Leverage Points in O&G Deepwater Well Construction

Improving the company man´s workplace by interventions at the systems level

Victor Ribeiro Nazareth | LUND UNIVERSITY

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Victor Ribeiro Nazareth

Under supervision of Eder Henriqson, PhD.

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Victor Ribeiro Nazareth

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Riskhantering och samhällssäkerhet
Lunds tekniska högskola
Lunds universitet
Box 118
221 00 Lund

http://www.risk.lth.se

Telefon: 046 - 222 73 60

Division of Risk Management and Societal Safety
Faculty of Engineering
Lund University
P.O. Box 118
SE-221 00 Lund
Sweden

http://www.risk.lth.se

Telephone: +46 46 222 73 60

ABSTRACT

The oil and gas industry is an activity that simultaneously resembles formula one and space missions. By the formula one´s side, it operates close to technological limits. And by the space missions' side, several experimental or semi-experimental technologies are broadly used. O&G industry is indeed a high-risk socio-technical system." (Eder Henriqson, personal communication)

Such a statement could lead the reader to think that the offshore well construction branch of the O&G industry has very advanced management and training requirements. Moreover, it could also lead to the feeling that training procedures adhere to the workplace reality. And a trustful environment where skilled professionals may raise concerns about daily uncertainties and ambiguities during operations.

This research investigates whether those claims are a reality of the current company man´s workplace. However, findings underpinned by semi-structured interviews showed that command-and-control practices, increasing bureaucracy, and safety expectations heavily focused on individuals are often prevalent management traces. Thus, the research goal focuses on recognize leverage points to improve, by recommendations at the systems level, the company man´s workplace.

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INTRODUCTION

Context and object of study

During the 18th century, the Industrial Revolution instituted the workplace known in factories and service providers like line assemblies and big orderly offices. However, such an evolution did not happen in a vacuum. Instead, it was underpinned by the Scientific Revolution and the Enlightenment of the 17th century suggesting that the "application of appropriate methods of reasoning provided humanity not only with reliable knowledge, but with power to shape the world" (Dekker, 2019, p. 6). The progressive development of technologies like steam-powered motors and the series of James Watt´s patents could be seen as good examples of how humans were reshaping the world (p. 7).

Indeed, as technological leaps took place worldwide over the past two centuries, new industries were created such as the Oil and Gas (O&G) industry. Despite the fact that natural leaks of petroleum had occurred in ancient times, the first onshore drilled well took place at the city of Tutsville, state of Pennsylvania (USA) in 1859 (ASME, 1979). Since then, the O&G industry has spread worldwide, and despite attempts at other energy sources, such as electricity, world oil production grew from 55 to 75 million barrels per day from 1973 to 2021 (EIA, 2021).

Currently, the O&G industry provides essential raw materials for the worldwide economy. O&G products are present in many indispensable items to humanity's well-being, from paint to high-technology plastics. However, despite its centennial existence, O&G has maintained its technological pace of growth.

The O&G industry is divided into two complementary business strands: (a) Upstream, also known as Exploration and Production (E&P), which is responsible for exploring, developing production infrastructures, and extracting oil and gas from the natural reservoirs. Another branch named (b) Downstream has the role of refining (producing several essential products like gasoline, diesel, and nafta) and delivering such products to customers. Deepwater offshore well construction, placed at the industry's technological state-of-art, is a risk-critical upstream activity.

On the one hand, the technological growth allowed the industry to explore new frontiers and produce oil and gas from unthinkable places like water depths beyond 2.000 meters, generating new job opportunities, research centers, and contributing to provide O&G products worldwide in a cost-benefit manner. On the other hand, constructing an oil well became more complex in deepwater environments. Particularly in the offshore context, modern drilling rigs are associated with the danger of handling hazardous activities towards production efficiency (Bruno, 2020, p. 9), operating complex systems with highly complex and tightly coupled interactions (Perrow, 1999). Furthermore, such high-risk systems are considered intractable, not fully knowable, semi-measurable, semi-predictable, and semi controllable (Bruno, 2020; Dekker, 2011; Dekker et al., 2013; Hollnagel, 2008, 2014).

Interestingly, despite the extraordinary amount of technical advances fueled by the increasing complexity (Dekker, 2011) and how O&G companies take pride about technical issues, several daily processes are carried on in a command-and-control way instead of adopting a systems approach (Bruno, 2020). An explanation would arise from the O&G industry belief on problem-solving strategies like increasing managerial supervision, the creation and dependance on standards, auditing, focusing on individual behaviors rather than systems. In sum, the O&G industry became, in most cases, a high-risk complex industry embedded in a command-and-control managerial mindset (Bruno, 2020), which had consequences for the system and the workers.

In addition, the mindset mentioned above has its system effects, like the understanding of how current work practices were shaped by "institutions, organizations, technologies, concepts, and methods that make up their professional lives (Vaughan, 2021, p. 125)." Such operational offshore sharp-end, particularly in deepwater well construction. However, the offshore environment is constituted not by a single organization membership, as studied by High-Reliability Theorists (La Porte & Consolini, 1991; Sagan, 1993; Weick, 1987), but by a rig as an complex ever-changing ecological network aiming to achieve the system mandates of efficiency, effectiveness, and safety goals while constructing an oil well (Haavik, 2017).

Despite the great number of organizations involved in a rig operation, it is necessary to keep in mind that the Operator (the O&G producer and the well proprietary) needs to coordinate offshore activities. In the industry jargon, by a professional named the 'Company Man' or 'Drilling Supervisor.' This study will adopt the term "Company Man" in reference to the workers that, as the operator representative, coordinate all onboard activities related to well construction. Briefly, the company man role is particularly important, being the focal point between onshore planning demands and offshore execution and available resources, aiming to execute well construction operations in an efficient and safe way (Hollnagel, 2009). In a few words, the company man is the bridge between the brain and the arm.

Understanding the company man's history and context are important facets of the context whilst studying normal work undertaken by them with a given set of constraints and goals (Dekker, 2011; Le Coze, 2020; Snook, 2000; Vaughan, 1990, 1996, 1999, 2021). Consequently, it would be reasonable to assume that analyzing how the company man performs daily could provide insights on system effects upon him and their contribution patterns in a proactive learning fashion (Vaughan, 2021). In other words, attempting to understand company man's normal work, including his history, rather than the abnormal one (e.g., learning about accidents and incidents) will leverage this research (Hollnagel, 2014).

Theoretical approach and research question

Meadows (1999, p. 1) defines leverage points as "places within a complex system (a corporation, an economy, a living body, a city, an ecosystem) where a small shift in one thing can produces big changes in everything. Moreover, skilled people know intuitively where leverage points are located in their jobs. To identify and identify such leverage points, it is paramount to access information about the workplace. Following this reasoning, workers would be the most valuable source of information. Gaining access to their perception of issues like history, context, normal work, conflicting goals, and how expertise is constructed are essential to identify the leverage points by analyzing the system effects over their workplace and the consequent macro-micro connections.

The study of normal work in complex social technical systems and the way workers reconcile demands (e.g., production, safety, quality, compliance) and conflicting goals (e.g., faster, better, safer, cheaper) has remained since the 1970s. At that time, Rasmussen and Jensen (1974) analyzed how electronic technicians dealt with real-life issues during their work. Despite a few pieces of research on O&G industry (Haavik, 2017; Rappini, 2019), other industries provided some inspiration, like air traffic control (Vaughan, 2021). Still, following such a micro-level perspective on normal work at the sharp end, Bosk (2003) brought up a health care perspective on the surgeons' construction of expertise at an American hospital, highlighting how they struggled to get the job done and reach their superordinate's expectations. Indeed, the surgeon's practical expertise had no correlation with their previous academic studies, but were remarkably influenced by how their leadership demanded expectancies and reacted to failures.

Starbuck and Milliken (1988), Vaughan (1996), and Snook (2000) described, in different ways, how normal work may lead to successes or failures. Starbuck and Milliken (1988, pp. 329-330) discussed the organizational tendency to attribute past success to technical, managerial, and procedural qualities, encouraging workers to fine-tune the system aiming to improve the status. Then, Vaughan (1996) argued on how a socially constructed worldview may be used to confirm or not events, tending to ignore, deny or misperceive events that did not fit their previous framework (p. 62) . Lastly, Snook (2000) highlighted 'Practical Drift' as how slow uncoupling of local practice from written procedures took place, motivated by demands for local efficiency, and hence becoming institutionally accepted (p. 193). In sum, the three approaches summarized how the same efforts may both lead to desired or not desired outcomes, highlighting the importance of understanding the social side of organizations as a paramount issue.

Indeed, so-called abnormal work is mostly perceived in hindsight (Dekker, 2014b), when an unexpected outcome is spotted. However, an unexpected outcome also represents workers' attempts to reconcile business demands, scarce resources, unexpected constraints, and conflicting goals (Rasmussen, 1997). For instance, in the aviation domain, the Swissair 111 flight accident final report (TSB, 2003, p. 232) attempted to make sense of the pilot's decision-making process relying on normal work rather than the abnormal one. Furthermore, Zille's (2015) account on the Brazilian flight Varig 254 accident (CENIPA, 1991) argued on how the system effects, characterized by historical organizational path-dependency processes, beliefs, and cultural aspects (Vaughan, 1996) over the social side of such an organization (Selznick, 1948) contributed to that catastrophic result.

Understanding how work is currently performed through its history, context, conflicting goals, and macro-micro connections – macrostructural forces related to competition, scarce resources, and production pressures (Vaughan, 1996, p. 38) - may shed some light on system patterns – as well as providing insights on leverage points to intervene in a complex socio-technical system. Therefore, it seems reasonable to present the following research question:

What are the leverage points to identify systems thinking-based improvements regarding the company man´s workplace? And what recommendations can be proposed to, in a sustainable way, intervene at the system level?

Such answers are expected to be achieved by exploring and gaining an understanding of the system effects through macro-micro connections over the company man’s normal work by its history, context, conflicting goals, and trade-offs.

Objectives

This research aims to, firstly, identify systems leverage points and, secondly, identify and propose recommendations to improve the complex socio-technical system where the company man is embedded. Furthermore, uncovering such leverage points requires an understanding of macro-micro connections: derived through exploring the system´s history, context, practitioner´s conflicting goals experiences, and their perception about the construction of professional expertise.

Theoretical and practical relevance

In 2010, the O&G industry experienced a catastrophic accident: The Macondo blowout (BP, 2010; CCR, 2011; DHSG, 2011). However, several studies and investigations focused on technical and proximal causes (Le Coze, 2020) instead of the systems approach (Hopkins, 2012, p. 168). Such a strong mindset may divert the view of the complexity of processes involved in offshore well construction, which could be illustrated by the persistence of simplistic injury-based indicators to (reactively) measure the level of safety (Bruno, 2020, p. 11).

Nevertheless, an increasing complexity stemmed from technological leaps, eco-system interactions, and new well configurations, leading to an undesirable managerial perception of loss of control. Then, to counteract such a leadership perception, enforcements in supervision, standardization, and compliance were (and mostly still are) carried on (Dekker, 2014c, 2021). However, such policy does not occur without the subsequent system effects on the formation of professionals and the development of their expertise (Vaughan, 2021).

In sum, the relevance of this research stands on the identification of places to intervene in the system, supported by an analytical framework drawn from systems approaches. Such an approach is expected to be fueled by exploring history, context, conflicting goals experiences, and the construction of the expertise by the lenses of company men and close stakeholders. In other words, how normal work is undertaken matters to improve the system.

LITERATURE REVIEW

Sociotechnical complex systems are influenced in a great number of ways, and their outcome (e.g., efficiency and safety) are described as emergent properties (Leveson, 2011). Interventions in such systems require a level of comprehension beyond analyzing cause-effect relations of parts, being necessary to enlarge the view to how parts are interconnected and contribute to the whole (Dekker, 2011). Meadows (1999) proposes the concept of Leverage Points, defining twelve places to intervene in a system, in increasing order of effectiveness. Considering the complexity involved, this research focuses on capturing the mindset or paradigm from which the system arises, making recommendations on how to transcend such paradigms – the two most powerful of Meadow´s leverage points.

At the same time, Meadows (1999) advised that leverage points are not easily accessible, requiring a deeper knowledge of how the system works (p. 19). In this spirit, workers would be the most valuable source of information. Gaining access to their perception about issues like history, context, normal work, conflicting goals, and how expertise is constructed are essential to recognize leverage points and provide a broad comprehension about the organization involved.

Analyzing organizations as part of a system requires knowledge beyond a simple snapshot of the current moment. While striving to survive in a scarce and competitive worldwide connected market (Rasmussen & Svedung, 2000), interventions are made by top managers at several levels to achieve profitability, efficiency, effectiveness, cost-effectiveness, stakeholders' satisfaction, conflicting goals reconciliation, and safety. However, taking into account the high level of interconnectedness provided by the current complex scenario, it is difficult to foresee the consequences of local optimizations (Dekker, 2011).

The survival conditions under the current complex and ever-changing scenario led to a different approach. Rather than focusing on causal and simple fixes, sustainable and transformational solutions would emerge considering "the structures, values, and goals that underpin complex problems at deeper levels (Abson et al., 2017, p. 31)." Or, as argued by Meadows (1999), considering improvements based on the leverage points of complex systems. However, such comprehension will demand to dig deeper into their history, context, and the system effects (e.g., how the macro-micro connection took place) while socio-technically constructed realms (Haavik, 2017; Latour, 2003; Vaughan, 2021).

Attempting to make sense of how work is currently carried out, underpinned by history, context, and socio-technical relations will be helpful to identify sustainable leverage points to intervene in a complex system, contributing to improve it.

The sociotechnical complex systems and its leverage points

> (…) then we are in a better position to argue that certain technologies should be abandoned, and others, which *we cannot abandon because we have built much of our society around them, should be modified*. *Risk will never be eliminated from high-risk systems*, and we will never eliminate more than a few systems at best. At very least, however, *we might stop blaming the wrong people and the wrong factors*, and stop trying to fix the systems in ways that only make them riskier (Perrow, 1999, p. 4, emphasis added).

In his influential book Normal Accidents, the American sociologist Charles Perrow (1999) theorized that systems simultaneously characterized by interactive complexity (e.g., unexpected interactions not predicted by designers) and tight coupling (e.g., delays not possible and invariant sequences) will be more prone to certain kinds of accidents, because multiple and unexpected failures will be inevitable (p. 5). For instance, nuclear power plants, space missions (p. 97), and deepwater oil well drilling (Perrow, 2011).

