Risk management in anchor-handling operations: The balance between control and autonomy

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ABSTRACT: The purpose of this paper is to explore different safety cultures in anchor-handling operations in the Norwegian offshore petroleum industry; how the crew and management cope with both critical and dangerous operations, compared to the periods in-between operations that are characterized by routine work. Between operations, officers function as middle managers fulfilling organizations needs for control, predictability and audit requirements. During operations, dangers and complexity demands full focus and presence towards that specific situation. Thus, the different demands are balanced by actualizing two different safety regimes and work practices. The discussion in the paper is based on two research projects conducted in 2009 and 2013, focusing on safety conditions at anchor-handling vessels.

1 INTRODUCTION

1.1 *Anchor-handling operations*

Anchor-Handling Tug Vessels (AHTVs) perform what is known as *advanced marine operations, extreme marine operations*, or simply *anchor-handling operations.* Anchor-handling vessels are an important part of the offshore operations in the production of oil and gas on the Norwegian continental shelf (NCS). According to statistics from the Norwegian Shipowners' Association, the offshore industry in Norway consists of approximately 600 vessels, where AHTV and supply vessels are the biggest category. The fleet is the second biggest offshore fleet in the world next to the US. Furthermore, this industry employs more than 12500 people and delivered 24 percent of the total value creation within the Norwegian maritime industry in 2012 (Maritimt Forum 2012). Moreover, in 2011, this industry is said to create values of more than NOK 30 billion, in an industry that creates about 150 billion in total.

The operations on board an AHTV vessel involve many dangerous work situations, which demand a strong focus on safety before and during operations. Seafaring has mortality rates considerably higher than populations ashore (Hansen et al., 2002; Roberts, 2002).

The standard rig move operations are integrated; anchors are recovered to the AHTVs, the rig moved to a new location, and anchors are placed at the new location and connected to the rig—all in one operation. This operation may take 6-10 days and requires a rather stable weather window. Also, it requires tight coordination between the parties; the rig and 2-4 anchor-handling vessels, where one of them has the lead.

1.2 *Rule-based offshore petroleum culture*

The offshore petroleum industry in Norway is controlled by regulations, guidelines, and standardization of operations. In this way, the industry is characterized by a rule-based organizational culture and structure, with normative concepts of behaviour. The aim of a rule-based safety regime is to reduce accidents on board and to develop a safe workplace. The regulating authority for all vessels and movable rigs on the Norwegian Continental Shelf is the Norwegian Maritime Directorate.

The planning of offshore operations has to follow certain guidelines. A "Risk assessment document" is prepared by the operator, the oil company, or a company contracted as Marine Representative. The planning is based on experiences of what could occur or previously have occurred. The guidelines are the NWEA, version 2 regulations. This is a generic document, which is intended for continuous updating during the preparation period and during operations, in accordance with the incidents occurring. A preparatory meeting is arranged with all parties present. The Guidelines and Risk assessment are presented and discussed. The risk assessment is revised as a result of feedback from that meeting.

When the vessels are hired from the spot marked, there are no vessel representatives at the above meeting. Long-term contracts, however, allow such representation.

At the base during mobilisation, the marine representative arranges a familiarisation meeting for all

vessel crew. This is a presentation of scope and a safety brief.

1.3 *Safety culture*

The relation between safety and culture has been one of the main topics of safety research for the last decade (Guldenmund, 2007; Haukelid, 2008; Stiansen, 2009). Research has shown that the cultural aspects of work practice influence safety as much as technology and formal organization structures.

According to Gherardi et al. (1998), safety is strongly linked to the work practice of a community. It is a collective competence that has developed through experience and training of seamanship. This also influences what is considered safe or dangerous behavior during operations on board. The seamen's identity is shaped by what is appropriate within the norms and values of the culture on board, and influence the way they perceive safety rules (Knudsen, 2005). According to Knudsen (2009), good seamanship is a blend of professional knowledge, professional pride, and experience-based common sense.

