KNOWING THROUGH INTEGRATED OPERATIONS IN CROSS-DISCIPLINARY VIRTUAL TEAMS – COLLABORATION AND SELF-SYNCHRONIZATION OFFSHORE AND ONSHORE.

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Abstract

We investigate the effect of self-synchronization, trust and knowledge sharing have on collaboration in virtual teams. The essence of the results we report as self-synchronization; a mode of operation where those that participate in collaborative work share a sufficient understanding and awareness in situations, and where resources are coordinated between participants to adjust to situations as they arise. This collaboration is dependent upon shared common goals, knowing your colleagues competence and thereby be able to share knowledge in cross-disciplinary collaboration and finally a shared language facilitated by technological visualization artifacts. The consequence is that through a shared language the ability to create collaborating relationships and share knowledge based on trust increases.

Key words: Knowing, knowledge sharing, trust, self-synchronization, virtual teams

Introduction

Globally distributed collaborations and virtual teams have become increasingly more common, as a result of globalization of many industries (Kotlarsky and Oshri, 2005). These teams are geographically and organizationally brought together, relying quite heavily on telecommunication technology (Powell, Piccoli and Ives, 2004). So far the main focus of the IS literature on globally distributed teams has been on technical aspects related to system development projects. Thus, necessary focus on humans and social aspects in global collaborative work is still limited. However, the importance of communication, motivation, trust and social ties has been covered (Ardichvili et al., 2003), recognizing that trust is the foundation but also most difficult to create in knowledge sharing. However, enabling knowledge sharing is essential to innovation and organizational success (Nonaka and Takeuchi, 1995; von Krogh et al., 2000) to ensure necessary collaboration and coordination in virtual teams. Consequently, we experience an emerging knowledge-centered discourse (Nicolini, Gherardi and Yanow, 2003), also when it comes to virtual teams and how developing a shared understanding and shared goals (Beyerlein et. al, 2008; Majchrzak et. al, 2000) contribute to positive outcomes and commitment.

A knowledge-based view demands for continuous exploration of new knowledge and exploitation of existing knowledge (March, 1991), whereas virtual teams benefit from bridging individuals with needed knowledge, skills, and abilities, regardless of location (Blackburn et. al, 2003). Critical to the success of virtual teams is therefore knowledge sharing among physically dispersed members. Understanding knowledge sharing, however, means to unfold a tendency to threat knowledge as an individual property, learned through individual acquisition of knowledge (Sfard, 1998; Elkjaer, 2004), Several researcher recognize that knowledge must be conceived as social and cultural phenomena (Brown and Duguid 1991; Lave and Wenger 1991; Blackler 2004; Tsoukas 2005; Gherardi and Nicolini, 2000), as a question of knowing how to perform and apply knowledge in social practices (Filstad and McManus, forthcoming). Knowledge as a question of knowing enables and enriches our understanding of the concept), where knowing and learning is to be considered as two sides of the same coin (Chiva and Alegre, 2005; Filstad and Blåka, 2007). Thus, being knowledgeable is about being able to frame situations and identify solutions and act accordingly (Eraut, 2000), as knowing through belonging, participating and communication (Catania, 1998). Knowing is dynamic, mediated, provisional, pragmatic and continually reproduced and negotiated in social participation (Nicolini, Gherardi and Yanow, 2003 and Blackler, 2004). Engeström (2007) calls into question our preoccupation with types of knowledge (tacit or explicit) in favour of a closer attention to its use. Drucker (1993) and Tsoukas (2005) regard knowledge as potential that is utilized in processes of knowing, such as learning, thinking or applying knowledge; the process of knowing to transform the knowledge potential in actual performance. This understanding of knowledge as knowing enables us to investigate knowledge sharing more fruitfully, in collaboration, situated in professional work. Knowledge applied as knowing, has a special meaning in solving practical work as knowing emphasizes the context-specific, the unique and different requirements in virtual teams.

In this paper, we address knowledge as a question of knowing through social practices of integrated operations in cross-disciplinary virtual teams onshore and offshore. This means that we take a process perspective, a practice-based approach, talking about knowledge in use as knowing. In doing so, we investigate how self-synchronization,

trust and knowledge sharing affect collaboration in virtual teams where the main challenge is knowledge sharing across boundaries.

