# Transferring knowledge from operations to the design and optimization of work systems: bridging the offshore/onshore gap

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# Transferring knowledge from operations to the design and optimization of work systems: bridging the offshore/onshore gap

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Knowledge from operations offshore is valuable when designing new rigs or optimizing existing ones. But, how to capture operational knowledge and experience from offshore units and how to transfer this knowledge to the design of new units and optimization of existing ones? To address this challenge, we structured a framework that can help: 1) diagnosing the current state of knowledge transfer from offshore to onshore in order to 2) develop methods to capture operational knowledge, systematise and transform this knowledge, and transfer it to engineering design projects. This framework has the potential to generate information of the actual work systems activities that might be a basis for innovations in multiple business processes: design and modification of installations, auxiliary equipment, and optimization of the daily operation and maintenance at offshore units.

**Practitioner Summary:** There is a big distance, both geographical and workwise, between the offshore operators and the onshore staff. This difference reinforces the need for a knowledge transfer system that overcomes the existing communication barriers. The aim of the research project is to generate a new understanding of the knowledge transfer topic by using the analysis of the existing work systems as the basis for the knowledge to be transferred. Combining the tacit knowledge from the operators with the technical knowledge from the engineering staff is valuable when designing or planning maintenance of rigs and can enhance both processes.

**Keywords:** Work systems framework, knowledge transfer, ergonomic analysis, drilling rigs

## 1. Introduction

Which tools or methods can be used to acquire knowledge about operational work that can be valuable for designing new work systems or optimizing existing ones? This is not a new question when it comes to previous studies involving ergonomics. However, which 'kind of knowledge' is needed and how to transform and transfer this knowledge are still open questions to be discussed. This paper considers these questions within a case in the offshore industry, where the geographical separation between rigs (offshore) and engineering offices (onshore) highlights the need of sharing and transferring knowledge.

Knowledge from operations offshore is valuable when designing new units or optimizing existing ones (Conceição et al., 2012). However, there are still serious challenges in capturing operational knowledge and experience from offshore units and transferring this knowledge to design of new units and optimization of the existing ones. We base this assessment on meetings and interviews with a drilling company's representatives and previous studies of the topic. In a former project (Vianello & Ahmed, 2012), researchers identified that there was no systematic transfer of operational experience from operations to engineering designers or between operating rigs; besides, it was difficult to retrieve and reuse the existing information in new projects. However, there is a potential knowledge source on the rigs to be exploited.

The highly complex, and sometimes hostile, environment that the oil drilling sector operates in creates a unique working environment for employees. Incidents and accidents of operating rigs have created a focus on constant learning and optimizing risk, health and safety. There is a continuous need for sharing knowledge and experiences about it on the oil drilling industry, through a coherent and systematized approach. However, when not only focusing on incidents and risk related situations; as evidences indicate, there is a clear gap on the knowledge transfer from offshore to onshore. The project teams onshore seem to lack both 1) information on the actual work processes during operations on the rigs and 2) communication channels from rigs crews to project teams on this information and on improvement suggestions.

How, then, to capture valuable data from existing work systems that can contribute to the knowledge transfer from operations into design and maintenance of these systems? And how can this data be

transformed and transferred to the appropriate people within the Organization? The aim of this study is to 1) develop a framework that can help diagnosing the current state of knowledge transfer from offshore to onshore, and 2) develop methods to capture operational knowledge, to systematize (and translate) this knowledge and to transfer it to engineering design projects.

Compared to previous knowledge management approaches, we suggest a framework to analyse the existing working systems that allows valuable knowledge to be transferred to engineers working with design and maintenance of rigs based on a drilling company's case. In this paper we present 1) the current knowledge transfer channels in the drilling company analysed according to the work systems framework and 2) the main challenges in order to improve the transfer of valuable knowledge from offshore operations to engineers working with design and maintenance of rigs.

## 2. **The challenges of transferring knowledge with the oil drilling industry**

We have looked into a number of empirical papers dealing with knowledge processes between onshore and offshore locations in the oil drilling industry and in geographically dispersed organizational structures in other industries. In general, the selected literature is within knowledge management, ergonomics, health and safety, and engineering design. Recurrent themes are the challenges of generating qualified knowledge, capturing and distributing this knowledge, and applying it in order to support the knowledge transfer into R&D (research and development) in a highly distributed organizational context.

