Planning an organizational simulation to support an integrated operation initiative in the oil and gas industry

Fausto MASCIA, Luciano GAROTTI[1], Francisco DUARTE[2], Eric MONTEIRO[3].

Production Engineering Department, University of São Paulo, São Paulo, Brazil

Abstract. An organizational simulation of an integrated operation initiative for logistics is planned to support this organizational project consisting of the implementation of a central collaborative environment and its satellite teams. The main driver of such simulation may be defined according to the ergonomic work analysis that highlights issues related to the mental representation of the logistic process, built by the collaboration between these distributed teams as a means of increasing the distributed situational awareness throughout the system.

Keywords. Organizational Simulation, Integrated Operations, logistics, distributed team.

1. Introduction

Simultaneously to dealing with remote areas and its related challenges, the oil and gas industry have tried new practices of work, named Integrated Operations (IO), with the main objective of improving the onshore support to offshore crew, as an attempt to reduce operational costs and extend the life-cycle of mature fields. The involved companies have built special offices in its onshore headquarters, with facilities as videoconference and ICT tools to allow better communication between onshore and offshore teams. In terms of results of such initiatives, Holst and Nystad (2010) pointed a relevant extension of the estimated life time of Brage, a mature Norwegian oil and gas field, by 10 years.

Since logistics efficiency is a key factor to the success of remote exploitation areas, the industry has invested in IO for planning and logistics, besides operation and maintenance. Issues related to collaboration between different teams, with different educational and professional backgrounds, and accumulated work and practical experiences remain to be studied in order to enrich these design processes.

In this paper we present evidences, resulted from an ergonomic work analysis, related to the strategies adopted by IO workers dedicated to logistics to build a mental representation of the logistic processes they take care. This analysis is part of the first of two phases of an ergonomic intervention in an IO initiative considered as an organizational project. Once presented a literature review on distributed teams and IO, and ergonomic work analysis and simulation, we present the data and discuss how an organizational simulation can be structured in order to promote significant input to the organizational design of the analyzed IO initiative.

2. Distributed teams in Integrated Operations

In an IO implementation, "new technologies enable new ways of organizing work…

particularly utilization of real-time data", allowing "better decision-making and new collaboration models" (Holst and Nystad, 2010). The importance of new forms of organizing the work, identified as "changed work processes" and "moving functions", besides the "use of information technology", is also considered by the definition of IO provided by the OLF - Norwegian Oil Industry Association (2006). Focusing on collaboration between involved teams and its pre-requisites, IO teams shall evolve from the understanding of their own tasks to a common understanding of main goals and tasks of each other involved teams, from written reports to real time data and from individual work to a multidisciplinary work independent of physical location (Ringstad and Andersen, 2006).

The collaboration without dependence of physical location is also considered by Skjerve and Rindhal (2012, pp.709) when affirming "the introduction of IO implies an increased use of distributed teams in operation of petroleum installations". The performance of such non-traditional teams, as virtual teams, is usually very important to the respective organization (Baan and Maznevski, 2008) and aspects as shared understanding, communication and trust are identified between the attributes of teamwork competences and success factors (Skjerve and Rindhal, 2012; Baan and Maznevski, 2008).

3. Ergonomic Work Analysis supporting the Organizational Simulation

Through the activity analysis the ergonomist can develop the enunciation of reasons, criteria and constraints of action, often present in the workers' self-confrontation, characterizing the professional logic, and find work organization issues, related to the external determinants which the worker can't influence alone (Carballeda, 1997). In settings where the competence is intrinsically dispersed in the collective of work, the ergonomist's allusion to the organization will focus less on the task prescription than on quantity of workers, task repartition internally to the team and the work temporal organization. Through the circulation of the activity analysis results, the ergonomist will be able to build organizational simulations that allow comparing the advantages and disadvantages of different possible solutions instead of looking for only the one optimal solution (Carballeda, 1997).

Both the ergonomic intervention and the simulation are opportunities for reflexive activity by involved workers. The ergonomic intervention does it through turning explicit the work and helping its reflection, while the simulation is a reflexive activity itself, with similarities to the alloconfrontation (Arnoud & Falzon, 2013). In the specific case of an organizational simulation, it's an evaluation of prescription rules, and real work centered, and its criteria rely on values, rules of social interaction and subjective representations (Van Belleghem, 2011). The characteristic action situation and the characteristic interaction situation, evidenced by the ergonomic work analysis, are important drivers to the organizational simulation (Carballeda, 1997).