Knowledge sharing as knowing across boundaries

Challenges of working in virtual teams involves issues of trust, coordination, collaboration, communication, participation and lack of mutual knowledge and/or understanding of each others positions and contributions (Soule and Edmondson, 2002); To ensure and create trust, knowledge sharing is important, but also the other way around, to share knowledge is based upon trust. However, knowledge is embedded in social practices, and therefore knowing does not exist apart from the participants in social practices. On the contrary, their knowledge (including tacit knowledge) is embedded in the stories their tell, in conversations and networking activities (Araujo, 1998; Brown and Duguid, 1991), and through behavior and activities. To share knowledge means allowing participants to talk about their experiences and to exchange their knowledge in problem-solving activities (Ardichvili et al., 2003). That means being able to observe each other, practice together, reflect upon experience and other forms of collaboration through practice at work. In integrated operations, as a virtual community of social practices, its members must be comfortable with participating in a computer-mediated, Internet-based world with little face-to-face communication (Ardichvili et al., 2003). Coming to know who knows what is far more challenging in globally distributed teams, where Faraj and Sproull (2000) suggest that instead of sharing specific knowledge the focus should be upon knowing where expertise is located and needed. Kotlarsky and Oshri (2005) conclude in their studies of globally distributed teams that social ties and knowledge sharing were keys to successful collaboration. Collaboration is here understood as a complex, multi-dimensional process of communication, meaning, relationships, trust and structures where successful collaboration is either product success or desired performance, achieved through group performance.

Trust in virtual teams

In virtual teams, trust is a challenge due to reduced face-to face interaction, and perceived commitment to team goals can also be reduced since implementation of goals and creating a mutual understanding of these goals is more difficult when members are distributed (Hertel et al., 2004; Malhotra et al., 2007). Trust has been defined as *"the willingness of a party to be vulnerable"* (Abrams et al., 2003, p.65) accepting this vulnerability due to positive expectations of intentions and behaviour of others (Lines, Stensaker and Langley, 2006). Sharing knowledge and sensitive information inherently involves risks and therefore trust is essential to knowledge sharing as it generates solidarity by fostering an atmosphere conductive cooperation and sharing. Expressing an emotional state that makes you vulnerable represents a risk to your position and therefore a culture of trust is important for knowledge sharing (Park et al., 2004). Mayer et al. (1995) believe that trusting in colleague will be determined by the trustor´s belief in his colleague having adequate knowledge and ability, benevolence and acting in the best interest of his colleagues and integrity in accordance to a set of compatible values.

The quality and characteristics of relationship between parties in social practices at work are often built on trust. Trust is more often present in informal social practices than formal. We choose who we want to build informal relationships with and therefore

often identify with and trust these colleagues (Filstad and Blåka, 2007). In an informal social practice the willingness to share knowledge and the willingness to use the practice as a source of knowledge apply to its characteristics. The participants will believe that the other party has the ability to handle knowledge that is shared and also believe in their willingness to share knowledge. As one of the respondent from our studies explains:

> It depend very much upon the person how difficult it is to get in contact. That again, I recognize that those I know well offshore, those I have travelled out and talked to earlier, that I know have a private boat, a cottage in the mountains, I know the name of their dog, things like that. Then it is much easier to contact them, and I also do that more often then.

