises? This thesis combines theoretical notions about unawareness of warning signals, atypical events, and factors contributing to that unawareness. This research analyzed the Deepwater Horizon oil spill in 2010 by using qualitative content analysis and theory testing in order to further understand the organizational aspects that contributed to the unawareness of warning signals. Findings showed that BP and the involved actors were unaware of warning signals and factors such as rigid institutional beliefs, information difficulties, failure to comply with existing regulation, and minimizing emergent danger contributed to that unawareness.

Chapter 1: Introduction

Crisis management is able to have a direct impact on human lives. More importantly, effective crisis management can make for resilient organizations. Charles Perrow popularized the notion that crises are negative consequences of the modern world. The process of crisis management starts in the sense making stage, where information is contextualized through processing in order to establish a potentially hazardous situation and comprehend its potential effects. However, it proves to be difficult to predict a crisis, meaning that failure of foresight can occur where certain events go unnoticed (Boin et al., 2016). This sense making stage is also closely related to the incubation period, where events that can be potentially hazardous go unnoticed and can eventually result in a disaster of its kind. Where in the sense making stage an emerging crisis can still be detected, the incubation period can foster failure of foresight through various conditions (Turner, 1967). Awareness of warning signals are of substantial importance in order to prevent potential disasters. Early warning indicators can prove to be useful in order to increase safe production of for instance oil and gas extraction. Development of such indicators can result in increased resilience, where much can be learned from previous crises in order to understand how and when the situation became hazardous (Paltrienieri and Khan, 2016). Major industrial accidents can be placed in different categories when considering particular characteristics. Pearson and Clair (1998) define an 'organizational crisis' as one of low probability with a high impact. Similarly Paltrinieri et al. (2012) define the concept of an 'atypical event' as one of low probability, deviating from the expected scenarios in case of a disaster and falling outside of risk assessment systems.

1.1 Research Problem

Even though 'atypical accidents' are considered to have a low probability, industrial accidents can have major impacts on human lives and their surroundings. Because of the low probability, such atypical events can put a strain on sense making (Weick, 1988). The awareness of early warning signals can possibly lead to greater resilience and can even prevent future crises from happening. In order to prevent disasters from occurring, a proactive stance is needed to

determine the conditions under which atypical events can occur. Early warning signals can be helpful in the process of understanding whether or not they could have led to the prevention of such disasters. Unawareness of early warning signals can result in neglect of potential hazardous situations (Paltrinieri et al., 2012). Turner (1967) explains that there are seven common causal features which can be responsible for this failure of foresight.

Therefore, the purpose of this qualitative master thesis is to examine the factors which are most prominent when it comes to awareness, or rather unawareness of warning signals in industrial crises. This leads to a central research question which is of an explanatory nature and goes as follows: *What are the factors that contribute to offshore oil and gas (O&G) industries being unaware of warning signals preceding industrial crises?* The chosen case for this master thesis is the Deepwater Horizon Oil spill in 2010. The Deepwater Horizon Oil spill, otherwise known as the BP oil spill, occurred on April 20th, 2010. The incident occurred about 50 miles away from the coast of Louisiana in the Gulf of Mexico. During the temporary well-abandonment procedures, the crew lost control of the well. An explosion occurred, which was resulted by the release of hydrocarbons on the rig, resulting in 11 casualties and 17 seriously injured employees. A critical cement barrier which was meant to prevent the release of hydrocarbons was not effectively installed. BP was the main operator and thus responsible for the well design. Transocean was contracted by BP and was responsible for the drilling actions, operating on the Deepwater Horizon drilling rig. The literature surrounding the BP oil spill is extensive, however proves to be mostly technical. The research gap therefore arises, where studying the BP oil spill on an organizational level could prove to add to the academic relevance and the surrounding debate about the topic. The technical literature on the BP is elaborated upon in the second chapter, the theoretical framework.

1.2 Academic Relevance

Studying the awareness of early warning signals is relevant for various reasons. First, this research can be used to create more early warning indicators and will broaden the topic surrounding the awareness of early warning signals. It can shine light upon the need to identify weaker aspects within an organizational structure, which can be done through analyzing previous accidents because these highlight weaker points. Moreover, theory testing adds to the academic debate and results in a better understanding of the common causal features used in

Turner's (1976) paper. Testing theories is substantially important because it allows for an explanation of a process or a series of events. Theory testing can enforce the understanding of the empirical world through the linguistic tools which are used to set up a theory (Colquitt and Zapata-Phelan, 2007). By considering a particular case study, the academic coverage on the topic will increase and the theory will be strengthened. Case studies are substantially important for the academic relevance because it can lead to findings that scholars can use to build upon again in future literature. While there is extensive literature on the BP oil spill, much of it proves to be technical. This thesis takes on a different approach in order to add to the academic debate and fill a literature gap by considering failure of foresight on an organizational level.

1.3 Societal Relevance

The societal relevance lies in the fact that early warning signals and awareness of them can help prevent potentially hazardous situations, which benefits the society. Academic research can therefore have societal relevance because the acquired knowledge can be used to strengthen various sectors of society. Disasters for off-shore industries can have great effects on the surrounding flora and fauna. Because oil spills have so much impact, it is beneficial for the society to understand what measures can be taken to improve future processes. That way, this research proves to be relevant because it concerns environmental and public safety. Furthermore, it can develop the oil industry sector by highlighting various decisions made by different parties and how that could have impacted the outcome. Companies in the future could possible adhere to these findings in order to create a safe atmosphere and possibly avoid future crises. Also it could lead to renewals of response plans as well as policies or regulations. This research creates understanding for the need of development on an organizational level, and can support policymakers in achieving a safer environment.

1.4 Overview

The objective of this master thesis is to demonstrate that awareness of warning signals can allow for organizations to prevent crises. The thesis will continue to demonstrate how in the specific case of the Deepwater Horizon oil spill, the organization was not able to prevent the crisis using Turner's (1967) seven common causal features. This in turn would prove that the organization was unaware of warning signals.

Moving on, the thesis will take on the following structure: heretofore, the introduction elaborated on the topic and research problem, establishing the scope of the master thesis. The second chapter includes the theoretical framework, where the most relevant concepts are elaborated upon. The third chapter includes the methodological strategy, methods of data gathering, methods of data analysis, operationalization and the feasibility of the research. The fourth chapter includes the analysis and the fifth chapter contains the conclusion.

Chapter 2: Theoretical framework

2.1 Crisis

A crisis can be defined as an undesirable and unexpected occurrence which disrupts the advancement of "a person, an organization, a community, an ecosystem, a business sector, or a polity" (Boin et al., 2016, p.5). Faulkner combined various characteristics and found that crises or disasters were caused by a high threat trigger event which could not be directly resolved but did contain a turning point, which could both be understood as positive or negative (Faulkner 2001). Crises can impact societies as well as organizations ranging from a small to a global level, taking forms as natural disasters, political crises, economic crises as well as crises on an organizational level. An organizational crisis is defined as a "low-probability, high-impact event that threatens the viability of the organization and is characterized by ambiguity of cause, effect, and means of resolution, as well as by a belief that decisions must be made swiftly" (Pearson and Clair, 1998, p.2; Weick, 1988). Roux-Dufort finds it problematic that the concept of crisis is not often used as an independent object of research but more as an amplifying tool for other concepts (Roux-Dufort, 2007). The question remains as to what are considered warning signals. If and when the management is aware of certain signals which could pose a threat but choose for inaction, the awareness of equipment and test failures could indicate an inconsistency, and when such results are inconsistent, this could instigate a preventive reaction to such a warning signal. Action or inaction could then be a result of different factors such as communication difficulties. Sheaffer et al. (1998) argue that past successes can lead to

dangerous managerial patterns, which can be problematic especially working with high-risk technologies (Perrow, 1984 in Sheaffer et al., 1998).

2.2 Crisis Management

A vast body of literature covers the topic of crisis management. Steven Fink argues that rather than calculating the costs after a crisis happens, prior knowledge of the effects of a potential crisis could help companies take action before a crisis actually happens instead after the damage has already been done. In order to calculate this potential cost, Fink proposes five questions that need answering, using a ten point scale system to answer each one. The questions concern aspects surrounding: crisis escalation, negative criticism from the media and government, disruption of daily operations, determining the level of organizational responsibility, and the effects on the profit (Fink, 1986). Where Fink proposes a plan of calculating the costs of crises, Quarantelli find the faults in crisis management. Problems within crisis management tend to include communication problems through improper use of available equipment, weak authority crisis response, and coordination problems on an organizational level (Quarantelli, 1986). However, there are various scholars who consider the traditional crisis management theories to be outdated. Roux-Dufort argues that crisis management needs to step away from managing exceptional situations because this does not allow for any long-term change. He proposes that crises should be considered as a process organizational weakness. Stepping away from the event-centered approach to seeing crises as a process, it becomes possible to consider the period before the crisis actually happens, the incubation period (Roux-Dufort, 2007). Topper and Lagadec similarly find that traditional crisis management theories are no longer capable of solving crises due to more and more upcoming 'wicked' problems. The authors are critical about the definition of the concept of crisis, the classification of crises, and the measuring of crises (Topper and Lagadec, 2013). Where crisis management can be prone to failure, Boin and Fischbacher-Smith found the necessity in creating a causal theory so that it would be possible to assess crisis management (Boin and Fischbacher-Smith, 2011).

Furthermore, there is a wide range of literature focusing the crisis management within the sector of O&G industries. Analysis of leadership and human failure has been analyzed by various authors. Pranesh et al. (2017) analyzed failures in leadership and demonstrated that there was presence of human failure through performing an analytic hierarchy process (AHP)

in order to evaluate the Consistency Index, the Quality Index, and the surrounding factors in the BP oil spill. Skogdalen and Vinnem (2012) performed a similar analysis considering the risk of offshore oil and gas drilling through the Quantitative Risk Analysis (QRA) approach. Hopkins (2011) on the other hand, tries to understand how the management of BP and the rig owner, Transocean, would be aware of the situation becoming hazardous, had they focused their attention on the well. But because of distraction, they failed to prevent the disaster.

Moreover, after a crisis occurs, it is important to have efficient ways of evacuation the personnel. One article concerns the evacuation, escape, and rescue (EER) possibilities for the personnel during the BP oil spill, which concludes with technical and non-technical suggestions on how to improve EER possibilities (Khorsandi and Vinnem, 2011). Similarly, Norazahar et al. (2014) analyzed evacuation procedures in the BP oil spill, however, through human and organizational factors. Paltrinieri et al. (2013) focus more on setting up a procedure which can recognize and mitigate atypical scenarios (DyPASI). The DyPASI method focusses on systemizing the information for early warning signals in relation to prior crises. This technique could provide for recognizing potential future crises by looking at warning signals from the past.

2.3 Sense making stage

When a crisis occurs, crisis management is needed to properly respond to the issues at hand. What are the important characteristics during strategic crisis management? Boin et al. argues that there are five critical tasks in strategic crisis leadership, namely: sense making, decision making and coordinating, meaning making, accounting, and learning (Boin et al., 2016). For the purpose of this thesis, only the sense making stage will be considered. In the stage of sensemaking, Weick argues that crises can get out of hand if the sensemaking stage is not focused on a crisis. He highlights an important aspect on sense making that it is impossible to understand a crisis before it has actually happened. The explorer is the one who gets feedback and later builds on that when dealing with potential crises. He finds if the focus is shifted to human interaction, which is part of the enacted environment, that it could explain the importance of understanding key organizational processes (Weick, 1988). Adding to that, Maitlis and Sonenshein want to build on existing sensemaking theories. For them, the importance lies in including the themes of shared meanings and emotion because it would allow

for strategic change and organizational identity building (Maitlis and Sonenshein, 2010). While Weick argues that enactment can lead to a greater understanding in the sensemaking stage, Turner finds that there are features which can be recognized as failure of foresight in the sensemaking stage of a crisis. Turner further elaborates on seven common causal features, and argues that a set of organizational patterns could possibly trigger reactions before the occurrence of a disaster. He defines failure of foresight as "the collapse of precautions that had hitherto been regarded culturally as adequate" (Turner, 1976, p.379). The first feature entails the assumption that rigidities arise through the organizational systems, which can lead to institutional neglect. Secondly, the decoy problem, means that for instance the management can get distracted by other minor problems and might miss the warning signals for a potentially hazardous situation. The third feature, organization exclusivity, suggests that information received from outsiders is largely ignored because it is assumed that they do not have sufficient expertise in the area. The fourth feature, information difficulties, arise when information is not adapted in an appropriate manner. This can result from poor communication, bad interpersonal relations, information neglect or unclear orders. The fifth feature, involvement of strangers, means that people without the needed expertise are cleared and can have access to places or being able to make certain decisions which could harm a situation. The sixth feature, failure to comply with existing regulations, means that personnel is not following the rules, either on purpose or simply because there are not right regulations in place. The last feature, minimizing emergent danger, results from underestimating a potentially hazardous situation which could be a trigger point and result in disaster (Turner, 1967).

