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The Use of Integrated Operations in Order to Improve Quality of Health Care and Medical Evacuations from Offshore Installations

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Abstract

Since the early 1970s, thousands of patients offshore have been treated on board by our medical staff, in cooperation with our on-call onshore doctors. Several hundred patients have been evacuated to hospitals due to acute illness and serious injuries. Our present standards will be described, as will our perspectives on the future treatment of, for instance, acute cardiac disease and pre-hospital diagnosis through the transfer of electrocardiograms (ECG) and the use of telemedicine to obtain a medical diagnosis directly from the receiving hospital's emergency care unit.

Norwegian regulations require nurses to be present on all installations, with doctors available on call onshore. Compared with ordinary nurses onshore, offshore nurses have wider responsibilities in normal diagnostic consultations and in emergency situations. Today, doctors and nurses discuss specific patients and cases by telephone, and they exchange photos.

We wanted to use our experiences from integrated operations (IO) and from telemedicine to improve the offshore health care services, in order to provide better quality and integration of the people and organisations involved.

Together with the NST (Norwegian Centre for Telemedicine), we studied the possibility of providing medical advice and support through the use of Telemedicine. Valuable experiences from Telemedicine projects, such as expert opinions in training and diagnosis, and follow-up of patients in rural areas and surgery, were collected.

The use of IO for training, diagnostics and emergency situations will improve communication and cooperation between nurses offshore and doctors onshore. It may also enable advice to be given through video conferencing.

The NST conducted a risk assessment of these new work processes, with special attention being devoted to the electronic transfer of sensitive information (photos/videos and other personal health data). Thirty threats were identified. None of them had an unacceptable risk level given the recommended solutions and the information management system applied. No corrective actions need to be taken, but some small changes in the procedures were suggested in order to reduce risks related to confidentiality, integrity and availability.

We have recently started pilot projects on several platforms involving the extensive use of videoconferencing and sharing of real-time data. The equipment supports direct communication between the patient and nurse on the offshore installation and the doctor or hospital onshore.

The results of the pilot tests will be presented, as will perspectives on future development and the relevance of the risk assessment.

Introduction and historical background

Since the start of petroleum exploration and production on the Norwegian Continental Shelf (NCS), medical health care has been provided on offshore installations. Offshore operations are associated with high risk, and, despite safety precautions, injuries do occur (Evensen and Brattebø 2006). With more than five thousand employees working offshore at any given time, illnesses of different degrees of seriousness are also inevitable.

Pursuant to national regulations, all permanent installations on the NCS are required to have a nurse available for reactive and proactive health care of offshore personnel. To limit the resources required to operate a proper health service, it has not been required to have a doctor on board each installation. However, an onshore on-duty doctor is required to be available at all times to assist the nurses when necessary. In addition, a doctor has the chief medical responsibility.

In the early 1970s, the communication between the on-board nurses and the onshore doctors took place using frequencies on regional radio networks. As telecoms technology developed, radio communication was replaced by satellite telephones. However, this medium caused delays between the participants, making communication

somewhat troublesome. In recent years, communication between onshore and offshore has been via the ordinary telecommunication link. The sharing of medical data, such as photos etc., is now done via internet instead of by fax.

In 2007, Statoil launched a pilot study to explore the possibilities of further improving the quality of communication. The initiative was taken in connection with the ongoing change effort, Integrated Operations, which focuses on communication challenges, organisational restructuring and improved decision making. By taking advantage of the technology and concepts of Integrated Operations, the pilot study has shown that offshore and onshore health services are now able to communicate and profit from real-time high-resolution video and sound transmission, as well as additional real-time data sharing. The pilot study has also generated new ideas for further enhancing the health service.

This paper introduces the reader to the concepts of Integrated Operations and how it has been used as a basis for HSE improvement. The results of the pilot project will be presented, as will the future possibilities this new technology offers.

Integrated Operations (IO)

Since the pilot for an improved health service offshore is largely based on the IO efforts in StatoilHydro, a definition and explanation of the term is necessary. StatoilHydro defines IO as collaboration across disciplines, companies and organisational and geographical boundaries based on the use of modern information and communication technology to ensure safer, better and faster decisions. Most of the operators and suppliers on the NCS have implemented initiatives that are related to or similar to IO, although different terms, such as Smart Operations, eOperations, Smart Fields™, Field of the future™, Real Time Operations, Smart Wells, and i-field™ (OLF, 2006), are used.