Many issues might have to be solved during the development of the organizational simulation: about the organization object of the simulation related to on which dimensions the ergonomist expects to act; which exigencies the organizational scenario must be adequate to in order to allow simulation, reflexive activity and instruction to the design process; and what activity dimensions must be simulated (Van Belleghem, 2011).

The organizational simulation differs a lot from the conventional PC usability test, when physical and social aspects are of little concern (Dahl et al., 2010). For the simulation to work as an effective tool in the organizational design process, it is critical to identify the right level of simulation fidelity but, by the other hand, "A fundamental challenge related to all simulations, then, is what aspects of the performance context can

be omitted without compromising the validity of the results." (pp.448, Idem).

Dahl et al. (2010) also propose two main dimensional categories of fidelity: physical and psychological, which are composed by two subcategories each. The physical fidelity contains equipment and environment fidelities while task fidelity and functional fidelity compose the psychological fidelity. According to the authors, the responsible for the simulation may choose which subcategories are relevant or not.

4. Methods

We based our approach on the ergonomic work analysis (Guérin, 2001) in an IO initiative for logistics in an Oil and Gas company. The first phase of the analysis was developed through initial meetings and interviews from August to December of 2011, and continued through in loco observations of IO workers of a satellite team, alternated with interviews and meetings from January to July, 2012. The second phase of the analysis has been developed since November, 2013 in a new IO team, responsible for centralizing the information of satellite teams as the team observed during the first phase. Here, most of the presented results are from the first phase and will be validated during the second phase, also because the implementation of the centralized teams brought changes to the organization.

Interviews with drilling engineers, managers, leaders and IO project staffs were conducted to achieve a basic understanding of the initiative in Integrated Operations for Logistics, and to know how the management members were conducting the IO teams in terms of an organizational project, as well as to get information about its first results. Complementarily, meetings were attended by the researcher as mainly an observer.

After the first block of interviews, the observations took place through open and systematic observations. Notes of observed actions and validation of interpretations were taken in parallel. The collected data was analyzed and the actions were tagged accordingly to its contextual relevance. This process of data analysis revealed emerged relevant aspects as need of situation awareness and mental modeling with interlocutors as important issues of the daily work done by the IO operators.

5. Case

5.1 Case setting

During the first phase, the analyzed work setting was the IO-Logistics team responsible for attending the Exploratory Drilling department of the studied company. Such team consists of one leader and five operators. Next to the team were a drilling engineer from the Exploratory Drilling Department and a technician from the Drilling Technical Support, both called material planners. Each IO operator usually took care of attending logistic demands of three to four rigs, being in contact with onboard drilling engineers, onshore supervisor drilling engineers, material planners and logistic sectors. In total, the analyzed team dealt with 8 different ports around the country coast, at least three onshore cargo terminals, and distances between onshore infrastructures up to 3,500km, attending from 16 up to more than 20 offshore drilling rigs simultaneously.

Formally, the IO operators should only take care of materials to be applied into the wells, e.g. tubes, blow-out-preventers and injected chemicals, considered critical by the involved managers. Backloads, transshipments between rigs, water, food, diesel or materials applied into the rig were out of scope. The work prescription encompassed three main tasks: prioritizing and consolidating transport requisitions together above mentioned material planners, and expediting the progress of materials until the offshore rigs together

logistic sectors.

5.2 Context of the IO initiative

After an internal survey among managers and drilling engineers, the Drilling department (DDrill) asked for an improvement on the offered logistic service to reduce the amount of work of the onboard drilling engineers on monitoring logistics. This extra workload was leading to a lacking focus on technical drilling issues and consequently increasing risks of tragic accidents and expensive downtimes.

Initially, the Logistic department (DLog) allocated representatives to work together DDrill's managers in weekly meetings. After short time, these logisticians were permanently allocated inside DDrill's headquarter offices. After the initial months, the drilling engineers and managers approved the initiative and considered the work of monitoring the logistic flows previously done by the onboard drilling engineers had reduced considerably. Based on these evaluations, it was decided to implement IO teams dedicated to answer drilling rigs' logistic demands.

Gradually, the responsible manager recruited internal workers to develop the IO project or to work as IO team operators. This initiative also intended to improve logistic service level and to optimize the use of resources. Seven IO teams of logisticians were implemented to work in different drilling sectors. In this study, the team which attends the Exploratory Drilling Sector demands was chosen to be analyzed since it was considered the team that best managed to implement the new way of working.