Safety is also strongly linked to management of safety, where the aim is to control and measure an organization's operational performance. According to Petersen (1978), safety conditions can be identified, predicted and controlled – through the means of defined work processes and procedures. Planning and setting goals are also a part of safety management.

In this paper, we address both these views of safety: 1) the importance of the culture of the seaman crew due to safety and 2) the impact of the offshore control routines concerning safety.

2 METHODS

The collection of data is based on qualitative methodology, involving semi-structured interviews, unstructured conversations and observations onboard AHTVs during operations. One researcher covered integrated operations over a period of one year (2009-2010) and one researcher covered a week's operation during a pre-lay operation in 2013. The main data source from the one-year fieldwork is thus participation on board AHTVs and interaction with crews on these vessels (Røyrvik 2012). In addition to participation and observation, structured and semi-structured interviews from all positions on board were conducted, on board narratives were collected, and operation documents were studied. In addition, the researchers participated in relevant contexts, such as operations planning, pre-operational meetings, AHTV operational and safety procedure simulator training programs and R&D related contexts.

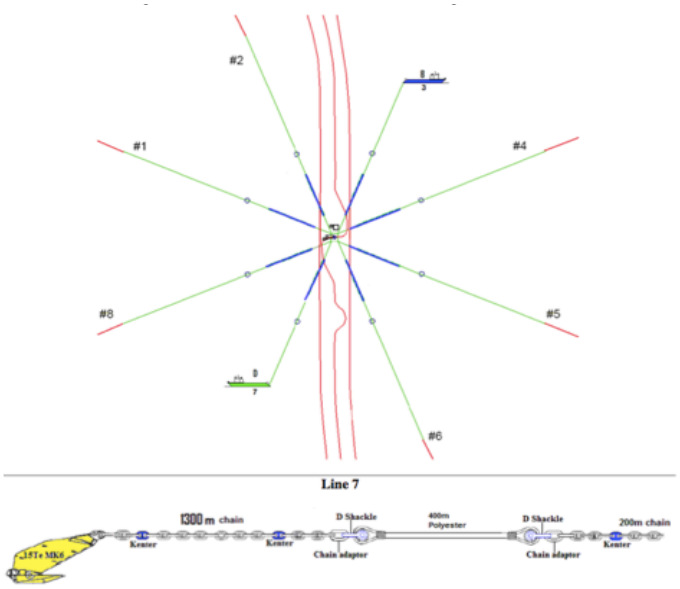
The positions interviewed in the 2013 data collection were: captain, first officer, chief engineer, deck foreman, ROV supervisor, surveyor, mooring supervisors/controllers and marine representative for the operator (oil company). Interviews were transcribed from audio files, as all interviews were recorded. The quotes used in this article are all translated from Norwegian. Observations with conversations in between interviews were conducted over a period of around 14 hours daily. Observational notes were taken at the time the observation was made or shortly thereafter and included in a field log as documentation. As the observations, participation and interviews that form the empirical basis of this article were made and conducted in 2009 and 2013, respectively, comparisons allow for discussion on developments in both operational practices and safety management.

3 RESULTS

Based on the analysis from the fieldwork, we will describe the characteristics of the working and living conditions on board the anchor-handling vessels. Overall, we found that the management and crew of seamen on board both strongly prioritize safety to avoid occupational accidents and major organizational disasters. How this is performed is very much affected by the fact that these vessels are part of a long-standing sailor tradition and a strong industry managerial regime. Thus, the officers are expected to function both as ship officers, focusing on seamanship, yet at the same time as middle managers of the greater corporations. The role as middle manager involves detailed planning and control in an effort to follow safety procedures and routines.

Depending on the organization of the particular operator, the oil company, as many as seven different parties may be involved in an anchor handling and rig move operation. The oil company may choose to include several of the functions from internal resources or use outsourced resources. The functions or processes involved are: A drilling management responsible for planning and drilling, an offshore marine representative advising the drilling management and operator being the representative on board the senior AHT, a planner function/company, drilling company/rig owner, site survey to confirm the correct site, navigation company to find and document the correct location, weather forecasting company and anchor and mooring handlers.