However, what is a system? Why will a systems view be helpful to understand current reality? And what leverage points will be more effective to intervene in a system rather than fine-tune it (Starbuck & Milliken, 1988)?

First, Meadows (2008) described a system as "an interconnected set of elements that is coherently organized in a way that achieves something. (…) a system must consist of three kinds of things: elements, interconnections, and a function or purpose" (p. 11). Also, Chapanis (1996) defined a system as "an interacting combination, at any level of complexity, of people, materials, tools, machines, software, facilities, and procedures designed to work together for some common purpose" (p. 20). A good example of a system is available below:

> A football team is a system with elements such as players, coach, field, and ball. Its interconnections are the rules of the game, the coach's strategy, the players' communications, and the laws of physics that govern the motions of ball and players. The purpose of the team is to win games, or have fun, or get exercise, or make millions of dollars, or all of the above. (Meadows, 2008, p. 11)

Second, almost all existing organizations are complex sociotechnical systems, at least part of a large system (Perrow, 1986). As stated above by Perrow, non-linearity, variability, and unpredictability will govern such systems or organizations, rather than linearity, predictability, and tractability (Hollnagel, 2014) . Indeed, due to their size, decisions at the organizational micro-level will attempt to make local sense "at the time given the goals, knowledge and mindset of decision-makers, can cumulatively become a set of socially organized circumstances that make the system more likely to produce a harmful outcome" (Dekker, 2011, p. 14). Or not, because such local rationality attempts to balance demands, available resources, and reconciling conflicting goals (Hollnagel, 2009). It may also lead to successes (Dekker, 2011, p. 185). In sum, failures and successes tend to have the same roots in a complex reality.

Third, if tractable reasoning does not apply to complex systems, because of their partly unknown principles of functioning, interdependence, and difficult control issues (Hollnagel, 2014, p. 119), how then to trace local optimizations or weak points that may incrementally lead the system to global brittleness (Dekker, 2011, p. 13)? Maybe looking at the whole system: Meadows (1999, p. 3) found a list of 12 places to intervene in a system, in increasing order of effectiveness. Although not all will be discussed here, the list starts with systems parameters (e.g., KPIs) and ends up with (c) the goals of the system, (b) the mindset or paradigm from which the system (e.g., goals, structure, rules, delays, parameters) arises, and (a) the power to transcend paradigms. Indeed, there is no ready receipt to a particular system issue.

Therefore, far from the well-known mechanical and predictable assembly lines, the current systems require a high degree of adaptive capacity to cope with an ever-changing environment, making organization´s survival possible in the long-term (Dekker, 2014c).

The social side of organizations

When management people argue about an organizations' arrangements, it is usual to find discussions on the formal structure and functionality. At most, comments are made on who is occupying a top management position regarding their individual strengths and weaknesses. In other words, such a view of organizations may be focused on a momentary snapshot and some personal issues. Organizations are traditionally defined as formal, visual, and rational instruments created to achieve goals (Selznick, 1948, p. 25). Barnard (1938) argued that organizations are "a system of consciously coordinated activities or forces of two or more persons" (p. 73).

Despite the logical sense of both definitions, they lack an account of the underlying dynamic adaptive structure or a "system of relationships which define the availability of scarce resources and which may be manipulated in terms of efficiency and effectiveness" (Selznick, 1948, p. 26). Instead of relying on the visible side of organizations, it is also important to acknowledge the invisible one to encompass a comprehensive understanding of organizations and their dynamicity.

Following this reasoning, Charles Perrow discussed how the rise of large organizations were reshaping society, evolving since the Industrial Revolution (Perrow, 1991, p. 725). Still, innovative products and services created a public dependency because other organizations depend on them to run their business (e.g., internet). The internet example may illuminate how the level of interdependence along with organizations had been growing in the wake of globalization (Le Coze, 2020).

In this way, the current economy is full of large, interconnected organizations, focused on provide products and services globally. Moreover, such organizations attempts to develop their business in a competitive and scarce environment (Rasmussen & Svedung, 2000), fueled by customers' demands for faster, better, and cheaper opportunities (Gross, 2001). And underpinned by the 1980s winds of liberalization, industry practices like outsourcing increased the number of organizations available, and their interconnectedness complexity (Le Coze, 2020).

From the macro to the micro level

In a macro-level perspective, Merton (1936) discussed that, either positive or negative, unanticipated consequences are expected from systems of social actions like organizations. However, Merton only discussed the social aspects, not the technical ones. Differently, Latour (2003, p. 29) argued that a constructed plan or action is called socio-technical when collectively produced by humans and a series of artifacts, structures, and equipment, resulting in a solid construction. In addition, Jervis (2012) warned of how a system assumes different characteristics from its parts, being human or not, because of their relations with one another.

Keeping focus on the relationship between parts, Perrow (1999) highlighted high-risk socio-technical systems that operate in a complex and tightly coupled manner will inevitably lead to failure, despite High Reliability Theorists' discussion to counteract Perrow's technological determinism (Sagan, 1993). In sum, an ecological system of organizations presents residual risks that will lead to unpredictable consequences. Their relationships are permanently constrained by ever-changing environmental and stakeholders' demands, creating incentives and rewards (financial and social) for workers to cope with such unique situations, providing arrangements to achieve the system mandates (Rasmussen, 1997; Vaughan, 1999).

However, such constraints at a macro-level needs to be transmitted to the micro one by the macro-micro connection or how macrostructural forces influenced the decision-making processes at the micro-level (Vaughan, 1996, p. 38). Furthermore, the system effects that flow from this, while understanding that "to understand decision making, we must look at individual action within its layered context: individual, organizational, and environment as a system of action" (p. 37). In this spirit, institutional forces may constrain some options by the influence of deadlines, limited number of knowledge alternatives, scarce resources, among others, while a bounded rationality process aims to satisficing rather than optimizing (Simon, 2013).

Thus, at the micro-level, the system effects will contribute to shape a cultural system of knowledge regarding a profession by a "set of embodied repertoires (cognitive, physical, emotional, and material practices) that are learned and drawn upon to craft action from moment to moment in response to changing conditions" (Vaughan, 2021, p. 122). Moreover, the continuous reinforcement of such repertoires, along with daily work practices, will result in the common sense, or the capacity, to act that is shaped by the system in which practitioners work. Consequently, common sense encompasses accepted practices to make sense of early signs and to acknowledge anomalies, shaping decision-making processes to meet conflicting goals (p. 122).

Finally, the system's constraints will affect the formation of professions from the novice to the expert stages (Dreyfus & Dreyfus, 1999), while the worker acquired situational discriminations associated with immediate, unreflective, and intuitive responses to each situation.

The normal work approach and the accidents paradigm

A usual adage in several industries says that there is a lot to learn from abnormal situations like accidents, incidents, and mistakes. Although such assertion is valid, it results in directing the mindset only to one side of the coin, preventing learning from normal work. Learning from abnormal situations is reactive on its own, normally leading to hindsight bias, judgmental wording, proximal focus, and counterfactual reasoning (Dekker, 2014b). Furthermore, focusing solely on unexpected events diverts attention from acknowledging what Hollnagel (2014, pp. 41-42) named the gap between work-as-imagined (WAI) and work-as-done (WAD).

Notably, Hollnagel´s reasoning may have its roots in Rasmussen and Jensen's (1974) study on how electronic technicians faced challenges during their daily work, raising insights on the existing variability (Ashby, 1957) that characterizes routine activities. In addition, Rasmussen (1983) drew upon how humans' course of action where context and environment-dependent, and goal-setting, being modified during the events because of previous experiences and new information, which is denominated teleological behavior (Rosenblueth et al., 1943). Despite prescriptive command-and-control rules, procedures, and constraints, workers attempt to get the job done by operational decisions taken. Then, "they will not be based on rational situation analysis, only on the information which, in the running context, is necessary to distinguish among the perceived alternatives for action” (Rasmussen, 1997, p. 188). In sum, practitioners strive to deliver the system mandates of cost-effectiveness, efficiency, and safety despite scarcity and unpredictable demands (Dekker, 2011; Vaughan, 2021), while coping with unforeseen challenges (Hollnagel & Woods, 2006).

Paradoxically, such huge delivery efforts by workers used to be left unnoticed, because of the lack of attention to things that go right (Hollnagel, 2014). Such a phenomena may be explained by habituation, a form of human adaptive behavior linked to “response decrement as a result of repeated stimulation” (p. 38). In a practical way, desired outcomes are taken for granted results mostly related to managerial, technical, and procedural competence instead of a result from practitioners´ efforts to cope with uncertainty, unpredictability, and complexity, keeping variability within an acceptable range to achieve organization’s goals. (Woods, 2010).

In such a fashion, it makes sense therefore, that the blunt end prefers counting adverse events like accidents or incidents, because it could be more visible to spot and fix failures, including the human ones. Consequently, system performance will be acceptable when good outcomes are delivered and vice-versa (Hollnagel, 2014, p. 41). Nonetheless, such a paradigm does not consider how the sharp end reconciles different goals like production pressures, quality, cost, schedule accomplishment, and safety (Hollnagel, 2009) – or the whole context involved (Snook, 2000).

The construction of professional expertise

The successful accomplishment of a task in high-risk industries does not occur in a vacuum. Though a strong organization structure and well-designed processes, supply chain, logistics, and proper equipment need to be available, practitioners´ technical and managerial expertise to run the business are fundamental. However, how does professional expertise emerge from the system? Dreyfus and Dreyfus (1999) argues for five steps for a practitioner to achieve expertise, as follows.

First, the beginner acquires basic and formal knowledge by academic classroom processes. Second, during early stages of real-work engagement, local and practical knowledge is gained on-the-job, mostly influenced by a trainer, coworkers, and social conditions of work. At this phase, the practitioner attempts to make sense between formal and practical knowledge, mastering the basic required actions. The third stage is characterized by the arise of competence skill, where the learner can recognize abnormal states, make plans, develop his own rules, and personal ways to conduct the job. Then, the fourth stage encompasses proficiency while responding based on his intuition, habit, previous experience, successes, and failures. Despite the increase in decision speed, the learner does not decide promptly and automatically yet. Finally, the fifth stage is achieved when the practitioner becomes an expert. Indeed, expertise requires a set of immediate, unreflective, intuitive response to each situation, carrying out the tasks in great speed (Vaughan, 2021, p. 178).

However, the conquest of expertise is not solely related to the progressive individual learning and skill acquisition, as described by Dreyfus and Dreyfus (1999), but also to the social processes embedded in the production of expertise (Collins & Evans, 2002). For instance, Collins (2010) recognized the importance of collective tacit knowledge, or "an unspoken set of cultural understandings about how work is to be done in the local work context (Vaughan, 2021, p. 179)." Furthermore, as mentioned before, the large social organization context and history will contribute to shaping how and why people do what they do (Eyal, 2013), this being an important issue to make sense of expertise construction. Like safety and efficiency, expertise will be interpreted as an emergent property of a complex system (Leveson, 2002) while "composed by a network of other actors, devices, instruments, concepts, institutional and spatial arrangements distributed in multiple loci yet assembled into a collective coherent agency (Eyal, 2019, p. 36; Vaughan, 2021, p. 180)."

In addition, it may be questioned as to what extent expertise is essential to leverage the decision-making processes in high-risk environments. Two interesting outcomes provided by experts need to be highlighted: articulation and interpretive work. An articulation skill is related to coordinate, align, and integrate a set of independent activities, aiming to achieve organizational goals by maximizing the effectiveness of available resources (Haavik, 2017, p. 54; Schmidt & Simonee, 1996; Strauss, 1985). In sum, articulation work aims to build collaboration among different actors (Haavik, 2017, p. 98), filling the existing gap not covered by formal work descriptions (p. 146).

Subsequently, articulation work needs to be preceded by interpretive work, because of the ambiguity and uncertainty generated by different goals of several actors embedded in a sociotechnical system (p. 147). Consequently, an expert need both well-developed articulation and interpretive work skills to face daily challenges in an ever-changing reality. Despite their importance on delivering results, such repertoire are considered invisible work, because they “make work work” (Schmidt, 2011, p. 138), leading mostly to expected outcomes. And, as previously discussed, good results are linked to managerial competence rather than to workers’ effort to get the job done.

This section aims to present expertise as an emergent property of a complex socio-technical system and an essential leverage point among the company man´s workplace, influenced by the system effects, its internal and external constraints, stakeholders’ agenda, managerial mindset, and which outcome became visible by how experts enact in their situated context. In sum, expertise belongs to the workplace and expert to individuals.

RESEARCH METHOD

Research Design

This research focused on the work challenges of a specific professional named 'company man' or 'drilling supervisor' in the Oil & Gas industry. Such a professional serves as an operational coordinator at offshore drilling rigs, being responsible for keeping the pace of ongoing operations (fig. 1) in an efficient, effective, cost-benefit, and safe manner. Although the mention of a single professional conveys the idea of focusing on the individual, it is usually a team composed of up to three professionals: leader, day, and night company men.

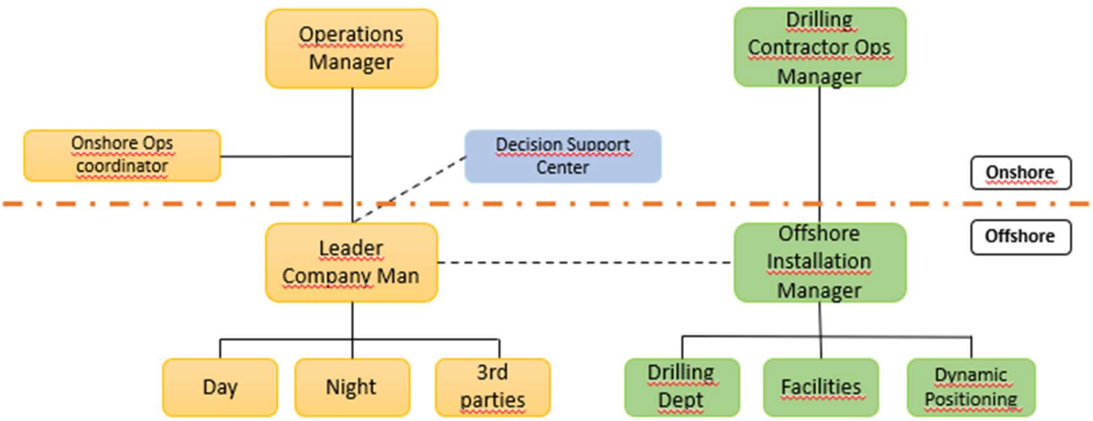
Figure 1

ROV monitoring the spud in of a subsea well (Rappini, 2019)

The leader is responsible for the aspects of the overall operation, a role normally assigned to the most senior practitioner, including logistics and planning issues. The day and night professionals focus on current operations, spending most of the time at the driller's cabin. Despite the drilling rig POB (personnel onboard) reaching 180 people, 30 directly report to the company man, named operator's third parties, which well service providers mostly constitute. The remaining practitioners are responsible for the rig availability for well operations, being managed by the OIM (Offshore Installation Manager). A simplified organization chart is available below (fig. 2):

Figure 2

Simplified organizational structure



The company man was chosen as a main object of study for a couple of reasons. First, such a professional is the focal point of contact between the operator's onshore organization and the offshore environment. Second, the company man may resonate with the system effects and the ecologically multifaceted and multicultural offshore rig scenario. The company man used to have a degree in petroleum engineering. His formation is grounded in technical disciplines like drilling, completion, well testing, and reservoir, to cite a few, and does not usually encompass humanistic or managerial formation. Most of their daily abilities are built from direct contact with seasoned colleagues, creating a local knowledge experience peculiar to a particular time and place (Vaughan, 2021, p. 34).