2.4 Early Warning Signals and Atypical Events

In crises, an 'atypical event' can be described as an accident where a situation escalates in a manner which would not normally be expected. Normally, 'atypical accidents' have large impacts but a low probability, which is why they are not considered in models. In tackling such atypical accidents, risk awareness is of substantial importance. Such events can result in difficulties of recognizing hazardous situations and incomplete crisis management. Low awareness of the situation can be caused by inexperience of specialists in a particular field for instance, or simply because they have not learned anything from previous lessons, which could have led to memory loss (Paltrinieri et al., 2012a; Paltrinieri et al., 2012).

Borrowing from terms popularized by Donald Rumsfeld, a successful case of crisis management is established where the incident is primarily 'unknown unknown', evolving into a 'known unknown' event, where the actors are aware of the situation and acknowledge that they do not know the situation. Finally, this would lead to a 'known known' event, where the actors are aware and know what actions to take in order to successfully manage this accident. In 'atypical events' however, relevant information is not absorbed properly and actors are only able to develop from 'unknown unknowns' to 'unknown knowns'. Also, using the symbol of a black swan, which can be found in either 'unknown unknowns', 'unknowns knowns', or disregarding of events (Figure 2.1).

Paltrieniri and Khan found that the BP oil spill might have been an example of a black swan, falling in the category 'unknown known', which could have resulted from a loss of memory. Atypical events could have been anticipated by warning signals, but the lessons have not been learned or in other words, loss of memory could lead to the happening of such events. In other words, one might argue that the BP oil spill was an atypical event because the involved actors did not know that they knew the warning signals because of memory loss, either not learning from the lessons before or forgetting the lessons learned (Figure 2.1). Similarly, the concept of dragon kings means the exceptional events which fall out of ordinary expectations, suggesting that there can be system which can predict such catastrophes (Paltrinieri,et al., 2012; Paltrinieri et al. 2012a, Paltrinieri and Khan, 2016; Rumsfeld, 2002).

Unknown knowns Events we are not aware that we (can) know by means of available (but disregarded) information	**Known knowns** Events we are aware that we know, for which risk can be managed with a certain level of confidence
Unknown unknowns Events we are not aware that we do not know, for which risk cannot be managed	**Known unknowns** Events we are aware that we do not know, for which we employ both prevention and learning capabilities

Figure 2.1 Definitions of Known/Unknown Events (Paltrinieri and Khan, 2016)

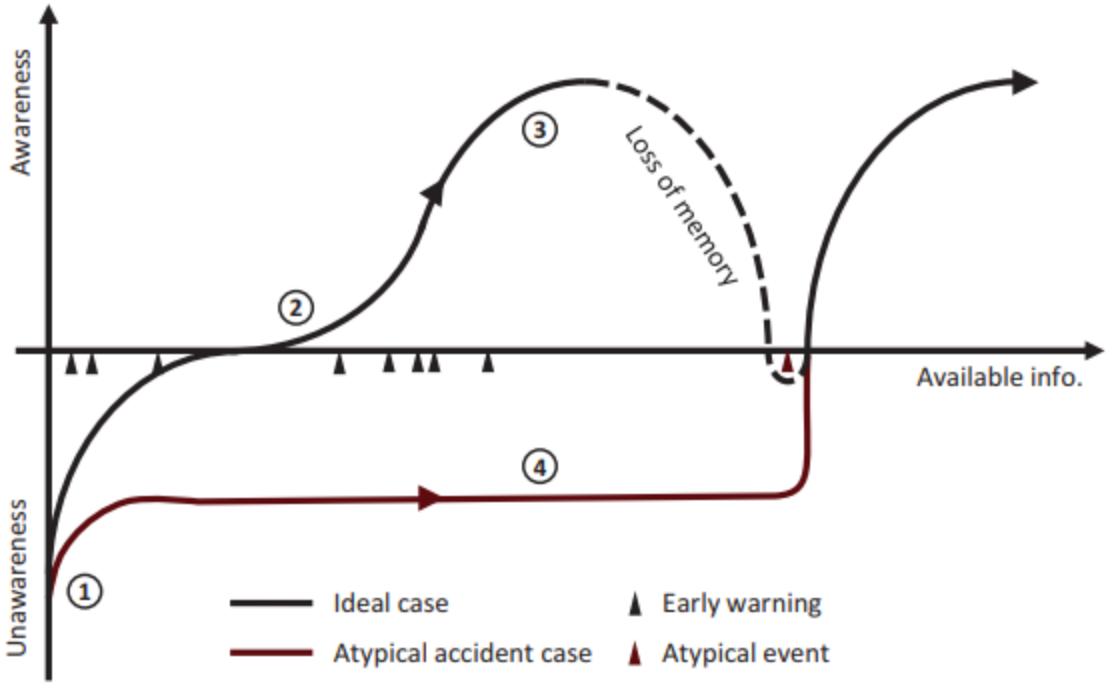

Figure 2.2 Two pathways on managing accident risks taking into account the awareness and information availability leading to an ideal case or an atypical accident case including early warnings and an atypical event. 1) Initial starting positioned in an unknown unknown scenario; 2) An ideal case positioned in an known unknown scenario; 3) an ideal case with the danger of memory loss leading to an atypical event, positioned in an known known scenario; 4) condition of unawareness develops despite the presences of early warnings, positioned in an unknown known scenario (Paltrinieri and Khan, 2016)

Two possibilities when identifying early warnings are the Resilience-based Early Warning Indicator (REWI) method and the so-called ‘‘Dual Assurance’’ method. These methods can indicate whether there have been any indicators of an ‘atypical accident’, which could enable actors to prevent it from happening. The REWI method develops early warning indicators through considering resilience as a starting point. The main elements entail: “(1) contributing success factors, (2) general issues, (3) indicators” (Paltrinieri,et al., 2012). There are eight contributing success factors, which consider the level of resilience in a company. There are three factors concerning the general issues, presenting a list of predetermined indicators of general issues. Furthermore, there are two factors which update and implement an improved set of indicators (Paltrinieri,et al., 2012; Øien et al., 2010).

The Dual Assurance method uses safety indicators in order to assess the level of safety regarding organizations as well as departments of it and activities within. There are six steps making up the first part of the method, allowing for needed information to be extracted for the participating organizations. The method analyzes safety management systems through the

application of leading and lagging indicators which can identify whether a situation is potentially hazardous. Leading indicators include systematic checks in order for processes to continue in an effective manner. Lagging indicators on the other hand, highlight potential weaknesses in the system. The indicators show when safety has not been established. Through the use of these two indicators, the Dual Assurance method can be achieved because the indicators balance each other out and can suggest possible bottlenecks within safety systems (Paltrinieri et al., 2012).

Chapter 3: Methodology

3.1 Research Design

The first chapter determined that awareness of early warning signals is substantially important since it can prevent potential hazardous situations. It is possible to detect an upcoming incident in the sensemaking stage. However, this stage also fosters failure of foresight on an organizational level, which can lead to collective blindness and in result in a disastrous situation. Where atypical events can be characterized by low probability with high impacts, it can put a strain on the preparation of such events in the sensemaking stage. This raised the question about what factors actually led to the unawareness on an organizational level of warning signals prior to crises. Consequently, this led to the following explanatory research question:

What are the factors that contribute to offshore industries being unaware of warning signals preceding industrial crises?

The research question aims to analyze what factors may contribute to the failure of foresight on an organizational level, meaning that one could speak of unawareness of warning signals. From the theoretical framework, Turner's (1967) seven common causal features from *The Organizational and Interorganizational Development of Disasters* are relevant in explaining the unawareness of warning signals. Prior to applying Turner's seven common

causal features, a preliminary analysis will shed light on awareness of warning signals and consequently atypical events, which is extensively elaborated upon by Paltrinieri and Khan (2016), and Paltrinieri et al. (2012). The conceptual framework below will elaborate on the concepts from Turner (1967) and Paltrinieri and Khan (2016) which will be used in order to conduct the analysis.

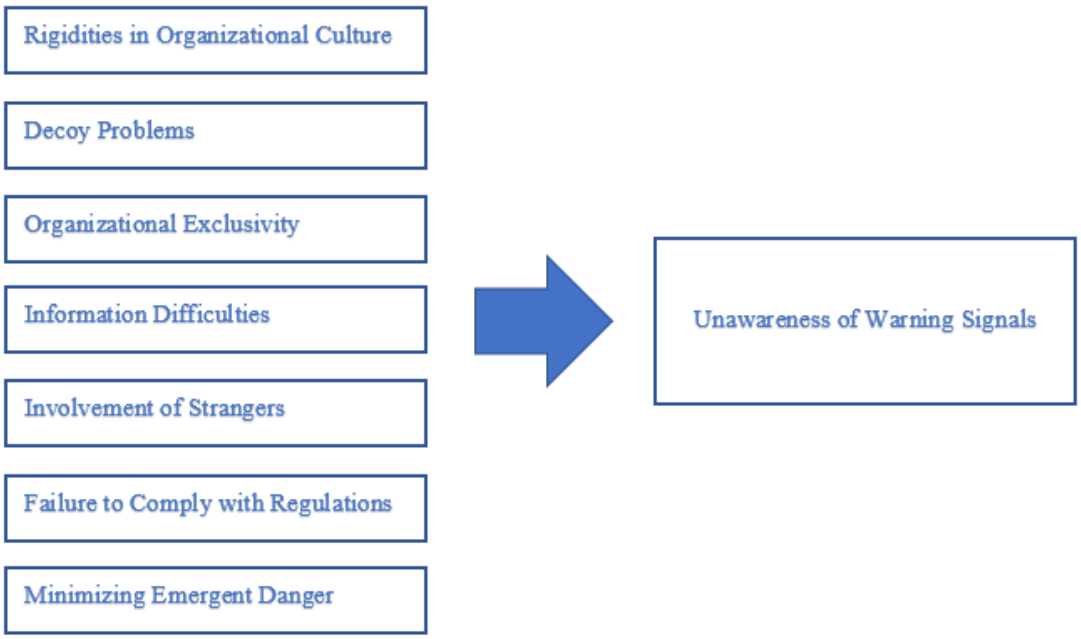

Figure 3.1 Shows Turner's (1967) seven common causal features, explaining that these features can lead to failure of foresight, meaning that unawareness of warning signals occurs.

Turner's (1967) *The Organizational and Interorganizational Development of Disasters* introduced seven common causal features which could be responsible for failure of foresight. The first feature includes rigidities in institutional beliefs. The fitting concept with the first feature includes collective blindness which can include ignoring tips as potentially dangerous. It is assumed that organizations each develop their own culture, which has great influence on decision-making processes on different levels within an organization. Moreover it can limit "openness to information and to alternative ways of doing things" (Nahapiet and Ghoshal, 2000; Turner, 1967).

The second feature includes distracting decoy problems. The main concept remains decoy problems, which means that for instance the management could be distracted by other phenomena resulting in neglecting the core problems. (Turner, 1967)

The third feature includes organizational exclusivity, whereby the opinions of nonmembers are often disregarded. The fitting concept for this feature is organizational exclusivity. Organizations often assume that they have more expertise in a particular area, which can often lead to a dismissive outlook when warnings come from outside of the organization (Turner, 1967). It has similarly been argued that organizations tend to protect their self-interest instead of the possibility of looking weak, which would include disregarding external warnings (Chan, 1997).

The fourth feature includes information difficulties. As a concept, information difficulties arise when there are not enough resources to handle an ill-structured problem such as this one. Turner stresses the fact that not all communication difficulties lead to disasters. However, there are various types of communication difficulties. The first one includes unresolved ambiguities concerning incoming warning signals or other processes. The second problem can arise due to misleading information, whether it be on purpose or not due to interpersonal difficulties. Information can also be present but not shared with the right actors. (Turner, 1967).

The fifth feature includes the involvement of strangers. People who are unqualified, untrained or uninformed can have serious impacts on situations, which could prove to be a risk for the involved companies. If the possibility of such people receiving access is diminished, this could lead to a considerable decrease of potentially hazardous situations. The difficult aspect of this feature is how to group this category of strangers because various groups might have access to sensitive information but might never actually use it. For the purpose of this study, strangers will include any external person not belonging to the involved companies, who had onsite access or could in any way influence procedures and outcomes which (Turner, 1967).