Even though we do not find a significant amount of studies on the transfer of knowledge from offshore operations back to the design phase of oil rigs, we find extensive literature about work and work processes and performance on oil rigs, and even more significant, development of procedures and integration of technologies and information systems that support the recording and improvement of work and work processes to improve documentation and performance. Here we present a brief overview of the main themes of interest for this study.

The importance of knowledge exchange systems in distributed environments creates high demands to the capability of a knowledge transfer system. But are knowledge exchange systems capable of replacing alternative channels like informal and face-to-face knowledge sharing? Gressgård (2011) states that communication media is incapable of transferring a certain amount of social information (cues) and may not be suitable for development projects where the need for electronically mediated communication is greatest because of the geographical and organizational dispersion of the team members. He points to the creation of a common social platform for interaction and sharing understanding. However, Gressgård (2011) also highlights the challenge for the electronic systems: the non-verbal behaviour that provides information, which is constructive for adjusting, modifying and managing the interaction, but is not as available as in face-to-face interaction.

Although a general optimism concerning the use of information technology is observed, one can argue that this may lead to a de-emphasizing of tacit knowledge (Johannessen et al., 2001). Tacit knowledge is as real as explicit knowledge, but the processes to acquire this kind of knowledge rely on awareness of details which cannot be specified or tested. But IT (Information Technology) systems do not stand alone when it comes to supporting interfaces through integration and collaboration.

In engineering design, knowledge management is recognized as more complex than standard IT systems and applications. IT solutions are not always the best strategy to support knowledge management (Vianello and Ahmed, 2012). A general challenge is the reliance on the knowledge systems and thus on the capability of these systems. But when alternative channels of sharing and transferring knowledge are hindered by geographical distances, the knowledge transfer systems become even more important.

Gressgård (2014) investigates how the importance and use of knowledge exchange systems increases when employees and managers work across distributed organizational structures as in onshore/offshore oil drilling industry. But more than transferred, knowledge needs to be transformed (Yakhlef, 2007). Transfer of knowledge from one context to another implies the transformation of both the target context and knowledge content. This transformation takes place through processes of translations, negotiation and bargaining among actors.

## 3. **Methods**

This is an ongoing study part of a two-year research project where three researchers work in collaboration with an international drilling company. Through exploratory interviews and document analysis, we collected data about the existing knowledge transfer systems in the company. We had ten interviews with different stakeholders from the company. The interviewees included, among others, project managers and offshore personnel. We got an understanding of the current knowledge transfer systems and how they are used during the projects. We also attended five meetings to present a new IT system for knowledge transfer in the company. These meetings were open to all employees in the company and each meeting covered one area of the new system.

We analysed the initial data using a work systems framework. The analysis focused on the understanding of interactions between people and all other elements within the system, and allowed us to identify how the knowledge is being transferred in the company and also which knowledge is being transferred. Besides, with the analysis we also identified the main challenges in relation to the knowledge transfer domain at the drilling company.

Subsequently, we will visit operating rigs of the company. The aim is to study in deep a couple of areas of a drilling rig and analyse them using the same framework. Our study focuses on the real work activities and is then suited for identifying the workers' tacit knowledge and making this knowledge explicit for onshore staff, which is an important part of the knowledge to be used when designing rigs. We look at how development of oil rigs can retrieve information and learn about existing operations of oil rigs and incorporate this knowledge into the new design to optimize operations on new rigs. All the analysis will serve as basis for developing and testing tools and methods to enhance this transfer.

### *3.1 The setting*

The drilling company part of this study has a workforce of about 4.000 people working both on and offshore. With a fleet of over 20 rigs operating in 12 different countries, the geographically dispersed work system requires a focus on the knowledge sharing across the company. The company has well-stablished knowledge transfer systems. These systems, however, still focus on working orders and registration of incidents or change orders. There is a gap in relation to operational knowledge to be transferred to R&D.

We are focusing our study in two specific departments of the company: the technical organization and the operational organization. Both departments are mainly situated in the company's headquarters. However, the operational organization includes the rigs, and as such its crews working offshore, and the support teams operating onshore, but in different countries, away from the headquarters. The technical organization stands for the engineering teams working with the design and optimization of rigs. They are subdivided into different teams and are the main target of the knowledge transfer we are investigating.

