Power imbalance between supply vessels and offshore installations may impede the communication of safety issues

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ABSTRACT

The power relationships between collaborators may affect communication in safety–critical industries, thus leading to inaccurate or unreliable representations of risks. We interviewed the bridge crew of nine offshore supply vessels (22 informants) about issues concerning their communication with offshore hydrocarbon production installations on the Norwegian continental shelf. We asked about the relationship between the vessel and other units, the aims for the communication, how it took place, and what the kind of communication problems that tend to arise. Template analysis showed that the sample believed there was a power relationship where the vessel is subordinate to the offshore installation. This relationship had consequences for trust between the two parties, for the exertion of pressure, for whether justifications were given for instructions, the sincerity of the communication, and for who had the power of decision in case of disagreement. The relationship also seemed to cause various communication challenges, such as the installation not responding to radio calls, the vessel not receiving sufficient information from the installation, or the installation having insufficient experience and knowledge about maritime work. In order to maintain safety in maritime operations, each party uses the communicated information to build a mental model of the opposite party and their shared situation. If power imbalances impede accurate communication as indicated in the current study, this may lead to inaccurate mental models, which increases the risk of unwanted incidents, and makes them more difficult to handle.

1. Introduction

The hydrocarbon-maritime industry often operates under difficult and potentially dangerous conditions, where efficient and accurate communication is crucial to avoid accidents and harm to personnel, the environment or equipment. The work takes place between distributed teams with infrequent contact, in stressful environments with noise and many distractions, which presents challenges for the communication. It is conceivable that power relationships between collaborating parties influence the communication in this setting in a way that impacts safety. Although power and social context has been shown to impact interaction (Cohen, 1958; Tjosvold, 1985), to our knowledge, the effect of power relationships on communication has not previously been studied for distributed teams in the maritime industry.

The hydrocarbon-producing offshore installations are serviced by offshore supply vessels that run supply missions over multiple days, transporting container and bulk cargos of supplies and equipment between port facilities and multiple offshore installations in the North Sea. Other vessels serve as additional storage for the installation, as stand-by for emergency purposes or to assist in relocating installations. The operations are assigned by the traffic control centre, and traffic control may make changes to the route while a mission is under way. The vessel must alert the installation an hour before arrival, and again to obtain safety approval to enter a 500 m safety zone. The installation's crane offloads the container cargo and loads the return cargo, while liquid cargo is pumped to or from the vessel using the installation's hoses. The crane operator coordinates the loading/offloading operation with the bridge and deck personnel by radio communication. The vessel informs the installation when it is ready to leave the 500 m safety zone.

Communication in a collaborative setting takes place in a power context, since power is part of and affects most forms of social interaction (Grimes, 1978). For example, a high-power actor's communication may be 'top-down', in a way that to little extent provides justifications for why the instruction was given, or encourages further discussion of the issue. On the other hand, a low-power actor may communicate in a way intended to show compliance, subservience and competence, and to downplay any critique or ambiguity. If power relationships lead to inaccurate communication, this could have

consequences for safety. Although the different parties in the hydrocarbon-maritime setting are not part of the same formal organisational hierarchy, power relationships can be expected to follow the allocation of resources such as financial control, privileged information and power of decision. The most obvious issue could be that the hydrocarbon-producing installation wields power over an offshore supply vessel by representing the company that chooses whether to continue chartering the vessel (thus controlling financial resources). At other times, the vessel may have the authority to cancel an operation based on an evaluation of the weather conditions, thus controlling the installation's work schedule.

1.1. Issues relating to communication

1.1.1. Communication theory

Shannon and Weaver (1949) described communication as a process consisting of five components: an information source, a sender, a channel, a recipient and a destination. The sender must code the message so that it is converted into appropriate signals suitable for sending through the relevant channel. The message may take different forms, for example as written words, sound transmitted through radio or by telephone, or face-to-face interaction. Shannon and Weaver's model (1949) was later expanded by Berlo (1960) to more clearly distinguish between sender, message, channel and receiver. Barnlund (1970) recognised that communication is a transactional and reciprocal process in which an individual can both send and receive messages simultaneously. This model emphasises that the message must be decoded to perceive its meaning, and to do so may rely on information not included in the message. Misunderstandings in the communication process can prevent the sender's message from reaching the recipient due to the sender failing to encode the message in a way that makes the meaning clear, due to signals not reaching the recipient, or due to the recipient failing to decode the message in the intended way. An example of such a misunderstanding in communication between the vessel and installation could be interference on the radio channel, or misalignment in the use of technical terms. Of particular interest for the current research question, Schramm (1954) emphasised the social interaction inherent in communication, and how a message could have both intended and unintended effects on the receiver.