The sixth feature includes failure to comply with existing regulations. This failure to comply can result from the regulations not being up to date as or difficult to follow because of changes in for instance technology, culture, or social differences, well as an attitude of trying to shift the responsibility or test boundaries of certain regulations (Turner, 1967). Because there are so many regulations on different levels such as the organizational level, the state level, and the federal level, it could prove to be difficult to take all these levels into account. Since this study has a research goal to better understand the organization process, it is only logical to take the organizational level of regulations into account. Due to the timeframe, it becomes rather

difficult to understand how the different levels are intertwined and therefore the regulations on state and federal level will not be taken into account.

The seventh feature, minimizing emergent danger, results from a failure to grasp the complete picture and to what extent a situation is potentially hazardous. Even when such situations are recognized, they can be severely underestimated. In situations when the problems become too substantial to deal with, noticeable behavior includes shifting blame to others, trying to take control of the problem through inappropriate means. Moreover, the problem becomes psychological because people fear ringing an alarm bell in case it turns out to be unnecessary (Turner, 1967).

Moving on, the literature on the ability of being aware of early warning signals can indeed be explained through multiple factors which were elaborated upon in the previous chapter, namely the theoretical framework. Because 'atypical events' usually fall outside of safety models, awareness of early warning signals can prove to be helpful in recognizing potentially hazardous situations and successfully manage and recover from crises. Moreover, it is the combination of the awareness factor together with the warning signals which allows companies to act coherently and diminish potential damage. Atypical events can either arise when the involved actors are unaware through memory loss, which would lead to an atypical event, or that they are unaware throughout the whole process, making it an atypical accident case. The operationalization will highlight the indicators present for early warnings and atypical events, which will be used in the preliminary analysis to explain their unawareness. After this has been explained, this thesis can build on an established link between unawareness of warning signals and Turner's (1976) seven common causal features concerning organizational failure of foresight.

Prior to answering the central research question, it is necessary to include a preliminary analysis in order to show whether the BP oil was an atypical event and that the involved actors were not aware of warning signals. If such is the case, then it can be argued that the involved actors in BP were unaware of early warning signals or that loss of memory occurred, which could have led to the atypical event (Paltrinieri and Khan, 2016). Also, prior events with similar outcomes are going to be used in order to show that there were previous warning signals but that BP simply did not learn from the lessons or forgot them through memory loss (Paltrinieri et al., 2012a). The literature presented in subchapter 2.4 and 2.5 in the theoretical framework will be used to prove that the BP oil spill was considered to be an 'atypical event' and that the

involved actors in BP were unaware of early warning signals. Having analyzed this preliminary part, it is then possible to move on to the central part of this thesis. Figure 2.1 and 2.2 will provide support in order to establish whether the BP oil spill was an atypical event.

After having completed the preliminary analysis, the central research question will be answered by analyzing the seven common causal features presented by Turner (1967). This study will take on a qualitative approach, in the form of theory testing. The chosen case for this research is the Deepwater Horizon oil spill, for which the British multinational oil and gas company BP was responsible. The oil spill resulted in serious environmental impacts, health consequences and 11 casualties (BP Accident Report, 2010). Because of the occurrence of a crisis one can argue that the organization was unaware of the warning signals.

3.2 Case Study

The sub-chapter Research design, briefly outlined the aim of this master thesis and the way to do this, which leads to the next part. The proposed methodological strategy for this research includes a case study design. The chosen case study is the Deepwater Horizon oil spill on 20 April 2010. This reason for choosing case studies is because they prove to be targeted, specific, can connect the academic world and its theories with particular situations occurring in real life. The reason for a single case study is due to the timeframe of this research as well as the possibility to explore one particular project and delve deeper into the organizational structure and see which factors are most prominent. The choice for the BP oil spill can be justified as it proved to be an atypical event, which is elaborated upon in the next chapter as well as a substantial industrial disaster, meaning that it is possible to learn from the errors. Case studies have developed in multiple fields such as social sciences, psychology, economics, and anthropology because the methodology allows for critically understanding the complexity of a particular case. As Johansson put it, a case study should "be a complex functioning unit; be investigated in its natural context with a multitude of methods, and; be contemporary" (Johansson, 2003, p.2). A case study design fits the explanatory research question because it allows to delve deeper into one particular case in order to understand the underlying organizational errors. For the given timeframe it is realistic to study one particular case because it can lead to a more valuable conclusion. By doing a single case study, it would prove to be much more feasible because the results would be more accurate and could add to the academic

debate. Considering that this topic is technical, within the given timeframe, a single case study is the most optimal choice.

The Deepwater Horizon oil spill, otherwise known as the BP oil spill, is considered to be a substantial industrial disaster, damaging surrounding flora and fauna. The incident resulted in 11 casualties, 17 injured and impacted its surroundings in the Gulf of Mexico for the upcoming years. The spill covered the coasts of Louisiana, Florida, Mississippi, and Alabama. After the disaster, the BP team had to provide the public with an inquiry report which included 8 main causes for the explosions and fire on the rig, with a continuation of the fire for another 36 hours and oil spilling which could only be contained after 87 days (BP Accident Report, 2010). Moreover, there were questions of culpability, where BP, Transocean, and Halliburton were convicted guilty of gross negligence and willful misconduct. BP's head of safety admitted that there was a lack in the risk assessment department and that the disaster could have been prevented if onsite managers would have observed the warning signs correctly, including the breach of a cement seal as well as incoherent pressure test results (Goldenberg, 2010; Mufson, 2014).

The choice for this particular case study includes the fact that the BP oil spill was one of the largest accidental oil spills in the world, followed by the Ixtoc blowout and the Exxon Valdez spill (Griggs, 2011). In the past, management tended to work in a reactive manner. However, with such disasters taking place there no denying in the necessity of predictive crisis management (Muralidharan, 2011). Surrounding the case study of the BP oil crisis, prior research has been conducted on the role of media during the crisis and how that influenced the reputation of the oil company (Muralidharan et al., 2011; Harlow et al., 2011; Kleinnijenhuis, 2015). Moreover, there has been coverage on the lessons learnt from the disaster and its impact on tourism in the area (Ansell et al., 2010; Mejri and de Wolf, 2013; Ritchie et al., 2014). There is literature on the BP oil spill, but most of it is technical. This is where this research would prove to add value on an academic level since it would approach the problem from a different kind of standpoint. This research mainly focuses on the strategic level rather than the operational level because these are long-term operational goals which are included in annual strategy plans of organizations. There is one article concerning the underestimation of the flow during the disaster, where the incorrect statistics are considered but there is no research on the error on an organizational level yet (MacDonald, 2010). This reveals a literature gap and a research opportunity in the field of sensemaking, combining it with the largest accidental oil

spill in history. Since the BP oil spill had detrimental effects, important factors for research include whether this disaster could have been prevented and if it is possible to prevent future oil spills. In order to understand the organizational errors, the incubation phase before the crisis includes the most relevant time period. Because of certain warning signals preluding to the disaster, the sensemaking stage becomes an important frame to research in light of this particular case study.

3.3 Method of Data Collection

Furthermore, now that it has been established that the research will start with a case study, it is necessary to determine the method of data collection. According to Yin (2003), there are six different data collection methods applicable for case studies: "documents, archival records, interviews, direct observation, participant observation, and physical artifacts" (Yin, 2003, p. 83). For this study, a series of written documents would be suitable to use because of the qualitative nature of this research. One has to take into account that certain documents are not open to public and that interviews are not a realistic option because this would not be feasible for the involved companies due to confidentiality issues and ongoing trials. However, because the disaster happened in 2010, there are various inquiry reports available. A thorough desktop analysis had been conducted in order to evaluate which information was available on the BP oil spill and accessible in the public domain. As multiple inquiry reports analyzed and incorporated witness hearings, internal documents, and email correspondence between the industries, the inquiry reports seemed to provide the most insights concerning the topic. It would therefore prove to be more effective to analyze all the available inquiry reports in the BP oil spill, as they could provide more information and analysis of the acquired internal documents, emails, and witness statements, which they had assessed and sorted through. The inquiry reports have been conducted by a selected team, and it is taken into account that certain information can be phrased in order to blame the other organizations or take away blame by leaving out certain crucial information. That is why the comparison of all the inquiry reports allows for a more solid conclusive statement. What needs to be acknowledged, is that there could be information which will never be known to the public eye because it has been destroyed or there are still ongoing court cases, which do not allow for such material to become public. The other

five data collection methods proposed by Yin are therefore not fitting to the case because the most relevant information can be derived from documents, and especially inquiry reports.

3. 4 Method of Data Analysis

Now that the method of data collection is chosen, the method of data analysis needs to be discussed. It can be argued that data collection and data analysis go hand in hand (Hartley 2004 in Kohlbacher 2006). This research will use qualitative document analysis. Over time, content analysis has been applied mostly in a quantitative manner. However, it is argued that including qualitative techniques can lead to increased effectiveness of the research, especially if one wants to draw conclusions from the studied data to a particular theory, rather than a population (Pashakhanlou, 2017). The research goal for this study is to understand to what extent the seven common causal factors were present and how that can explain the failure on an organizational level of the BP, Halliburton, and Transocean management. This research takes on a deductive approach through theory testing and will be strengthened with triangulation by combining theory testing with content analysis. For the theory testing as well as qualitative content analysis, Turner's seven common causal features will be used as the theoretical framework in *The Organizational and Interorganizational Development of Disasters* (1976). These seven common causal features will be tested in order to evaluate the successes and failure of the sensemaking stage during the BP oil spill.

Content analysis is a method where specific content ranging from traditional media channels to new media channels can be analyzed using this method. Content analysis specifically, means finding signs and symbols within that specific content (Robinson et al., 2014). The qualitative content analysis will be performed by considering various inquiry reports. These inquiry reports can be found on the internet in order to understand the combination of successes and failures in the sensemaking stage and what common causal features were most prominent. The unit of analysis are O&G organizations and the unit of observation includes the analysis of official inquiry reports surrounding the BP oil spill. This content analysis will be performed in a qualitative matter through indicators, in order to successfully draw conclusions from the proposed theory. The variables will include Turner's (1976) seven common causal features and have to be operationalized.

Considering the data analysis section, this research will adhere to the following protocol:

Step 1: Print or download all the available inquiry reports

Step 2: Close read the texts and highlight all the sentences, paragraphs, or pages if they fit a certain common causal feature, considering the indicators.

Step 3: Create an overview in separate tables for each present common causal feature.

Step 4: Write down the findings according to the information in the tables with references to the inquiry reports.

3. 5 Operationalization

Moving on to the operationalization, there are seven common causal features that need operationalization. Table 3.5 shows all of the indicators concerning the presence of warning signals as well as the seven common causal features presented by Turner (1967).

Table 3 Framework	Feature	Indicators
Atypical events (Paltrinieri and Khan, 2016)	Atypical events	-Feature is present when a hazardous event cannot be apprehended by existing hazard identification methods because the event deviates from what is expected in scenarios ranging from unwanted events to worst cases.
Early Warning Indicators Methods (Paltrinieri, Øien & Cozzani, 2012)	Unawareness of early warnings	-Feature is present when there are more lagging than leading indicators. Leading indicators can include: routine systematic checks, overdue plant inspections and tests, and accident risk assessments. Lagging indicators can include: number of injuries, workforce fatalities, high potential incidents, major incident announcement, number and volume of oil spills, fires, explosions, and gas releases with ignition risk. -Feature is present when potentially hazardous information is not acknowledged from prior incidents.
Seven Common Causal Features in the Incubation Period (Turner, 1967)	Rigidities in institutional beliefs	-Feature is present when one can speak of failure of perception in recognizing a potentially hazardous situations. For instance, when events go by unnoticed through rigid structures within an organization or erroneous assumptions. This can be influenced by the selection of process safety indicators, personal safety indicators, and performance indicators. Failure of perception can be either structured or reinforced by organizational, cultural, or subcultural practices. -Feature is present when collective blindness occurs on important issues, which occurs through bounded rationality. This can include the absence of internal procedures, insufficient personal training, a strong focus on personal safety indicators, and no protocols in place.

Decoy Problems	-Feature is present when actors are distracted by other, less relevant, problems. If these actors act upon lesser, more unimportant problems, this can be considered as an indicator for decoy problems.
Organizational Exclusivity	-Feature is present when complaints are not adequately dealt with or when nonmembers are disregarding when they try to approach the concerning actors. -Feature is present when outsiders, who can also be considered professionals from different companies or organizations, are concerned about possible danger and these comments are disregarded by the organization. This can be in the form of reports or recommendations.
Information Difficulties	-Feature is present when there are insufficient resources or no proper ways to communicate adequately and therefore the information is not properly received. -Feature is present when there are unresolved uncertainties concerning warning signals, procedures, tests, responsibilities, controls, risk management, and safety management. -Feature is present when there is insufficient communication between the various levels in the concerning organization. -Feature is present when wrong or misleading information is sent from one group to another or when information in not interpreted correctly. This also includes the action of purposefully not sending available info to another party. This can be due to interpersonal difficulties or when information is not considered significant by one party.