### *3.2 The framework*

It is a new approach looking at offshore operations using a work systems framework focusing on the interactions between workers, equipment, space, and work organization. This approach allows us to analyse and classify the acquired data focusing on the knowledge to be transferred. A work system, as described by Alter (2008) is a system in which human participants and/or machines perform work using information, technology, and other resources to produce products and/or services for internal or external customers. The framework helps identifying the elements of the system and the general relationships among them that need to be considered during the analysis. It provides a general set of variables that can be used to analyse and it helps generating the questions that need to be addressed when conducting the analysis (Ostrom, 2011).

In this study our main focus in on the work practices and their interrelations with the participants of the work activities, the physical environment where the work is carried out, the information needed and generated for this work, and the tools and technologies needed for the work. Products and service, as well as customers, are not on focus as they interfere less in our object of study: the knowledge transfer from offshore to onshore. Figure 1 shows the work systems framework adapted for this study and also how the three dimensions encompassing the others elements relate to the system: environment, infrastructure and strategies.

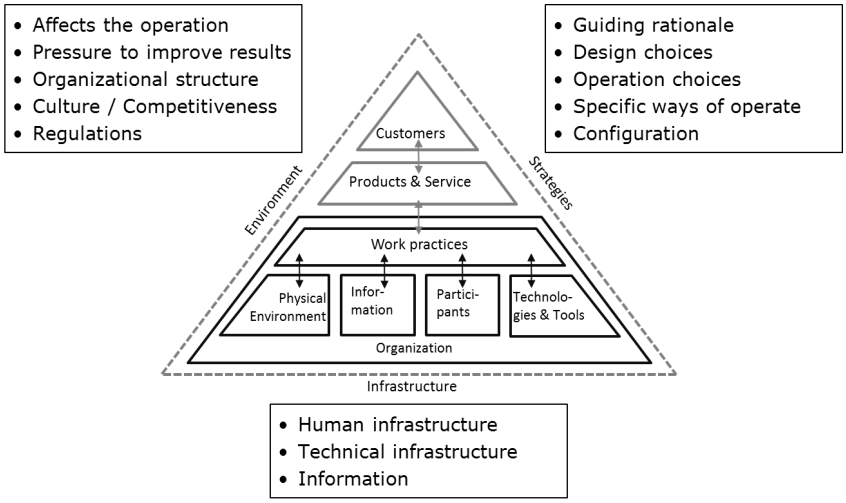


Figure 1. Work systems framework (Adapted from Alter, 2008).

### *3.3 The analysis*

The analysis is based on a systems ergonomics approach. It is rare that any study or intervention can embrace every aspect of a system (and all human factors). Resource availability and logistics dictate against this. But even then, the rest of the wider work system is acknowledged as context. "*System ergonomics examines, accounts for and enhances the design of a system, and people's interactions with it, rather than concentrating on an individual part of it*" (Wilson, 2014). It treats the system as holistic, with the whole usually greater than the sum of its parts, and focuses on the understanding of interactions between people and all other elements within a system, and design in light of this understanding.

If we look into the work system(s) of the drilling company, we can clearly see a distinction between an onshore work system and an offshore work system, both sharing knowledge (Figure 2). Having the work systems framework as a starting point, the work practices are the central unit of analysis. In this case, also the main source of knowledge to be transferred from offshore. The information from the rigs, as well as the different means to communicate this knowledge (part of the technology involved), are part of both systems. However, the participants and the physical environment are totally isolated from each other.

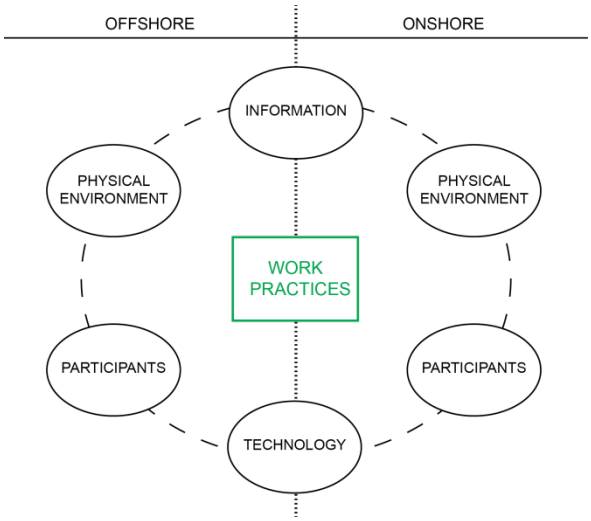


Figure 2. The work system under analysis.