Data collection

The collection of data considered the following sources: (a) semi-structured interviews, (b) work-related documents, (c) and onshore (presential and online) participant observation.

Semi-structured interviews

A fundamental assumption of this research is that context and history matter (Snook, 2000, preface). And the link between the current work practices, beliefs, and habits may be connected to understanding patterns fueled by the system effects (Vaughan, 2021). Indeed, exploring how daily workers' actions undertake routine work will contribute to unveil their perception. Giving voice to practitioners increased the chances of finding out how the past blunt-end decisions and macro-micro connections (Vaughan, 1996, p. 38) influenced the environment and decision-making process.

Therefore, qualitative semi-structured interviews were conducted because it allowed capturing a broad view from interviewees without being normative (e.g., structured mode) or moving away from the research purpose (e.g., no structured interviews) (Seale et al., 2004). Three main questions were proposed to explore important aspects (see table 1).

A total of 17 practitioners were interviewed as follows:

- **08 company men:** 02 professionals by each of 04 sectors available, preferably one senior and another junior company man in each sector (coded as CMX).
- **04 operation managers:** one focused on drilling operations and another completion, workover (well maintenance), and abandonment (coded as MGRX).
- **05 Decision support center engineers:** with different backgrounds (coded as DSCX).

All participants were invited by e-mail (see appendix 1), and a copy of the transcriptions was sent to each interviewee for further approval. In sum, all of them gently granted permission to go along with this research.

Although interviewing company men and their managers would be seen as the obvious choice, the decision on interviewing decision support center’s people was based on their daily close contact along with the next operations planning. Managers granted access to professionals after a researcher's presentation letter to both (Appendix 1). Ethical considerations will be discussed further.

The interviews were conducted in person or virtually. In a semi-structured fashion, notes were taken by the researcher. The interviews were not recorded, attempting to increase confidence level. Finally, the interviews lasted between 1 and 2 hours. Diversity was considered regarding gender, age, experience level, and geographical job location. Such a strategy was adopted to allow different points of views under several working realities. Table 1 shows the set of interview questions, sorted by theme and including the question´s rationale.

Table 1

Qualitative semi-structured interview questions

Theme	Question	Rationale
1. History (socio-technical system)	How do you perceive the company man's history in the organization?	History has a relation to the present through the problem-solving actions of social actors (Hughes, 1979). Then, understanding history will help to make sense of the current status (Vaughan, 2021).
2. Context (social side of organizations)	Currently, what do you perceive that facilitates or hinders the work of the company man/manager/decision support center today?	Acknowledge the current context's constraints, vices, and virtues, looking for common patterns, expectations, frustrations, and validate or not as 'system effects.' (Snook, 2000; Vaughan, 2021)
3. Conflicting Goals (macro-micro connections)	If you have experienced it, talk about a situation where it was necessary to make some sacrifice in terms of duration, cost, or safety.	Understand patterns and rationale involved in routine decision-making processes while conflicting goals emerge (Rasmussen, 1997).
4. The construction of expertise	In your opinion, what makes an expert or competent company man?	Recognize the system effects and macro-micro connections in the organizational mindset that assesses a company man's professional competence (Vaughan, 1996, 2021).
5. Leverage Points	Based on your experience, concerning the work that the company man performs, what should: a) Stop doing (because it does not add value or gets in the way of goals?) b) Keep doing it (because it may guarantee important results in terms of the business performance)? c) And start doing it (because it is not done yet, but should it be done) to evolve in terms of the system mandates of efficiency, efficacy, cost, and safety?	Seek improvement points based on the practitioner's perception, attempting to make sense of the system's leverage points. (Meadows, 1999)

Documents

Despite the set of documents not being extensive, the emergence of new opportunities and ideas were expected during the interviews. For instance, the company man’s responsibilities are described in a specific standard document, which prescriptive and detailed characteristics would shape practitioners' mindset, performance, beliefs, embodiment, and interpretive thinking (Vaughan, 2021, p. 35). To cite a few documents, well intervention project, intervention history, shift handover, driller’s daily operations sequence, SITOP (6 am and 12 am online operations report), and management of change procedures (Rappini, 2019, pp. 28-29). Unfortunately, because of research time limitations, not all documents available were analyzed. This study will focus on daily operations sequence and the company man´s attributes standard procedure. Similarly to the interviews, searching for correspondences between history, context, trade-offs, expertise, and leverage points. Furthermore, documents’ analysis will be framed jointly to interviews and field observations (Braun and Clarke, 2006).

While referring to documents and meetings, coding will be used as follows:

- D1: Company man´s standard
- D2: Operational sequence
- MX: Number of the daily onshore meeting

Field Observations

Field observations referred to the researcher’s observational participation on onshore daily meetings, where managers and practitioners attempted to understand the last 24 hours (or weekend) operations, and to plan upgoing tasks, risks, and contingencies. The notes were analyzed similarly to interviews and documents. It was expected to attend a total of 08 (eight) meetings, once a week, over two months, mostly on Monday.

In practice, a total of nine meetings in two different operational branches out of three were attended. Despite their daily recurrence, most of the meetings attended were on a Monday, for two reasons: (a) the richness of discussions stemmed from weekend operations and (b) matching the researcher's agenda. Table 2 shows complementary information like branch, date of attendance, schedule, duration, attendance, and number of rigs in charge by the branch:

Table 2

Meetings schedule witnessed by the researcher

Coding	Branch	Date	Time (24 h)		Duration (h)	Attendance	Nr. Of Rigs
			Initial	End			
M1	#1	May, 02nd	7:45	8:52	1:07	65	07
M2	#1	May, 09th	7:45	9:16	1:31	63	08
M3	#1	May, 16th	7:45	9:02	1:17	80	08
M4	#1	May, 23rd	7:45	9:45	2:00	60	09
M5	#1	May, 30th	7:45	9:25	1:40	56	08
M6	#1	May, 31st	7:45	9:20	1:35	-[1]	08
M7	#2	Jun, 06th	8:30	9:30	1:00	130	08
M8	#2	Jun, 17th	8:30	9:28	0:58	100	08
M9	#2	Jun, 20th	8:30	9:45	1:15	130	09
		Total hours			**12:23**	-	-

Data Analysis

The data produced was analyzed according to the Thematic Analysis procedures proposed by Braun and Clarke (2006) (Table 3).

Table 3

Phases of thematic analysis (Braun & Clarke, 2006, p. 87)

Phase	Description of the process
1. Familiarizing yourself with your data:	Transcribing data (if necessary), reading and re-reading the data, noting down initial ideas.
2. Generating initial codes:	Coding interesting features of the data in a systematic fashion across the entire data set, collating data relevant to each code.
3. Searching for themes:	Collating codes into potential themes, gathering all data relevant to each potential theme.
4. Reviewing themes:	Checking if the themes work in relation to the coded extracts (Level 1) and the entire data set (Level 2), generating a thematic 'map' of the analysis.
5. Defining and naming themes:	Ongoing analysis to refine the specifics of each theme, and the overall story the analysis tells, generating clear definitions and names for each theme.
6. Producing the report:	The final opportunity for analysis. Selection of vivid, compelling extract examples, final analysis of selected extracts, relating back of the analysis to the research question and literature, producing a scholarly report of the analysis.

Souza (2019) recommends that it is fundamental to highlight the need for intimacy and familiarity between the researcher and the data collected by a deep reading before starting the coding phase, where the codes will be organized into particular groups of meaning (Tuckett, 2005).

[1] Missed data

During phase 2, codes created stem from data or theory, allowing possibilities for triangulation. Visual representations may be useful tools, providing an initial thematic map (fig. 3). Phases 3 and 4 dealt with the selection processes, aiming to generate the final themes to be graphically represented (fig. 4 and 5) (Braun & Wilkinson, 2003).

Phase 5 was expected to clearly define themes, writing a detailed analysis of each one. Identify the story that each theme is about, considering how it fits into the larger story being told about the data concerning the research question or questions to ensure no overlap of themes. Therefore, it is necessary to consider the themes separately and each theme with others (Souza, 2019, p. 61).

Finally, Phase 6 began with the final analysis and writing of the report. The task of reporting a TA encompassed telling the complex story of the data to convince the reader of the merit and validity of the analysis performed. The study (your writing, including data extracts for illustrations) must provide a concise, coherent, logical, non-repetitive, and interesting description of the story the data tells, within and across themes (Souza, 2019, p. 62).

Figure 3

Initial thematic map, showing five main themes (Braun & Clarke, 2006, p. 90)

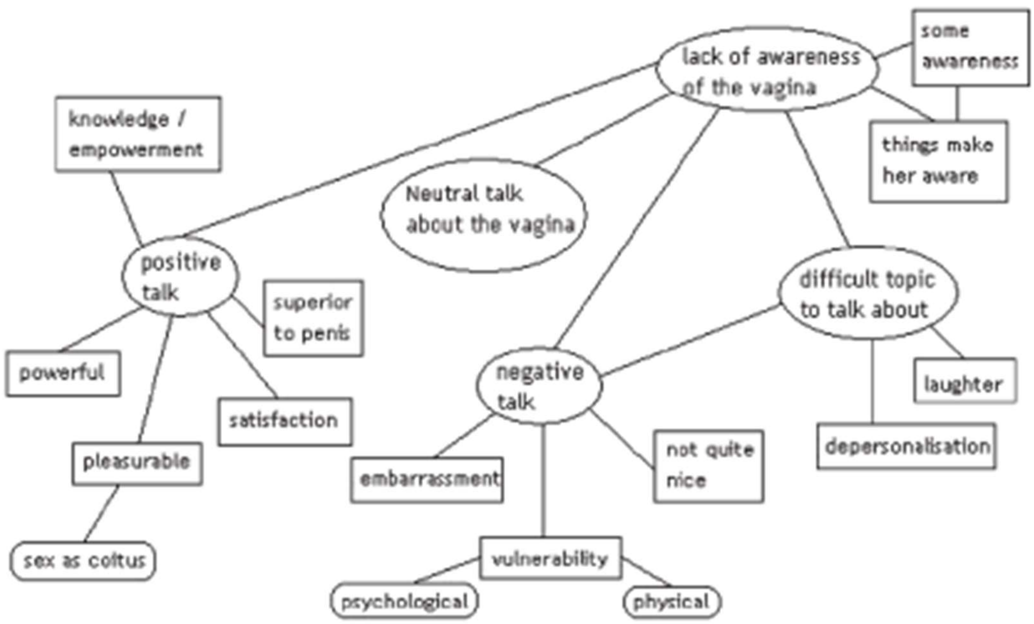


Figure 4

Developed thematic map, showing three main themes (p. 90)

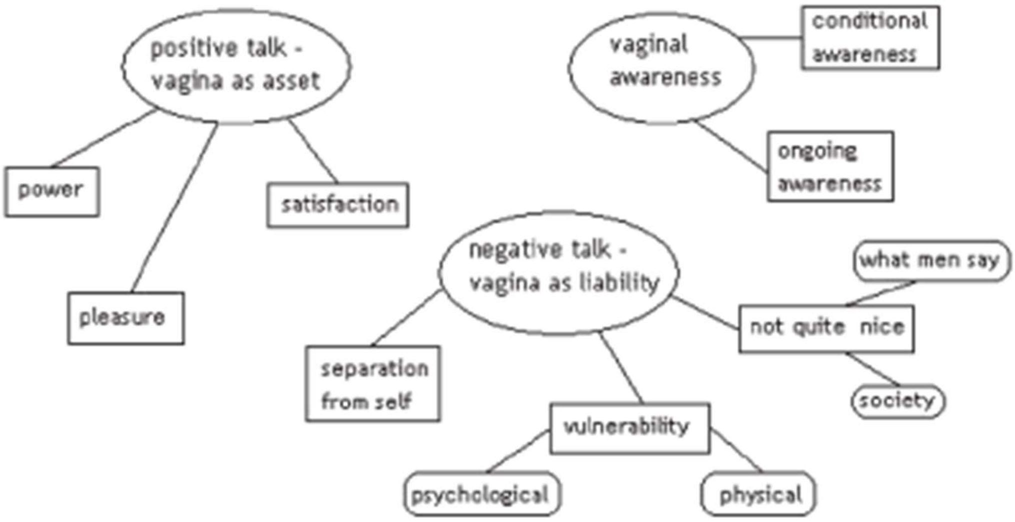


Figure 5

Final thematic map, showing the final two main themes (p. 91)

Such thematic analysis needs to encompass all data collected. The research quality was also a concern. Seale et al. (2004) argued how authors of social science studies "have learned their trade through a widespread kind of apprenticeship system, in which witnessing and reflecting on others' practices leads to their incorporation into their own studies (p. 418)."

Triangulations between interviews, documents, field observations and literature were undertaken, attempting to make sense of the meaning (Suchman, 1987) produced by the company man's work about "how they themselves enact change as they incorporate cognitive, organizational, and technological innovations, adjusting plans to fit the local situation" (Clemens, 1993; Orlikowski, 1996; Vaughan, 2021, p. 11). In sum, the research aimed to explore how past events and actors external to the system influenced the way practitioners work in the present.