There are two dimensions of trust that promote knowledge creation and sharing: benevolence and competence. Benevolence-based trust allows one to query a colleague in depth without fear of damaging self-esteem or one's own reputation. In contrast, competence-based trust, allows the individual to feel confident that a person knows what he or she is talking about and is worth listening to and learning from. Abrams et.al. (2003) have investigated different factors that foster trust in organizations. The most important factor is the establishment of personal connections. They believe that when individuals share information about their personal lives, especially when they compare similarities, the result is a stronger bond and trust is developed. They also find that in relationships outside the organization individuals are more human and themselves, and therefore are considered trustworthy. As a consequence, they see that frequent, close interactions typically lead to positive feelings of caring about each other and an understanding of each other's knowledge and expertise. One way for managers to approach the meaning of trust is to establish shared goals and visions in which individuals identify because individuals who share goals and visions find it easier to form close bonds and to understand each other. Another managerial aspect is that decisions should be fair and transparent and this will lead to more fair and transparent decisions in a trusting environment (Abrams et. al., 2003). It is, however, important to note that even though values and norms can engender trustworthy behaviour that again leads to confidence, it is some confusion in the literature about precisely what it is about values and norms that creates trust. Adler (2004) explains: "*We might reasonable distinguish a spectrum running from weaker forms of trust based on the predictability imparted to other actors´ behaviour by their adherence to any stable norm, to stronger forms of trust based on the predicted benevolence of actors with whom we share norms that privilege trustworthiness (p.311)"*. Adler (2004) outlines direct interpersonal connect, reputation and institutional context as most important mechanisms by which trust is generated.

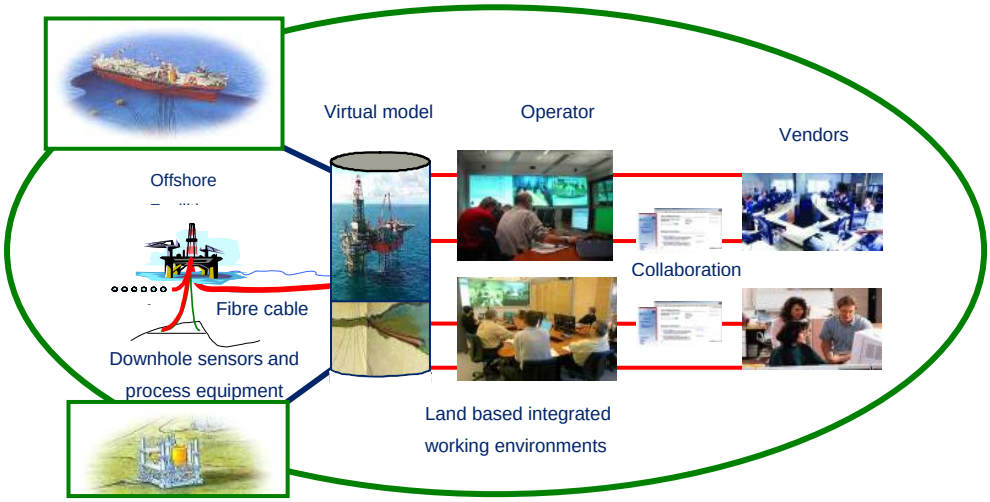
Methods– Integrated operations in cross-disciplinary virtual teams

Data was conducted in the largest oil-company in Norway through in-depth interviews with employees working in cross-disciplinary virtual teams (as integrated operations) offshore and onshore. One offshore platform, Kristin was followed since 2003, through participatory observation of work, formal and informal meetings and in the asset first during the project phase (2003-2004, total 4 weeks)) and later in operations (2006, 2 months). This was observation of both co-located and virtual collaboration in the asset. This work provided an important screening for what would later become key themes in the later research phase, like empowerment, shared situation awareness and self-synchronization. Most empirical data for the Kristin case is comprised of observations and interviews undertaken in 2007 and 2008. It has been undertaken by SINTEF (Næsje

et al., 2009; Skarholt, et al., 2009). They have interviewed managers both onshore and offshore within most of the disciplines. The collected material comprises semi-structured interviews with a total of 69 informants, as well as extensive participating of observations both onshore and offshore. In this phase, we helped SINFEF make sense of and structure the data gathered. Analyses of interviews were conducted based on the principles of grounded methodology (Strauss and Corbin, 1998) with qualitative coding techniques. During research we had monthly ongoing discussion of the findings with key representatives from the asset. Here misunderstandings were sorted out, and findings that needed interpretation were discussed. This way of validating the data also contributed to co-learning and reflection on work practices between researchers and practitioners in Kristin. The second set of data included in our studies is in-depth interviews with onshore personnel representing Operations West (Oseberg, Brage and Troll) and Operations North (Åsgard and Heidrun) from 2008. All interviews with a total of 15 informants were recorded and transcribed and the data material from this second study was analyzed using open coding technique and the data analysis tool for qualitative research: Nvivo8.