It is the fine understanding of the working activities that makes it possible to associate: 1) factors determining the activities, 2) characteristics of the activities, and 3) effects (in terms of health or development of skills) and results (in terms of productivity and efficiency). We aim to bring up this knowledge to also be shared between the two systems.

## 4. Results

In this study we put together a framework on how to handle the use of the potential knowledge from the rigs into the design of rigs in a beneficial way. Information of the actual work systems activities that might be a basis for innovations in multiple business processes: design and modification of installations, auxiliary equipment, and optimization of the daily operation and maintenance at offshore units. We identify the main issues with the current knowledge transfer channels at the drilling company, as well as the main challenges to improve this knowledge transfer.

### *4.1 The existing knowledge transfer channels*

The drilling company part of this research project has a well-established knowledge transfer system based on different IT systems. All IT systems are used from both offshore and onshore staff. However, the first interviews and analysis point to a gap in the systems where 1) some valuable information from the rigs does not have a clear place where it can be registered and 2) some valuable information from the rigs is registered in a non-systematic way that is hard to be retrieved afterwards. This knowledge is not shared and, many times, lost.

There is one main IT system (A) and two complementary ones (B-C). Besides the formal systems, exchange of e-mails and phone calls, or face-to-face meetings, directly connecting offshore and onshore staff also happen; but mostly in an informal way dependent on personal network and experiences. Figure 3 illustrates the main channels used to transfer knowledge at the company. Even though these channels exist, they are still not enough to fulfil the gaps for a more contextualized knowledge to be retrieved from the design teams.

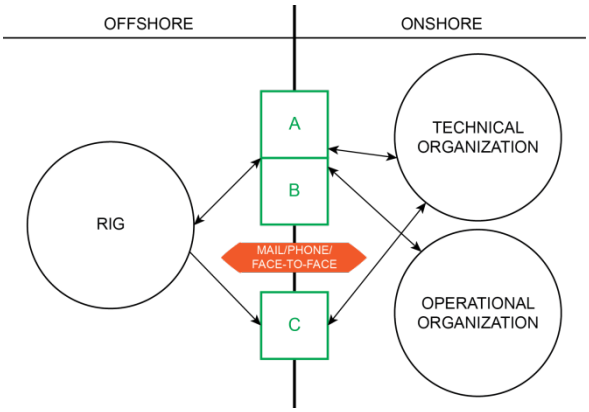


Figure 3. Current knowledge transfer channels at the drilling company.

The main system A is in a changing process: the company was implementing a fully new IT system to substitute the current one. The new system is broader than the previous one and incorporates information previously available in the complementary system B. This secondary system is specific for registering audits and non-conformance reports, and reporting incidents and accidents at the rigs. System A, on its turn, gives an overview of all tasks, activities and work orders for each and every project and rig, but still leaves gaps identified by the employees and the project managers.

One crucial gap refers to the possibility of suggesting changes or improvements on the rigs. The systems allow the offshore staff to register whenever any part or equipment: needs maintenance, does not

work properly or caused any incident or accident. However, if something still works but could work better if changes were made, this information has no place to be registered.

On an ongoing project, no matter if it is a new rig being developed or major/minor maintenances being planned for operating rigs, the project managers report on the formal systems to acquire information about the operation of the equipment on the rigs. They look for the reports on equipment failures or incidents occurred to capture the information on changes that need to be made, for example. However, most of what project teams members and managers find in the systems completely lack contextual information and can therefore not be transformed into something that qualifies a design decision.

The project managers report that the direct communication with the offshore staff is not easy to happen, unless is made informally due to personal contacts. In a bigger project, it is common that a rig manager or supervisor stays onshore during the project providing the project team with needs and demands from the rigs' operation. In these cases, this offshore person might come up with suggestions that, otherwise, would never arrive to the project team. This is an ongoing way to overcome the lack of information. And, even if it is important to have a rig worker representative participating in the projects, this also has some limitations; it is dependent on a specific person and his/hers personal experiences, network and know-how.