	Involvement of Strangers	-Feature is present when there are untrained or uninformed people, who are not part of the organization, present at the scene of an organization, where they could make decisions which could lead to a potentially hazardous situation. -Feature is present when access to untrained or uninvolved people is not restricted.
	Failure to comply with Existing Regulations	-Feature is present when involved actor do not comply with internal regulations, existing precautions, or when the safety tools within a company are violated. -Feature is present when involved actors approach the regulations or policies within a company in a way of 'what can we get away with?' -Feature is present when involved actors when actors are not following regulations within the company because these have not been updated to the current situation due to changed social, cultural, or technical factors. -Feature is present when the organization itself fails to implement the required internal regulations, policies, defined practices, or safety requirements.
	Minimizing Emergent Danger	-Feature is present when actors underestimate potentially hazardous situations and the magnitude of it. -Feature is present when the potentially hazardous situations are recognized, but adequate action is not taken by involved individuals or groups. -Feature is present when there is uncertainty about whether or not an issue is potentially hazardous and actors undervalue the severity of the results from for instance tests, documents, controls, or reports.

		-Feature is present when potentially hazardous situations are diminished because of fear that the situation might have the worst outcome.

3.6 Feasibility

Qualitative content analysis can lead to certain pitfalls. These could include difficulties defining the variables and deciding which indicators to include. Especially the first , the fifth, and the sixth feature, could prove to be difficult. One way to go around the difficulty of the first feature is to consider response plans and safety or risk indicators in order to see what faults can be found. Moreover, the involvement of strangers is a difficult aspects because it needs to be established what the term 'strangers' actually entails. Furthermore, it is important to set up different categories which can be linked to the seven common causal features proposed by Turner (Robinson et al., 2014). The involvement of strangers will need to be limited in order to fit the time frame because multiple parties were involved and the differences in regulation could prove to be difficult to research. The sixth feature, failure to comply with regulations, will be limited to the regulations within the companies, as they portray the best perspective of the organizational structure. Also, the federal and state regulations are rather complex and it would be more fitting to dedicate an entire research focusing on the regulations on different levels. Due to the scope and timeframe of this study, the regulations on state and federal level are therefore excluded from the findings. Also, qualitative research does not provide external validity because it does not draw conclusions from studied data to a population but rather a theory. This means that generalizability deceases. However, theory testing adds value to the academic field and conclusions can lead to more suggestions for future research. Furthermore, this research design is feasible because all of the reports are public domain and can be found on the internet. The reliability of this research is sufficient because all inquiry reports are analyzed systematically. However, this could be deprived by the fact that interpretation can be considered subjective and that there are documents which were destroyed in the process. Considering validity, the external validity might be low because the research considers one single case study, meaning that it is harder to generalize the outcomes. However, this is compensated by the internal validity of this research, which is high due to the triangulation of methods because of theory testing and content analysis.

Chapter 4: Analysis

This chapter will present an overview of the preliminary analysis as well as the central analysis specifically concerning the case of the Deepwater Horizon oil spill in April, 2010. Prior to the preliminary analysis, it is in order to briefly elaborate on the events on the days before the incident in order to grasp the bigger picture. The Deepwater Horizon oil spill, where the Macondo Well exploded and caught fire in April 2010, led to 11 fatalities, 17 injured and substantial environmental damages. When the accident occurred, the personnel had temporarily abandoned the well after the completion of drilling the well. The Macondo well was a source of uncertainty considering "the geology the petroleum resources, and the formation characteristics that make the well easy or difficult to drill" (CSB vol. 1, 2016, p.8). Parties that were involved in the accident include BP Exploration & Production Inc., who was the main offshore lease holder or operator. Transocean was their drilling contractor and Halliburton and Sperry-Sun Services provided the necessary well services. Cameron was contracted through Transocean and provided "updated parts, testing, technical assistance, and repair services for the Deepwater Horizon BOP throughout its service period" (CSB vol. 1, 2016, p.9). One of the tasks for Transocean to maintain well control in order to prevent fire and blowouts. BP maintained control on the aspects of the drilling programs including the completion activities as well as the mud and casing program. The US Offshore regulator included the Minerals Management Service (MMS), which was part of the Department of Interior, who was in charge of supervising offshore O&G operations and checked whether relevant actors complied with existing regulation. During the preparations, the well design was exploratory because there were issues concerning the type and quantity of the oil as well as the efforts needed to extract it. At the time of the explosion, 126 employees from 13 different companies were present on the Deepwater Horizon rig, including cleaning personnel and cooking staff. The accident occurred during the abandonment of the well, a process that would temporarily plug the well, in order for them to return at a later stage. Test results were misinterpreted concerning cement integrity, which led to the erroneous belief that the well was correctly sealed when it was not. The crew failed to recognize that fluids from the well were increasing, and continued removing more of the drilling fluid column, which allowed for the hydrocarbons to escape from the well and they

continued flowing through the wellbore and the blowout preventer for almost an hour without any intervention (CSB Vol. 1, 2014; BP Accident Report, 2010).

4.1 Preliminary Analysis

4.1.1 Atypical Events

Prior to conducting the analysis concerning the Deepwater Horizon oil spill in 2010, it is necessary to set up a preliminary analysis which will establish that the oil spill was an atypical event. In order to do this, the literature on *Early Warning Signals and Atypical Events* from subchapter 2.4 will be utilized. Paltrinieri and Khan (2016) argue that safety systems fail to include 'atypical events' because of the low probability, meaning that hazardous situations are not recognized in a timely manner. The indicator includes that an atypical event can be considered present when a hazardous event is not recognized by existing hazard identification methods because the event differs from what is expected in scenarios which range from unwanted events to worst case scenarios. In their article they argue that there can be two different scenarios which eventually lead to an 'atypical event'. Figure 2.2, effectively shows the different pathways where both an ideal case and an atypical accident case can lead to atypical events. For the purpose of this thesis, the main argument will include that BP, Transocean, and Halliburton were unaware of warning signals at all times before the oil spill. The preliminary analysis will argue that the BP oil spill is an 'unknown known' event, where possible hazardous events were disregarded or unnoticed despite early warning signals, which were provided through previous accidents. The preliminary analysis will build on the existing theory in order to support the statement that BP experienced an atypical event due to memory loss despite the existing early warning signals.

In their article, Paltrinieri and Khan (2016) already argue that the BP oil spill could prove to be an example of a black swan, a rare accident with extreme consequences which was hard to anticipate, one of an unknown known type. Such rare accidents provide opportunities from which it is possible to learn from and are clear examples of 'atypical events'. Figure 2.2 illustrates that both an ideal case and an atypical accident both starting from an unknown unknow position, can result in the occurrence of an atypical event. This master thesis will argue that the situation was an atypical event and that BP, Transocean, and Halliburton were unware of the warning signals prior to the oil spill. The preliminary analysis will show that there were early warning signals from preceding crises. When available information from early warnings

is disregarded or when actors were not aware that they knew about events, it is possible to consider this a form of for instance memory loss. The analysis hereafter will establish what factors on an organizational level contributed to this unawareness (Paltrinieri and Khan, 2016; Paltrinieri et al., 2012).

Where personal safety incidents are more likely to occur, history has shown that process safety incidents have had tremendous effects. If these process safety indicators, which can be considered hazard identification methods, then it could lead to a hazardous event going by unnoticed and result in an atypical event. Now when a company is performing well on the personal safety, it might wrongly suggest that safety has been well managed where process safety indicators are neglected along the way. An example of this can be considered the fires and explosions at a Phillips chemical plant in 1989, killing 23 employees. Prior to the disaster, there were several million work hours without a report of an incident. However, research after the disaster showed that there were no indicators which could assess process safety and hazards. Secondly, in 2004, the BP Texas City refinery had been applauded by the CEO to be the best year ever considering the safety performance rates and the low statistics on injury. However, that same year there had been found serious gaps in the process safety indicators, which had not been reassessed prior to the disaster where an explosion injured over 180 employees and resulted in 15 casualties. In 2007, the Valero McKee refinery in Texas similarly experienced positive personal safety performance with low injury statistics, but similarly suffered from a process safety accident. This was because of an ineffective hazard analysis, a lack of management and guidance, and the fact that safety process indicators had not been addressed sufficiently. Moreover, in 2009, CITGO's Corpus Christi refinery experienced an accident which resulted in a fire and released dangerous hydrofluoric acid. Nevertheless, the year after the incident, the company got rewarded with a national industry recognition in relation to safety performance because of the low recorded injury statistics. Considering all of these prior accidents, one could argue that process safety indicators proved to be extremely important in establishing a safe and preventive environment. However, O&G organizations seem to fail to learn from these events, which can all be considered warning signals, and in turn can lead to an atypical event (CSB Vol.3, 2016). Now considering the BP oil spill in 2010, BP and Transocean similarly relied on personal safety indicators and did not test for process safety indicators such as "hydrocarbon releases, inspection frequency, number of well kicks, well kick response time" (CSB Vol. 3, 2016, p.136). The second part of the analysis will elaborate more on the

relationship towards personal and process safety indicators. This shows that because the focus was on personal safety indicators, which were considered to be hazard identification methods, the focus on process safety indicators seemed to be lacking. This in turn led to the failure to recognize the upcoming incident on the 20th of April because there were no systems in place which could correctly recognize and prevent such an event from happening, as it fell out of the expected scenarios.

4.1.2 Presence of Early Warnings

Considering the case of BP, there were various early warnings. There are two indicators for the unawareness of early warnings. The first indicator includes that lagging indicators are more used than leading indicators, and the second indicator includes that the unawareness of early warnings is present when potentially hazardous information is not acknowledged from prior incidents. In a time period of ten years, BP has suffered various serious incidents including "Grangemouth (2000), BP Texas City (2005), BP Prudhoe Bay (2006), and Macondo (2010)" (CSB vol. 3, 2016, p.196). Moreover, 4 months before the BP oil spill, a well control event occurred on the rig Sedco 711, where gas and drilling mud got discharged onto the rig due to a well kick. Differently from the BP oil spill, the Sedco 711 rig did not catch fire. The Grangemouth accident in 2000, where three accidents happened within one year, was considered to be caused by a decentralized organizational structure, which could in turn result in cultural and systemic differences between the different levels of organizations, meaning that information difficulties can arise (CSB vol. 3, 2016). The accident in Texas city was caused due to the refinery exploding and catching fire, resulting in 15 casualties and 170 injured employees. An investigation found that there was a failure of leadership, where no member in the board of directive had the needed professional knowledge, meaning that they could not interpret available information correctly, which could again point to information difficulties (CSB vol. 3, 2016). The Prudhoe Bay accident was resulted by pipeline corrosion and led to leak over the period of five days (De Wolf and Mejri, 2013). Figure 4.1 has been adapted from Paltrinieri and Khan (2016) in order to illustrate the position of the BP oil spill and how there have been previous warnings, establishing that at the time of the incident, BP or its contractors were not aware that they knew they had available information or simply disregarded it, resulting in the atypical event of the BP oil spill. Considering this in combination with the theory presented by Paltrinieri and Khan (2016), this thesis will argue that BP was indeed unaware of

early warning signals, which led to an atypical event, the BP oil spill in April 2010. Having concluded this, the next part of the analysis entails reporting the results by applying the seven common causal features presented by Turner (1976). This shows the presence of the second indicator, where BP had experienced several incidents over a period of ten years, including blowouts and oil spills, suggesting that there is a chance of a similar incident occurring, BP chose to not take any particular action in order to decrease the chances from such an incident occurring again, which indicates that they were unaware of early warnings.