3.1 *Anchor operations*



Picture 1: Map of an anchor system – and specifications of anchor # 7

seabed according to position data. Traditionally, an anchor operation consists of three main parts: 1) the pulling of an anchor, loosening the rig from the sea bed, 2) tugging the rig to a new position, and 3) anchoring the rig in place at that new position. Such operations involve coordinating four AHTVs and one rig. Furthermore, an operation typically involves recovering and repositioning eight anchors, with each vessel working with and taking on board two anchors and their anchor systems.

The new pre-lay type operation consists of one recovery and pre-lay operation and one concerted (4-5 days) rig move (1-2 days). This requires two sets of anchor mooring spreads, one owned by the mooring equipment supplier and the other often owned by the rig company. The spread is left on the seabed from a previous rig move about 2 weeks prior. Anchors (usually 8) are all recovered and brought to the new location and spread according to a spread plan and buoyed with light buoys. On the rig moving day, the anchors at the "old" location are all buoyed, the rig is moved with the help of two AHTVs, wires are recovered and the rig connected.

Prior to any operation, a decision has to be made whether to carry it out as a pre-lay or integrated operation. There are advantages and disadvantages to both types of operations, and they both involve comprehensive planning: mooring analysis and equipment, vessel requirements, additional personnel, logistics, notification of others parties of location, and various risk assessments, such as Safe Job Analysis (SJA).

3.2 *AHTV vessels*

The AHTVs vary in terms of hull design, and there are different kinds of propulsion systems, as well as anchor handling systems. Some of the more modern AHTVs are equipped with an ROV (Remotely Controlled Vehicle) to inspect the seabed and recover the anchor lines. This significantly reduces the need for grappling functions (see section below). Nevertheless, there are some characteristic similarities between all AHTV vessels, like the positioning of the living quarters and bridge afore, the long working deck at sea level and the large winches mounted to the living quarters facing the work deck. The dual work chairs of the coxswain and the winch operator are another special feature of AHTVs. During operations, their work positions are at the bridge, overlooking the work deck. Independent of the type of AHTV, the positions on board are highly specialized, from the bridge and deck to the engine department.

The vessel is built specifically for towing and oilrig anchoring. Towing implies towing a rig from one location to another, and oilrig anchoring means anchoring the rig so it sits steadily in the water. To achieve this, four or five vessels must collaborate to stretch and tighten the enormous wires or chains, and anchor them to the ocean floor. The anchor is sometimes a kilometer away from the rig, so the thick wires are bound to be very heavy.

To cope with the great forces of the wire or chain, as well as nature, the vessels are very powerful and thus very demanding on resources. As the operations also take place some distance from shore, the vessels usually spend weeks offshore to get as much work done as possible on each trip. Each vessel can be considered to be a complete and integrated organization, because of the limited physical frames the crew live and work within over some time. The crew all have different tasks, qualifications and responsibilities, and everyone and every task is necessary in order to be able to stay offshore for such extended periods of time every trip. Some are responsible for food, some for cleaning, and some for maintenance of the vessel.

Picture 2: An AHTV docked at Kristiansund

3.3 *Positions on board*

The crew consists of a minimum of 13: four on the bridge, four on deck, four in the engine room and one cook. Usually though, cadets and apprentices join the crew in training to become officers or able seamen, and it is common that the size of the crew varies between 15 to 20.

The four people working regularly on the bridge hold positions of captain, chief officer and first and second mate (sometimes two first mates). These four work closely together. During operations, the captain and one mate work on one shift together, and the chief officer and the other mate work the second shift. The shifts rotate—six hours of work and six hours of sleep, which implies that for twelve hours a day, two of the officers sit next to each other on the bridge collaborating on controlling the tension of the anchor systems, coordinating the work on deck to minimize risk, and making sure that the vessel is working properly. Between operations, they are also working and living closely together, and although other aspects, such as age and different personalities, influence the way the crew interact with each other, it is clear that "the bridge" defines both work and social roles and relations.

This is true also for the other positions on board. The able seamen, also working in pairs during operations, have their own work areas—the work deck—and resting area—the dirty mess, which allows for the seamen to rest and wait for orders still in their work outfits.