As a starting point to try to solve this communication gap, system C started being implemented in the past year. It started with an "idea campaign" where employees could register their own suggestions related to specific projects or subjects. The team implementing the system carried out workshops based on selected ideas that were, indeed, valuable for the project teams. System C, however, is not yet seen as a solution for the knowledge transfer barrier; it has its force in the campaigning aspect but it is not a continuous knowledge transfer process. Not all employees participate on one side and not all project managers are willing to check the suggestions on the other side.

Having the understanding of the current channels to transfer knowledge at the company, we can highlight some observations regarding this transfer from rigs to engineering teams onshore. The main observation is the existence of different systems for knowledge transfer and lessons learned in use at the company; however, part of the knowledge captured from operations offshore is not transformed into valuable information to be transferred to the project teams. In fact, there is more operational information in the formal systems than can be retrieved and used in projects; part of the information is only captured. This happens for two main reasons: because there is not a systematic way to register data in the systems, meaning that each person chooses the action title and subject, making it hard to find or retrieve that information if one is not aware of the situation, and because there are no systems or management strategies for bringing in operational knowledge to the technical organization of the company.

Another important observation is that the technical organization teams pull more operational knowledge than this knowledge is pushed from the rigs. One indication to that are the "nice-to-have" lists from rigs coming in too late in the projects. These lists are a collection of ideas or possible improvements that could be done on the rigs, even if they are not related with any equipment breakdown or risk situations. As there is no place where these ideas can be registered in the formal systems, they are usually kept by the rig managers, coming in to late in the design process when (and if) they are asked about it. Another indication is the informal contacts made by the engineering teams through phone call or e-mails, mostly relying on personal networks, to ask questions related to operational issues.

We also observed that the operational knowledge is not always taken into account in the early phases of the projects, not getting into the formal specifications. Without the formal channels and the information push from the rigs, many times important operational knowledge is not taking into account when developing the initial contract for the projects. This makes it more difficult to include changes in later stages when the knowledge arrives to the project teams. In addition, as there is not a formal transfer of knowledge and experiences from project to project, many problems turn to be recurrent in different projects. The current situation in the company shows that a different approach is needed to bridge the existing issues with the transfer of knowledge.

### *4.2 The existing challenges*

After analysing the current situation, we could identify the main challenges to target when developing new methods to capture and transfer knowledge offshore-onshore. These challenges were discussed and validated by the innovation manager in the company, who is the one in charge of the ideas system (C). One of the main challenges identified is that a lot of the knowledge transfer depends on pro-active individuals,

mostly using informal channels rather than the formal current systems. Depending on the personal experience of the project team members and on their personal network within the company, more or less knowledge from operation will be included in the project.

Another challenge is that the technical organization teams cannot find the (relevant) information in the current systems. In fact, there are too many IT systems, what makes retrieving information difficult. Another issue with the existing systems is that what can be found is raw data, not contextualized information that provides a basis for actions. The project teams then need an operational person to bring the information they need. It is common in most of the projects that a rig crew member is brought to work onshore during the specific project. This person acts as a knowledge broker, bringing in the lacking operational knowledge. However, relying on a single person to bring in all operational knowledge needed over a project does not cover all aspects.

Yet another big challenge is the design of the current systems. They are designed for performance of operation and incidents tracking, not meant for (re)design projects purposes. The information is registered in a way not favourable to retrieve it in order to use in projects. The statistics the systems are able to generate and the search methods do not make it user friendly when looking into operational knowledge to be used in projects. In addition, the key performance indicators for the rigs do not encourage this knowledge transfer, once the rig crew members working hours directly target the productivity of the unit rather than time spent registering this knowledge.

### *4.3 The outline of our approach*

Having identified the current knowledge transfer channels and the existing challenges, we now aim at developing methods to face these challenges and contribute to the transfer of potential knowledge from operations into design and optimization of drilling rigs. Our approach can be outlined into three main steps: capture, transformation and transfer of knowledge.