Ethical considerations

Regarding the company's Code of Ethics

Ethics are a paramount value for the author and the organization he works for, setting research limits. As per the Swedish Ethical Review act, there is no reason for obtaining formal approval for this research. Besides, according to my Organization's Code of Ethics, there is no need for proper permission to external written works, including academic work, when:

- The organization’s name is mentioned in the curriculum or mini curriculum of the author only.
- Scientific or technical publications that do not cite the organization do not present internal classified information and are not funded by the company.
- External presentations on employee's initiative, at his own cost, outside working hours, and without being linked to the organization

Regarding the interviewees and other contributors

While discussing ethics in interviews, Kvale (2007)[2] made an introductory statement:

> Ethical guidelines for social science research emphasize the need to obtain the subjects' informed *consent to participate* in the study, to *secure the confidentiality* of the subjects, to *consider the consequences* for the subjects of participation in the research project and to be attentive to the researcher's role in the study (p. 31, emphasis added).

The above excerpt highlighted three important ethical issues: (a) obtaining a voluntary consent to participate from the interviewees and their managers, (b) the importance of securing their confidentiality by assuring deidentification means to their contributions, and (c) keeping in mind possible unpredictable consequences for those involved in the research.

[2] Thanks to my Lund HFSS colleague Tomi Tervo for this source.

In sum, ethical principles must be achieved by demonstrating the author's openness, knowledge, experience, honesty, and fairness (Kvale, 2007, p. 29).

RESULTS AND ANALYSIS

This section was organized into two parts. Firstly, a general work description of the Company Man´s work is presented by showing attributions, routines of operational sequence and meetings. Secondly, the analysis is guided by the exploration of the empirical material according to the five themes presented in the literature review. In order to strengthen validity, the sources of data and empirical evidence are triangulated in for the analysis.

General work description

Attributions standards

The company has a standardization system ranging from managerial to practical levels. Administrative standards tend to focus on more general guidelines, while practical standards tend to be more detailed. Although standards are necessary to clarify tasks and expectancies, constant effort is needed to keep it balanced between vagueness and prescriptiveness. From another standpoint, a document that reflects real-life issues would be helpful to encourage trust between blunt and sharp ends.

The declared aim of this document is to provide general guidance to the company man, establishing attributions and responsibilities. In the past, the company man's organizational structure was dispersed, allowing several standards to coexist loosely. While each branch had experienced proper contexts, the criteria presented significative variability. During the last decade, a well construction centralized organizational structure was created to face current challenges. In this spirit, the corporate area unified the existing standards, attempting to encompass distinctive characteristics among different working demands.

For instance, the procedure allows different crew configurations (from one to five professionals) without being prescriptive. On the other hand, the criterion for choosing seems to not be clearly stated, indicating that a 5-person crew model is adequate and robust. The reason behind this was that such a configuration would make it possible to attend to issues on safety (process and occupational) and operational excellence (integrity, efficiency, and optimization) (D1). A significant number of pages, nearly half, are dedicated to listing tasks and responsibilities.

The procedure aims to provide general guidance for the company man crew. However, its prescriptive character emerged from interviews and document analysis, which will be discussed further. In short, there are ninety-three attributions, divided into six tables and subdivided into a myriad of tasks (table X). Each standard´s table has a specific purpose: tables 1 to 4 are related to operational safety, and 5 and 6 belong to other administrative activities like logistics. Table 4 shows, for each table in the procedure, the number of items and its goal. Table 5 summarizes one example from operational planning section.

Table 4

Company man´s crew duties list

Table	Items	Description
1	20	Operational planning
2	16	Monitoring of operational coordination and execution
3	07	Services and equipment contractor oversight
4	13	Onboard formal company representativeness
5	23	Material, equipment, and crew logistics
6	14	Other administrative tasks and demands
Total	**93**	

Table 5

Company man´s standard item example

Item	Responsible	Description
Well program	Leader, Day, Night Company Man	Current operations for the next few days together with supervisors and discuss suggestions and corrections with the offshore coordinator.

In the very beginning, the procedure highlights the composition of the crew, ranging from solely a company man to a full team composed by:

- 03 company man: leader, day, and night.
- 01 logistics auxiliary.
- 01 rig engineer, not related to well operations but to rig integrity and compliance.

It is also remarkable that the procedure demands a focus on (occupational and process) safety and operational excellence (integrity, efficiency, and optimization). Despite the rig engineer having a specific job standard, his work is cited here to ensure integrity, HSE, and conformity. Moreover, the leader company man is assigned to:

- Keep the intervention adherent to the original program and applicable regulations.
- Monitor and evaluate operational parameters related to well integrity during the intervention.
- Ensure that the operational sequence contains the records of the solidary sets of barriers defined in the project.
- Monitor the verification of the integrity of the solidary sets of barriers as provided for in the well design.
- Ensure that the solidary sets of barriers are functional and available for use upon approval of the hold points by the responsible decision support center engineer.

Thereafter, a one-page argument is posed to explain how to select the proper crew configuration according to the rig and intervention complexity. Despite the general recommendation of keeping five people onboard crew, small arrangements are allowed. In case of crew shortage, a warning was made to redistribute tasks over the remaining practitioners on board. In other words, the workload is constant, regardless of the available workforce.

Furthermore, a short paragraph mentioned a mandatory training requirement, following another procedure regarding the HSE training program. Tables 6 and 7 show a list of mandatory and desirable courses and its related required hours as shown in D1. In this study, each course was then assigned according to its nature as technical (i.e., knowledge needed to perform the job), normative (i.e., internally required by the company), and legal (i.e., required by external actors like regulators or law).

Table 6

Mandatory courses

Mandatory Courses	Hours	Nature
Platform basic safety training	40	Normative
Emergency response plan – drilling unit	02	Normative
Basic first embark training	10	Legal
Environment education program for workers	04	Legal
Human factors in well engineering	02	Legal
Tropical helicopter underwater escape training	08	Normative
Well control – supervisory level	40	Legal
Incident command system – emergency response	04	Normative
Dynamic positioning operations safety practices	20	Technical
Technical regulation of the well integrity management system	04	Legal
Basic concepts of human factors	04	Normative
Well integrity management in the project, construction, intervention, and abandonment stage	04	Normative
Total Hours	**144**	

Table 7

Desirable courses

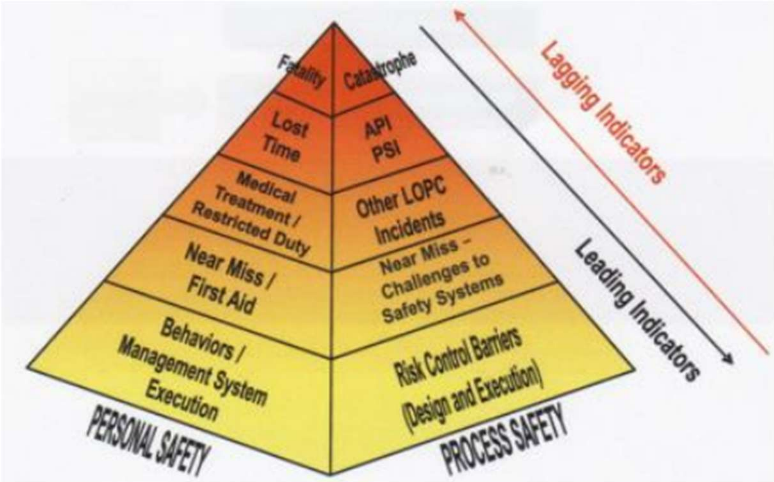
Desirable Courses	Hours	Nature
Risk management in rigs – installation	08	Normative
Risk management in rigs – tasks and wells	08	Normative
Safety barriers in well interventions	16	Technical
Fundamentals of abandonment of wells	16	Technical
Occupational safety basic training	04	Normative
Fundamentals of safety practices in operations with DP rigs	08	Technical
Behavioral audits	08	Normative
Process cycle check for company men	02	Normative
Basic on management, supervision, and audit of services contracts	06	Normative
Managed pressure drilling basic training	16	Technical
Managed pressure drilling operational procedures	24	Technical
Management of change	16	Normative
Total Hours	**148**	

Almost a page was devoted to sharing some safety beliefs: behavioral deviations may linearly lead to incidents, accidents, and casualties. Thus, a deficit language was used, mostly by the word "fail" when referring to unexpected outcomes. Moreover, using pyramids to show a cause-effect relationship between minor and major events, and targeting energy release as a significant safety issue (D1) (see fig. 6). The procedure also referenced other standards and norms to be followed (D1).

The final section lists the name of the company men who signed (or not) the procedure as acknowledged (D1).

Figure 6

Personal and process safety pyramids (D1)



Operational Sequence

The operational sequence is a document developed by the past company men, not enforced by procedures, but meant to cope locally with working demands and communications efficiency. It has two original main goals. Firstly, to set the communication standard between the company man and the rig crew mostly targeted to the driller. Secondly, a simple, short, and clear document will provide an understanding of the next operations. It used to be a one-page text listing the operations for the next 24-48 hours in a sequenced way.

The document is prepared and issued daily by the company man. Copies are delivered to the rig crew and well specialists after the onboard daily meeting, usually at 7 pm. In the past, the focus was to translate the well program into palatable wording for the driller. In the beginning, translating the text into English was also needed because many crew came from abroad. Currently, it is available only in Portuguese.

The original operational sequence may be compared to a flight plan: while not carved in stone, it opens room for changes despite ongoing operations. It provides guidelines, recommendations, and remarks to make operations run smoothly without being prescriptive and excessively detailed. Final adjustments would take place at pre-operational briefings. Or, in a loosely coupled manner (Weick, 1976), during 'fine-tuning' conversations between the rig crew and specialists, regarding cargo handling, interface details, pressure tests, availability of resources like energy, pneumatic, and hydraulic supply, and others.

Currently, the operational sequence also encompasses compliance information like basic data, sets of barriers available, risk assessment analysis, mandatory checklists, management of change summary, process safety information, and dynamic positioning contingencies. From a single one-page document, it grew to twenty pages long, the first five pages regarding compliance as related above.

However, the operational sequence is still a relevant source of information, being a common ground for the offshore well construction community. While in the past the responsibility for preparation was exclusively the company man, a review is now carried out by the Decision Support Center team.

Daily Operational Meetings

Daily onshore operational meetings are an established practice by well engineers and their managers. In the past, the meeting aimed to help the (only one) company man. It made sense then, considering that the communications system was poor, so did access to general information, and specialists were few. Concerning communications, radio was the only option, which evolved to the telephone and then the internet. Moreover, few specialists were on board to support the company man's decisions.

In this spirit, daily operational meetings aimed to understand and discuss current operations by analyzing the past 24 hours and providing general guidance for the next procedures. Again, there was only one company man on board, which made decision making more difficult, especially during non-administrative periods (nights, weekends, and holidays). Also, there were no cell phones, making it hard to find someone outside of working hours. In sum, this meeting was an important forum to align those involved with the well operations.

Typically, the meeting is attended by managers, onshore well engineers, leader company man, geologists, and service providers specialists, including third parties. Nowadays, the Decision Support

Center (DSC) engineer conducts the meeting. The reason for that is to receive more information during the DSC crew shift at 7 am. In the past, the operational manager was responsible. Normally, the DSC allows onshore coordinators to briefly explain past operations, current situations, upcoming tasks, and logistics involved.

Cross-level analysis

History (sociotechnical complex systems)

The question aimed to explore whether history relates to the present through the problem-solving actions of social actors (Hughes, 1979). Then, understanding history will help to make sense of the current status (Vaughan, 2021).

During the early stages of offshore well construction in Brazil, around the 1980s, difficulties in communication and personnel resources, enforced by a 'can do culture (Vaughan, 1996), stimulated a need for autonomy while making operational decisions.

The company man embarked alone on 14 x 14 days working schedule. (CM1)

The company man had absolute autonomy. The work was artisanal, with a little onshore interface. The working processes were poorly consolidated. (CM4)

In the beginning, communication was very difficult. What the company man decided, he did, right or wrong. (DSC1)

As the company man did not have broad and continuous onshore support, he demanded greater autonomy. (DSC2)

The company man's job was to ensure that the rig complied with the schedule and that it was done in the shortest possible time. (MGR4)

Well projects were simpler, demanding less engineering knowledge. Thus, specific professional development was taken for granted. The company man was a Petroleum Engineer assigned to coordinate the well project onboard a drilling rig:

I did not have a specific training program as a company man. There were basic, mandatory, well control courses. My first criticism is putting such a young professional alone in a high-risk scenario. (CM6)

The company man has always had the role of supervisor and official company representative in the operational area. (DSC2)

The organization has always had a historical tendency to treat the company man as a commodity. Anyone can be added or removed without a problem. (DSC5)

They were technicians and engineers who lost their fear on top of what they did in the past. In the past, the 'make it happen model' made sense, otherwise, it would make the business unfeasible. (MGR4)

A professional attitude towards command-and-control or fear-driven was encouraged:

In the past, the company man needed to be more respected. (MGR2)

We left the model that the company man was, how to say, the boss, the big shot. (MGR3)

Safety and compliance were mentioned only one time, while operations were prioritized:

In the past, I saw greater engagement in technical issues, seeking to optimize operations. And less engagement in related matters like compliance and HSE. (DSC2)

In the past, wells were simpler, like well-known onshore wells. In this spirit, the drilling rig crew had intuitive notions of the basic requirements for planning the next operations. Then, the company man issued a simple document, transmitting specific details to close gaps between project and execution. There was no standard regarding the role of the company man.

Daily onshore meetings had started up in an environment where communication resources were limited (e.g., radio) and the phone was available only during working hours. Moreover, only one company man was available onboard to take care of a 24-hour operation, and there were few technical specialists, even onshore. The original aim was to make sense of the current operations, guiding the company man to coordinate the next operations in a safe, efficient, and efficacy way. Recalling from interviews:

Projects were simpler, and we had more autonomy. (CM1)

We had the freedom to decide, and a lot less control, but that left us subject to more failures. (CM8)

Technical support was very limited. Knowledge was propagated on a day-to-day basis in an unstructured way. The advantage, which is also the disadvantage, is that the systems were simpler. (DSC4)

Mostly supported by interviews with experienced practitioners, the company man´s history would be related to a Petroleum Engineer embedded in a 'can do', technical, and 'macho' environment (Vaughan, 1996, p. 209). While working alone in a 24-hour operation, the company man attempted to get the job done, despite poor communication tools, personnel selection methods, managerial knowledge, and limited onshore support.

