



The influence of interorganizational factors on offshore incidents in the Norwegian petroleum industry: Challenges and future directions

Vibeke Milch^{a,*}, Karin Laumann^a

^a Department of Psychology, Norwegian University of Science and Technology, No.-7491 Trondheim, Norway



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ABSTRACT

In the petroleum industry, incident investigations are an important means to understand and learn from undesired events. Whereas investigations in the petroleum industry typically focus on technical, human and organizational factors, there is a growing tendency towards outsourcing and more complex forms of organizations. Processes occurring at the interfaces between companies represent important influences that should be considered when investigating incidents. The current study aimed to gain a better understanding of the influence of interorganizational factors on offshore incidents on the Norwegian Continental Shelf. Twenty-two investigation reports were analysed to identify interorganizational factors that contribute to incidents. Factors at the inter-organizational level contribute to both occupational incidents and major near accidents. Four themes were identified: *Ambiguities in roles and responsibilities between personnel from different companies, inadequate processes to ensure sufficient competence across interfaces, inadequate quality control routines across organizational interfaces and communication breakdowns between companies.* The identified factors reflect underlying systemic deficiencies at the interorganizational level that contribute to obscure operational processes and at the same time reduce the effectiveness of existing safety barriers. Broadening the scope and incorporating factors at the interorganizational level when investigating undesired events is important in order to sufficiently learn from incidents.

1. Introduction

In the petroleum industry, incident investigation represents an integral part of safety management, and considerable efforts are made to investigate undesired events seeking to learn from them and implement measures to avoid future occurrences. This is important, as seemingly trivial errors in complex socio-technical systems can potentially escalate to cause uncontrolled situations, and, in a worst case scenario, result in major accidents [34].

Major accidents are complex events that cannot be ascribed to one single cause, but result from intricate interactions between several factors at different levels in the system. This means that everyone involved in work processes both directly, and those that influence work processes more indirectly, can potentially influence an accident scenario [40]. Indeed, academics and practitioners have come to realize that, in order to learn from incidents, a broad perspective that takes into account the complexities and intricate relationships that can lead to major accidents, is required. In this regard, the influence of organizational factors such as the role of management, safety culture, communication, division of responsibilities and pressure factors have been accentuated in research literature in recent years [42].

Investigative approaches have experienced a similar shift, evolving from a primary focus on proximal causes of a human and technical nature, to wider approaches that incorporate more remote factors at the organizational level [14]. This development can be seen in light of recent societal changes and accelerating technological developments that have introduced more complex organizational systems, and subsequently, more complex forms of accidents [9,15,40]. This evolution has simultaneously sparked a shift in accident causation thinking, moving from linear models of cause and effect, to more complex models that consider accident causation in terms of complex interrelations in the system as a whole [45].

Despite the fact that incident investigations in the petroleum industry now pay attention, to a larger extent, to the identification of root causes at the organizational level, severe incidents still occur. In Norway, regulators keep asking “why isn't the industry learning?” One explanation could be that current investigation practices do not sufficiently cover all levels of complexity within the systems that influence risk. As the petroleum industry, like many other high hazard industries, relies extensively on contractor and sub-contractor services, work processes span across a large number of companies with varying degrees of involvement. Emerging evidence from serious incidents in the

* Corresponding author.

E-mail addresses: Vibeke.Milch@ntnu.no (V. Milch), Karin.Laumann@ntnu.no (K. Laumann).

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petroleum industry, including the Deepwater Horizon accident, reveal several problems at the interfaces between companies as contributing to serious incident and accident scenarios [2,29,30,49]. Arguably, looking into inter-organizational factors may add to the understanding of incidents, thereby also increasing the learning potential from incident investigations.

The objective of this paper is to gain a better understanding of how interorganizational factors relate to incidents in the petroleum industry. Through analysing investigation reports issued by the Petroleum Safety Authority (PSA) from 2006–2016, we aim to explore how inter-organizational factors are linked to incidents on the Norwegian Continental Shelf (NCS) in order to gain a better understanding of which factors may produce unwanted outcomes. In this respect, our intention is not to account accurately for the prevalence of incidents attributable to interorganizational factors, but rather to identify potential challenges and areas of improvement. The following research questions are explored: *What types of incidents and accidents are related to interorganizational issues? What interorganizational factors can be identified in investigation reports contributing to incidents offshore?*

The present study is part of an ongoing research project aiming to develop new knowledge on safety challenges related to interorganizational complexity in petroleum operations, as well as on the connection between interorganizational complexity and risk of major accidents in the petroleum industry.

