Analysis of Resilience in Offshore Logistics and Emergency Response Using a Theoretically Based Tool

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Abstract. In this paper we use a theoretically based tool for analyzing resilience in offshore logistics and emergency services focusing on work process design in an international oil and gas company.. Analyzing resilience can be structured in different manners, but the classification of monitoring, anticipating, responding and learning is widely recognized. The logistics department is responsible for the second line emergency preparedness, evacuation and utilization of transportation resources in emergency situations. In the paper we argue that *anticipation* is the most challenging area for the logistics department when it comes to resilience. This is due to the fact that they always have to be on the alert for emergencies that they cannot anticipate themselves. Close collaboration with the operating disciplines, forming good relations with them, knowledge of logistical needs related to operation activities and uncertainties and possible consequence for the logistics are crucial to be able to respond in emergency situations. Emphasizing these factors will, in turn, also be beneficial in improving the logistical planning in general, supporting communication and coordination between the different actors in the supply chain.

1 INTRODUCTION

"Integrated Operations" denotes a change process that has been and still is taking place in the oil and gas industry. Integrated Operations (IO) are usually defined in the following terms: *"The vision of the Digital Oil Field is one in which operators, partners, and service companies seek to take advantage of improved data and knowledge management, enhanced analytical tools, real-time systems, and more efficient business processes"* (Edwards et al., 2010, p. 1). Furthermore, they describe three aspects that

are central to recognizing operations as IO:

1. A move to a real-time or near real-time way of working.
2. The linking up of one or more remote sites or teams to work together.
3. A move to more multidisciplinary ways of working.

Supply chain management is the integration of business processes for co-ordination of activities and processes within and between organizations in the supply chain (Cooper et al., 1997). The case in this study is the logistics department in a large oil and gas company in their process of defining new work processes. The company is operating a considerable amount of offshore installations for production of oil and gas. The department is responsible for the logistics emergency response in terms of evacuation and re-routing of helicopters and vessels to fit the needs in emergency situations and also not affecting the response level for other offshore installations.

This paper includes an analysis of resilience in the logistics department in a major oil and gas company. A theoretically based tool for analysing resilience was developed in an earlier work (Ose and Steiro, submitted to Safety Science April 2013). In this work, an onshore support center in a drilling company was used as a case. The scope of this paper is to apply the theoretically based tool for analysing resilience on suggested new work processes for the logistics department to uncover areas that should be emphasized during implementation of these work processes.

2 MATHERIALS AND METHOD

The theoretical foundations for the analyzing tool are High Reliability Organizations (LaPorte and Consolini, 1991; Weick, 2001; Weick and Sutcliffe, 2007) and Resilience Engineering (Hollnagel et al., 2006; Hollnagel et al., 2011). We have also included the concept of communities of practice from the field of organizational learning (Brown and Duguid, 1991; Wenger et al., 2002). We chose to use normal operations as the basis for our analysis, since what is needed in a crisis must in some form be present in the normal situation (Antonsen et al., 2013).

The data gathering was done in the last half of 2012 and consisted of written documentation and governing documents as well as meetings with operational personnel and through participation in internal meetings in the oil and gas company to develop new work processes for logistical planning. In addition, workshops with representatives for the operation of two selected installations were conducted. The workshops were summarized in memos that were distributed to and commented on by the involved participants. Finally, a report was written on analyses of the new suggested work processes.

3 THEORETICALLY BASED TOOL FOR ANALYZING RESILIENCE

Hollnagel et al. (2011) defined four essential capabilities of resilience, namely: the ability to respond, monitor, anticipate and to learn. In this paper, we use these capabilities as developed by Hollnagel (2011) and include the Capability Platform theory described by Henderson et al. (2013), which introduced the sub-categories Technology, Process, People and Governance/Organization. The work of structuring the capabilities of resilience in this manner was started by Albrechtsen and Weltzien (2013) and we also include their work in this study. We have also developed criteria for resilience in earlier work (Ose and Steiro, 2013) and we restructure these criteria to fit the structure of the Capability Platform for Resilience.

Safety is a dynamic non-event (Weick and Sutcliffe, 2007). Major accidents are complex and rare. However, insight derived from High Reliability Organization (HRO) research encourages also the study of everyday practice (Weick, 1987, LaPorte & Concoilini, 1991). Interaction patterns lay the foundations of communities of practice and the way in which deviations are handled. Weick (1993) demonstrated that hastily-assembled groups face difficulties in establishing mutual trust in extreme situations. Sharing more of the same operation on a day-to-day basis may be an important foundation for dealing with crises. Weick and Sutcliffe (2007) argue that the ability to deal with crises requires a broad repertoire of experience and action alternatives and the ability to recombine experiences into novel responses. They also point out that knowledge of the system is important prerequisite for action. Tveiten et al. (2012) see the value of previous involvement as an important feature in dealing with emergencies. Antonsen et al. (2012) claim that what is needed in a crisis must be present in some form in a normal operation. In this paper we concentrate the work around indicators of resilience that exist during normal operation.

We have chosen to treat the various capabilities of resilience as a group of capabilities that must be looked at holistically, which is where the whole picture is larger than the sum of its parts. Having made this selection, removing the capabilities from this holistic picture is not advised because they may not be complete outside of the holistic context or possess some possible flaws. The following sections presents a paragraph for technology, processes, people and organization/governance for each of the main capabilities; monitoring, anticipating, responding, and learning. A summary of the main characteristics for each of them is given in Table 1.

Table 1. Summary of the main characteristics for the capabilities for resilience.