What is Integrated Operations?

When most major oil companies and globally operating service companies address their future way of doing business as oil exploration and operation enabled by information and communication technology there is a certain logic behind this vision: integration of people across geographical, organizational and disciplinary boundaries, integration of processes in terms of business integration and vendor collaboration and finally; integration in relation to technology: data, sensors, protocols, fibre optics, standardization and others (OLF 2005a, OLF 2005b). This vision of integration is seen in a typical definition of an e-field; an instrumented and automated oil and gas field that utilizes people and technology to remotely monitor, model and control processes in a safe and environmentally friendly way in order to maximize the life value of the field. Even though the scope varies among actors in the industry most of the initiatives evolve around planning and implementation of new work processes/practices enabled by the latest real-time information and communication technologies (OLF 2005a). Real time data and information are made available from a remote location, typically the down-hole reservoir/well of an oil and gas asset's or from a process facility through a high-capacity fibre-optic infrastructure (Hepsø, 2006). Various professionals with multidisciplinary backgrounds onshore-offshore, inside or outside the oil companies/vendors of geographically distributed organizations analyze the data in increasingly virtual collaborative environments and take decisions to support and optimize the production of oil and gas, see Figure 1. This is what is described as *integrated operations* in this paper.



Since the turn of the century Norwegian oil companies and vendors have been developing and implementing integrated operations practices and technologies both in Norway and in a global setting. International oil companies like BP, Conoco/Philips and Shell use Norway to test out integrated operation concepts before they are rolled out globally. As such the NCS has been testing site for future operational concepts, virtual collaboration and provided the setting for substantial knowledge development and learning in this period. The Norwegian Oil industry association (OLF), the Norwegian Petroleum Directorate (NPD 2006) and PeTil (Petroleum Safety Authority Norway) see integrated operations as an opportunity for the Norwegian society (NOU 2005; OLF 2005a; OLF 2006a; OLF 2006b; OLF 2006c); a potential to brand new integrated technologies and work processes in a sophisticated Norwegian style based on the tradition we have related to democratic industry collaboration, that American investors have tagged "enlightened socialism"[i].

The emerging situation in the oil and gas business in Norway has been described by both the employer organizations (OLF 2005a; OLF 2006a; OLF 2006b; OLF 2006c) and government (NPD 2006, NOU 2005) to have interesting consequences for both learning and knowledge development. Oil companies and service organizations are very competent organizations where the personnel have peak specialist competence not necessarily possessed by managers in the same companies. In most settings egalitarity and informal employee-employer relations are increasingly seen as a key property in the innovative and knowledge creative organizations of the future in this industry in Norway. There is an increasing development of small and lean assets that are expected to enable operations irrespective of time and place. Increasingly planning and execution of operational tasks are handled as parallel and concurrent tasks enabled through close-continuous communication and shared situation awareness among people where some are located onshore and others offshore. At the same time we see an increasingly demanding work-force that want work challenges and improved learning opportunities. A more "hands-on" offshore/onshore management is expected to spend time and attention in developing the work-force. These are important challenges in knowledge sharing across boundaries where integrated operations are designed to meet these challenges through collaborations onshore and offshore. However, integrated operations can only become successful depended upon how employees use the framework, understand the logic behind the vision and allow for an integration of technology and people. In that sense, Kristin started up operations in 2005 and is in principle designed for IO. It has an offshore organization of 31 people, very close to the emergency level organization requirements set by the authorities. The onshore operations management, onshore technical support, and production support, (total of 18 man-years). Operations

are organized as one partly virtual team, sharing collaboration facilities. The offshore and the onshore management team are co-located in a virtual onshore-offshore collaboration room. All operators and contractors are co-located in an office landscape offshore. An asset like Kristin is streamlined for four important activities: maintain and improve HSE-level, maximize process uptime/availability, control operational costs and know and maintain technical condition. Other virtual teams and social practices vary when it comes to their experiences with integrated operations and how they work in accordance with its vision. In the discussions we therefore compare the results related to our research questions on how self synchronization, trust and knowledge sharing affect collaborative virtual teams offshore and onshore.