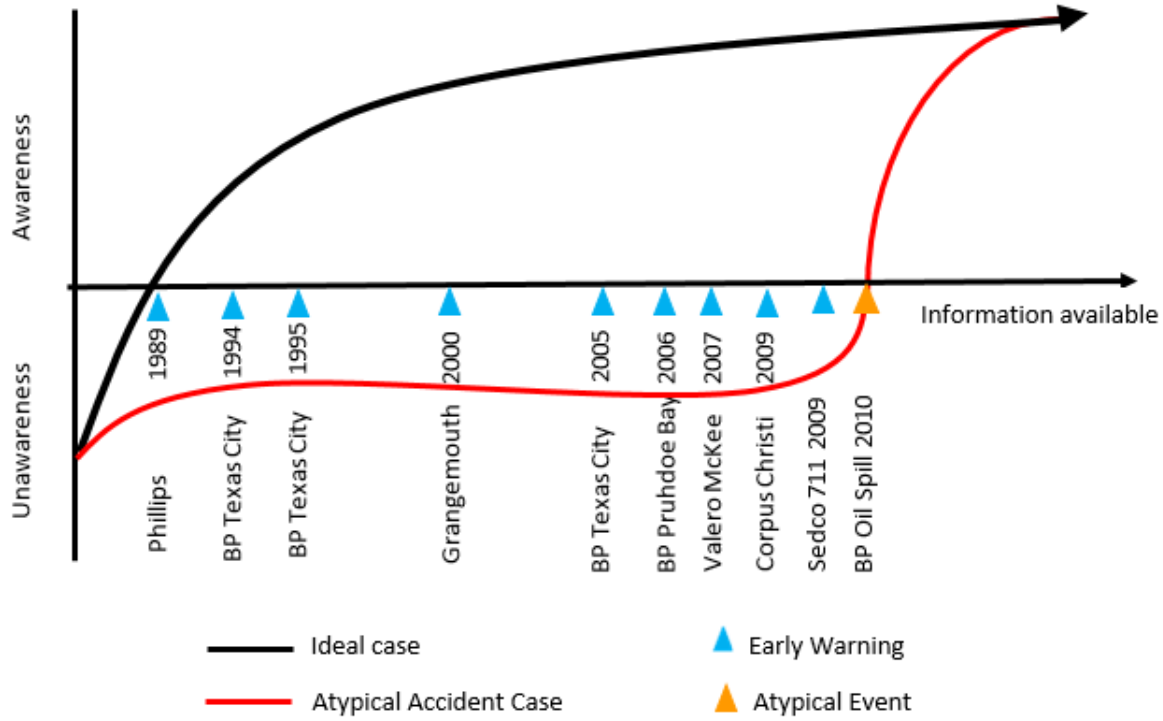

Figure 4.1 Shows the BP oil spill as an atypical event, considering previous warnings from earlier accidents (Adapted from Paltrinieri and Khan, 2016).

Moreover, the U.S. Chemical Safety and Hazard Investigation Board (CSB) investigated an internal company document from BP, the so-called Maroon Book for the year of 2009. The CSB derived from that there were 9 out of 14 lagging indicators were present, in comparison to 1 out of 4 leading indicators being present. The analysis of the document suggests that BP indeed was unaware of warning signals. The most outstanding factors in the lagging indicators, there were 11 high potential incidents (HIPOs), 26 cases of loss of primary containment, 11 cases of flammable gas releases, 8 cases of oil spills which were less than a 100 barrels. In the leading indicators, there were 9 HIPO lessons learned reports issued. There was no data to assess "safety management systems, safety critical barriers, or even well kicks, several of which

BP-contracted Transocean rigs experienced" (CSB, 2016, p. 138). Considering this information, there were warning signals such as the number of high potential incidents, loss of primary containment, flammable gas releases, and the number of oil spills. Similarly, Transocean, the contractor of BP, experience problem concerning well kicks, or safety critical barriers, which had not been addressed in the 2009 document at all, where for instance well kicks could lead to a blowout with a chance of fire. This shows the presence the first indicator, where there were more lagging than leading indicators used. When focusing on the lagging, and neglecting the leading indicators, it could prove to be difficult to prevent and be aware of early warnings. Because there was no data available on leading indicators such as number of well kicks, safety critical barriers and safety management systems, which supports the assumption that BP and Transocean were indeed unaware of early warnings because there were no accident risk assessments in place or tracking the number of well kicks.

4.2 Analysis of BP Oil Spill

4.2.1 Rigid Institutional Beliefs

The presence of rigid institutional beliefs proved to be prominently present in the inquiry reports. Indicators included that one could speak of a rigid organizational structure if it would mean that situations could pass by unknowingly because of the rigid structure within an organization. This could be for instance influenced by the selection of process safety indicators, personal safety indicators, and performance indicators, which would shape the rigid culture where employees are assessed and rewarded on certain actions and penalized by other ones. A second indicator includes the occurrence of collective blindness due to bounded rationality. This is enforced by the absence of internal procedures, insufficient personal training and a lack of safety protocols or a large focus on personal safety indicators. The analysis found that BP relied too much on positive personal safety statistics, which can provide a false sense of safety and are not sufficient to prevent or detect major accidents. Personal safety indicators can include low injury rates among employees, the amount of days they are away from work, the frequency of occupational illness, and the number of observing employee behavior. Because the statistics showed a negative trend for key personal safety metrics such as the frequency of injuries and days away from work, it was assumed that the safety record was improving, and this created collective blindness as to what other factors could possibly play a role and could create a hazardous situation. Prior cases showed that personal safety performance indicators do not

assess the possibility of low probability accidents with large consequences, which is problematic because it entraps managers into believing that the corporate safety is under control. Personal safety considerations were noticeably more prominent in the evaluation of the safety level but failed in establishing a meaningful way towards preventing a major accident (CSB, Vol. 3, 2016). This evidence shows the presence of both indicators, where the selection of personal process indicators creates a false perception of safety and thus can lead to collective blindness, contributing to rigidities amongst employees.

In their selection of performance indicators, what was noticeable is that BP used lagging and personal safety performance indicators in order to evaluate and manage process safety. BP created the Maroon Book, which was an internal document tracking all the progress, containing goals and processes in order to maintain the growth of the company. This led to the negligence of process safety indicators such as low frequency accidents with large consequences, releases of harmful materials which caused fires or explosions, environmental damage, "hydrocarbon releases, inspection frequency, number of well kicks, well kick response time" (CSB Vol. 3, 2016, p.136). Transocean, contracted by BP, experienced several well kicks on their rigs previously, which could be grounds for adding at least that as an indicator in order to somewhat cover process safety. Despite this knowledge, process indicators such as the number of well kicks and for instance hydrocarbon releases were not mentioned nor tested by BP. There were twelve lagging indicators included and four leading indicators in the Maroon Book. However, there was no reported data on three of these leading indicators such as tests and assessment concerning the risks of major accidents (CSB, Vol.3, 2016). This evidence shows the presence of the first indicator, where the selection of the process safety indicators, especially the focus on lagging rather than leading indicators, led to the institutional neglect of process safety indicators which could have supported the detection of a hazardous situation by including for instance the number of well kicks and the respond time to them.

BP also measured individual performance goals, which are supposed to enforce safety within a company. An analysis on the way BP employees were reviewed and again showed the lacking of process safety goals, with the focus being on the number of recordable incidents and days away from work. To be more specific, from the year 2008 to 2009, there was need for substantial cost reduction. The former BP vice president of drilling and completion stated that his performance indicators included cost containment goals and no process safety metrics, and that he needed to cut hundreds of millions. This means that there are no controls and that the

company does not require a certain level of safety which inherently enforces the rigid structure where employees find that they do not have to focus on for instance process safety because they are not reviewed by it in their performance. This is problematic because it established an organizational culture where there is no need, and perhaps no place, to discuss safety-related decision making on various levels (CSB, Vol.3, 2016). The first indicator is present because the selection of individual performance goals showed that there was a lacking focus on safety, which inherently enforces the rigid culture where employees are awarded for reducing monetary costs instead of considering safety measures.

Moving on, Transocean similarly struggled in selecting adequate and measurable performance indicators. The THINK program would allow for risk assessment of the rig crew, and the second program START would monitor behavior of the crew in order to determine safe and unsafe choice made by the personnel. What was noticeable is that the focus was again on personal safety indicators and the process safety indicators that Transocean did use were considered to be insufficiently focused on in preventing accidents. This discontent was also voiced by the Transocean President Steven Newman in a string of emails to other Transocean senior managers, 8 months before the accident. Prior to this statement there was an audit in December 2008, which focused on assessing safety critical tasks of the employees. The indicators used during the audit however, were vague and lacked focus on well-specific hazards. This meant that the audit was not of much use because nothing was done with the findings other than a final statement that there should be more focus on management systems. Moreover, the bonus awards indicators focused mostly 20 percent on safety performance, 70 percent on financial performance, and 10 percent for 'new builds'. This means that the company favors lower costs over safe performance, which in turn can lead to employees neglecting certain safety measures because these are simply not regarded as substantial and could lead to not recognizing a hazardous situation. One could argue that the rigidity of the indicators is what led to failure of foresight and even when this rigidity was recognized that there was not much done about it (CSB, Vol. 3, 2016). Considering safety management and risk reporting, a review performed by Lloyd's register in March 2010, a company hired by Transocean, showed that 43.6% stated that they worked with a sense of fear that they would be punished if an accident occurred and the process had to be slowed down, making it also less likely for them to report safety issues even if they had detected them (CSB, Vol. 3, 2016; BSEE Vol. 1, 2011). This again shows a presence of the first indicator, where the selection of performance indicators

leaves no room for the acknowledgement of hazardous situations, which can be assessed by process safety indicators, meaning that this only enforces the rigidity of Transocean. Financial performance covers 70 percent of the bonus award indicator, which contributes to the establishment of the organizational rigid culture, where employees are encouraged to perform well financially, but are not nearly as highly rewarded for safety performance.

Now one might argue that because of the combination of performance indicators and bonus reward metrics, this could have led to the improper interpretation and handling of the negative-pressure test performed by Transocean and BP. The Transocean crew for instance, should have been wary about the possibility of the cement job failing. Instead, their expectations were that the cement job was done sufficiently and that the well could not be flowing, so the crew continued with various tests in order to confirm their own expectations. Because there was no system in place for either BP and Transocean to interpret negative-pressure tests, neither the rig crew or the well site leader were provided with requirements on what actions to take when the test results are failing, which goes hand in hand with information difficulties and will be elaborated upon at a later stage (National Commission Report, 2011). Moreover, this also ties in with the second indicator, where the absence of sufficient personal training and the lack of protocols on what actions to take in case of negative tests result, led to the failure of assessing the situation and eventually collective blindness because the crew continued despite the negative results.

Halliburton was responsible for the cementing process and foam cementing testing, but analysis showed that there were no adequate risk assessment factors in place, which allowed Halliburton to perform multiple tests on the cement slurry with all of them concluding that the slurry was unstable. There was no structure in place that would mandate the Halliburton team to review the slurry design because there was no clear protocol and what to do in such situations. This also led to Halliburton not communicating their results to BP and instead changing the test conditions in order to get a favorable test result, which is also similarly connected to information difficulties (National Commission Report, 2011). This shows the presence of the second indicator, where due to an unclear structure and poor protocol, created a rigid culture where Halliburton employees were not pressured enough by the institutional rigidity to report or even act on the failing cement slurry testing.

4.2.2 Decoy Problems

After analysis of all available inquiry reports, the feature of decoy problems was not sufficiently present in any of them. The indicator included that decoy problems are present when the concerned actors are distracted by less relevant problems and thus do not have adequate time to focus on the actual hazardous situation. This was not the case before the Deepwater Horizon oil spill. The reason for this is that BP, Transocean, and Halliburton were all working on the same project and if a problem would arise on for instance the rig or the communication between the companies, it would be a relevant problem because neglecting it could possibly only enable a hazardous situation. The main goal was clear but what was more important is that the procedures and the information and training available for the employees was lacking, which will be elaborated upon at a later stage. Chapter four in the National Commission Final Report slightly touches upon the assumption that the crew might have been distracted by other issues because no one noticed that the drill-pipe pressure was increasing while the pump rate stayed at the same level (National Commission, 2011). However this is not enough and insufficient in order to consider as the presence of decoy problems. There was no evidence that employees were specifically distracted by less relevant problems and also acted on them.

4.2.3 Neglect of Outside Complaints

There is no sufficient evidence in order to state that this common causal feature was present. Indicators included that the feature was present when complaints from outsiders were not dealt with in an adequate manner. Furthermore, the second indicator included that possible concern from professionals outside of the involved companies were concerned about possible danger and that these comments were similarly disregarded. If anything, there was a lack of monitoring and it seemed that there was not much external expert involvement at all, apart from the BP and its contractors. However, there are various reports from previous accidents, especially BP Texas City (2005), who came up with several recommendations for BP in order to prevent similar crises in the future. These reports derive from the CSB, the BP US Refineries Independent Safety review, and the Baker Panel. The reports stress that process safety indicators are underdeveloped and that they need to implement more safety process measures as well as monitor these metrics and take preventive measures when needed. Research showed that BP did show some board governance improvements but there are still aspects which have not been

considered which means that the changes made did not diminish the chances of a major accident event. Transocean was even less willing to implement changes. The reports were not direct complaints concerning the what is now known to be the BP oil spill, but it were nevertheless expert views with valid recommendations and showed that BP did not much to change the situation after for instance the BP Texas City (CSB, Vol.3, 2016). However, with this being the only finding, it still means that the feature was not sufficiently present throughout the reports. While the second indicator was present in one piece of evidence, where various reports on process safety indicators were disregarded, this is not sufficient to conclude the presence of organizational exclusivity.