The work carried out in the engine room is considered a bit more separate than the other tasks on board. As with the other positions, they work in pairs (and depending on the engine, there may be a daytime electrician as well), monitoring the systems on board the ship, tinkering with the engine and spending their working hours mostly without having to coordinate their work much with anyone other than the captain.

As a crew works closely together, a collective practice of both work and social interaction develops. This is true both for those working in similar positions as well as for those working at similar times. During operations, the same ABs and officers will collaborate around the clock, as well as eat and sleep at the same times. As a result, although conducting the same work, crew on different vessels, as well as different shifts and the different positions on board may both work and socialize differently.

3.4 *In between operations*

Anchor operations must be performed during specific *weather windows.* A weather window in this context means predicted weather conditions that are defined as safe enough for the time it takes to carry out the operation. The technical definition of a weather window, in this context, is when the *significant wave height* is predicted to be less than 3.5 meters 1.5 times the predicted operational time (DNV rules for marine operations). A typical operation may last for many days. Therefore, in the North Sea, and especially during the winter months, anchor-handling involves a lot of waiting around and working in-between operations.

If the weather forecasts predict an extended waiting period, the crews will stop working shifts and work on maintenance during the day, perhaps washing down or painting the vessel, fixing tools, checking the electrical systems and so on. As hiring an AHTV is expensive for operators, they may decide to use the vessel in other types of operations, if the waiting period is predicted to last long. These operations, such as cargo runs, are considered to be considerably less difficult and dangerous, and, as a consequence, the atmosphere on board during such operations is more relaxed, and the crew is more sociable and talkative.

The workday is also very much characterized by paperwork and safety management. Most tasks performed on board include some type of risk, either from being performed in an exposed environment (such as outside in high waves, or high up somewhere), from involving heat (such as welding work), or from working with hazardours substances (like paint or gasses) or closed environments.

In these cases, and many others, permissions are required in order to perform the tasks. SJAs are performed, and an officer, together with the one who performs the task, must sign that they have performed the analysis and that they have taken every safety precaution required.

Picture 3: In between anchor operations: cargo-run

3.5 *Advanced operations*

The first step of an operation is to lower the grapple in to the sea. The able seamen have prepared and positioned the grapple at the back of the ramp on the work deck. Grappling means fishing with the grap-

Picture 4: On-deck personnel working on an anchor

pling hook, for a wire located on the seabed, which is connected to the anchor at one end. This process may take some time, and can't be carried out by the bridge alone, so, depending on the time of day, it is common for the rest of the crew to come and observe the grapple being lowered and the grappling to begin. It is a bit of a competition between the vessels to see who is the first to recover the wire/chain and bring it on board, and so the atmosphere on the bridge is slightly excited and easy. As soon as the wire/chain is on board though, it is secured by the so-called "shark jaw" (a device that locks the wire and later chain in position), and it is time for the sailors to go out on the work deck and connect the wire to the vessel's winch, and for the bridge to apply tension to the system.

From the moment that the wire is connected to the vessel and tension is applied to the system, the situation, and thus also the atmosphere, change dramatically. Now, if something goes wrong, simply sailing away is no longer an option (as the vessel is connected to an external system), and the energy that could be released if anything were to happen is potentially catastrophic due to the tension of the system. As a consequence, everyone, and the vessel itself as a collective entity, goes in to a focused state of mind. Silent concentration falls over all aspects of the boat and crew; all interaction is reduced to carrying out the operation, like a purposive bubble of extreme presence.

The majority of the hours during an operation, are spent "driving the chain". In the North Sea, depending on the depth, an anchor may lay a kilometer or so from the rig. And when the chain between the rig and the anchor is either recovered or put down into the sea, the winches that either pull or release propel the vessel—while the propellers or thrusters are used to maintain position or a specific heading. This work goes on for hours and hours, in a monotonous and, at first glance, seemingly routine way.