Results and Discussions

Production optimizing as collaborative work rely on integration of employees, technology and organization, where preconditions for synchronized distributed teams present rely heavily on knowledge sharing and knowledge development, shared situational awareness and trust, both in the competence of employees offshore and onshore, but also trust in the technology and its uses. To investigate creation of necessary knowing through collaborative work in virtual teams, we concentrate our discussion around what we consider to be the two must important findings in our studies. First, how moving from data and information as knowledge sources to recognizing that data, information and knowledge only indicate chunk of reality, context-free, and therefore without meaning (Baets, 2006). Second, by recognizing that data, information and knowledge find its relevance and meaning in social participation among colleagues as situated (Filstad and Blåka, 2007), how knowledge is a question of knowing through work and how self-synchronization in collaborative work emerges as most important key to success in virtual teams (Hepsø, 2009).

Changed focus from data and information to knowledge as *knowing through collaboration* in virtual teams

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There are at least three technological drivers that stand out as the main forces for integrated operations. First, is the continuous development and increase of transfer networks, the movement from low bandwidth satellite onshore-offshore communication to fibre-optic networks that transfer Giga and Terra bits of real-time data (video, audio, data control and steering, monitoring data and 3D pictures/models) to move over long distances. In conjunction with this trend the evolution of the Internet has provided new opportunities for information sharing and collaboration for teams across technical, organizational and geographical borders. Individuals in different locations, working for different companies can access and/or manipulate the same data at the same time, See Figure 1. The second driver for integrated operations is standardization of telecommunication software/hardware platforms and data exchange formats as that based on XML-schemes (WITSML, PRODML, OPC UA) that has eased the integration of data (OLF 2005b). The final contributor is the ongoing convergence between computing and telecommunications, and the development of collaboration tools/software, like video-conferencing, Net-meeting, Smart boards, instant messaging, and 3D visualization that has made communication across distance easier. These three drivers form the backbone infrastructure for integrated operations.

However, these drivers are the important enablers for integrated operations, nothing more. An important feature is actually to be aware of the difference between data, information, knowledge and knowing. Data are signs that are indicating a chunk of

reality. They represent observations, measurements or facts that are context-free, and therefore data alone is therefore without direct meaning. For data to become useful as information it must be placed and understood in a meaningful context. Virtual collaboration requires shared access to data and information but a main issue is the sensitivity the organization has concerning the treatment of knowledge. That is, necessary focus on the interpretation and mutual understanding of information in relation to practical situations where people work together. Because knowledge is only knowledge if it represents action and creation. Otherwise we can only speak of information (Baets, 2006).

Knowledge is anchored in the commitment and beliefs of its holder arisen through participation in social practices at work. A shift from knowledge as a substance to knowing as a process, knowledge not only emergent from practices, but itself a practice that is a situated activity creating linkages to action (Gherardi, 2006). Practicing becomes a knowledgeable activity, as knowing-in-practice (Soule and Emondson, 2002). Knowing, as being able to frame the situation, therefore includes the exercise of judgment, the capacity to make interpretations, critical assessment of data/information and ability to transfer information to knowledge and knowing. Thus, it is a continuous exercise of professional judgment in the effort to solve ongoing problems. Knowing is a continuous emergent process where meaning is achieved through its continual relation to context referred to as situation awareness. Shared situation awareness in this virtual setting is the ongoing interpretation of representations, ie. of human activity and artifacts, enabled through, ie. common availability to incoming data and information (loudspeakers and widescreens), or through people providing information about their action by talking to themselves or others. Bringing together various representations enabled by integrated operations is more than search and retrieval of documents, making data commonly available or give access to a shared model. It also involves activities like validation, double-checking, comparing and contrasting the different representations in order to make them useful (Rolland et al., 2006). Knowing is based on representations but not reducible to knowledge representations conveyed as data or information through the communication channels that integrated operations provide. Various team members can have different information resources that must be combined and coordinated to develop a shared understanding. The meaning of information embodied in these artifacts is not always clear and must be interpreted and negotiated between team members. A shared situation awareness that develops in a virtual collaboration of this kind is a practical accomplishment which arises in and through social action and activity (Hepsø, 2009). It is always achieved (or lost) through collaboration. Cooperative work and virtual collaboration is with no exception, based on the existence of mutually shared and interdependent goals between team members, as stated by the following explanations from Kristin:

> The collaboration room enables access to important information, where we get to know about each other tasks and an overall impression of the work onshore and offshore. Thus, we perform the work as a management team, and not only as individuals.
>
> One important aspect with integrated operations at Kristin is the informal communication that happens 16 hours every day. In the operation room I receive a lot of useful information from the other managers who are sharing this room with me.
>
> ..A main advantage is to be able to read facial expressions and body language. This is highly important. We focus heavily on quality in sound and picture. It is the most important, much more than other technologies.

While others experience more on differences and difficulties in collaboration between offshore and onshore:

> We find that the working processes we have now, the information flow works well. Dialogs can always improve, that is, between offshore and onshore. But again, that is also depending on different personalities. You know, the culture that exists on the platform is good for us. It is open and forthcoming. While on other installations they are more closed and distant towards us onshore".

> Yes, I believe it is a mutual understanding of the importance of interaction. And it is an understanding towards good results from using video conferences. We get the same working platforms or pictures that we show and discuss. And we have the screen pictures so that both of us – both onshore and offshore recognizes the work processes. They are developed to share and be used as bases for discussions.

> Yes, it is a certain distance between offshore and onshore. The collaboration will somehow not be easier. I hope that our communication will improve, and that we all have a mutual understanding of what we are talking about, what we want to achieve and from here. That we don´t want to control them. That is probably the risk. We are talking about cameras in the control rooms, and it can lead to a feeling of being supervised. Very important that they do understand what we want to achieve with integrated operations. That we are not suppose to take over their tasks, but on the contrary make things easier for us and for them.

Those working onshore have an interpretation of integrated operations as team work, communication cross time and space, access to real time data, and technical supporting interaction between offshore and onshore installations. However, their interpretation of offshore personnel and integrated operations is that there are controlled and monitored. Without building necessary trust in goals and visions related to integrated operations and also trust in how to use the technology, clearly there is a challenge in bridging offshore and onshore when it comes to necessary knowledge sharing through collaborative work. One of the onshore personnel explains:

> What I get an impression of is that people offshore generally sees this as something we do onshore…they think that we are now going to govern all operations onshore.

Concerning Kristin, we find that the elements supporting shared situation awareness are the features intrinsic to the one directed onshore-offshore team that the asset has succeeded in developing. Such awareness is supported through the use of shared work areas, via establishment of shared goals, by having technicians and operators involved in the engineering, procurement, and construction phases of the installation and a close collaboration between the technicians and the onshore technical support. Næsje et.al (2009) argues that it is through this the crew establishes a higher degree of knowledge about the artifacts, particularities, and history of the installation, and a higher degree of knowledge of the priorities of the installation. The challenge of which Kristin has superseded this is to go from a traditional division of labor with information sharing to self-synchronization with shared situational awareness, while the other teams are not there yet. It can be size, different culture, mistrust instead of knowledge sharing and lack of mutual understanding of goals and visions and working towards the same goals. This will be discussed further when recognizing self-synchronization as the driver for knowledge sharing.

Self-synchronization as the driver for knowledge sharing.

Self synchronization can be defined as a mode of operation where those that participate in collaborative work share a sufficient understanding and awareness in situations, and where resources are coordinated between participants to adjust to situations as they arise (Alberts & Hayes 2003). It is based on the ability to empower those in front with shared situational awareness to operate as autonomously as possible and give them the ability to plan and execute their tasks. There are some important preconditions for self-synchronization. First, as already mentioned, a sufficient understanding of goals and directions must be enabled by coordination processes, by developing a high degree of available quality information. Shared situation awareness can become institutionalized and situated in work processes, values and collaborative culture. Further, that those that do the work have the necessary skills and competence on all levels, and finally that there is high level of confidence/trust to managers, colleagues and equipment needed to share information and data.