6. Results

The interactions of the IO operators with drilling or logistics workers vary in terms of goals and direction (from the IO operator to other sector or the opposite). Mainly, beyond the information transfer, the observed goals were to achieve satisfactory situation awareness, build a usable mental representation of the logistics processes, or acquiring confidence from the interlocutors. In sections 6.1 and 6.2 we present results from the first phase of the field research.

6.1 Distributed situation awareness

According to one observed IO operator, when attending a rig with reduced capacity of cargo, she has to contact the onboard drilling engineer for checking if available material can be shipped to the rig. In these cases, the port will carry materials to the supply vessel only after authorization of the IO operator. The rig's reduced cargo capacity increases the effect of operational variability on the logistic chain by reducing its room for maneuver, requiring more collaboration between involved workers to harmonize and synchronize logistics and operations. From this point of view the more frequent interactions with onboard drilling engineer are a strategy of the operator to deal with the impact of the rig's reduced cargo capacity into the logistic functioning. Such interactions can also be considered as a manner of sharing awareness between the distributed workers.

In fact, the operators usually receive calls or emails demanding information on schedules of supply vessels or about which is the specific port to support determined rig, information that will probably be used by the interlocutor to plan some transportation or issue the formal requisition on the ERM system. Apparently, the IO operators are considered by other workers, mostly by onboard drilling engineers, to be in an advantageous position in the system that enables the IO operators to be accessible by the interlocutors, and to have access to different parts and information of the system, as supply vessel programmers and even contracted companies. From this point of view, the IO

operators are a hub of the system's situation awareness.

6.2 Mental representation

Through mentioned interactions the observed IO operator manages to have clues about what is going on with the rig (e.g. delays or speeded operations and special needs related with rig's restriction), port and other logistic sectors. This way the IO operator becomes able to create a mental representation considering materials' lead time, supply vessels availability and operation needs. Based on this mental representation, the observed operator can collaborate with others in order to achieve a satisfactory synchronization of involved operations, materials and transport resources.

Unusual observed cases also required numerous interaction of observed operator with logistic sectors in order to evaluate and negotiate conditions and lead times. In one observed situation, two power generators would arrive on port one day delayed because problems with the land transport. After noticing this requisition on the Enterprise Resource Management system (ERM) in emergence status, the operator called the land transport responsible and started to monitor the transport to the port. The day before, other materials hadn't been shipped as scheduled to wait for the generators. At this moment, the operator was facing three main issues: the synchronization between the generators' arrival and the carrying of the waiting materials, the lack of authorization of the onboard drilling engineer on the shipment of the latter materials, and the fact the mentioned rig was on demobilization and delays in last operations risk resulting in extra costs due to additional rig renting days.

After checking information presented in emails and the ERM system, and by phoning other workers, the IO operator got the necessary information to enrich its mental representation and synchronize the different material flows. After this, she checked the progress of the processes and called the onshore engineer to inform it as well as the lead times estimated of remaining procedures as receiving the material on the port, carrying it to the supply vessel and the navigation until the rig.

7. Discussion and Conclusion

The simulation emerges as a potential tool to analyze and predict how these interactions may function in a new organizational structure, as with the implementation of the IO-Logistics centralized teams. Specifically the work simulation arises as a methodological device that can help to acquire knowledge between uncertainty, as a possibility of testing still weak hypotheses (Béguin, 2003). Regarding an organizational project as the object of this study, an organizational simulation should be considered the most suitable, despite its actual still low formalization which demands innovation in order to allow representing the organization to be designed (Van Belleghem, 2011).

In comparison with the ergonomic work analysis (EWA), obligatorily done *in situ*, the experimental simulation has advantages as immediate access to relevant situations, created "on demand", and possibility of pausing the actions to collect warmed feedback (Dahl et al., 2010). By the other hand, the necessary realism is not easily achieved, but can be supplied by the EWA as a mean to determine what is important to be present in the simulation. Between the fidelity dimensions presented by Dahl et al. (2010), the presented results of the EWA point to the task fidelity as the most relevant, since it reproduces organizational rules that shape the social interactions of the distributed teams in order to develop a satisfactory mental representation of the logistic chain, in order to improve the synchronization of its different links.

Finally, the organizational simulation to be done in order to help the design of the

setting mentioned herein, considering satellite and centralized IO-Logistic teams, must focus on the involved decision taking processes, after analyzing how they are regarding high or low prescription. Despite the high complexity of the possible scenarios to be simulated, the EWA will help to define which scenarios to consider, which operators to take part in, and which physical tools to support it, as scaled objects representing the links of the chain, organizational charts, process maps and/or spreadsheets.

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