2. Theoretical background

2.1. Accident and incident analysis

Accident and incident investigation is based on the notion that it is possible, through piecing together information about the sequence of events leading up to unwanted outcomes and exploring factors related to the event, to uncover the cause(s) and thereby prevent similar occurrences in the future. A central objective is to learn and implement means so that future occurrences can be avoided [6,13,42]. An investigation can take many forms, as there are numerous approaches and methods available. However, in a general sense, an investigation can be regarded as a diagnostic process, typically involving the following steps: collection of evidence and information about the accident, a thorough analysis to establish the cause and contributing factors, the development of recommendations for remedial actions and finally a follow up on remedial actions taken [16,46].

The investigation process is shaped by a number of varying factors. The direction and focus of an investigation process is determined by the underlying accident model, embodying assumptions about the casual nature of accidents and how accidents can be prevented [16]. The approach and underlying assumptions of the investigation team will influence what they look for, and therefore inevitably also what they find in the investigation [22]. Moreover, the level of scope, the composition of the investigation team in terms of competencies and the investigators' professional background together with the available resources and time frame are all factors that will influence the focus of the investigation which will also determine what is uncovered [23].

Investigations of accident and incidents can be carried out internally, which is often the case for minor incidents and mishaps. However, in the case of more serious incidents and accidents, an external investigation is commenced, often carried out by an independent investigative body. In the Norwegian petroleum industry, external investigations of incidents and accidents are carried out by the PSA. The PSA is the regulating body of the Norwegian petroleum industry, responsible for supervising safety, emergency preparedness and work environment [35]. As an element of the tripart regulatory approach in the Norwegian petroleum industry, the main responsibility for regulating petroleum activities on the NCS is left to the operating companies. They are obliged to ensure that operations are in accordance with regulatory requirements, which also means that the operating

companies themselves are obliged to supervise their own operational activities. Consequently, the majority of incidents and accidents are investigated internally by the companies. The PSA, however, conducts independent investigations of accidents or incidents that they judge to be particularly severe. These include: major accidents and major near accidents, fatal occupational accidents, serious occupational injuries with a potential to cause death and severe weakening or loss of safety functions and barriers threatening the integrity of the facility [35]. On average, the PSA conducts approximately five to ten investigations each year. The reports are made public two to three months later on the PSA's website.¹

The PSA's investigation process is rooted in an MTO (hu(man)-technology- organization) perspective, applying the method MTO-analysis [50] adapted from the Swedish nuclear industry [3]. The MTO-perspective considers accidents to be the result of complex interactions between human, technological and organizational factors [43] and the MTO-analysis represents a linear hierarchical accident model and aims to map out human, organizational, and technological factors contributing to an event, assuming an equal representation of the factors. However, the method does not specifically include factors at the inter-organizational level. Due to its linear representation of the sequence of events and corresponding causes, some researchers argue that the method insufficiently captures complex interrelationships among factors which can lead to major accidents [20,46,52]. It has also been questioned whether this format of analysis influences the mindset of the investigators to focus on lower levels of analysis, thereby devoting less attention to more abstract higher level factors such as those pertaining to organizational aspects [44].

Several newer investigative methods have emerged such as Accimap [41], FRAM [10] and STAMP [20] that take into consideration accident factors in the socio-technical system as a whole, of which inter-organizational factors are integral. They seem to be favoured by academics, but not by practitioners, which means that, in practice, these methods are rarely applied in the industry. Underwood and Waterson [51] argue that this can most likely be explained by issues with usability and user bias, validity and that the models do not identify individual factors at the individual level so that blame can be assigned. Moreover, since these methods target higher-level factors that are more remote from the chain of events, recommendations for improvements can appear more diffuse and less specific, as they are not directed at concrete situations or tasks, but rather highlight dysfunctional systemic properties or interactions. Preferably, several investigation methods should be combined in order to sufficiently highlight all aspects of a complex accident or incident [46].

2.2. Interorganizational factors and incidents

The steady increase of outsourcing in the petroleum industry and other high-hazard industries has prompted debate in safety research about the implications for safety management and increased major accident risk [19,32]. The reality of outsourcing is that operational activities are no longer confined to the operator company, but are performed by a constellation of individual autonomous actors. In petroleum operations, contractor companies are involved in a great variety of safety-critical activities, spanning from design and construction of offshore facilities, maintenance and modification activities, to specific expert services pertaining to drilling and well activities. When activities are distributed across a growing number of contractors and sub-contractors, organizational processes become more fragmented and more challenging to manage, and it becomes more difficult to maintain a "big picture" understanding, as no single organization or individual is responsible for the overall result [1,38,39]. Moreover, companies differ,

¹ All investigation reports issued by the PSA are available online: <http://www.psil.no/investigations/category893.html>.

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