Context (The social side of organizations)

Supported by system history, a contextual analysis acknowledges the current constraints, vices, and virtues, looking for common patterns, expectations, frustrations, and validating or not as 'system effects' (Snook, 2000; Vaughan, 2021). This section aims to recognize the current status while making sense of history.

The recent stages of company man's work evolved from a single professional to an entire crew, reinforced by 24-hour onshore support by the so-called Decision Support Center (DSC). Furthermore, communications evolved from radio to telephone (1990's), then to the omnipresence of the internet (2000's and onwards).

The role of the company man is not formal in the organization. (CM1)

The company man has not gotten it into his head yet that he is a manager on board. He must manage the operation. Few company men know how to manage. (DSC4)

There is a feeling of growing discredit for the role. I have already embarked on my own, but we played. It was the operational focus. Nowadays, there is a huge focus on compliance issues, and it is no longer possible to repeat the previous work model. (MGR3)

Today we are much more technically qualified and supported with more standards and norms. (DSC5)

Despite being labeled 'the boss' on board, when he started to work in the onshore environment, the man in the company was just another engineer. Previously, a technical and hierarchical stance was demanded, in contrast to several administrative tasks posed currently. As an effect, the rising belief that more standards and norms contribute to a safer workplace (Dekker, 2021).

Technology and a more distributed cognition are two sides of the same coin (Haavik, 2012). The extensive use of the internet as a communication tool and the 24-hour availability of specialists at the Decision Support Center brought up improvements and some concerns.

> *(...) today it is possible because of information technology, being able to hold remote meetings. Integrating different sites, rigs, coordination, and vessels with an adequate multidisciplinary analysis is possible. The probability of having an unmapped factor is greatly reduced, as it involves the people directly compromised with the work. (CM3)*
>
> *Excessive monitoring can generate embarrassment or psychological pressure on board. Several people may monitor and interpret data and speak directly to the rig crew. Mapping a situation that does not match reality. This takes time, focus, and balance. (CM3)*
>
> *The public increased, and the consumption of products as well. Every time the audience increases, you need to be attentive and not fail. One premise I have developed is that I do not make any decisions that I cannot justify well. (CM6)*

The Decision Support Center (DSC) was created at the beginning of the 2010's. It was partly motivated by the lessons from the Macondo accident decision making process, mostly offshore decisions (Hopkins, 2012). At the same time, newcomers had just arrived, lacking knowledge and experience. The idea was to keep the new company men supported by the DSC and seasoned onshore supervision to compensate for their offshore inexperience. However, those newcomers acquired experience during the last decade, but the enforcement of supervision persisted.

> *Sharing information makes life easier and simultaneously more difficult, looking at the day-to-day context. I can gather many people who also have many opinions. We call people who can help us. However, there had been a high problematization of simple situations. (CM4)*
>
> *There are company men who think the DSC is a Decision Center, not a supportive one. They used to transfer the decision to the DSC or their managers. (...) Several operations are decided by the DSC. The system is addicted to the DSC. (MGR1)*

In short, during the initial stages, the very same profession that suffered from a lack of personnel in the past now debates how to deal with a complete structure. Moreover, despite its technical origins, the current scenario has driven the working system toward compliance and bureaucracy.

Following the previous conclusion, the operations sequence and the company man standard reflected the need for compliance (D1). Born as a straightforward document aiming to help the driller, the operations sequence evolved from a single page into an extensive document, attempting to serve as evidence for regulators' audits or to protect the organization against failures and liabilities.

In this spirit, an analysis was conducted along with the company man's standard stated ninety-three duties (D2). Each task was sorted according to four criteria, as follows:

- **Administrative:** bureaucratic task lacking practical relevance concerning safety or efficiency (Dekker, 2014a; Smith, 2018).
- **Expertise:** Technical and/or managerial expertise required to perform the task (Vaughan, 2021; Weick, 2007).
- **Diffuse Responsibility:** The task was described in a way that allows diffuse responsibility to take place (Snook, 2000; Vaughan, 1996).
- **Practicality:** The real possibility of task delivery, which may be seriously constrained by scarce resources such as time, personnel, communication tools, internet band, and others (Dekker, 2011; Woods, 2010).

Table 8 shows the results from the analysis above, which will be discussed further:

Table 8

Task analysis results

Administrative	Expertise	Diffuse Responsibility	Practicality	Total Duties
74	33	45	52	93
80%	35%	48%	56%	100%

During the discussions, three main aspects were remarkable: (a) bureaucratic and political accountability, (b) managerial participation, and (c) logistics. Moreover, it was perceived that the focus on rendering accounts for past operations prevailed over discussing future operational risks.

- **Bureaucratic and political accountability:** this item refers to proceduralism and hierarchical commitments, instead of past professional responsibility, or "the system built on the trust of and deference to the skills of those at the bottom of the organization" (Vaughan, 1996, p. 211). the rise of compliance may be perceived by how managers demanded administrative procedures to ensure that rules were followed rather than to make the operation safe, avoiding demands from audits and regulators (Dekker, 2021):

An operations manager questioned whether the pressure test validation followed specific technical and monitoring criteria, asking the staff to be 'super meticulous.' (M2)

An operations manager questioned the readiness of a Management of Change (MOC) form and its registration for attending a quality meeting with the service provider company. (M5)

During a results presentation, a Line manager emphasized the goal of keeping the 4 phases drilling project as a great challenge. Then, a certain frustration in the GEPs when the times of the wells are above P25. The focus of presentations was solely on the physical schedule. Expressions like "such delay or anomaly will greatly impact the index" were frequent. (M8)

- **Managerial participation:** most managers started their careers as company men, preserving their technical knowledge fueled by practical experience. While attempting to provide technical contributions, several interventions were made during the discussions:

Line manager performing various technical interventions. Sector managers remained in silence. The line manager emphasized the need for the company man to lead the operation. (M3)

Commented by a sector manager while criticizing a technical failure regarded as a criminal form by the partner company. He claimed for the application of consequences because it was not an honest mistake, that it was something done intentionally, and that there were three serious incidents with the same company this year. (M4)

The line manager stated that the team's perception of risk was very low, and he did not know what to do or how to "put" a better perception of risk in people's heads, who in the various onboard audits did not catch the problem. (M4)

- **Logistics:** indeed, an important feature of offshore operations. Normally, logistics are dedicated to ensuring that equipment and services will be available according to the operation's needs. Yet, it is impossible to keep all resources onboard due to the lack of onboard deck space. Thus, it is necessary to manage them continuously. There are dedicated practitioners onboard and onshore to make it happen, usually supported by the leader company man.

However, the supply vessels' fleet is not dedicated to each rig but shared among several other rigs and production units. Such a strategy created a situation where the logistics business unit serves its own goals, maximizing local results instead of global ones (Ackoff, 1971). Furthermore, requiring a permanent negotiation, normally satisfying rather than optimizing (Simon, 2013). Such tensions in negotiations and contacts were perceived along with several interactions. Being a time-consuming activity, it diverts the practitioner's attention from major risks (Weick, 2007).

The current context revealed improvements and drawbacks. By the improvement´s side, communications, DSC, and 24-hour company man´s availability are remarkable. By the drawback´s side, increasing bureaucracy (i.e., company man´s standard), micromanagement (see meetings) may be added to the persistence of technical and command-and-control working environment despite how well construction became more complex.

Conflicting goals (Macro-micro level)

While dealing with complex socio-technical systems like offshore well construction, the need for trade-offs is inevitable. On their own, trade-offs emerge from real-life issues like scarcity, competitiveness, uncertainty, ambiguity, and rewards to achieve certain goals (Rasmussen & Svedung, 2000). Then, adaptations are undertaken to balance cost pressures, resource availability, and safety (Hollnagel, 2009; Rasmussen, 1997; Vaughan, 1999).

The same adaptations will lead practitioners to make sense of conflicting goals, opening room to make decisions and get the job done (Dekker, 2011, p. 14). However, in real life, the decision-making processes are far from purely rational, being dominated by local rationality. Actors have a limited view of the system, and things may work smoothly locally but not globally, contributing to a slow and unperceived system degradation (p. 12).

The company man's craftmanship is rooted in a strong technical capacity (Rappini, 2019). Vaughan (1996) sees the engineering world as a 'can do' environment "characterized by ambiguity, disagreement, deviation from design specifications and operations standards, and ad hoc rulemaking" (p. 200). However, tensions arose between technical pride, scarcity, compliance, and demands from the emergent bureaucratic and political accountability. Some conflicts on how to deal with the rig contractor may be spotted:

Time is the lord of reason, and we live under the yoke of time, everything is written down. Time is money. (CM1)

Partnership is better, but with a rose in one hand and a bat in the other. (CM1)

We worked on a win-win basis because we often needed the support of the rig contractors. (CM7)

The company man's bias was always the time that affected the rig performance the least. The rig indicator is down-time. (MGR4)

A conflicting goal between safety and costs was a concern:

We must make decisions about what is safest. If you are as conservative as possible, you will have no problem, but at what cost? It is all a matter of risk and cost-benefit analysis. (CM2)

Some aspects of bureaucratic accountability regarding the belief of safety as documents to deliver and checklists to be done, while administrative controls replaced safety.

Then we spent a season taking care of hands and fingers, another with a crane, another with a catline. In the more recent past, we are stopping that because we are creating more checklists, showing that the work has been done. (CM5)

A political accountability issue may be related to an organization's program to promote job rotation between the offshore company man and onshore engineers. Despite the best intentions, a side-effect behavior of conflicting avoidance was presented:

As there is a current culture of (job) rotation and a fear of leaving the offshore role, nobody wants to talk about certain subjects. Nobody wants to expose themselves to slap their face. We should have a posture of questioning what we will give up doing. (CM5)

Anyway, today there is much more onshore support from DSCs to analyze pressure tests. In the recent past, there were managers who pressed the company man for holding point approval. Remember that you are always threatened by the (job) rotation, you lose a little focus, you lose peace because of it. This climate of the constant threat of rotation is very bad, it generates overload. (CM8)

You have no idea of the time spent on any event that is out of the ordinary. It consumes too much. Untimely demands. Everything on a hurry, including demands from regulators. We do not stop. (MGR1)

A climate of fear may impair the system while silencing people to enforce bureaucratic and political accountability demands, despite managerial discourse on courage as a value. According to Brown (2018), courage emerges when an action is undertaken despite the fear involved. And a question for reflection: what extent does fear (Edmondson, 2018) harm system mandates of efficiency, cost-effectiveness, and safety (Vaughan, 2021)?

To implement innovative solutions, we need to share risks in a relationship of trust. (CM4)

We do not see everything that happens in the well. Below the rotary table, there is a lot of religion. We need to have the courage to act, speak up and have confidence. We may break some paradigms. We do not want to set fire to, just solve a problem. (MGR3)

Regarding the operations sequence and the company man's standard (D2), a clear trade-off between time available and work demands was established. The operations sequence became bigger, used as evidence for audits, and the standard was considered prescriptive (D1). The company man needs to prioritize his daily schedule on his own.

The routine of the company man is a constant analysis of where his performance is most effective. If you are going to fulfill everything, you do not have enough time available. Sometimes you opt for the operational sequence in more detail, and sometimes, in a more extensive operational meeting to clarify certain points. (CM5).

When did you have a study to evaluate the duties of the company man? Doing it all to perfection is impossible, even with 03 company men. You become dependent on people turning down jobs. But what do I reject? (CM5)

The managerial intervention during the daily onshore meetings frequently drove the discussions towards explications of what happened in recent operations:

When asked by an operations manager about the delivery date of equipment [this subject was discussed a week before], the onshore engineer confirmed the delivery dates. (M3)

The operations manager asked for details about an incident and related operations. He justified seeking to understand improvements. The line manager demanded an explanation after the meeting. (M5)

A technical comment made by DSC while demonstrating frustration due to an unsuccessful operation fueled a discussion among the managers for over 5 minutes. An operations manager recalled another unsuccessful operation, despite the low-cost and high-benefit expectations. Other participants remained in silence. (M9)

In sum, managers' prioritization of past or current events would prevent practitioners from discussing the next operations and risks. In this way, human resources are invested in being accountable to managers rather than planning next operations.

While dealing with routine issues, the company man experienced tensions in reconciling bureaucratic, managerial, technical, and political goals. Bureaucratic demands arose from occupational safety and audit demands (i.e., operational sequence, company man´s standard, and meetings). Moreover, a bureaucratic accountability was established by the daily meetings’ model, contributing to a climate of fear, fueled by the risk of job rotation and the use of vocabularies of human deficit by managers. Finally, a micromanagement attitude was noted while requesting excessive operational and logistical details, despite the amount and experience of professionals involved.

The development of expertise

This section aims to identify the system effects and macro-micro connections in the organizational mindset that assesses company man's professional competence (Vaughan, 1996, 2021). According to Weick (2007), expertise belongs to the relational side of work:

> Expertise is an assemblage of knowledge, experience, learning, and intuitions seldom embodied in a single individual. And even if expertise appears to be confined to a single individual, that expertise is evoked. It becomes meaningful only when a second person requests, defers, modifies, or rejects it. (p. 78)

The company man used to undertake a one-year specialization course in Petroleum Engineering, where technical disciplines like drilling are individually taught. However, real work is more than engineering: one branch has relationships with another, including rig knowledge, dealing with people, and contracts management, to cite a few.