To elaborate on the term, it includes technological, human and organisational aspects. New developments, such as increased bandwidth through the use of fibre optics, new advanced sensors and videoconference tools, enable real-time communication and sharing of data. The human and organisational challenges consist of utilising the possibilities the technology offers.

The petroleum industry has started to use new technology in order to improve the utilisation of resources. More specifically, the competence of onshore engineers and specialists can be used to a greater extent by the offshore installations. This is done by having onshore multidisciplinary teams that, through real-time video communication and data transfer, are able to advise and make decisions about what should be done during operations. In addition, activities such as planning and administrative tasks can be moved onshore. StatoilHydro's strategy is to strengthen the decision-making onshore organisation and the executing organisation offshore.

These new work processes are expected, and have been proven, to produce several gains. First of all, the utilisation of resources onshore can result in a potential increase in production, the expansion of reserves and a reduction in costs (Petoro, 2007). Moving personnel onshore, improved planning, shared understanding, letting offshore managers focus on safe operations and improved proactive maintenance are all HSE gains that were expected and have been experienced as a result of IO (OLF, 2007). A report published in 2006 estimated the potential net present value of the implementation of IO on the NCS to be USD 40 billion (Jansen et al., 2006).

To further explain the benefits StatoilHydro experiences as a result of IO, a specific example will be given of how IO is utilised in StatoilHydro.

The use of IO in exploration and drilling

IO has been implemented in several areas in StatoilHydro's core business. One of the areas where IO is extensively implemented is in drilling and well operations. Geosteering is now performed by multidisciplinary teams, the majority of whom are located in onshore support centres from where they communicate with drilling managers offshore. The teams are responsible for both well planning and well placement during the drilling. New communication tools have enabled the company to bring data to the experts instead of bringing the experts to the data. By gathering expertise in onshore support centres, better plans and more optimal decisions are achieved. The introduction of IO in drilling has also improved the interaction between the onshore and offshore organisations and the interdisciplinary understanding among the team members. Onshore support centres make it possible to foresee potential obstacles and to take action before they develop into problems. An example of the results this has produced is the drilling of 12 wells for the Kristin platform. The reservoir is a high-temperature high-pressure reservoir, and, normally, one would expect a well control situation for every second well. The term 'well control situation' refers to a situation that could develop into a problem. IO principles were used during the drilling of the wells on Kristin and no such well control situation occurred. This is truly an HSE improvement.

The 2007 Statoil Health Pilot: Telemedicine offshore

The use of communication technology to overcome the challenges of long distances between nurse and doctor is not unfamiliar to the health service industry. In fact, the health service industry has been among the leading practitioners, using ICT to deal with such challenges. As mentioned, formal consultation between nurses offshore and doctors onshore has existed since the 1970s. In addition, telemedicine has been an area of research and practice in Norway since 1987, due to the challenges presented by sparsely populated areas in the northern regions of Norway. In short, telemedicine is a term for performing medical consultations and collaboration independently of time and place, using communication technology.

Today, this technology is used in several medical situations. One example is that hospitals and medical offices with little expertise in kidney diseases can get

professional assistance through videoconferences. Haemodialysis is a treatment given after renal failure that needs to be performed, for example, three times a week, each session taking five hours to complete. The introduction of telemedicine has reduced the amount of travel and resources needed to perform this treatment (NST). It also improves the quality of life of the patients, since treatment is more easily accessible.

In this light, it is not unreasonable to claim that telemedicine is directly comparable with IO as defined above. Because of this, the health service offshore has been expected to fit in naturally with and benefit by being included in the IO efforts. A pilot project involving the use of telemedicine on the NCS was therefore initiated.

Purpose of the pilot

The purpose of the pilot was to test the consequences of implementation of telemedicine through video conferences on offshore installations. As having professional expertise onshore produces extensive gains in the core business, telemedicine with onshore support from doctors and other experts was expected to take the offshore health service to a higher level. In a risk analysis report performed by the Norwegian Centre for Telemedicine (NST) in cooperation with StatoilHydro and Tandberg, it was proposed to use videoconferences for three purposes. The proposals in the report are reproduced below:

1. Training, interaction, joint meetings.
2. Consultation between patient and nurse offshore, and the doctor on duty onshore. This collaboration could also take place without the presence of the patient.
3. A consultancy service expanded to include hospital emergency units when necessary (AMK).

(Henriksen 2007)

The pilot involved the onshore company health services at Sandsli, Stjørdal and Forus and the health offices on Gullfaks A, Statfjord C, Snorre A and B, Visund and Heidrun offshore. A model of the pilot and possible extension of the system is shown in Figure 1.