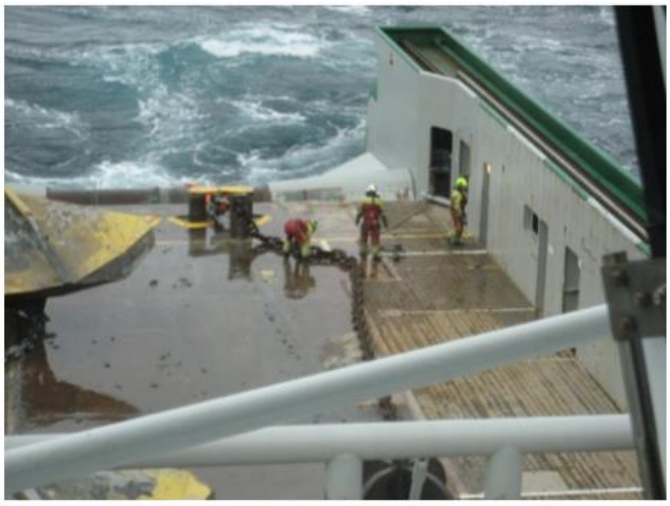
Although this seems like a routine part of the operation, it has proven to be very dangerous work. Every chain link weighs about 20 kg, and handling and controlling a one-kilometer chain is thus highly demanding on both equipment and crew. The incident involving Bourbon Dolphin showed the consequences of losing control of such forces; the currents affected the chain, which in turn dragged the vessel out of position. The crew and the vessel fought the forces that pulled them off course for hours, but a fatal turn of events, after hours of fighting, caused the ship to suddenly capsize. This final and tragic event happened very fast, as the weight of the chain made the pull direction drag from the port side after a maneuver intended to ease tension and increase the maneuverability.

It is literally a matter of life and death for the bridge crew to maintain their focus and control the situation in order to follow the precise line of motion that ensures the tension and pull, keeping the vessel in the right position. When anchors are set, they are tested for tension. The anchors are pulled with a set force, called bollard pull, in order to test if the anchor is able to hold its position in the seabed during a calculated 100 years worth of impact from weather conditions. During the test, the bridge is mostly silent. Everyone is waiting for the moment of truth; will the anchor hold or break? Thumbs up if the test is successful and the anchor is holding within the seabed. If not, the process has to be repeated all over again, and the operation is redone.

The great tension of the anchor systems poses a considerable danger, not just for capsizing the vessel. More often, accidents or so-called near-miss-incidents endanger the sailors working on deck. The wires recovered from the seabed might be twisted, releasing energy stored by the twist when they are pulled up. If a wire snaps, the backlash would seriously hurt anyone being hit. The entire system of activities is potentially dangerous, and at the same time, the work conducted out on deck is both physically demanding and conducted in harsh environments. Therefore, it is of great importance that there are no misunderstandings that the deck is clear when tension is released on the system, that a bolt is not left inside or not fastened when it should not, and so on. The bridge and the deck crew therefore depend

Picture 5: The bridge – winch is handled from the left chair, the vessel from the right

on knowing that the others involved knows every situation as well as they do themselves.



Picture 6: On-deck work during an operation - seen from the bridge

4 DISCUSSION

This paper explores the safety culture at two levels: 1) the culture and work practice among the seamen on board performing the operations (occupational culture), and 2) the organizational culture of the offshore petroleum industry in Norway, i.e. safety management systems/regimes that involve detailed planning and control of operations. These two organizational cultures have different ways of perceiving and performing safety.