> *Building expertise is a very difficult issue. The Petroleum Engineering Course (PEC) did not help much. The rest was on a daily basis. Currently, we basically have normative and mandatory training. (CM5)*
>
> *You took the generalist course (PEC). I did an internship at the end. We did purely technical training. Unfortunately, there is no training that meets the training needs of the company man specifically about his work. (MGR2)*
>
> *Training is in operation. Learning how to fly by flying. Learn to be a company man by being a company man. (DSC5)*

Furthermore, several seasoned practitioners commented on what skills are expected from a competent company man:

> *Leadership: having the gift of making people work for him. Multiply the commitment. Promote synergy and multidisciplinary teams, and mediate conflicts. Do not let someone fool you because there are tricksters onboard the rig. (CM4)*

About the technical part, I think the professional needs to be a good engineer with clear concepts of physics, geology, materials, and equipment. The interpersonal part is indispensable. The company man has the power to build or destroy an operation, depending on how they deal with people. The company man must know how to listen to what people are willing to say. And they need to filter information, balancing cost-benefits to apply or not what was heard. (CM6)

I would hire a company man based on management ability. It is hard to know everything. Today, the universe is huge. In the different disciplines, the universe has increased a lot. Listen and manage. Knowing how to argue so as not to attack people. (DSC4)

How was the best company man formed? These are the guys who have the profile that fits the role. It is a profile of curiosity, proactivity, not letting a problem arise, and dealing well with the unforeseen. It is the systemic vision that we learn over time. These are the best company men. (DSC5)

Issues on professional formation were mainly related to how the work is carried on by practitioners in the real world:

The company invests but does not know how to build the company man's expertise. There is no plan to build expertise at the organization. Attempts were made, but they were abandoned. Local attempts were made for a while without measurement of results. You cannot know the outcome. Expertise is chaotically constructed in practice. (DSC5)

Company men learn a lot on the job. People who boarded with professionals with "addictions" caught the same "addictions." A lot depends on the demand and characteristics of each area. The training course (PEC) gives a very good understanding of several disciplines, but with a lot of theory and little practice. (DSC3)

There is no way around it: what matters is an experience of what was lived. As much as you train, read. The PEC does not teach you how to be a company man; it teaches you petroleum engineering and gives you a base. In the end, it is the onboard experience that matters. (CM8)

The training of the company man to manage people is zero. It needs leadership but does not consider the professional profile. Things happen for a lack of leadership. People are afraid to talk to some company men. Then they start hiding things from you. (DSC3)

According to the interviews, expertise is initially delivered in a loosely coupled way of teaching, focused on technical skills. Nonetheless, a tightly coupled and systemic understanding of petroleum engineering and management is required to get along with daily operations.

Such lack of knowledge regarding daily work may be perceived from the high standard's prescriptiveness level while attempting to compensate for such a gap. Or by trying to increase certainty in the face of the uncertainty level of real work knowledge in a socio-technical system (Latour, 2005) in a bureaucratic fashion (Dekker, 2014a). From the standard:

> The leader company man is responsible for *managing* the integrity of the well during the intervention, in accordance with the guidelines defined in the well engineering procedures and compliance with the requirements established by the regulator. This *management process* is supported by *other roles* such as the onshore engineer, DSC, and well designer. It must ensure that the intervention adheres to the well design and the regulator's requirements. (D1, p.4, free translation, emphasis added)

This bureaucratic approach fits nicely with what managers expect from the operational sequence, while starting (and giving importance to) with administrative controls rather than operational guidance.

Onshore meetings are not conducted by the company men, but the way discussions are undertaken may affect their worldview. The adopted managerial tone would influence their expectations:

When asked by an operations manager for details about the incident and related operations, he justified his reasoning by seeking to understand improvements. Then, the line manager reinforced demands for understanding operational issues after the meeting. (M3)

A line manager requested to keep the focus on the current well operation instead of preparatory phases. (M4)

An operational manager enforced to allocate "non-productive time" in an operation, demanding an explanation. Explained his expectation on pursuing the grade "ten." (M5)

During the release of an HSE alert, an onshore engineer used a retrospective, contrafactual, and judgmental terms to explain what happened in a safety event. (M7)

Such approaches may be connected to interviews:

When an accident happens, managers used to ask where the company man was. It lacks the offshore experience for anyone who asks that. (CM5)

There was a teacher at PEC who said, "the problem is not the well, it is the people involved." (CM7)

The success of the company man depends a lot on the ability to deal with adversities and people. He plays the role of manager on board, even if informal. Lack of preparation for that. The company's management team highly values preparation in the technical area and less emotional skill and management expertise. (DSC2)

In sum, focusing on results rather than processes may be interpreted as prevalent, which will be discussed further.

Interviews revealed an extensive gap between available and demanded training. An attempt to compensate such gap was providing a prescriptive company man´s standard, detailing it at maximum. Meetings also revealed the existence of a lack of managerial expertise to deal with a complex sociotechnical system, maintaining practices mostly related to command-and-control instead of creating an atmosphere of trust.

Leverage Points

According to Lloyd (2020), individual behaviors are not the real problem faced by organizations, but visible expressions of deeper systemic issues. In this spirit, Meadows (1999) identified the need of seeking improvements based on systems' leverage points. In addition, most insights may arise by conversation with workers about normal work (Conklin, 2012). Indeed, practitioners being a valuable source of information makes developing a trustful relationship a mandatory step. Furthermore, as noted by Haavik (2017) in the context of drilling operations, being a seasoned insider and knowing most of the interviewees personally influenced the emergence of an atmosphere of trust and respect.

The concept of leverage points was useful to shed some light over interviewee´s opinion: what he or she believes that the organization should stop doing, keep doing, and start doing. Indeed, practitioner´s knowledge would be helpful to recognize leverage points (Meadows, 1999).

- **Stop doing:** indeed, few answers pointed out to stop an activity. Bureaucratic measures and zero accident goal were usually a target.

  The operational sequence includes several compliance items. Is there no alternative for us to communicate with the regulatory body? (CM3)

  One thing that bothers me is zero accident goal. There is always the possibility of having an accident, it is randomness, you cannot fight it. I will do my best to avoid it, but goal zero is unrealistic. (CM7)

  When an accident happens, someone asks what was not done well. It is difficult. Zero accident is utopia. (MGR1)

  Outsourced activities checklists take unnecessary time. Stop requesting paperwork like HSE evidence. Hangs a bunch of stuff for evidence in the operational sequence. (CM4)

  I realize that we believe a lot in control tools: Work Permit, Risk Analysis, and other tools to control the operation, like a checklist to ensure whether the sea condition is adequate. (…). We try to surround it with a control tool, fill this, fill that. We have a lot of that in our culture of creating controls. We do not lack controls. (…). But it is not adding more controls that will solve this. We must stop creating controls. (MGR3)

- **Keep doing:** a great number of citations regarding to add improvements to the working process. Issues like operational sequence, expertise, and bureaucracy were cited. About operational sequence:

  A very detailed operational sequence is harmful. Things should be the driller's day to day. (CM8)

  The operational sequence today is no longer made for the driller. (DSC4)

The part of detailing the operational sequence could be made easier, without detailing what would not be necessary - relying more on the technical background of the team on board. Do not treat people like children. (DSC2)

We must write the task analysis in the operational sequence to generate evidence. It has 12 pages. Only the introduction has 3 pages. The way we deal with compliance is very expensive. (MGR2)

Improvements of managerial expertise by the company man and managers were recognized:

We could add value by developing company men in management skills. It is a barely visible gap, even because it has an onshore support, not being a priority for managers. Such a gap could be extended to the managers themselves. (DSC2)

When the whip hits the loin harder, the crowd pays more attention. When there is an evaluation of the team, people are worried about showing results. When we pretend that everything is ok, then it does not work. (MGR1)

One thing that I think company men need is to develop trust. Does the company man know the team? If he does not know the driller's life, it is a bad sign. Because his role there is to develop trust. (MGR4)

For those who are entering the role, they should have a leveling course, in the technical and managerial parts – that is for new ones. For those who are more experienced, it would need to be something that makes sense. We have a lot of training, but that is much more in compliance with regulatory bodies than continuing education. There are few courses that bring knowledge gain to perform our function. (CM7)

Not surprisingly, bureaucracy issues were extensively cited:

We need to find the balance dose between controls and processes. We went from no dose to a poisonous dose. (CM6)

We need to keep the third company man on board to face with so much bureaucracy that exists today. The clerk is also important to help with logistics. The company man does not need to be so worried about logistics. (...) While onboard tasks had increased, the number of people must *increase. To have more performance, we need to have more people seeing improvement points. (DSC3)*

Minimize meetings, maintain compliance, invest in more automated systems. There is always someone feeding systems, not everything we automate. With that, we earn manpower and release team. (MGR2)

We have a bias to understand that the company man must be busy 100% of the time. Doing an operational sequence, ok, it is important. Now, making bureaucratic processes is questionable. Behavioral audit, what is the validity of this for the company man? He needs time available, to check equipment, talk to people, follow tests. It is from this work that the insights for improving safety and efficiency emerge. It is this view that must be changed: command-and-control. It needs trust. (DSC5)

Some concern was raised about an annual job rotation program promoted by the organization, which official aim regards to allow experience and operational exchanges between onshore and offshore practitioners:

Today, 30% of company men are less than 3 years experienced, because of the rotation. In my opinion, my night company man still does not have enough knowledge to perform the work. I constantly need to review what he did. (CM6)

To make things worse, we have third party company men now. Despite having a seasoned leader company man, both night and day company man have little capacity. Do we not want to comply with the procedural rite? So, we need adequate resources. But we do not have them. What do I do? (CM6)

The [job] rotation is very good, it just needs to be applied more evenly, taking company men that you disregard, because they are not aligned with management dominant thinking. Diversity helps to run the business better. (DSC3)

They invented this process called rotation, with nebulous criteria. I would think of the process differently. It should be local; it should have a profile. Not an institutionalized process, being replaced by who knows who, without profile evaluation. The manager's motivation is to preserve *his best professionals by sending them to the DSC, saving them from rotation process. There is a lack of perception of who has the profile to be a company man. There are a lot of guys who do not have the conditions to be a competent company man. (DSC5)*

- **Start doing:** some points on career planning, knowledge construction, business view, psychological safety, and liability were raised:

  When boarding ends, you want to rest. But you also need to develop an individual career plan. Seek knowledge you do not have. What training will contribute to be a better company man? Seek additional training. Know the impacts of actions on a day-to-day basis. Is constructing the well at the lowest cost the best for the company? Bring the value of decisions to everyday life. (CM4)

  Less checklists and more statistical analysis, less determinism. To save as a company, in a globally fashion, not locally. We do not test because we are segmented. Your result depends on your box. We segmented and placed it in such a way that the result of the whole does not come from the result of each part. Each part must have a less good result, so that the whole is better. There are certain boxes, that the area of activity of one or the other is in a gray area. If you look, a lot of people have perfect ratios, but what about the company? (CM5)

  We improved a bit the issue of allowing people to speak up on board. Exercising the right of refusal, who says he is not safe to perform the operation. And not having a crisis because of every refusal event. Often the dead letter of a procedure puts too much pressure on them, that they are indicative, not immutable, that people's judgment can be considered, especially of the people who will perform the task. We see people playing with the rule under their arm. You do not want to know if you can do it or not. Tuck the rule under your arm. (MGR3)

  A lot of things (compliance) we will have to preserve because it is part of the rules of the game. Change carries a risk we are not allowed to take. Many checks have legal issues behind them that go beyond enforcement. (MGR4)

The table 9 summarizes all findings from interviews:

Table 9

Findings summary

Stop doing	Keep doing	Start doing
- Compliance on operational sequence - Zero goals - Seeking for culprits - Creating more controls	- Improving operational sequence, focusing on the driller - Operational sequence with less compliance items - Developing non-technical skills for managers and company men - Building trust - Reducing onboard compliance issues - Reducing meetings and administrative appointments - Adjust annual job rotation program - Less compliance training	- Career planning - Expertise building - Psychological safety environment - Remove compliance items without violating regulations and laws.

The standard was rarely mentioned during interviews, maybe related to its prescriptive and administrative characteristics (D2). In other words, the standard would be far from reality. A possible reason for being of limited usefulness (Leveson, 2010). During the research, an informal contact with a standard´s reviewer provided the information that only related standard numbers have been updated or deleted. On the other hand, the operational sequence was extensively cited as a useful tool, requiring improvement especially regarding to compliance issues (D1). Most interviewees recognize the importance, particularly to help the driller and the rig crew. Moreover, an excessive interference from DSC was perceived, giving rise to disagreements and feelings of infantilization by some company men.

The daily meetings should have a prospective rather than a retrospective focus. The meeting environment was guided towards a bureaucratic perspective, where the onshore engineers are hold accountable by their managers (Giampetro-Meyer et al., 1998). As a side effect, past operations discussions dominated, in a hindsight fashion, contributing to a general defensive attitude (Fischhoff, 1975). From another standpoint, managers maybe had been held accountable from those at the echelons of the organization, attempting to keep themselves well informed (Vaughan, 1996). A prospective approach needs to be addressed (Dekker, 2014b) in an ethical responsibility way by managers.

The interviews demonstrated the need for lowering the enforcement on bureaucratic (e.g., operational sequence), compliance (e.g., company man standard and third parties' checklists), and occupational safety (e.g., behavioral audits) tools. Moreover, the need for the 'keep doing the job' rotation program but adjusting it to contextual and local issues. Such an adjustment would contribute to improve daily meetings in prospective rather than retrospective focus, by creating a climate of freedom to speak up. In conclusion, all research points (interviews, documents, and meetings) indicated the need for attention to improving the way expertise has been built.

DISCUSSION

This section initially approaches how the system effects from the dominant command-and-control managerial mindset influenced three aspects of the company man´s domain: the development of expertise, the bureaucratization of the profession, and the structural secrecy. The conclusion section focuses on proposing leveraging points to intervene at the systems level, providing suggestions to overcome such effects, giving rise to improve the workplace in way compatible to a complex rather a linear workplace.

The system effects from a command-and-control mindset in a complex sociotechnical system

According to Bruno (2020), the O&G industry remains in a command-and-control mindset. Meaning that shared beliefs related to linear models and behavioral-based approaches, like fault tree analysis and behavioral audits, are still prevalent while analyzing incidents and accidents. Furthermore, the daily application of such practices (e.g., onshore daily meetings) and bureaucratic documents (e.g., operational sequence and company man's standard) were noted. Such issues were considered system effects on the workers (Vaughan, 1996, p. 38).

Rappini (2019) recalled the need for command-and-control practices during the rise of Brazilian offshore drilling activities. There was only one company man onboard, and the communications resources were poor, leading to difficulties during abnormal situations, like contacting an onshore specialist. However, well projects were simpler, contributing to a more accurate view. One of the interviewees said that “the world was smaller” during the 80s, in the sense that the company man had fast and easy access to critical activities like logistics.

Nonetheless, the company grew. For instance, oil production is currently up to ten times more. The profession's embedded world became bigger, more complex, and opaque. The organization also became more departmentalized. As a result, each department created its performance indicators, varying efficiency, efficacy, compliance, and safety, giving rise to conflicting goals and relationships. In other words, each part of the system attempted to maximize its local performance (Ackoff, 1971) at the expense of a global one (Meadows, 1999).

Such macro-micro connections, or macrostructural forces - in this case, the competition, scarce resources, and environmental production pressures (Vaughan, 1996, p. 38) - affected the company man's work view. Then, raises the question: How to keep the historical pride of engineering technical knowledge and the current enforcement by management to being also updated with operations, logistics, third parties' issues, and HSE aspects?