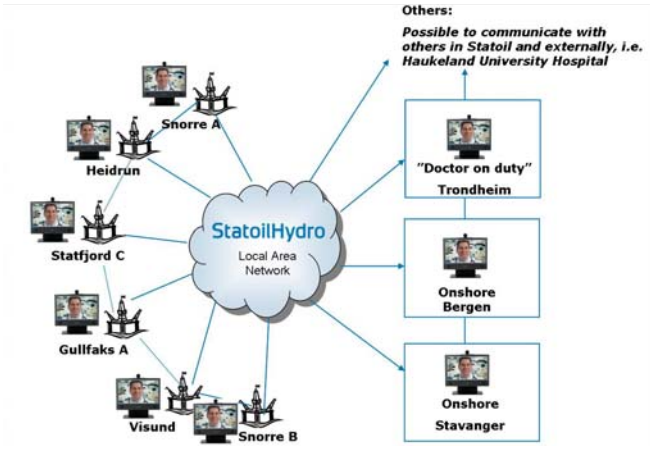

Figure 1 Sketch of the health pilot

Pilot coverage

The whole range of applications suggested for the use of IO in the offshore/onshore health service has not yet been explored. So far, patient consultation using video conferences has been postponed in order to gradually introduce the new tools and working methods. In the pilot, IO has been used for joint meetings between offshore installations and/or onshore medical support centres. Some of the issues that have been dealt with at such video conferences are:

- Daily meetings are held to report undesirable incidents and the medical condition from the platform to the onshore organisation
- Planning and development of HSE efforts to be implemented
- General health and working environment issues on board offshore installations
- Industrial hygiene and challenges related to handling toxic chemicals
- Residential and food hygiene, cleaning and inspections
- General medical and emergency preparedness on the platforms
- Planning of HSE-related training offshore

At the start of the pilot, several of those involved were sceptical about the project. Prior experiences with video conferencing were marred by poor bandwidth and visualisation tools, making communication difficult. The over-complicated user interface also meant that personnel were reluctant to use the equipment. However, as the participants in the pilot project started to use the new technology, their scepticism quickly disappeared. They were astonished by the high-resolution video conference standard as well as the good quality of the sound. The ability to communicate without interruption in real time was considered a major step forward.

The responses to the pilot project are very positive. The possibility of real-time communication and the fact that all participants can see the same information at the same time (by connecting a PC as part of the conference) have improved decision-making about health and working environment (H&WE) issues. In addition, the planning and reporting of H&WE projects have become more efficient and resulted in improved cooperation between the different parties involved.

Pilot expansion

In future, the plan is to expand the pilot project to include other applications of video conferences. The next application scheduled for implementation is real-time consultation between patient and nurse offshore, and the doctor on duty onshore. This will result in several improvements in the diagnosing and treatment of offshore personnel. It will enable the doctor to see the patient himself/herself. Today, the normal procedure is that the nurse has to carry out the visual inspection of the patient

and then try to explain what he or she sees to the doctor. This is certainly a source of error that could cause the wrong decisions to be made. Pictures of the patient are occasionally sent via the internet, but the doctor is unable to conduct a real-time visual inspection of the patient. With new cameras and high bandwidth data transmission, the doctor can, for instance, perform eye or ear examinations, look at a patient's ECG or carry out other inspections without using the nurse as a second-hand source. The doctor can also monitor treatment administered by the nurse if necessary.

The potential gains are evident. The doctor can make a more accurate diagnosis, and can initiate treatment earlier than is the case today. By reducing the time before treatment is initiated, the degree of seriousness of an incident should decrease, and the probability of surviving serious accidents or illnesses will increase. Improved diagnoses will also reduce the amount of transportation of offshore personnel to onshore that is required in order to make an accurate diagnosis. In short, by using video conference tools one is able to move the medical competence to the incident in order to obtain an efficient and secure diagnosis and to start immediate treatment.

In addition, the general communication between the patient, nurse and doctor will improve, since important non-verbal communication can be carried out at video conferences. This is important in order to achieve a shared understanding of the incident and what needs to be done. Video footage can also be stored for subsequent review, a feature that can often be more valuable than a written report.

A further suggested improvement is to include expertise at hospitals, for example Haukeland University Hospital, in the support network. In serious incidents where support from a doctor is not sufficient, hospital emergency care units can be contacted in order to get the necessary support. The helicopters used for emergency evacuation from offshore to onshore are also equipped with technology that enables real-time connection with onshore. Together with the video conference equipment on platforms, this enables support to be provided by hospital emergency units during the whole period from the occurrence of the incident until the patient has arrived at the hospital.