4.1 *Two modes of work*

The two safety cultures described above are reminiscent of how Pool (1997) and Weick & Sutcliffe (2007) describe so-called high reliability organizations (HROs), exemplified by a nuclear aircraft carrier from the US Navy and Diablo Canyon nuclear power plant in California. A central issue in Pool's discussion focuses on how certain organizations can be strictly hierarchal, with factors such as rank and routine, and being more dynamic in character on the other. The latter mode is of crucial importance when the organization is facing stress, for example during the launching and recovering of planes on board an aircraft carrier. The gear engaged "when things heat up", is distinguished by a focus on communication and expertise, rather than rank, stability, predictability and thick manuals. The success of high reliability organizations lies in their ability to include, request and balance these two "modes of operation" within their organization. This requires, for example, involvement from everyone in the organization. One should, on board the aircraft carrier, be able to achieve a situation where "the welfare of the ship and crew is [seen as] everyone's responsibility (1997:261). Pool continues by stating that: "Besides communication, high reliability organizations also emphasize active learning, not simply the memorization of procedures. Employees should not only know why the procedures are written as they are, but should be able to challenge them and look for ways to improve them" (1997:266). Being part of this process of active learning, the rotation of crews is portrayed as an advantage for the organization rather than an obstacle. As Pool argues: "The collision of fresh, sometimes naïve approaches with a conservative institutional memory produces a creative tension that keeps safety and reliability from degenerating into a mechanical following the rules" (1997; 261). This argument shows both the existence of two modes of work, and how safe work practices stems from the co-existence of these.

On board an AHTV, the transition between the two modes is very noticeable. First, there are structural changes in how the crews organize and conduct their work. They begin working six hour shifts at their respective work positions, not allowing for any non-work related social interaction except during meals. Second, there are very noticeable changes in the atmosphere on board. The crewmembers' presence changes very much—they are quietly focused on the tasks they conduct. Words exchanged are work-related, information-redundant messages such as "clear deck" or "release tension". The atmosphere mirrors the tension of the anchor system, when the weak link is broken, the crew ease out.

4.2 *Occupational culture*

The social organization of a ship is often characterized as a "total institution" (Goffman, 1961). To enter into a total institution is to leave a multitude behind and instead be surrounded by and eventually be part of a universe, which is "something more than a formal organization, but […] something less than a community" (Goffman 1961:103).

Total institution refers to the fact that a ship is not divided into isolated arenas for interaction, but instead represents a collapse in that respect, in the sense that the seafarers on board spend 24 hours a day in the same place, and the activities they engage in—both related to work and leisure—are carried out simultaneously and with the same people. The seafarers on board are there to make sure the operation goes smoothly and on schedule. In other words, a ship is first and foremost a place for work.

We found that during anchor handling operations, it is much more important to "have control" than to control and audit the job. In order to manage having

control among the seamen, one important assumption is competence, training, work experience and autonomous tasks on board. The findings from the interviews illustrate this, as one of the seamen on deck experienced the importance of autonomous tasks: *"If the foremen are giving orders all time on deck, you may feel unsecure about the work tasks. Then things may go wrong. Luckily, our manager doesn't tell us what to do in detail."* Being a good seaman seems to have much to do with working autonomously, without having someone telling you what to do, and to deal with unforeseen events as they arise.

We found management style to be essential in the effort to empower crewmembers. Based on our findings, the management on board holds the belief that crewmembers learn what to do by performing work tasks. As one of the deck foremen stated: *"When new seamen arrive on board, I think it's very important to let them know what's happening on the vessel. It's important to be hands-on and allow the new seamen to be actively involved in the operations. This is how they learn."* This is another example of how the management on board is involving the crew*: "I'm not a kind of manager that tells the seamen what to do. Here, we plan and do the operations together, and it works well."* We find that the managers on board empower the crew to develop practical skills and being able to perform as a team.

This is in accordance to one of the five principles of HRO; deference to expertise, established by Weick & Sutcliffe (2007), focusing on the respect of the HRO for the expertise held by the operator. Decisions regarding how to perform are made at the front end of the operation, rather at the top. This recognizes and takes care of the knowledge held by front end operators. In anchor handling operations the expertise on how to best perform safely stays with the deck team as a team. The Captain is in charge of what to do according to the scope of work, but he mostly leave to the team how to perform. The effectiveness of knowledge and experience sharing in a team will, however, depend upon the openness and trust established (Jonassen, 2014).

4.3 *Balancing regimes*

Within the oil and gas industry in Norway, major companies have largely standardized the work processes on board in an effort to control and measure operations. Safety management systems (regulations, procedures, work processes) may influence safety on board in a positive way, such as carrying out necessary operations planning.