It was no longer possible for a sole company man to have time available to satisfy the rising level of activities. The company man's crew evolved from a second professional (the night company man), then a third one (the leader company man). Finally, a logistics auxiliary, called 'clerk,' was added. In sum, to deal with more complexity and bureaucracy, control and supervision were increased.

Furthermore, in the wake of the Macondo accident in 2010 (BP, 2010), the Decision Support Center (DSC) was created. The initial idea was to provide continuous support by onshore experts, helped by supervisory and communication tools. Beyond Macondo, a significant number of new engineers were being hired. The belief was that DSC would compensate for the newcomer's lack of experience, which made sense for managers at that time. According to the interviews, that was why the operational sequence was submitted to DSC.

However, those newcomers gained experience over time and submitting the operational sequence remained a procedure. The result was the infantilization of those onboard, which was perceived by complaints from managers and company men over how the system was 'addicted' to DSC. Addicted in the sense of submitting unnecessary decisions to DSC. According to the interviews, a situation was made visible by delegating simple offshore decisions to DSC, onshore support, or even managers. Recalling Hollnagel (2008) while discussing the changing nature of the risk surrounding the relationships between managers, company men, and DSC: what was initially envisioned as a remedy gradually turned into venom.

In conclusion, almost all operational managers and company men are former engineers. Such backgrounds need to be carefully considered. According to Vaughan (1996):

> When technical systems fail, investigators consistently find an engineering world characterized by ambiguity, disagreement, deviation from design specifications and operating standards, and ad

hoc rule-making. This messy situation, when revealed to the public, automatically becomes an explanation for the failure, for after all, the engineers and managers did not follow the rules. But the myth of precise science-based technology is further perpetuated, says Charles Perrow, by the inherent bias of all accident investigation findings. The engineering process behind a "non-accident" is never publicly examined. If non-accidents were investigated, the public would discover that the messy interior of engineering practice, which after an accident investigation looks like "an accident waiting to happen," is nothing more or less than "normal technology." (p. 200)

Like other high-risk systems, the world of offshore well engineering has plenty of uncertainty and ambiguity (Leveson, 2011). The issue here would be how to embrace a sensemaking approach (Weick, 1993), understanding that rules and procedures will not encompass all possibilities in complex systems, being necessary some degree of adaptation to get the job done in a efficient and safe way.

The development of expertise

Expertise is chaotically constructed in practice. (DSC5)

Such a small, short sentence holds a strong meaning for both company men and their managers. First, as shown previously, the initial one-year training (named Petroleum Engineering Course – PEC) was focused on discrete disciplines, like drilling and completions, in a classroom environment. Moreover, individual grades tend to be a competition criterion while being assigned along business units at the end of the course. Working offshore as a company man tends to be desirable to a Petroleum Engineer due to the possibility of not leaving his or her hometown, earning higher salaries, and more day-offs.

Second, being the formation course the initial contact with the organization it is possible to affirm that the main goal was guided towards individual performance. Indeed, the competition scenario reinforced the role of the individual, not influencing classmates to share knowledge and collaboration. In some cases, enmities were formed, possibly harming future teamwork. Weick (2007) recalled the distinguished character of expertise as relational rather than individual (p. 79).

Moreover, the traditional course structure carried a substantial gap between work as imagined and work as done (Hollnagel, 2014).

This gap may be perceived immediately after the course, when Petroleum Engineers, including company men, started their work. Extensive on-the-job training was necessary, even though previous professional profile assessments were not undertaken. Thus, it was usual for managers to recognize a professional unfit for being a company man. However, such a conclusion needs a period varying from 6 to 12 months because of working cycles and specific training programs (e.g., well-control courses and basic safety training). In this spirit, it is impossible to affirm that the proper professional was placed according to his capacities.

Third, expanding this view throughout the organization requires several personnel adjustments and replacements. Therefore, the construction of expertise was, at minimum, delayed. Moreover, there needed to be a continuous training program targeting operational excellence instead of filling bureaucratic demands. The current training opportunities described by the company man's standard were mainly related to legal and normative demands. Additionally, there were constraints to pay extra hours, encouraging a managerial preference strategy for online training during embarkment time. Finally, the company man's construction of expertise had been underpinned mostly by technical and bureaucratic demands instead of real work and humanistic ones.

Fourth, from the operational meetings, it was noticeable that the operational and line managers based their participation mostly on technical knowledge. Viewed in isolation, it is not a problem. However, 'old view' organizations also rely on deference to authority rather than expertise (Weick, 2007, p. 75). Recalling NASA's Columbia Accident (CAIB, 2003), another high-risk organization:

> "NASA's culture of bureaucratic accountability emphasized chain of command, procedure, following the rules, and going by the book. While rules and procedures were essential for coordination, they had an unintended negative effect. Allegiance to hierarchy and procedure had replaced deference to NASA engineers' technical expertise." (Vol. 1, p. 200)

The interviews noticed an additive fear arising from the job rotation program. Thus, it would be reasonable to assume that such issues combined may lead to organizational silence motivated by a fear-driven climate (Edmondson, 1999). In addition to bureaucratic accountability practices, line and operational managers were demanded from those above to be updated about operational details. Again, while most managers are engineers, relying on their technical knowledge and on an 'old view' command-and-control mindset, their actions made sense: people under manager´s responsibility had been seen as a problem to control rather than a solution to harness (Dekker, 2001).

Fifth, what could explain such management behavior? An adage says that if the only tool you know is a hammer, possibly all you see will be nails, and your only known action will be hammering. A possible rationale may be related to organizational processes regarding managerial selection and development. Managers are usually selected from the operational front. In this spirit, it uses to be more comfortable for new managers to follow the existing working scheme, not promoting disruptions, and allowing operations to proceed smoothly. In other words, managers tend to satisfy rather than optimize (Simon, 2013).

The last sentence connects to the managerial expertise development problem. There needs to be a structured program to promote consistent managerial knowledge. Again, expertise is chaotically developed in practice. And despite operating in a high-risk, complex sociotechnical system, both managers and company men deal with unpredictable, uncertain, and ambiguous situations daily. In addition, drilling rigs may be described as total institutions (Goffman, 1961). People on board lives are routinized and regimented in the company of others, like prisons, mental hospitals, and monasteries. The most important feature to shape a member is the institution, not individual characteristics (Vaughan, 2021, p. 180).

Such a scenario demands a differentiated managerial development of expertise for managers and company men beyond command and control. Although offshore well construction system produces common traits, the complexity of the current operations only allows a single manager or company man to know some things about an operation. Knowledge is imperfect and residual risks remain in complex systems (Leveson, 2011). These characteristics demand local knowledge, so even a “standardized system cannot handle every eventuality in a standardized way.” (Vaughan, 2021, p. 182).

In conclusion, the management repertory on trust and systems thinking need to be developed across managers and company men to deal productively with the current complex and high-risk environment.

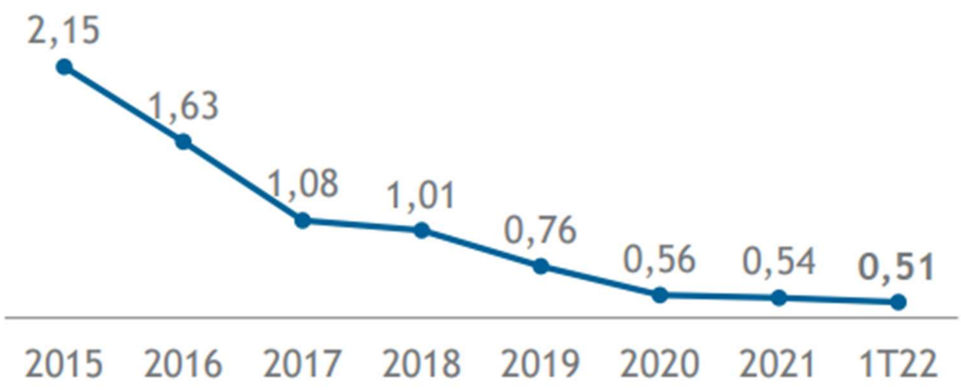
The bureaucratization of the profession

We have conflicts in the aspect of being responsible for safety on board. But I do not see that part of the checklists has contributed to the improvement. Some are, others are time-suckers. An operational sequence today has two pages at the beginning that are pro forma. I realize the driller will not read that. (CM5)

As previously discussed, organizations focused on command-and-control practices tend to see people as a problem to control. Moreover, a mindset towards certainty and unambiguity prevails, attempting to reduce uncertainty and ambiguity, and manage liabilities (Dekker, 2021, p. 6). For instance, the studied organization published a graph on its home page, correlating safe operations with a consistent reduction in the level of occupational accidents during the past years (fig. 6):

Figure 7

Recordable occupational accident rate per million person-hours from the studied O&G organization[3]



Being that the O&G industry is a high-risk, complex sociotechnical system (Haavik, 2017), such an affirmation leads to an oversimplification of safety. In complex systems, safety is described as an emergent property, highly dependent on initial conditions and constraints during normal work (Leveson, 2002). Nevertheless, focusing on individuals simplifies it, targeting attention to people at

[3] Source not mentioned to deidentify the organization.

the sharp end (Dekker, 2014b). While making sense of a mindset focused on individuals instead of the system, several administrative controls were implemented. To cite a few: mandatory checklists, documents to fill, and several audits to be delivered.

During the interviews, complaints from company men and managers regarding growing bureaucracy and paperwork were remarkable: management of change (MOC) demands for minor operational adjustments, accident and incident informs to managers, risk analysis documents, lessons learned forms, critical deviation checklists, behavioral and permit-to-work audits revealed the strong level of the safety-documented belief. All of these were routinely enforced by managers during daily meetings. Moreover, documents like the operational sequence needed approval by the DSC and listed much bureaucratic information, increasing its uselessness to its most important user - the driller.

In contrast to the high number of citations on bureaucracy, little was said about the company man's standard. Far from a resource to help practitioners, such a document demonstrated a prescriptive and administrative characteristic by listing obvious tasks, like sending the daily operations report. Indeed, the procedure analysis indicated:

- Total of 93 different attributions.
- 74 attributions (80%) related to administrative tasks.
- Only 33 attributions (35%) required expertise to be undertaken. Another interpretation: it is not necessary to be a skilled practitioner to carry 65% of a company man's attributions.
- 45 attributions (48%) leading to diffuse responsibility.
- 52 attributions (56%) lack practicability, leading practitioners to, according to the interviews, prioritize what needs to be done daily. The risk of failure is assumed by company men, which is to be potentiated by the uncertainty about the professional future motivated by the job rotation program.

In conclusion, through the interviews, documents, and meetings undertaken for this research, it was demonstrated how the system effects from a strictly command-and-control managerial mindset over the practitioners, by the enforcement of different ways of professional bureaucratization, may lead to a fear-driven scenario, infantilization, and disengagement of workers.

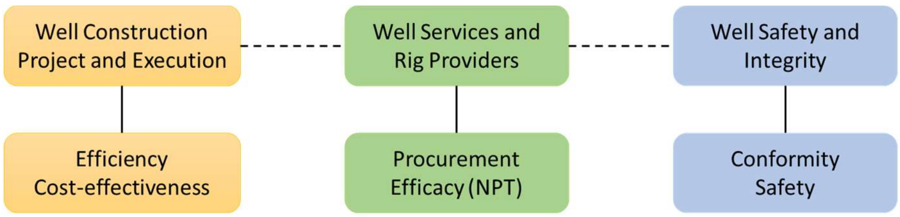
Structural secrecy

Structural secrecy is related to "the way that patterns of information, organizational structure, processes, transactions, and the structure of regulatory relations systematically undermine the attempt to know and interpret situations in all organizations" (Vaughan, 1996, p. 238). More specifically, "it refers to how the structure of an organization, its hierarchy, division of labor, and specialization – limits the ability of people in different locations within it to know and understand what is going on in the other parts" (Vaughan, 2021, p. 568).

The offshore well construction's organizational structure was designed based upon specialized service provider structures, coordinated by a generalist structure, where the company man and project engineers are placed. There are two service providers: well services and rig contracts. Additionally, another branch is responsible for well safety and integrity (including conformity). The scheme below (fig. 7) clarifies the different branches and their respective main drivers:

Figure 8

Different branches and conflicting goals[4]



Despite the coordination effort involved by operational managers (where the company man is placed), each area has different and conflicting goals – a primary source of drift (Dekker, 2011). The problem is not the existence of conflicting goals *per se*, but how to deal with them. It requires negotiation skills to deal with conflicting goals, balancing efficiency, cost, conformity, workload, and safety (Rasmussen, 1997). However, the current workplace is marked by a search for certainty and

[4] NPT is an acronym for Non-Productive Time, commonly used in well construction KPIs.

unambiguity instead of embracing sensemaking. In this spirit, solutions tend to be guided towards satisfying rather than optimizing (Simon, 2013), fine-tuning what is possible instead of necessary (Starbuck & Milliken, 1988).

The argument mentioned above lies in the prevalence of an engineering mindset in the workplace. Most professionals involved in offshore well construction are engineers. According to Perrucci (1971), engineering is a bureaucratic profession. Being hired to apply technology in production processes, engineers have cost and efficiency as core concerns (Dorf, 1974). While discussing engineering culture, Vaughan (1996) asserted that:

> To succeed as an engineer is to conform both to bureaucratic procedural mandates, chain of command, and production goals and to the rules for technical decision-making learned while training for the engineering craft. (…) They are used to and expected working conditions created by the upper echelon that include production pressure, cost cutting, limited resources, and compromises (p. 208).

Moreover, most engineers aspire toward upward mobility by promotions to management positions (Raelin, 1984). Career interests link them to the organization in a long-term fashion by creating "a stake in the maintenance of the industrial order and in the rules of the game, on which the expectation of advancement is based" (Zussman, 1985, p. 230). Practical reasoning to make sense of the engineering way of selecting managers was raised by Weick (1973): "accept what gives pleasure, reject what causes pain; accept immediate responses, reject slow responses; accept a new answer, reject a conventional answer; accept the rational, reject the irrational" (p. 57). Indeed, a binary and mechanist approach (Dekker, 2011).

However, what still encourages such reasoning? The offshore deepwater well construction operates at a technological forefront, overcoming several engineering challenges. Recalling what Vaughan (1996) referred to as NASA's original technical culture, known by the shorthand 'can do', or "give us a challenge and we can accomplish it" (p. 209). While good results are achieved, an atmosphere of celebration used to take place. Nevertheless, Starbuck and Milliken (1988) asserted:

> Success breeds confidence and fantasy. When an organization succeeds, its managers usually attribute this success to themselves, or at least to their organization, rather than to luck. The organization’s members grow more confident in their own abilities, of their managers' skills, and of their organization's existing programs and procedures (p. 329).