Technical infrastructure

On the NCS, StatoilHydro has its own intranet between offshore and onshore. The main installations are connected via a fibre optical cable, while the satellite installations are connected by radio link. The latter is also compatible with holding video conferences. In general, the energy industry prefers networks that can secure the quality of IP traffic. An industry-specific network such as Secure Oil Information Link (SOIL) is an example of such a secure network. It has been proposed that this SOIL network could be used to connect to the health network (Henriksen, 2007).

The risk analysis report by the National Centre for Telemedicine suggested that dedicated video conference units should be used. They offer a more user-friendly and high quality solution than using a computer and web camera. The video conference units also enable footage to be stored as a supplement to the electronic medical records system, Pride Journal.

Figure 2 shows possible future infrastructure for a health and working environment support arena. The figure suggests that laptops could be used by the doctor on duty. This ensures that the doctor can give full quality support almost irrespective of where she or he is located.

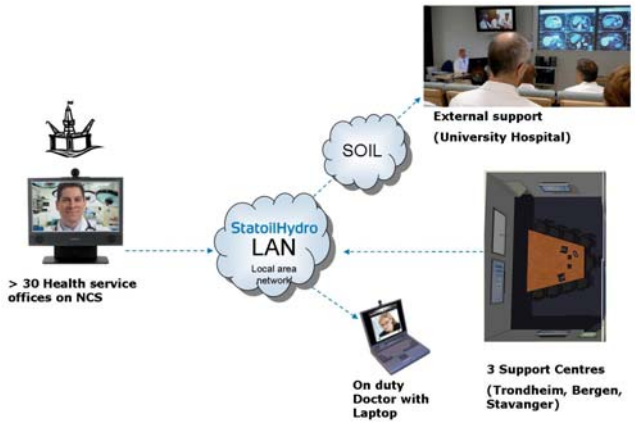

Figure 2 Possible infrastructure for the health and working environment support arena

The figure also suggests three H&WE support centres located in Trondheim (Stjørdal), Bergen (Sandsli) and Stavanger (Forus). It will not necessarily be the case that all these support centres have to be operative at the same time. Each centre can, for example, have the role of supporting unit every third week. The other two weeks can be used for other H&WE tasks.

Security/risk issues

Patient consultation involves storing and transmitting personal health data and this information is considered to be sensitive. Pursuant to national legislation, this status has implications with respect to information security. The risk analysis report mentions four aspects from the national legislation:

- Confidentiality
- Integrity
- Availability
- Quality

The term confidentiality implies that only personnel involved in the treatment of a patient are allowed to view personal information and information about the patient's health condition; it is not the case that all health workers are allowed to view the information. The integrity of the information must also be ensured, i.e. no unauthorised persons should be able to change it, and all changes should be traceable. Information, both ongoing communication and historical information, should be available to the involved parties whenever it is needed. This requires the telemedicine service to be available 24 hours a day, 365

days a year. By quality of information is meant that it must be correct and not misleading (Henriksen 2007).

The analysis carried out in order to identify threats to information security by using the new communication technologies identified approximately 30 issues that were associated with risk. However, none of the threats was considered to have an unacceptable risk level. The new method of providing a health service can therefore be implemented throughout the company without additional risk reduction efforts. If desired, the report suggests some actions that can be taken in order to further reduce the risk. The suggestions mostly concern encryption and other technical solutions to prevent outsiders from accessing the data and the development of procedures for the use of communication equipment (Henriksen, 2007).

Conclusions

The pilot study into the use of the concept of Integrated Operations in the health and working environment organisation showed that there are several potential gains. So far, the pilot has only been used to discuss, plan and coordinate offshore H&WE issues. The results show that the quality of the decisions made and the planning and coordination have improved because of the greater opportunity for cooperation provided between assets and onshore support centres.

The participants in the pilot were sceptical about the use of video conferences since prior experience was that it had poor video and sound quality, making it ineffective to use. As they got to know the new equipment, their scepticism quickly turned into enthusiasm about the great possibilities the technology offers.

A further expansion of the pilot will include patient consultations through video conferences. This will enable doctors to make efficient and correct diagnoses, and to start treatment immediately. The result is that fewer incidents will evolve into critical emergencies, and fewer people will have to be sent onshore for additional diagnosis or treatment.

A risk analysis report concluded that all the identified security threats had an acceptable risk level. This implies that the use of video conferences for patient consultations can be initiated without further risk reduction efforts. The report does suggest, however, some actions that can be taken in order to further reduce the risk level. Encryption and the establishment of procedures are among them.

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