Let us take an example from Kristin first (Næsje et al., 2009, Skarholt, et al., 2009). After a planning/preparation session in the offshore landscape, personnel typically go to the workshops, stores, and the process plant. Maintenance work orders partly set up by onshore Kristin personnel are retrieved from the SAP IT system, and for each role or discipline there is a set of programmed/scheduled activities and a set of corrective activities. These are all part of the planned activities for the week and these activities are truly coordinated and managed by the integrated management team. There is one planning meeting for the O&M-crew, held every Saturday, with a plan responsible person within each discipline. Now, giving leeway to other tasks, the operators can actually choose which work orders to complete/start: “There are many examples of how this promotes higher self-synchronization. When discussing the day’s work with one technician, he described how his planned task—the scheduled refurbishment of a large valve—was moved to after lunch. This was agreed at the planning/preparation session in the morning. Then he went back to SAP to find something less complex to fill his day until lunch. He pointed out that he always had a set of work orders at hand, in order to be ‘‘doing something useful’’ precisely for such situations. Accordingly, this work practice makes the organization more robust in order to withstand changes and arising situations. The operators have—given the premises of what goes on in the larger O&M-crew and what is prioritized from management—a certain amount of sway over which work orders to pick up. These decisions are made on the lowest level possible. Personnel have full responsibility for the task, including its planning, execution, and reporting. This means that material must be found or ordered before execution and work is reported in one integrated loop. Correspondingly, SAP-proficiency in the asset is very high. Says one informant: ‘‘Those who want a list of tasks you have to do today put in their hand, will not apply for work on Kristin”.

The experience from Kristin is that shared understanding between and within virtual teams and especially between offshore and onshore is crucial to the success of integrated operations. Through shared and mutual understanding of goals and visions, resources are better coordinated through collaboration. Knowing how to solve problems when they occur and trusting in each others knowing in order to improve integrated operations, also require necessary empowerment and autonomy among employees in these knowledge networks that is characterized as being cross-disciplinary.

In our other study, the situation is not directly comparable with Kristin, and we find potential when it comes to using self-synchronization as the driver for integrated operations:

> One of the most important factors is that the continuity actually lies onshore and not offshore. They are working offshore for two weeks and then have four weeks vacation. So of course, they don´t represent the history and a total overview of the history. They do not know what happened the week before….so if they are suppose to make decisions then often that will be based on limited background. That is why they need us to assist them. And additionally, they do not have engineer competence offshore. So it is important to get that competence integrated with those working offshore, so that they have that aspect as well.
>
> It is easy to sit onshore and say that ”ok, you managed this much last night, then you have to manage at least as much today as well”. Earlier then, they explained, if you push this bottom then the compression will work like this. Actually we have not been able to understand exactly what they have been talking about, but we have improved that it sound reasonable, without really knowing where they are in the processes and what they mean. But know we can just pick up the same curve and look at precisely the same things as those offshore.
>
> It depend very much upon the person how difficult it is to get in contact. That again, I recognize that those I know well offshore, those I have travelled out and talked to earlier, that I know have a private boat, a cottage in the mountains, I know the name of their dog, things like that. Then it is much easier to contact them, and I also do that more often then.

An important condition for self-synchronization is trust, whereas these citations give an impression that there sometimes is a lack of trust between people offshore and onshore. Important is the fact that when they have build a relationship based on direct social interaction, face-to-face, then it is easier to make contact through the technology later on. Then they know the person and identify him as for instance Knut, instead of just those “offshore”. And also, some of the respondents are also much aware that you need to earn trust. Two of them explain:

> You have to show that you know what they are talking about. For example when you come to a meeting you know for a fact that a circumstance is real and not just something you have been told.
>
> Meeting people is important, especially when it is people you are suppose to work with…it have to do with knowing who you work with..knowing a person creates trust…

So things are improving, many of the respondents claim. Being organized in distributed teams they express a better understanding of different roles and responsibilities, leading to a better base for collaboration. One explains:

> I think it is a much better understanding today about the different duties and operations people do, and based on this we get a much better basis for collaboration than it was before.