In summary, interviews, documents, and meetings demonstrated a belief in command-and-control managerial practices and bureaucratic accountability to operate a complex system. Adding the expansion of administrative structures motivated by the need for procurement, auditing, and others, the scenario faced by the organization resembles NASA during the Space Shuttle development program (Vaughan, 1996, p. 211).

Leveraging the system: recognizing and transcending paradigms

Leverage points are points of power in complex systems (Meadows, 1999, p. 1). However, such points are also emotionally and politically costly in organizations because parochial interests may be evoked. Power relationships may be stressed, causing reactions in unseen ways by those in charge of powerful or bureaucratic positions (Perrow, 1986). Then, a comfortable option to avoid conflicts may be keeping things as is.

For instance, as demonstrated by Bruno (2020), the O&G industry's blunt end still relies on command-and-control managerial practices, beliefs in safety such as the absence of occupational accidents as safety performance, and viewing people as a problem to control, because they are unreliable, by enforcing strict adherence to norms and procedures. A paradigm that resembles administration practices from the 19th century, during the rise of line assembly factories (Dekker, 2019). However, the world changed (Le Coze, 2020), so has the nature of risks (Hollnagel, 2008), and consequentially demanding new strategies to cope with such a reality.

This research moved efforts towards recognizing the system effects from a command-and-control managerial mindset and its macro-micro connections over a representative worker named Company Man. Thus, the following interventions at the systems level and listed below, were derived from this research as contributing to identify and transcend paradigms (Meadows, 1999, p. 3):

First, question whether the organizational structure is the most suitable for present and future challenges (Hopkins, 2012). Do not let success breed overconfidence (Starbuck & Milliken, 1988). The current organizational structure was useful to past challenges, but it needs to be critically analyzed. However, the design fosters local rationality while encouraging parochial interests like structures aiming to maximize individual and conflicting goals like efficiency, conformity, cost, and safety, giving rise to structural secrecy and internal competition. Top managers should seek an organizational solution to achieve global optimizations rather local ones.

Second, both managers and company men need selection processes, basic professional formation, and continuous training development approaches based on systems thinking (Meadows, 1999), normal work (Hollnagel, 2014), trust building (Bill et al., 2003), non-technical skills (Flin et al., 2003), and psychological safety (Edmondson, 2018). Complexity requires diversity (Dekker, 2011), and expertise needs to be perceived as a collective emergent property of the system (Weick, 2007). In other words, human skills need to be considered an integral feature on professional development guidelines instead of solely technical knowledge.

Third, inspired by HROs (Rochlin et al., 1987) like air traffic control (Vaughan, 2021), commercial aviation, and nuclear industry (Amalberti, 2013), keep the organization preoccupied with failure, resistant to oversimplification, sensible to operations, committed to resilience, and deferent to expertise (not to experts or authorities) (Conklin, 2019; Weick, 2007). Learning opportunities need to be undertaken by skilled investigators and driven by providing sustainable solutions at the systems level.

Fourth, recognize and negotiate conflicting goals by enlarging (not narrowing) overall comprehension over global optimizations rather than local ones (Hollnagel, 2009). Risk has a changing nature, being continuously negotiated (Hollnagel, 2008; Rasmussen, 1997). Quantitative assessments are necessary, however not sufficient to deal with ambiguity, uncertainty, and ignorance. The development of concepts like sensemaking would be helpful to overcome this challenge.

Fifth, de-emphasize the role of behavioral-based approaches and occupational safety indicators to guarantee that safety is alive and well (Woods, 2010). The Macondo case is meaningful, recalling that a major accident occurred just after the rig Deepwater Horizon had being recognized as a safe unit after seven years without occupational injuries (Hopkins, 2012). History and context are important (Snook, 2000), so the need for spreading techniques like storytelling to improve organizational learning.

Sixth, fostering partnerships with third parties and other internal actors, recognizing their contribution (interpretive and articulation work) to dealing with complexity by increasing positive capacities and success probabilities (Haavik, 2017). Fostering an environment where psychological safety prevails is paramount to achieve this goal.

Seventh, Start investing time to understand how real offshore workers perform, attempting to acknowledge what had made their job more difficult, uncomfortable trade-offs, excessive bureaucracy, and scarce resources followed by proper feedback (Conklin, 2012). According to Forrester (1971), practitioners know intuitively where leverage points are. For instance, a visible and essential quick win would emerge from the operational sequence's debureaucratization.

Eighth, outline the importance of understanding safety and accidents as an emergent system property rather than establishing moral judgment and start seeking for culprits (Dekker, 2014b). In this spirit, accidents are seen as a consequence of uncertainty and complexity embedded in complex systems, not demanding stand-downs or reactive measures (Leveson, 2011).

Nineth, learning by seeking what and why something happened, not who did it (Conklin, 2022). It will require proper personnel selection and comprehensive training to allow better learning opportunities. Moreover, while overcoming the paradigm of investigating accidents, including the opportunity of learning from normal work (Conklin, 2012).

CONCLUSION

This research attempts to offer universal directions despite focusing on a sole offshore well construction professional, the company man. However, it could be possible to replace the company man with a surgeon, a maintenance engineer, or operational managers. Indeed, all those professionals are embedded in high-risk systems. Improvements to foster sustainable operational excellence must be addressed at the systems level, like formation, personnel selection, and professional development, to cite a few.

Achieving the goal of answering the research question was possible because practitioners contributed to identify system effects and macro-micro connections that affected their work, while sharing their history, context, conflicting goals, and daily trade-offs. In sum, they guided the researcher throughout relevant waypoints to understand their concerns. As an example, while offering their account on how the persistence of 'Old View' practices in a complex workplace may lead to overload workers with bureaucratic accountability, undermining trust, creating conflicts, and diverting priority from the core issue: constructing oil wells as per the system mandates of efficiency, cost-effectiveness, and safety.

Therefore, special attention and resources need to be prioritized toward understanding the system where workers perform their tasks. Moreover, attempting to extract essential information about issues and constraints emerging from real life. From the banality of daily routine. Unfortunately, the O&G industry still relies on learning from undesirable outcomes like incidents and accidents. In other words, something bad needs to happen to spark the need for an 'investigation' – look how police vocabulary is used, probably seeking for culprits. A reactive strategy.

Furthermore, such an approach uses a vocabulary that typifies human deficit: words such as fail, fault, error, and others. How in the world someone could provide relevant information in a fear-driven and judgmental environment, like post-accident interviews? We must ask ourselves if there is a proactive and humanized way to do it. And yes, there is. But gaining access to this new dimension will require new skills, especially for leaders. Trust needs to be regained by humble and curious leadership, offering two ears and one mouth, in that proportion, to subordinates.

This research was conducted in a sole organization. It just scratched interorganizational relations and had not delved into regulators, peer companies, or services providers. Exploring such boundaries may benefit the whole system while understanding relational aspects and interdependencies. The persistence of command-and-control practices in one organization would be a symptom of deeper issues along with whole system.

Although there is no recipe, keeping the current command-and-control paradigm will probably not help. While embracing complexity to overcome linearity limitations, features proposed by the Human Factors approach, like systems thinking, normal work, trust building, non-technical skills, and psychological safety, may be helpful to provide new directions.

And none of this is about reinventing the wheel. High-risk industries like air traffic control, commercial aviation, and nuclear industries are viable inspirations. Healthcare and maritime domains would share challenges with the O&G industry. Furthermore, the academy, regulators, peer companies, and service providers need to keep joining efforts in the name of business sustainability. Including safety, not as an absence but as a real presence across all levels of the organization while pursuing operational excellence.

This research was conducted in a micro-cosmos of a particular organization and focusing on a solely professional, the company man. Then, it will not be possible to generalize conclusions and recommendations to the whole O&G industry. However, the methods and approaches adopted may be useful for further studies, like using sociological and systems-thinking based approaches to normal work, aiming to seek for systemic improvements rather than focusing on parts – a current paradigmatic issue to O&G industry.

Also the author may be considered a 'researcher-practitioner', being a company man in the beginning of his career. This approach may provide a unique insight from fulfilling the role in the context of being a researcher too. It means that the author will probably see things that others will not necessarily. Similarly, daily activities and interactions can be interpreted in new ways by the author.

APPENDICES

Appendix 1 - e-mail of invitation

Appendix 1 - e-mail of invitation

Dear Mr./Ms.

My name is Victor Ribeiro Nazareth, a MSc. student in Human Factors and Systems Safety at Lund University in Sweden and with a background in petroleum engineering, particularly in offshore well intervention.

Currently, I am conducting a research project for my master's thesis, which aims to explore the role of the company men in the Brazilian offshore well constructing environment by analyzing their workplace in a systemic approach. The expected outcome are a comprehensive understanding of their reality, providing a set of improving proposals based on a systems approach view.

However, as an initial step for this research, it is essential to understand the current view of key professionals working as company man or close stakeholders to evaluate better how such perceptions may be affected by the systems they are embedded on and its possible consequences achieving efficient, efficacy, cost-benefit, and safe operations in the long term.

To be able to do so, I have selected a group of professionals to interview within the key players in the offshore drilling in a National Brazilian O&G operator. Such a distinguished group of practitioners should provide a broad overview of this subject as more robust and accurate as possible.

In this regard, I believe you and the organization you represent are a natural choice to take part in this research as a key representative of the (to be added) group. The idea is to carry out a semi-structured interview with you, as a representative professional, to get your thoughts on this matter. The interview shall take from around one hour to no more than two hours of your time.

Since it aims to support academic research, every information will be treated as classified information. It shall not be disclosed in any way the source, or your organization could be identified. Notwithstanding, the interview will be recorded and a transcript for the purpose of accuracy and fidelity. The transcriptions will be at your disposal as you wish.

Please, let me know if you agree on taking part in this research project and, in case of an affirmative answer, your availability by indicating the best time and place at your convenience, and I will do my best to match it.

Thanks in advance and best regards,

Victor Nazareth

Lund University, Sweden – MSc. Human Factors and Safety Systems Student

Appendix 2 – operational sequence model (translated into English by the author)

<table>
<tr><td>Well: X-AAA-ZZZHD-MMM
Rig: AA-BB</td><td>Water Depth (m): xxxx
Rotary table (m): xx</td><td rowspan="2">Company Man: Mary, Alex, and Steve
ROV / Well Services:</td></tr>
<tr><td>Date: xx/yy/zz</td><td>Issue: nº (date)</td></tr>
<tr><td colspan="3">Title:</td></tr>
<tr><th colspan="2">WELL BASIC DATA</th><th>SOLIDARY BARRIER SETS</th></tr>
<tr><td colspan="2">(Examples)
Well head:
Casing Shoe:
Mud Weight:
Section OD:
Gas Oil Ratio:
Fracture pressure:
Etc</td><td>SBS 1:
SBS 2:</td></tr>
<tr><th colspan="3">OPERATIONAL SAFETY</th></tr>
<tr><td colspan="3">Mandatory:
• Risk Assessment Analysis
• Check Lists
• Management of Change
• Process Safety</td></tr>
<tr><th colspan="3">PRELIMINARY INFORMATION / PREPARATIONS</th></tr>
<tr><td colspan="3">(Optional)</td></tr>
<tr><th colspan="3">TITLE OF THE 1ST MAIN OPERATION</th></tr>
<tr><td colspan="3">EMERGENCY DISCONNECT SYSTEM MODE (EDS)</td></tr>
<tr><td colspan="3">1.
•</td></tr>
<tr><td colspan="3">2.</td></tr>
<tr><td colspan="3">3.</td></tr>
<tr><th colspan="3">TITLE OF THE 2nd MAIN OPERATION (IF ANY)</th></tr>
<tr><td colspan="3">4.
•</td></tr>
<tr><td colspan="3">5.</td></tr>
<tr><td colspan="3">6.</td></tr>
<tr><th colspan="3">NEXT OPERATIONS</th></tr>
<tr><td colspan="3">• Mandatory</td></tr>
</table>

P-01 – Drill String above BOP	***P-02 – Bottom Hole Assembly in front BOP***	***P-03 – Drill String in front BOP***
ADVISORY STATE	**ADVISORY STATE**	**ADVISORY STATE**
Notify the company man immediately and wait for a decision.	*Notify the company man immediately and choose safer option: Pull out BHA above BOP, select EDS #2 and wait for decision* *OR* *Run in hole BHA below the BOP, hang off and select EDS #3.*	*Notify the company man immediately and wait for a decision.* *The continuation of the operation will be defined, pull out of the drill string above the shoe and/or hang-off + change to EDS #3.*
YELLOW ALARM	**YELLOW ALARM**	**YELLOW ALARM**
Slip drill string *Close shear rams*	*<u>Choose the safest option:</u> Pull out BHA above BOP, slip drill string, close shear ram, and select EDS #2.* *OR* *Lower BHA below the BOP, secure shear element in front of the BOP and select EDS #4.*	*Secure shear element in front of the BOP* *and prepare to disconnect.*
RED ALARM	**RED ALARM**	**RED ALARM**
☐ EDS #1 (NO SHEAR) – S/ AUTOSHEAR ☒ EDS #2 (LBSR+UBSR) ☐ EDS #3 (CSR + UBSR) ☐ EDS #4 (CSR+LBSR) ☐ EDS #5 (NO SHEAR) – C/ AUTOSHEAR ☐ EDS #6 (UBSR+LBSR) ☐ EDS #7 (CSR)	☒ EDS #1 (NO SHEAR) – S/ AUTOSHEAR ☐ EDS #2 (LBSR+UBSR) ☐ EDS #3 (CSR + UBSR) ☐ EDS #4 (CSR+LBSR) ☐ EDS #5 (NO SHEAR) – C/ AUTOSHEAR ☐ EDS #6 (UBSR+LBSR) ☐ EDS #7 (CSR)	☐ EDS #1 (NO SHEAR) – S/ AUTOSHEAR ☐ EDS #2 (LBSR+UBSR) ☐ EDS #3 (CSR + UBSR) ☒ EDS #4 (CSR+LBSR) ☐ EDS #5 (NO SHEAR) – C/ AUTOSHEAR ☐ EDS #6 (UBSR+LBSR) ☐ EDS #7 (CSR)

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