In settings where operators make decisions about safety-critical issues based on information that is held by their collaborators, the quality of the communication is a determinant for safety. In a review of factors that could threaten the safe operation of complex, dynamic systems, Salas et al. (1995) stated that 'communication' was the only factor that all the reviewed researchers agreed was crucial. Other studies (e.g. Bearman et al., 2010) have argued that breakdown in communication often precedes accidents and negative safety outcomes.

1.1.2. Media richness theory

The *media richness theory* (Daft and Lengel, 1986) states that the channel through which the communication takes place restricts the receiver's interpretation of the message. Media richness is determined by the media's capacity for multiple simultaneous information cues, for facilitating feedback and for establishing a personal focus (Lengel and Daft, 1989). Communication media can be arranged along a continuum from 'rich' to 'lean' (Rhoads, 2010), where face-to-face communication is a rich medium, since it can convey information both verbally and nonverbally, can provide immediate feedback and result in a personal understanding of the information conveyed (Lengel and Daft, 1989; van der Kleij et al., 2009). Phone calls or radio communication allow for instant feedback, but cannot capture non-verbal signs, such as eye contact and body language (Lengel and Daft, 1989; van der Kleij et al., 2009). Written documents and emails are even leaner, as they have limited capacity for personalisation, immediate feedback and variation of expression. The theory states that richer forms of media are more suitable in complex situations where the task is ambiguous and the

personnel are relatively experienced (Lengel and Daft, 1989). Thus, rich media appear to be preferable for communicating safety-critical information, and in particular for communication during emergencies. Leaner forms of communication may be sufficient and efficient when the sender and recipient have shared expectations based on previous experience.

1.1.3. Media synchronicity theory

In a critique of the media richness theory, van der Kleij (2007) argued that the theory does not encompass the flexibility modern communication technology allows for, and that real-life communication can be adapted to the situation at hand, rather than having an optimal mode of communication. The *media synchronicity theory* (Dennis and Valacich, 1999) takes into account that one can follow several conversations simultaneously, that communication partners can be assigned equal weight and that agents may adapt their use of a medium. Rather than rating mediums from lean to rich, the theory emphasises the way the medium is used, given the situation and social context, and notes that combining or alternating between media can reduce the communication's efficiency (van der Kleij, 2007).

1.1.4. The relationship between trust and communication

Communication is a form of social exchange, and engaging in communication can entail some costs, while rewards are uncertain. Blau (1964) argued that *trust* is one of the factors underlying effective social exchange, and is thus essential for effective communication. Interpersonal trust can be defined as an actor's positive expectations of another actor's conduct (Lewicki et al., 1998), or as 'an expectation about a future behaviour of another person and an accompanying feeling of calmness, confidence, and security' (Kassebaum, 2004, p 21.). Deutsch (1958) argued that having something invested in a relationship is a prerequisite for building trust. Grimes (1978) saw trust as a result of the actors' previous experience of the relationship, and argued that how power issues are resolved could result in a trust relationship of confidence, neutrality or alienation.

Greenberg et al. (2007) distinguished between cognitive trust and affective trust. A *cognitive trust* judgement is based on a rational and calculated assessment of the collaborator's integrity and abilities. In the current setting, cognitive trust may result from the vessel's crew having repeated experience of collaborating with a given installation (and vice versa), and evaluating the extent to which the partner has been reliable in the past. An *affective trust* judgement is based on the emotional and social ties that develop in reciprocal relationships. It consists of an evaluation of the opposite actor's kindness and hospitality. In the current setting, affective trust may result from the non-task-related communication and interaction between the installation and vessel crew, such as exchanging greetings and friendly banter, and making allowances and accommodations for the collaborator.

Trust has been seen as necessary for effective collaboration (Blau, 1964; Greenberg et al., 2007; Staples and Webster, 2008). This implies that collaborators and collaborating parties in safety-critical settings need some level of mutual trust to perform shared tasks while maintaining safety. Previous research has shown that trust plays an important role in the team members' motivation to share knowledge (Butler, 1999), which is important for the team to work safely and effectively. In meta-analyses of a number of independent studies, Mesmer-Magnus and DeChurch (2009) and Mesmer-Magnus et al. (2011) found that information sharing is important for team performance, cohesion, decision satisfaction, and knowledge integration, and that information sharing was positively correlated with the team's discussion structure, cooperation, and face-to-face interaction.

1.2. Issues relating to social power

1.2.1. Power and power imbalance

Social *power* can be understood as the ability of one individual or