And also, shared language is recognized as important while during daily interaction meetings they report using a more simple language without to many abbreviations, in contrast to when two engineers work together using technical terms. Several respondents indicated that it used to be a challenge before, but know they have managed to develop a common language even though representing different disciplines.

The current trend of organizational restructuring into flat organizations and autonomous work teams means that personnel in the oil and gas industry to a larger extent have to

lead and support each other. A lean offshore organization with few persons within each discipline necessitates flexible problem solving. Collaboration across disciplines to support each other's work is a necessity. This change in roles and practice among workers also changes the role of leadership in this business. Let us again use Kristin as an example with the ambition to sustain the One-Directed Team- model. This model uses empowerment of separate functions and work arenas (such as the landscape, the collaboration rooms) for problem-solving, and tries to develop shared situational awareness as a means to achieving the four mentioned operational goals of HSE, uptime, cost-control, and knowing the technical condition. The combination of empowerment and shared situational awareness enables the operations and maintenance crews to be proactive in problem-solving. This also keeps transaction costs inside the functions, in the team, and between teams and external functions low, securing effective problem-solving. The operational model promotes a high degree of ownership of tasks, but also a high degree of transparency around work. Such a transparency is critical for both the dynamic between functions (between operations, management, and technical support) and for the self-synchronization experienced in the crew. Transparency makes the connection between tasks and functions visible; if a task is not completed it is easy to see who is responsible. With a full-planning-execution loop in the work processes and a high level of transparency around who is responsible for tasks, the number of hand-offs are reduced and motivation strengthened. Self-synchronization is achieved via transparency, reducing the need for coordination from management and promoting safe and reliable operation.

Conclusion

In this paper, we have addressed knowledge as a question of knowing when investigating how self-synchronization, trust and knowledge sharing affect collaboration in virtual teams offshore and onshore. Two main cases were constructed, both as explorative qualitative studies of Statoil/Hydro "integrated operations". Integrated operations means integrations of people across geographical organizational and disciplinary boundaries, integration of process in terms of business integration and vendor collaboration and integration in relation to technology, sensors, protocols and others. Or in other words, integrated operations basically mean integration of people, technology and organization.

We find that collaborations in virtual teams are depended upon a mutual understanding and shared goals and visions. The challenges is not the new and advanced technology itself, but the organizational aspect, thus shared goals and visions, but also trust and the willingness to share knowledge. Knowing throughout the virtual team results in knowing your colleagues competence and thereby be able to share knowledge in cross-disciplinary processes. Team members adjusted their language depending upon social context as knowing what language to use. Also, when members get together in a collaborative environment, a shared language is used facilitated by artifacts such as technological visualization tools. Through a shared language the ability to create relationships based on trust increases. The main purpose of integrated operation is virtual contact between offshore and onshore, with technology used to facilitate the possibility of "being in the same room", for collaboration that result in better decision making and mutual in-depth knowing of the same problems and situations, and thus create a shared situational awareness. However, empowerment and transparency is crucial to understand knowing through collaboration and therefore self-synchronization is the driver for knowledge sharing and the building of trust, especially between offshore and onshore personnel. Lack of shared understanding is subsequently

generating different goals, less trust and poor collaboration. Integrated operations means that onshore and offshore are connected through assignments. Instead, virtual teams tend to divide between onshore and offshore. However, the result from Kristin is more positive, where self-synchronization related to empowerment and autonomy is more present. Kristin provides freedom to the workforce and empower them to do daily tasks. A successful virtual integration between onshore and offshore management team has enabled shared situation awareness and removal of back-log activities. Onshore management is ”hands-on” and shared situation awareness among management leads to quick decisions but little involvement in the operations and maintenance team. Still there has been a successful integration into the O&M-team, even though the latter team wants more management attention and support in daily technical problem solving. The offshore workforce wants to use IO to improve collaboration with onshore technical experts to maintain and improve their competence and skills.

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