4.2.4 Information Difficulties

The feature of information difficulties was strongly present among and between BP, Transocean, and Halliburton. Indicators include when there are insufficient resources or no proper ways for adequately communicating. The second indicator considers unresolved communicative uncertainties concerning test, safety management, responsibilities, and controls. The third indicator includes insufficient communication between the various levels of an organization. Finally, the fourth indicator is present where wrong or misleading information is exchanged between groups, which can be either purposefully done or not. There were various uncertainties and a lack of information or guidance from the managing positions which ultimately played a role in the BP oil spill. Transocean seemed to experience the most information difficulties. BP and Transocean had singed a bridge document, indicating that they were both responsible for the "Health, Safety and Environmental (HSE) programs" (BSEE Vol. 1, 2011, p.100). Any allegations that BP was solely responsible for the drilling plan and procedures can thus be discredited. Interestingly, this then shows that Transocean failed to adequately train and provide the crew and management on board with sufficient information in order for them to "full responsibility for the safety of the vessel, including during a well control issue" (BSEE Vol. 1, 2011, p.100). The safety management system (SMS) training consisted out of a PowerPoint presentation, of which the details are not present, and the person responsible for the implementation of these safety systems who testified during the Joint Investigation Team hearing on 12 September 2010, could not recall the content of the presentation nor the exact location of the SMS material on board, be it on a computer or in a

printed out version. If these systems are not in place, it can be assumed that the rig crew and well site leaders could face difficulties trying to get a hold on that information. This evidence is coherent with the first and second indicator, since information which concerned safety systems was not communicated in proper ways from the top management levels to the employees on the rig. The second indicator was also present because there were uncertainties concerning the responsibility for HSE programs. The results were that employees from BP and Transocean did not receive adequate training, meaning that neither teams were able to take responsibility for the safety of the vessel and had no instructions on how to proceed in case of a well control issue.

Furthermore, there were two procedures regarding the understanding on when systems are shut down for repair, the procedure where employees 'tag out', and the procedure 'permit to work' (PTW). An audit in July 2009 showed that the PTW program failed because the official who is responsible for the program is not always around, as was shown to be the case on April 20th 2010, where the Chief Electrician and other personnel were working in the Mud Pump Room at the time of the explosion and the personnel controlling the PTW systems were not in place at that time so they could not warn them. This evidence shows the combination between the first and the third indicator, because there was no proper communication between the different levels, in this case between the Chief Electrician and the official responsible for the PTW program, which was inherent to the organizational structure and finally resulted into 11 casualties. Had there been proper communication systems in place, then the chance of the employees surviving could have gone up if the information would be communicated in time. A later audit in September showed that the contractors had no sufficient knowledge "drilling and well operations practice or engineering technical practices" (BSEE Vol. 1, 2011, p.101). Furthermore the audit showed that Transocean failed to train their crew for emergency preparedness, were the employees were allowed to override emergency safety mechanisms, but no one from the crew actually knew the technical reasons behind as it became a routine to bypass these systems (BSEE Vol. 1, 2011). This evidence ties in with the second indicator, where the contracted employees experienced uncertainties concerning drilling and well operations because this knowledge had not been provided to them adequately.

Moreover, investigation showed that the weekly emergency drills held by Transocean did not prepare personnel on how to respond in emergency situation in case of a well control event or a fire. The crew had so much difficulty with the launch of a lifeboat that other crew

members chose to jump in the water instead. This shows that because of the unpreparedness of the crew, they would have to make last minute rash decisions because there was not enough guidance within the organizational structure. Similarly, there were not enough instructions for the Transocean rig team concerning properly managing risk. The team had difficulties with the completion of well drilling, experiencing maintenance shortcomings, and did not possess adequate knowledge concerning safety due to the lack of training, which points to the clear incapacity to assess safety risks. There were no available risk assessment tools or other methods provided by Transocean in order to determine the level of safety and possible risks which led to the absence of safety time outs or risk reporting by the crew because there were uncertainties or simply a lack of awareness by the crew members. Analysis also showed that both BP and Transocean presumed that the other was responsible for conducting a proper hazard analysis, leaving the crew with the responsibility in the end, which caused great confusion for the negative-pressure testing (CSB Vol. 3, 2016; BSEE Vol. 1, 2011). Similarly, this evidence is consistent with the second indicator, where uncertainties existed which left the employees unprepared on how to act in a hazardous situation. This also ties in with the third indicator because the uncertainties of the Transocean employees were present due to a lack of communication and guidance between the various levels within the organization. BP and Transocean assumed that the other was responsible, which created information difficulties for the rig crew, because they were the ones to execute operations and complete the well drilling but lacked in knowledge and training on how to proceed in unexpected situations.

There were also some communication difficulties between BP and Halliburton, where information was deliberately withheld or the available information was not correctly used by the other party. During the cement slurry testing, making sure that the cement job will hold under various circumstances, certain difficulties arose. On March 8, Jesse Gagliano[1] requested a series of pilot tests on the cement slurry, which he later sent to BP and included a recommended plan for cementing. An expert would have immediately seen that the results showed the instability of the cement slurry. However, neither Gagliano nor anyone from BP made any comments concerning the tests and it is still uncertain whether BP actually examined the data sent by Gagliano in the first place. Moreover, it turned out that Halliburton had conducted a cement slurry test in February with failing results and that they performed a series

[1] Halliburton Engineer

of tests including a test concerning the foam stability, where the test results again showed that the slurry was unstable. However, these findings seem to never have been reported intentionally to anyone in BP. On the other hand, there were information difficulties coming from BP concerning the amount of centralizers needed between the casing. The decision to only use six centralizers[2] at Macondo instead of the recommended 21 centralizers and failed to address this issue at an early stage, leading to BP not informing Halliburton about last-minute changes concerning the amount of centralizers used as well and BP did not request them to create a new model, assessing the impact it would have on the casing using only six centralizers. This is rather interesting because the contractors were responsible for the modelling of centralizers, whereas BP made unexpected changes without discussing it with the responsible parties (Transocean Report, 2011; National Commission, 2011). This evidence is coherent with the fourth indicator, where information concerning the recommended plan for cementing was not correctly interpreted and perhaps neglected. Adding to that, significant information concerning the negative cement slurry test results were deliberately withheld from BP. Also, information difficulties arose when BP chose not to inform Halliburton on last-minute changes about the number of centralizers.

On the day of the accident the BP well site leaders and the rig crew received a seven step procedure which they would use for that day for the temporary abandonment where they changed and added several steps which were not included in the plan on April 12. The time notice was relatively short because it was the first time that the employees saw the seven steps. Analysis showed that they never got through all of the steps but despite experiencing difficulties with several steps still continued until the situation got out of control. The positive-pressure test showed no uncertainties and the team continued with the negative-pressure test[3], where the team was faced with uncertainties. The team experienced three failed attempts to get the pressure down to zero even after shutting the well back in, meaning that the test showed that well integrity had not been established. After the well site leaders and the rig crew had discussed the findings amongst each other, the only explanation they could find for the test results was the so-called 'bladder effect'[4] and after the fourth and final test, which failed again, they chose to confirm the integrity of the well, despite the test results since there was no protocol on what

[2] Screws placed between sections of casing, reducing the risk of gas migration (Transocean Report, 2011)
[3] Tests the integrity of the casing as well as the bottom hole cement job (National Commission, 2011)
[4] For more information look into National Commission Final Report, 2011, p. 107-109

to do when the well integrity had not been established (National Commission, 2011). This evidence shows the presence of the second indicator, where the crew was still struggling with uncertainties concerning the negative-pressure test results, perhaps because they were provided with an updated version of the seven step procedure shortly before they would initiate the temporary abandonment, which could have led to the erroneous belief that it was safe to continue the seven step procedure.

4.2.5 Involvement of Strangers

The common causal feature involvement of strangers was not sufficiently present in any of the inquiry reports. Indicators include the presence of untrained or uninformed people, who were present at the scene where they could be involved in actions of a hazardous nature. The second indicator includes access for these untrained or uninformed persons. The absence of this feature is logical because the Deepwater Horizon rig was located far from the coast, making it unlikely that individuals who were not employees or at least in some way part of the organization to be present at the rig. In other projects that might take place on land, precautions on potential involvement of strangers should be considered but for this particular case it is simply not needed and there was found no evidence in the analyzed materials. What the reports did show is that the Transocean rig crew, The Halliburton employees, and the BP well site leaders were insufficiently informed and rather untrained as to what actions to take in case of for instance deviating test results, which will be more elaborated on further (National Commission Report, 2011; BP Accident Report, 2010).

4.2.6 Failure to Comply with Regulations

The failure to comply with regulations was present in the findings of the inquiry reports. The first indicator involves actors who failed to comply with the their internal regulations or safety tools. The second indicator includes the approach of ‘what can we get away with’ from the employees within the company. The third indicator includes employees not following internal regulations because of changed social, cultural, or technical factors. The fourth indicator includes failure to implement existing internal regulations, policies, practices, or safety requirements. A review of two reports provided by Transocean which concerned the installment of the blowout preventer. These reports stated that Transocean conformed with the regulations concerning the testing of certain blowout preventer back-up systems. However, daily reports

show that two, namely the AMF and ROV intervention systems, of the four back-up systems had not been tested at all, which could imply a failure to comply with regulations. Reviewing 8 years of these summarized reports, BP found that Transocean did not have the function to test these two back-up systems, where the ROV intervention could in retrospect have detected the leakage in the blowout preventer (BP Accident Report, 2010). This evidence is coherent with the fourth indicator, because Transocean supposedly conformed to the regulations of the BOP back-up systems but there were no functions to test these back-up systems, meaning that they failed to actually follow and implement these regulations.

Moreover, Transocean had a system in place where employees had to self-report on a daily basis, explaining their correct and incorrect actions taken on the rig, which was done through the THINK and the START program where the goal was to reinforce safe behavior. However, this program resulted in under-reporting because employees were wary of the fact that there would be negative consequences because of breaking safety rules. These programs concern for instance matters such as safety breaches, where employees fail to conform to rules and policies, examples of which can be "missing personal protective equipment, poor housekeeping" (CSB Vol. 3, 2016, p.143). Where these programs could actually lead to increased safety, the rig personnel was required to submit daily START observation cards where they would include all of their positive and negative actions taken that day. This led to an attitude of 'what can we get away with and because these START cards had to be filled in systematically, this took away from employees bringing out their real concerns about potential problems. It could be expected that employees would be wary about reporting on their own mistakes, which could ultimately result in minimizing emergent danger because it could mean that individuals would be held responsible when breaking a safety rule. If personnel would report less safety breaches it could result in information getting lost and could result in more problems along the way. This ties in with the last feature which will be elaborated upon hereafter (CSB Vol.3, 2016). This evidence is coherent with the first and second indicator, where the employees were wary of the consequences of self-reporting, and therefor failed to comply with the safety precautions and tools which initially were meant to reinforce safe behavior. However, it only led to employees reporting less on safety breaches because they could be penalized for not upkeeping safety measures.

Moving on to BP, the November 2009 issue of the internal BP manual on Operation Management Systems (OMS) and drilling operations, stressed that the risk management system

needed to be amended. The Group Defined Practice (GDP) of BP in 2008 concerning OMS focused especially on Health, Safety, Security and Environment (HSSE) 3.1-0001. Analysis showed that BP did not meet these safety and security requirements because the best practices developed by BP still provided the employees with minimal guidance. The Macondo risk register, which was created by BP, lacked on including persons who were accountable for the drilling process, as well as no clear indication of the roles and responsibilities, meaning that the HSSE impacts were substantially left unconsidered. This evidence shows the presence of the first and fourth indicator, where BP failed to comply with and implement the GDP in 2008, failing to meet the HSSE 31-0001 requirements.

In order to reduce risk, BP chose to use the as low as reasonable practicable (ALARP) tool, which would be incorporated in the risk matrix of the Beyond the Best (BtB) Common process used by BP. However, analysis showed that the risk register of BP did not fulfill the ALARP requirements. It was acknowledged by former Drilling and Completion BP Vice President as well a senior process safety engineer that the BtB risk register failed to address HSSE risks, that there were no processes to indicate that the well control safeguards were in place and that risk practices were not as low as reasonably practicable, despite the ALARP requirements (CSB Vol.3, 2016). Moreover, it was found that the Major Accident Risk (MAR) process was not implemented by BP. Internal documents show that the leader of BP's Drilling and Completion was responsible to make sure that the "MAR study is completed, reviewed, and the results communicated to the appropriate level" (CSB Vol.3, 2016, p.183). This evidence is coherent with the fourth indicator because BP as an actor failed to fulfill the ALARP requirements, where there were no practices in place which adhered to the ALARP tool.

