# Anticipated challenges for cross-organisational distributed collaboration in reactive telemedicine

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**Abstract.** On the Norwegian Continental Shelf, several operators have invested in technologies that are enabling and enhancing real-time collaboration between personnel onshore and offshore in order to achieve more effective decision-making. This is thought to improve operational performance, including delivery of offshore healthcare. Frequently in offshore healthcare, distributed collaboration takes place between medical personnel belonging to different organisations. Despite advances in and use of collaboration technologies, there is still potential for improvements in the cross-organisational collaboration. A system perspective is used to address some of the issues that need to be considered for successfully enhancing cross-organisational collaboration in telemedicine.

**Keywords.** Distributed collaboration, Telemedicine, Cross-Organisational collaboration, Oil & Gas

## 1. Introduction

Since the term "telemedicine" was first used in the 1970s, it has been subject to a variety of definitions (WHO, 2010). In broad, however, telemedicine refers to "the use of information communication technologies to improve patient outcomes by increasing access to care and medical information" (ibid). In line with technological developments, the term telemedicine is now covering a range of applications, in addition to the consultative services that it originally described (Moore, 1999).

Telemedicine has received a lot of attention during recent years also from oil and gas companies due to its potential advantages: reduction in number of unnecessary evacuations, shorter response times, early initiation of treatment in critical conditions, and increased perception of safety by offshore personnel (e.g. Anscombe, 2010; Mair et al., 2008).

### *1.1 Telemedicine on the Norwegian Continental Shelf*

In the case of telemedicine offshore on the Norwegian Continental Shelf (NCS), communication between offshore and onshore medical personnel started out in the 1970s by use of radio networks (Evensen & Fjærtoft, 2008). Today, telemedicine equipment on the NCS usually involves video conferencing systems for real-time collaboration between offshore and onshore medical personnel. Such video conferencing systems are often used for different purposes, including support in medical situations involving a patient for diagnosing and decision on treatment, education and training of medical personnel, recertification of medical personnel, meetings, etc.

The current use and focus of telemedicine by operators on the NCS can be seen as a continuation of the development and application of integrated operations (IO). The core

idea of IO is to configure (virtual) teams who together hold the competence and experience to make the best possible decisions (Drøivoldsmo, Rindahl & Mydland, 2013), usually referring to real-time collaboration between onshore and offshore with access to real-time data pertaining to the relevant field (OLF, 2008). To understand an IO organisation and activities performed by it such as telemedicine, it is useful to use a system perspective in which the performance of any activity or task by the organisation is a result of how its resources have been put to use. Complex systems such as the oil and gas companies consist of resources that may be broadly classified into four categories: People, (work)Process, Technology and Governance (Henderson, Hepsø & Mydland, 2013). These resources are interdependent for the delivery of intentional activity. Further, it is crucial to understand that configurations of the organisation's resources might be dependent on the external environment in which the company is operating.

In the context of offshore operations on the NCS, the telemedicine system consists of different roles belonging to different organisations. All permanent offshore installations are required by national regulations to have a state-authorised nurse on board for provision of proactive and reactive healthcare. In addition, the companies operating on the NCS are required to have an onshore oil duty doctor who is available 24/7, as well as a doctor to hold the overall medical responsibility of the company. The oil duty doctor is usually a service provided by an external company serving several installations and/or companies on the NCS. The proactive healthcare services that the offshore nurse serves pertains to supervision of hygienic conditions on board. Reactive healthcare services, on the other hand, involve the performance of urgent care, outpatient assistance, and monitoring of the health status of the personnel on board. Consequently, the use of telemedicine offshore today is focused on reactive healthcare as this is where it has its greatest benefits, connecting offshore medical personnel with onshore medical personnel.

Another contextual factor that may impact the use of telemedicine in Norway is availability of medical information to the different roles due to privacy concerns and lack of coordination of ICT systems in the healthcare system. Today, patients have a journal at each institution they have received treatment. Hence, patient's medical information may be widely dispersed and difficult to obtain for the current medical personnel.

Despite great advances in terms of collaboration technology for use in telemedicine, there are still potentials for improving the collaboration between the offshore nurses, the oil duty doctor and medical experts at the hospitals. We have studied the current use of telemedicine in an oil and gas company on the NCS. Using a system perspective to understand the current use of telemedicine in offshore oil and gas operation on the NCS as well as possible improvements, it seems that the greatest challenges are not related to technology, but rather people, process and governance issues. We will also use insights from previous studies of collaboration in IO to highlight the challenges and potentials for improvement of distributed collaboration across organisations. This topic is highly relevant for the successful implementation and use of telemedicine (Zanaboni & Wootton, 2012; Nicolini, 2005; Yellowlees, 2005).