By capture of knowledge we mean acquiring knowledge from operations by means of our own observations and also from operators' experiences. Again based on the work systems framework, we are working on systematic methods for both observations and interviews supported by tools or templates. The aim is to use these methods to capture potential knowledge from the experiences and the tacict knowledge of the operators embodied in their activities that can be codified afterwards.

The intermediary step stands for transforming the captured knowledge. This knowledge needs to be systematized and formatted according to the receivers' needs. As receivers we understand the engineers and project team members working onshore. The knowledge has then to be codified and "translated" into the design context, making it valuable for improving design solutions. The use of pictures and drawings is one of the strategies to achieve a more common language for communicating the desired knowledge.

Last, the knowledge has to be transferred. How will this knowledge arrive to the receiver is paramount and includes storage in a computer-based repository with easy-to-retrieve features. More than features to make it easier to retrieve this knowledge from the system, a "push feature" is also relevant. It is important that the whole system has a continuous functioning and by that information has to also be registered, and this way "pushed", into the system to contribute to the full cycle of knowledge transfer.

## 5. **Discussion**

In the literature concerning the area of oil drilling we see both a focus on knowledge management systems but also a recognition of knowledge as more complex than a codified piece of information that can be transferred without being transformed. A general challenge is the reliance on knowledge systems in distributed organizational structures and thus the capability of these knowledge systems.

As observed at the drilling company, it is not enough to capture knowledge. This knowledge has to be translated into valuable information for its target group. Today we see a systematized approach to activities performed on the rigs that seeks to capture routines, new activities and lessons learned to both optimize performance and keep a high level of safety offshore. In this context, IT systems become relevant in order to capture, index and store information and lessons learned together with proposals for improvement of work processes, which support the optimization of both safety and performance of the rigs.

Knowledge sharing within and across structures of the Organization to support decision making is one of the ways the oil drilling industry seeks to improve operations and performance. However, understanding the operational work on oil rigs in its complexity is paramount if we want to be able to capture, transform and transfer valuable knowledge that can be used in design processes. As pointed out by Haavik (2010), the way people actually work is not always apparent; there is a need to account for this "invisible work" and the tacit knowledge embodied in it when codifying and transferring this knowledge. But also in order to make this transfer possible, as highlighted by Vianello and Ahmed (2012), understanding which transfer mechanisms are suitable is also a key issue to be considered.

The literature points to the gaps in the existing knowledge transfer system and in key aspects to be taken into account. However, there are still questions not answered. Could other ways of capturing and sharing knowledge support the existing knowledge management systems? Which methods are suitable to capture operational knowledge in order to allow its codification and further translation? How to transform the captured knowledge into a systematized knowledge targeting design improvements? And finally, which format should the knowledge transfer have to address the relevant people using this knowledge? These still open questions are directing the next steps of our study.

## References

Alter, S. 2008. "Defining information systems as work systems: implications for the IS field." European Journal of Information Systems 17: 448–469.

Conceição, C., Silva, G, Broberg, O. and Duarte, F. 2012. "Intermediary objects in the workspace design process: means of experience transfer in the offshore sector." Work 41: 127–135.

Gressgård, L. 2014. "Knowledge exchange systems usage: the importance of content contribution and application in distributed environments." Journal of Knowledge Management 18 (2): 329–341.

Gressgård, L. 2011. "Virtual team collaboration and innovation in organizations." Team Performance Management 17 (1/2): 102–119.

Haavik, T. 2010. "Making drilling operations visible: the role of articulation work for organisational safety." Cognition, Technology & Work 12: 285-295.

Johannessen, J.-A., Olaisen, J. and Olsen, B. 2001. "Mismanagement of tacit knowledge: the importance of tacit knowledge, the danger of information technology, and what to do about it." International Journal of Information Management 21 (1): 3–20.

Ostrom, E. 2011. "Background on the institutional analysis and development framework." The Policy Studies Journal 39 (1): 7–27.

Vianello, G. and Ahmed, S. 2012. "Transfer of knowledge from the service phase: a case study from the oil industry." Research in Engineering Design 23: 125–139.

Wilson, J. 2014. "Fundamentals of systems ergonomics/human factors." Applied Ergonomics 45: 5–13.

Yakhlef, A. 2007. "Knowledge transfer as the transformation of context." The Journal of High Technology Management Research 18 (1): 43–57.