However, what is key to this finding is to recognize that there were severe problems with the required regulation, on a state and federal level, more so that there was a lack of mandatory regulatory requirements for safety management systems, risk reduction, environmental management, and management of change. There also proved to be a lack of compliance concerning international regulatory models, uncovering a culture that accepted minimal regulatory compliance. This falls out of the scope of this research, but is nevertheless considered a substantially important feature when researching how the various levels lacked regulatory presence and there was not much need for BP, Transocean, and Halliburton to implement certain for instance safety regulations (CSB Vol.3, 2016; CSB Vol.4, 2016; BSEE, Vol.1, 2011; National Commission Report, 2011).

4.2.7 Minimizing Emergent Danger

The feature of minimizing emergent was present in the inquiry reports. The first indicator includes actors underestimating potentially hazardous situations. Following that, the second indicator considers the recognition of such situations but the failure of acting upon them. The third indicator concerns undervaluing the results from tests, documents, controls, or reports, and thus possibly not recognizing emergent danger. The fourth indicator includes minimizing emergent danger out of fear of it being the worst case scenario. Following up on the pervious feature, the daily self-reporting of Transocean personnel could have led to minimizing emergent danger because the THINK and START programs, which were aimed at monitoring safety and identifying correct and incorrect employee behavior. This is because these the indicators of correct and incorrect behavior are directly identifiable and therefore take away from the possibility of recognizing potentially hazardous situations. The programs focused on safety rules which were easily identifiable, resulting in employees being hesitant in self-reporting on breaking safety rules, which could have led to minimizing emergent danger because they were wary on the negative effects it could have on their jobs. Because Transocean personnel were required to submit these action cards daily, it could have led to employees be less willing to admit their own faults, especially if these decisions would have a greater impact on the whole process (CSB Vol.3, 2016). This ties in with the fourth indicator, where employees are wary of being penalized for negative actions and which could therefore lead to minimize emergent danger and not report on it.

Moreover, the probability of a blowout on the Deepwater Horizon rig was assessed only though one risk management tool, more specifically the Major Hazard Risk Assessment (MHRA), which should identify the major hazards on the rig itself. However, the MHRA had not been evaluated for almost six years prior to the assessment, and despite the chance of a well blowout being a medium risk, Transocean chose not to give any recommendation regarding the outcome of the assessment. The associated risks with a blowout are known, characterized by high severity and low probability, which is why it is problematic that the MHRA had not been revised for almost six years at the time of the BP oil spill. It is also trouble sum that there was only one higher level risk management activity which was completed, namely the MHRA, because this led to Transocean neglecting critical elements in the higher level risk assessment, such as the manually activating the blowout preventer. If the blowout preventer is not treated

as a safety critical element and there are no routine inspections, it could lead to failing components in the blowout preventer going by unnoticed. This turned out to be the case for the BP spill because the necessary inspections could have established the "latent BOP failures of the emergency systems components" (CSB Vol.2, 2014, p.62). Transocean had no documents to prove that the blowout preventer had been evaluated and that the human and process controls have been correctly implemented (CSB Vol.3, 2016; CSB Vol.2, 2014). This evidence is coherent with the second indicator because the potential dangers are recognized, meaning that the risks of a blowout are known, but the fact that there had not been an MHRA assessment for almost six years is grounds for minimizing emergent danger because failing components could go by unnoticed.

Such negligence is also shown in the fact that the Major Accident Risk (MAR) process had not been implemented by BP. While BP did identify a loss of well control, especially blowouts, as one of the two highest risks in the MAR process, there was not action taken to actually to actually apply the MAR process of the Deepwater Horizon rig. Where Transocean had experience six riser unloading events in 2008, there were similarly no actions taken despite the fact that a riser unloading event could result in a well kick event. Internal Transocean documents show that they had experienced an increase in well kicks from 7 to 19 over the period of 2006 until 2009. Despite increasing numbers of well kicks and riser unloading events, both parties did not consider the situation hazardous, as there were no actions taken to implement more risk assessing processes. While both parties knew that a blowout could have disastrous effects, one could still speak of minimizing emergent danger because the probability of a blowout was still considered low, which could be an explanation for the inaction of both BP and Transocean to perform a MAR study (CSB Vol.3, 2016; CSB Vol.4, 2016). This evidence is coherent with the first and the second indicator because the potentially hazardous situations had been underestimated by both Transocean and BP as well as a lack of adequate actions taken in order to implement extra risk assessing processes.

Moving on, there were some serious problems concerning the negative-pressure testing. While it is necessary to establish well integrity during the negative-pressure tests, there were various occasions where the test results were failing and because the results of the fourth test also did not show that well integrity had been established, the Well Site Leaders explained the results by pertaining to the assumption that it was a 'bladder effect'. Despite the personnel reviewing the results knowing that a failing outcome of the tests could lead to great

consequences, no one on-site chose to take any action and the process continued. They chose to wrongly believe that the results were caused by a bladder effect and therefore were unable to predict the hazardous consequences that their actions would have (BP Accident Report, 2010; (National Commission, 2011). This evidence is coherent with the third and fourth indicator because the teams were uncertain about the possible severity from the test results and also diminished potentially hazardous situations by assuming that the results were caused by a bladder effect because if they did not, these failing outcomes could lead to great consequences, which in the end, is indeed what happened.

Chapter 5: Conclusion

This chapter elaborates on the main conclusions as a result of this research in combination with the reflections, in which the limitations of this research are discussed, as well as the recommendations for future research.

5.1 Central Research Question and Findings

The aim of this master thesis was to contribute to the academic debate by analyzing the what factors in the sense making stage contribute to O&G industries being unware of warning signals preceding organizational crises. This was done by examining organizational failures through the theoretical framework as proposed by Turner's (1967) seven common causal features, which can foster failure of foresight in the incubation period. The features include: rigidities in the organizational culture, decoy problems, organizational exclusivity, information difficulties, involvement of stranger, failure to comply with regulations, and minimizing emergent danger. Specifically, the case of the BP Deepwater Horizon oil spill on April 20, 2010, was chosen because it has been the largest accidental oil spill in the world. A single case proved to be adequate for this research because it allowed for more accurate and thorough research, which could therefore add value to the academic debate. The research was conducted through the lens of theory testing and qualitative content analysis. Turner's (1967) seven common causal features in *The Organizational and Interorganizational Development of Disasters* were used in

relation to the BP case in order to understand the factors that contributed to their unawareness of warning signals before the Deepwater Horizon oil spill. The data was gathered through a content analysis of all available inquiry reports concerning the Deepwater Horizon oil spill. In order to answer the research question, the evidence from the inquiry reports was used to analyze how many of the common causal features were present.

For the central research question of this thesis, '*What are the factors that contribute to offshore industries being unaware of warning signals preceding industrial crises?',* the answer can be argued in the following way: The factors that contributed to offshore industries being unaware of warning signals preceding industrial crises include rigid institutional beliefs, information difficulties, failure to comply with existing regulation, and minimizing emergent danger.

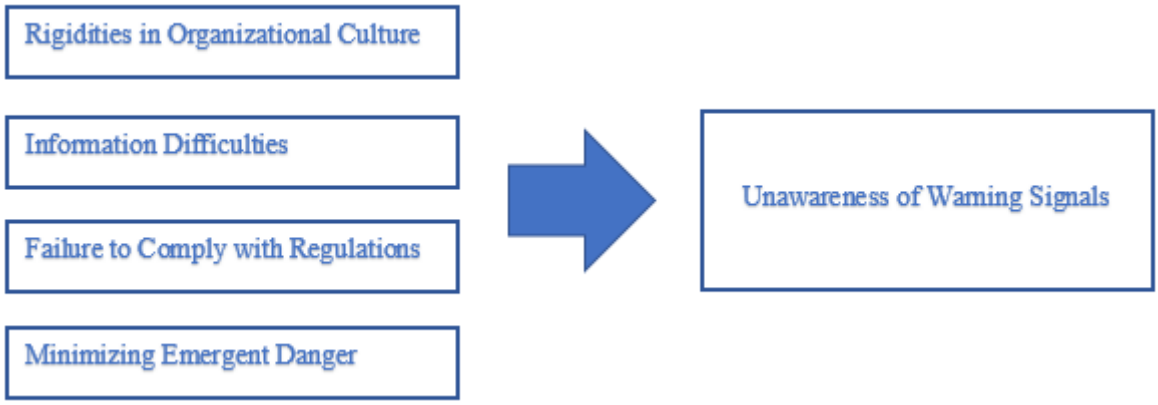

Figure 5.1 Illustrating the factors that contribute to the unawareness of warning signals

While the central research question can be answered by referring to the four common causal features theorized by Turner (1967), this research also shows that the features are somehow intertwined with each other, where problems can overlap multiple features. A rigid organizational structure could be connected with information difficulties, and failure to comply with regulations overlapped with minimizing emergent danger.

Prior to answering the central research question, a preliminary analysis had to be performed in order to establish that the O&G industries involved were actually unware of warning signals and that the BP oil spill could be considered an atypical event. The BP oil spill proved to be of an unknown known scenario, experiencing unawareness for the warning signals at all times before the crisis occurred. Analysis has showed that despite previous crises, which

showed that personal safety incidents do occur more often but do not have the same impact as process safety incidents. Despite this, BP still did not incorporate important process safety indicators into their organizational structure. Prior crises showed that companies were applauded for increasing personal safety statistics, but still experienced process safety incidents. Examples of Phillips in 1989, Grangemouth in 2000, BP Texas City Refinery in 2004, BP Prudhoe Bay in 2006,Valero McKee Texas refinery in 2007, and Corpus Christi refinery in 2009 showed that process safety indicators were not considered adequately. These examples should be ground for change and this research analyzed what factors contributed to the unawareness of warning signals, making the Deepwater Horizon oil spill an atypical event.

5.2 Reflections and recommendations

The key findings of this research of this analysis revealed interesting insights on the factors that contribute to the unawareness of warning signals preceding crises in O&G industries. The four present factors showed that a substantial problem in the organizational structure was negligence, which inevitably led to the presence of these four common causal features. The involved O&G industries did not create a solid foundation of safety and risk elements, for the employees or any other staff to timely recognize hazardous situations. Even more so, evidence proved that one could be reprimanded if negative actions were taken, which contributed to the rigid organizational culture, where information difficulties were present, which led to an attitude of 'what can we get away with'. Such a rigid organizational culture also led to the failure of compliance with regulations and employees minimized emerging danger because budget costs and saving time could get them rewarded. It is interesting to see how all the common causal features are connected to each other in some way.

Tying into the importance of budget cutting and time management, these were some of the reasons for the lack of focus on safety performance and can explain for instance the minimizing of emergent danger. What was also prominent in the inquiry reports is the aspect of neglect. Because the project was much greater in size than BP had ever experienced, one could question the inevitability of a disaster. Another interesting finding which fell out of the scope was shareholder activism, which is an important concept to take into account because shareholders can influence the direction of the processes because the O&G industries depend on their resources.

There were no sufficient controls in place to establish a safe organizational culture, and the regulation between state and federal level can be considered inadequate because there were not enough mandates at the time and responsibility was not clearly established and divided. However, this falls out of the scope of this research due to the timeframe, but it does create an interesting opportunity for future research. One could examine the problematic areas in the sphere of federal and state regulation and research how this trickled down into organizational failure and the way O&G industries actually used this in their favor because it could possibly lead to lower cost and a smaller timeframe.

The strengths of this research included that the analysis was divided into two steps. One of the strengths of this research is that the preliminary analysis laid down the foundation for the central analysis because it made grounds for the assumptions that the involved O&G industries were unware of warning signals. The main analysis then continued by studying why they were unware, and evidence proved that there were certainly common causal features present. The analysis shows that there are multiple organizational failures which means that there is possibility to develop in order to decrease the occurrence of possible future disasters. However, because it was such a substantial project with various parties involved, it remains rather difficult to establish to what extent all the information is truthful. Every party has their own interest, which is often the case, and due to the size and effects of the oil spill, it can explain the still ongoing trials for the involved companies.

That being said, this research added to the academic debate because it applied Turner's (1967) seven common causal features to the grand Deepwater Horizon oil spill, which has not been researched before in combination with this theory. The analysis proved that the theory was of importance and relevant because the organizational failures in the BP oil spill still applied to four out of the seven common causal features. What could be combined with the theory for future research, is some sort of resource aspects. Whether it be the need for budget cutting or the influence of shareholders on the process, it could prove to better explain the reasons for O&G industries being unaware of warning signals. Because this research also established that the evidence was applicable to multiple common causal features, another interesting research perspective can include establishing whether there is a relationship between the common causal features and if there is perhaps a pattern.