In the case from 2013, we found that a new position had been included on board the AHTV. The mooring equipment, such as anchors, links and buoys, is often hired from a mooring company for pre-lay operations. The company will then supply and control the complete logistical chain, including control work on board. Controllers are positioned on board to control, in detail, all the mooring equipment and register all the numbers on individual pieces. They socialize with the crew, as they spend time together in the dirty mess while waiting in between operations. In addition to other possible gains, this position may be seen as serving the needs of both the organization (by auditing the work, registering and reporting) and the situation (as the controller is not disturbing the performance or presence of the sea farers). Although the formal reason for this position is to serve the control function, their presence is socially accepted by the added on board value they provide and their position among and with the ABs in the dirty mess. Ideally then, this type of resource both adds to the structure and standardization (needs of the organization) and contributes to on board flexibility.

From the example above, the addition of the controller function seems to contribute to a stronger focus on controlling safety on board. Making sure work processes comply with strict safety requirements and routines, leads to more administrative work on board, compared to earlier. According to Knudsen (2009) and Antonsen (2009), the seamen seem to have an aversion against the introduction of new rules and requirements by written procedures. They don't consider this very useful for operations. The seamen perceive it as traditional ideals of seamanship being under attack by attempts to regulate work by formal regulations and more paperwork.

There appears to be a great deal of inconsistency between the informal ideals for work performance and the formal ideals conveyed by safety procedures (Antonsen, 2009). Formal work requirements seek to standardize work processes. Standards can be seen as formalized rules that serve to prescribe and document efficiency and control within and across organizations. According to Mintzberg (1988), there are four different forms of standardization: standardization of work processes (specification of how worked is to be performed), outputs (what is to be done), skills (education and certification of competence) and norms (share a common set of beliefs).

Another effect of standardization is simplification, which is a two-edged sword. On the one side it helps people to better understand and remember. On the other it covers the fact that a complex structure or organization actually is complex. Imposing an image of simplicity may lead to dangerous situations. The reluctance to simplify is another of Weick & Sutcliffe's principles of HROs. Standardization reflects the experiences of past and may represent a

hindrance to solve or prevent future problems. As Hollnagel argues: “Safety cannot genuinely be improved only by looking to the past and taking precautions against accidents that have happened. Safety must also look to the future. It must be proactive” (Hollnagel, 2008).

Standardization may be contrasted with improvisation. Improvisation refers to what is not planned for and involves a low degree of predefined structures. The weakness of standardization may be less room for improvisation (Antonsen, Skarholt and Ringstad, 2012). According to Antonsen et al. (2012), improvisation skills are necessary when unforeseen situations occur on board. In such situations, the management and crew have to quickly find solutions that have not been planned for and for which no procedures exist. The ability to improvise is very much dependent on the empowerment and autonomy among the crewmembers, in addition to knowledge of each other's experience and competence. This kind of expertise develops in a strong community where seafarers share norms and identities. Leadership practices influence the crew's ability to act in such situations.

5 CONCLUSIONS

The aim of this article was to discuss how a rule-based safety management culture and an occupational culture influence safety on board. On board anchor handling vessels, cultural traits of both industrial management and experience-based seamanship is present. Between operations, officers function as middle managers, filling the organization’s needs for control, predictability and audit requirements. During operations, danger and complexity demand complete focus on and presence in that specific situation. The different demands are thus balanced by actualizing two different safety regimes and work practices.

We found that the seafarer's skills, experience and close collaboration are strengths in terms of safety on board. Safety is, to a great extent, a matter of maintaining control over work carried out within an organization. In this paper, we have discussed how control is gained through good seamanship characterized by a culture of empowerment, responsibility, experience, and, not least, a strong focus on safe conduct during the operations.

We conclude that rule-based safety and the work practice among the crew on board are mutually dependent. Safety management systems (regulations, procedures, work processes) influence safety on board in a positive way, for example by requiring necessary operations planning. However, the need for control in the offshore oil and gas industry seems to increase, as seen for example through the new control position and function on board. In the future, the challenge thus becomes maintaining what is considered to be good seamanship; professional knowledge, professional pride, and experience-based common sense.

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