## 2. Methods

In the telemedicine study, interviews were conducted with people in all roles that are directly involved in the system; offshore nurses, medical supervisors and medical director in the oil company, oil duty doctors and specialists at a hospital. Interviews with medical supervisors, medical director and specialists at the hospital were semi-structured and performed individually. Interviews with offshore nurses and oil duty doctors were performed in a group setting due to practical reasons. In total, 15 roles were interviewed.

Key issues were identified in accordance with the four main categories of resources comprising the telemedicine system; People, Technology, Process and Governance.

We have also used data from previous studies on IO collaboration in two different production optimisation teams with the purpose of identifying collaboration challenges within IO. 18 production optimisation meetings were observed and 31 meeting participants were interviewed. The meetings had participants from different locations, with different background and competencies, and from different organisations.

## 3. Case Study

### *3.1 Current use of telemedicine in offshore reactive healthcare*

In medical situations where the offshore nurse feels in need of support, he/she contacts the oil duty doctor who is responsible for treatment of the patient. The oil duty doctor, in turn, may contact any hospital for further assistance if he/she feels in need of support for making a decision regarding the patient. Traditionally, the contact between the different roles has been by use of telephone, meaning that transfer of medical information has been mainly through verbal communication.

In 2011, the case company installed technology facilitating collaboration between onshore and offshore medical personnel in its offshore installations on the NCS. This technology enables live video and audio transfer from offshore to onshore through high-definition cameras. Medical equipment is available offshore, some of which is electronic and can be connected to the video conferencing equipment for live transfer of data, e.g. electronic otoscope. Vital parameters may be shown live by using one of the cameras to zoom in on the monitor. In cases where medical data such as ECG images is obtained, this is sent to a hospital for interpretation by a specialist.

Using the video conferencing system enables the oil duty doctor to make a potentially more informed decision regarding treatment of the patient because he/she can see and talk to the patient themselves (e.g. Bolle, Larsen, Hagen & Gilbert, 2009), as well as certain objective medical data in real-time. As such, the offshore nurse obtains the medical information that is deemed relevant in the situation, while the oil duty doctor interprets the information and makes a decision regarding treatment.

Today, the case company uses the video conferencing system in situations with a patient offshore in both non-emergency and emergency situations. This includes internal use in the company, for instance for coordinating resources in case of a potential evacuation of the patient or for having a colleague to support.

### *3.2 Potential Improvements for Telemedicine*

The case company is currently looking into how they may facilitate a more seamless transfer of information between the different medical roles involved, seeking ways of improving the information basis for medical decisions. The interviewees also referred to possibilities of improvements regarding the ease of access and use of the video conferencing system with the oil duty doctor, the need to reduce time spent on sending medical information and contacting different roles in emergency situations.

In line with the IO philosophy (e.g. Henderson, Hepsø & Mydland, 2013), the main purpose of installing video conferencing equipment in the offshore medical bay was to improve the collaboration with the oil duty doctor and potentially specialists at the hospital. IO is thought to improve decision making through cross-discipline collaboration and use of real-time data (Albrechtsen, 2013). In our current case, this is often not accomplished due to lack of availability of responding roles (oil duty doctor and specialist) in the video

conferencing system. The oil duty doctors serve their duty in a mobile manner, e.g. at home or in a car, and are required to be available for calls 24/7. However, nothing has been specified regarding their availability on video conference. Thus, in situations where using video conference would be beneficial, it may not be possible to do so within adequate time. Further, in cases where the oil duty doctor feel in need of support from a specialist, they use the telephone, since no video conference connection is set up with hospitals for this purpose. Thus, the different roles do not have the opportunity to use the same real-time data as basis for their collaboration, e.g. see/talk to the patient or see vital parameters of the patient. Instead they rely on verbal communication of medical information. Transfer of objective medical data such as ECG-images is possible, but doing so introduces a series of extra steps, resulting in more time spent because the data is not connecting to collaboration technologies for sharing in real-time, nor is the specialist for interpreting the image.

The case company is now looking into possible solutions for improving the collaboration by having a technological solution in which all relevant medical information is accessible to the involved roles, including documentation possibilities, as well as having the opportunity to collaborate in real-time through live video and audio (Thorvik et al., 2014). Although the main driver appears to be the development of a new technological solution, the real challenge, it seems, is being able to put it into good use in a system consisting of three different organisations.