Some practical recommendations could include the need for process safety indicators, and an official mandate on either state or federal level, which would mean that O&G industries

would have much more incentive to incorporate process safety indicators. Moreover, it is recommended that there need to be organized procedures and possibly regulation that would diminish some of the information difficulties when it comes to sharing test results and the steps to take in case of a failed test result. Also, there need for clearly established safety critical elements, which could prove to be important in preventing major hazard. Because O&G industries have great responsibilities, meaning that disaster affect the flora and fauna around it as well as the population, these industries need to have several preventive risk assessments. More importantly, these risk assessments should be performed on multiple level, with special focus on the rig crews and on-site employees. Because there was a lack of organizational guidance, it created a large gap between the on-site employees, the rig crew and higher levels. This could possibly be helped by establishing more controls in between operations and more communication between the rig crew, the on-site employees and the staff who is responsible for other matters which are still relevant for the process.

In conclusion, this analysis establishes that the involved O&G industries were unware of warning signals, which were provided in prior crises, and their failure of foresight can be explained by various factors. The present factors proved to be connected to each other somehow, which enforces the fact that there were various problems on an organizational level, which enabled the unawareness of warning signals prior to the Deepwater Horizon oil spill on April 20th, 2010. The consequences for O&G industries includes the necessity of regulatory authority from outside organizations concerning proactive assessment of safety structures, a greater focus on process safety indicators, and an increased engagement of the employees on-site, meaning that there is transparency in communication and clear division of responsibilities as well as the necessary training needed to handle and recognize potentially hazardous situations.

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Appendix

Feature 1: Rigidities Organizational Culture			
Report	Date	Quote/Explanation	Source
National Commission Final Report	01/2011	Explaining that the rigid structure allowed for Halliburton employees to have failing results on cement slurry tests because there were no adequate risk assessment factors in place and that the rig crew was not prepared nor provided with the right procedures on how to handle in an alarming situation (p.117-119).	http://www.iadc.org/osc-report/
National Commission Final Report	01/2011	Explaining that the Transocean rig crew started from the initial assumption that the well could not be flowing, and worked in the direction that would prove them right (p.119)	http://www.iadc.org/osc-report/
National Commission Final Report	01/2011	Explaining that Halliburton failed to have sufficient controls in place in order to establish that tests were performed in time and that these documents were available (p.123).	http://www.iadc.org/osc-report/
BSEE Volume 1	9/09/2011	"a significant proportion (43.6%) of the personnel participating in the perception survey reported that they worked with a fear of reprisal if an incident or near hit occurred"	https://www.bsee.gov

CSB Investigation Report Volume 3	17/4/2016	Explaining and giving examples why personal safety indicators are a wrong fit to monitor safety, the prevention of major accidents, and that process safety was not adequately addressed (p. 132-136)	https://www.csb.gov/macondo-blowout-and-explosion/
CSB Investigation Report Volume 3	17/4/2016	"BP primarily used lagging, infrequent, and personal safety performance indicators as a means of assessing, measuring, and managing process safety." (p.137)	https://www.csb.gov/macondo-blowout-and-explosion/
CSB Investigation Report Volume 3	17/4/2016	Explaining that the Transocean performance indicators and bonus awards included vague and wrong indicators, making them unfit to prevent accidents, focusing on personal safety and financial performance (p.143-148).	https://www.csb.gov/macondo-blowout-and-explosion/
CSB Investigation Report Volume 3	17/4/2016	"This type of bonus calculation formula did not provide for balanced safety goal-setting, nor did it lend itself to developing or implementing adequate process safety performance indicators which could boost a company's ability to prevent catastrophic accidents" (p.149)	https://www.csb.gov/macondo-blowout-and-explosion/
CSB Investigation Report Volume 3	17/4/2016	"Instead, personal safety considerations predominated over process safety and major accident prevention, and the bridging document failed to look ahead in a meaningful way toward major accident prevention." (p.193)	https://www.csb.gov/macondo-blowout-and-explosion/

Feature 3: Organizational exclusivity			
Report	Date	Quote	Source
CSB Investigation Report Volume 3	17/4/2016	Explaining that there are various reports with recommendations for BP and Transocean to undertake actions and focus on process safety indicators, but	https://www.csb.gov/macond

		that BP has failed to actually implement any changes (p.195-197)	o-blowout-and-explosion/

Feature 4: Information Difficulties			
Report	Date	Quote/Explanation	Source
National Commission Final Report	01/2011	Explaining that a seven step procedure for the abandonment of the well was not completely followed by the onsite crew, and that there were uncertainties throughout the process (p.104-109)	http://www.iadc.org/osc-report/
National Commission Final Report	01/2011	Explaining that there both BP and Halliburton deliberately chose to not share information concerning failed slurry tests and last minute changes on the design and number of centralizers (p.101-102, 115-117, p.123)	http://www.iadc.org/osc-report/
National Commission final report	01/2011	Explaining that reported cement slurry results from the necessary pilot tests were delivered from Halliburton to BP, showing that the slurry design was unstable, but that there were no actions taken by either BP or Halliburton (p.101, 117-118).	http://www.iadc.org/osc-report/
National Commission final report	01/2011	Explaining that there was no communication towards the rig personnel on the difficulties concerning the cement jobs prior to the negative-pressure testing and monitoring the well (p. 123-124)	http://www.iadc.org/osc-report/
National Commission final report	01/2011	"Transocean failed to adequately communicate to its crew lessons learned from an eerily similar near-miss on one of its rigs in the North Sea four months prior to the Macondo blowout" (p.124)	http://www.iadc.org/osc-report/
Transocean report	06/2011	"BP did not properly communicate to the drill crew the lack of testing on the cement or the uncertainty surrounding critical tests and procedures used to	http://www.iadc.org/wp-content/uploads/2016/04/TR

		confirm the integrity of the barriers intended to inhibit the flow of hydrocarbons" (p.10).	ANSOCEAN-Macondo-Well-Incident-Investigation-Repport-Volume-I.pdf
Transocean report	06/2011	Explaining that the contractors were responsible for the type and strength of casing, cement, and centralizers and how less centralizers had been installed than discussed before (p.17, p.26, p.42)	http://www.iadc.org/wp-content/uploads/2016/04/TRANSOCEAN-Macondo-Well-Incident-Investigation-Repport-Volume-I.pdf
BSEE Volume 1	9/09/2011	Explaining how Transocean's programs 'tag out' and 'permit to work' (PTW) fail to ensure the location of personnel on the rig in order to warm them for potential hazards (p.99-100).	https://www.bsee.gov
BSEE Volume 1	9/09/2011	"Contractors were not knowledgeable with drilling and well operations practice or engineering technical practices" (p.101)	https://www.bsee.gov
BSEE Volume 1	9/09/2011	Transocean did not supply their crew with sufficient information and knowledge to handle adequately in maintaining the safety of the vessel, managing control of alarm, and conducting risk assessment (p.100-103).	https://www.bsee.gov
CSB Investigation Report Volume 3	17/04/2016	"at Macondo, the operator and drilling contractor each presumed the other was responsible for a proper negative test procedure. The crew was left to put together something to get the work done" (p.102).	https://www.csb.gov/macondo-blowout-and-explosion/
CSB Investigation Report Volume 3	17/4/2016	Explaining that the communication between BP and Transocean was problematic due to the interface of safety management systems (p.168-174).	https://www.csb.gov/macondo-blowout-and-explosion/

CSB Investigation Report Volume 3	17/4/2016	"Transocean offered minimal internal guidance and unclear expectations of the risk management tools its personnel should use for an offshore operation or facility" (p.171)	https://www.csb.gov/macondo-blowout-and-explosion/
CSB Investigation Report Volume 3	17/4/2016	"Lloyd's Register reported that Transocean's offshore workforce was confused about the risk management hierarchy and that the workers viewed the tools as poorly described and lacking guidance on "when and how [the tools] should be applied" (p.173-174)	https://www.csb.gov/macondo-blowout-and-explosion/
CSB Investigation Report Volume 3	17/4/2016	"but neither board effectively communicated process safety performance in the form of leading indicator data and lagging metrics of sufficient scope and frequency, which could have provided greater depth concerning the safety of drilling operations" (p.209)	https://www.csb.gov/macondo-blowout-and-explosion/

Feature 6: Failure to Comply with Regulations			
Report	Date	Quote	Source
BP Accident Report	9/09/2010	Explaining that Transocean did not following their own policy and did not test the BOP emergency back-up systems accordingly (p.171).	https://www.bp.com/
National Commission Final Report	01/2011	Explaining that BP did little to create a realistic oil spill response plan, despite it be mandatory according to the Oil Pollution Act of 1990(p.83-85).	http://www.iadc.org/osc-report/
CSB Investigation Report Volume 3	17/4/2016	Explaining the 'what can we get away with' attitude from Transocean personnel in relation to self-reporting on personal and occupational safety (p. 143-146).	https://www.csb.gov/macondo-blowout-and-explosion/

CSB Investigation Report Volume 3	17/4/2016	"While BtB listed commercial impacts, BP's Group Defined Practice (GDP) for Assessment, Prioritization and Management of Risk, GDP 3.1 – 0001, issued in 2008, focused specifically on "Health, Safety, Security and Environmental (HSSE) and operating risks in projects"(p.181)	https://www.csb.gov/macondo-blowout-and-explosion/
CSB Investigation Report Volume 3	17/4/2016	"the Macondo risk register completed later that month was not reviewed or revised to address HSSE risk consistent with GDP 3.1-0001"(p.182).	https://www.csb.gov/macondo-blowout-and-explosion/
CSB Investigation Report Volume 3	17/4/2016	"Despite BP's ALARP requirements, no documentation shows that BP performed any analysis that well control safeguards were effective and that safety risk was driven to as low as reasonably practicable" (p.183).	https://www.csb.gov/macondo-blowout-and-explosion/
CSB Investigation Report Volume 3	17/4/2016	"Ultimately, the leader of each BP Operation, such as D&C, is accountable for ensuring a MAR study is completed, reviewed, and the results communicated to the appropriate level"	https://www.csb.gov/macondo-blowout-and-explosion/
CSB Investigation Report Volume 4	17/4/2016	"While Transocean and BP had adopted some of these process safety concepts into their corporate policies, they did not apply them at Macondo. This disregard of their stated commitments reveals a culture of minimal compliance with regulations" (p.18).	https://www.csb.gov/macondo-blowout-and-explosion/

Feature 7: Minimizing Emergent Danger			
Report	Date	Quote/Explanation	Source
BP Accident Report	9/09/2010	Explaining that the negative-pressure test showed that well integrity was not established, and that the crew failed to recognize the hazardous situation. Moreover, the Transocean rig crew and	https://www.bp.com/

		BP well site leaders failed to recognize significant indication of hydrocarbon influx (p.38-42).	
National Commission Final Report	01/2011	Explaining that the Transocean crew as well as the wellsite leader ignored the negative-pressure test readings despite the results showing that the well integrity had not been established (p.105-109)	http://www.iadc.org/osc-report/
CSB Investigation Report Volume 2	05/05/2014	Explaining that the blowout preventer (BOP) on the rig was not considered a safety critical element, and that the absence of inspection could have shown the failures of emergency systems on that specific rig (p.62-66).	https://www.csb.gov/macondo-blowout-and-explosion/
CSB Investigation Report Volume 2	05/05/2014	"Failure of safety critical elements and tasks could cause or contribute to major accident events" (p.64)	https://www.csb.gov/macondo-blowout-and-explosion/
CSB Investigation Report Volume 2	05/05/2014	BP and Transocean control manuals both advised to switch from an annular preventer to a pipe ram as a well control event, knowing that this could lead to pipe buckling (p.77-78).	https://www.csb.gov/macondo-blowout-and-explosion/
CSB Investigation Report Volume 3	17/4/2016	Explaining that daily self-reporting for Transocean personnel on personal safety led to minimizing danger because employees were hesitant about admitting that they broke safety rules and afraid for potential consequences on their careers (p. 143-146).	https://www.csb.gov/macondo-blowout-and-explosion/
CSB Investigation Report Volume 3	17/4/2016	Explaining that the risk assessment tool 'major hazard risk assessment' had not been revised for almost six years prior to the BP spill, and that it was the only tool used to assess the rig. The possibility of a blowout was a medium risk, but Transocean took no specific actions (p.174-175).	https://www.csb.gov/macondo-blowout-and-explosion/

CSB Investigation Report Volume 3	17/4/2016	"If BP had worked with Transocean to develop an MAR study, it could have examined a Transocean 2009 report that expressed riser unloading events as "the biggest concern" when identifying areas for improvement. Transocean experienced six such events in the previous year" (p.184).	https://www.csb.gov/macondo-blowout-and-explosion/
CSB Investigation Report Volume 4	17/4/2016	Between 2006 and 2009, Transocean recorded an increase from 7 to 19 well kicks from one single driller but did not acknowledge it as a hazard (p.83).	