## 4. Potential Challenges for Improving Cross-Organisational Collaboration in Telemedicine

### *4.1 Technology issues*

Besides the improvements sought after in terms of a new technological solution as mentioned above, there are other technology issues that might be crucial for an adequate collaboration between organisations. Some examples are: having adequate network connections in all sites that support the collaboration and sharing of medical data, assuring secure communication of confidential patient data, and ensuring that the necessary equipment is available, functional and maintained at all sites.

### *4.2 People issues*

Successful collaboration in telemedicine is dependent on participants having sufficient competence in using both the collaboration technology and the medical technology (e.g. Gururajan, Moloney & Soar, 2005) to such a level that they feel confident they can use it in situations where the technology will provide an advantage. It is also important to know in which situations to use the technology - for instance when the offshore nurse is uncertain about the patient diagnosis - and knowing when it may not give relevant support – like when there is no doubt that the patient needs evacuation. It is also necessary to know the work processes in which they are to be used and the responsibilities and roles involved. Further, specific teamwork competences can improve the quality of the collaboration process (Skjerve & Rindahl, 2012). In telemedicine, all involved roles have very specialised competences, which emphasises the need to trust that one's collaboration partner can use the technology correctly, interpret data correctly and convey the correct information. Adequate training of all these competences should be provided.

Collaboration across organisations can be challenging due to differences in priorities and goals. Ideally, each role should consider their contribution in terms of the entire patient flow. Therefore, it seems important that participants have an understanding of what information other roles need to achieve the common goal. An example can be a nurse accompanying a patient during evacuation that understands what medical information the

hospital needs and therefore can obtain the necessary data during evacuation.

*4.3 Process issues*

There should be an alignment of processes for telemedicine between the three organisations in a way that safeguards the patient, including handovers between the organisations. Further, to ensure the effectiveness of telemedicine activities, there should be processes for more than the telemedicine activity itself such as training and evaluation processes.

*4.4 Governance issues*

Through interviews with personnel in the oil company and the oil duty doctor company, it became evident that changes to the arrangement between the organisations might be needed for telemedicine (beyond the use of telephone) usage to be effective. The oil duty doctors seem in need of restrictions regarding their location while on duty if they are to be increasingly available on video conference. Conducting a patient consultation on video while in the supermarket may be technologically possible, but ethically and professionally inappropriate. The interviewees also stressed that the oil duty doctors' competency in using the technology varied, pointing to a need for the oil duty doctor company to enhance the training of their doctors. In addition, the companies need to comply with current laws regarding transfer and storage of information. Because the oil duty doctor may use their laptop anywhere and anytime, it was deemed unsafe to provide them with access to the company's electronic patient journal. This issue might also be solved by restricting the whereabouts of the oil duty doctors while on duty.

The need for structural changes also applies to the hospitals for the effective use of telemedicine: They would need to have the relevant technology installed, know how to use it properly, acceptance for using it by the people who are to use it, and a structure that ensures a rapid response to requests for support. Today, this is not in place in the hospitals. According to our interviewees from the hospital, quite a lot of effort would be needed for convincing the hospitals to initiate such activities. One of the main reasons for this seems to be a current lack of financing plan for provision of telemedicine services in Norwegian healthcare, and therefore little incentive for hospitals to consider telemedicine services.

In a setting of collaboration across organisations, trust can be supported by ensuring predictability of actions and a set of transactional norms (Skjerve & Rindahl, 2010). This may be implemented by having agreements in place specifying how the collaboration shall take place. A finding from the studies of IO collaboration is that these agreements need to be developed over time to make sure they are adapted to the actual working conditions.

## 5. Implications for future improvements to telemedicine on the NCS

Telemedicine is dependent on collaboration technologies for sharing medical data in real time. However, the biggest challenges are not necessarily related to the technology, but initially to governance issues, and subsequently to people and process issues. According to Zanaboni & Wootton (2012) the main inhibitors of successful telemedicine implementation are related to legal and/or medical issues. As such, obstacles related to structural matters need to be addressed early in the project. For instance, privacy issues need be addressed and medical information should be made easily accessible while complying with existent laws, guidelines, and requirements. If a direct link with the hospitals is requested or anticipated, the hospitals need to be committed to the concept of telemedicine, install the equipment needed, and establish a structure for providing medical support when needed by pre-hospital roles. When these factors are in place, the people and process issues can be

tackled: training users to accept and use the technology, work according to new processes and understand their role in the telemedicine activity; as well as establishing processes to ensure the telemedicine activity is evolving in line with the needs of involved parties. This highlights the need to early on consider how efforts to improve telemedicine usage may impact on and call for related changes in the whole system for such improvement initiatives to be successful.

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