Capability Resilience	Technology	Processes	People	Organization/ governance
Monitor	Structured monitoring of current situation using available technology.	Ensuring quality and availability of both real-time and historical data.	Overlap in knowledge. Willingness and ability to share knowledge.	On-shore experts are involved in decision-making. External experts and inter-disciplinary teams included.
Anticipate	Simulations of future development. Operational risk assessments.	Ensuring expertise availability. Participation in risk assessments.	Mindfulness and situation awareness to understand, interact and predict. Concurrent learning.	Expectations communicated and shared. Development of communities of practice supported.
Respond	Simulator training.	List of events to prepare for. Support from a community of practice.	Skills and knowledge by using simulator & scenario-based training. Common knowledge that is transferred and translated.	Involvement of experts during normal operation to increase the ability to provide support in emergency response.
Learn	Use technology also for learning purposes.	Sharing reports and experience as well as knowledge in operation.	Learning at individual, group and organizational levels.	Learning of strategic importance for the organization, participating in learning activities is legitimized.

The splitting of the capabilities into technology, processes, people and organization/governance could make a valuable contribution to safety management, as this is a structure that includes all the important factors that influence safety. In this respect, it closely resembles the MTO (man/human, technology and organization) approach that has been developed by for instance Hollnagel (2004), but has also included processes which are an important element not so clearly seen in the MTO

approach. In the tradition of MTO analyses, functions that primarily involve the activities of individuals are M-type functions. T-type functions typically involve the functioning of technological systems and O-type functions primarily involve organizational aspects.

4 DESCRIPTION OF THE CASE

The case that is analyzed is the logistics department in a major oil and gas company. The company is operating a considerable amount of offshore installations producing oil and gas. The main objective for logistics and supply chain management is to optimize supply operations in long and short term to meet offshore requirements. Figure 1 shows key actors representing the demand chain/customers and the operations supply chain.

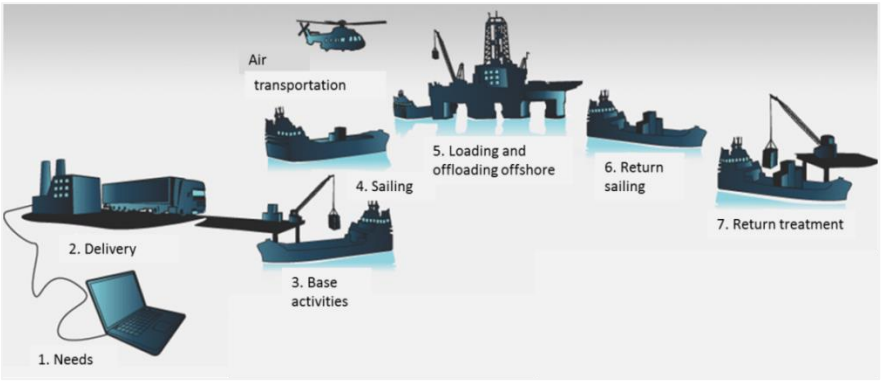

Figure 1. The logistical chain in an oil and gas company (www.logistikkportalen.no).

The supply process covers several categories of supply; food and consumables, operations supplies, drilling material and drill tubes. Each category will have its specific demand characteristics and supply *service requirements which should be taken care of independently for planning purpose, but collectively* for developing the total scope of the service infrastructure and resources (Asbjørnslett, 2003). Roughly, food and consumables are steady consumptions, operations supplies are quite steady and drilling supply and drill tubes are highly variable.

In addition to providing the offshore installations with supplies, the logistics department is also responsible for the second line emergency response. This means to be responsible for evacuation of personnel when needed and also to be responsible for a satisfactory emergency preparedness on the other installations if an emergency situation occurs.

5 RESILIENCE IN THE CASE

Building resilience into the new work processes for logistical planning in the case company was not stated as an objective, but it may, as we see, give an additional value to analyse how resilience will be built and maintained in these processes. As they are not yet implemented, this may give some guidance on what should be emphasized during implementation. The logistics department is a central actor in emergency situations as they are responsible for allocating the transportation resources such as helicopters for evacuation of the offshore installation, re-routing of vessels and also making sure that the emergency preparedness is kept for the rest of the installations when accidents occur.

Monitor

Depicting the current situation is a mean to know what is going on. The new work processes has taken this factor into consideration and efforts are made to make information more easily available and shared in the department. A center is established to get easier access to information from the different parts of the supply chain. Emphasis will also be put on developing shared knowledge. One of the key challenges is to improve collaboration with the operating units and develop a common understanding of the current situation with them. It is also challenging to get the information and to piece it together because the offshore logistics are interacting with many disciplines from the operational units, different sub-contractors, the supply bases, the supply vessels, helicopters and the offshore installations. It is also essential to have a

Anticipate

It is essential for an optimal utilization of the logistical resources that it is possible to foresee possible consequences and changes that are likely to occur. It has been a goal for the logistics department to increase the amount of planned activities and decrease the number of unplanned ad-hoc solutions. In order to be able to do this, it is necessary to have both the close collaboration with the different units and also having the competence to translate what the activities in operation means in terms of logistics. The new work processes will improve this from the current situation, but gaining and increasing competence in these areas needs to be a long-term process that must have strategic importance in the department in order for resources to be spent on it. In order for communities of practice to be developed, there has to be a group of people working together and continuously develop and share the knowledge. It is not realistic that the logistics department can have an overview of all the risks that may cause accident in the company, they always have to be on alert and it is essential that they have systems and routines for knowing where the resources are at any given time to enable them to respond quickly.

Respond

Training in emergency preparedness is done regularly for different scenarios. It is important to build relations to different experts in the normal situation to be able to quickly contact the relevant personnel in an emergency situation. It is also essential to have the technological tools to get necessary information quickly and to be familiar with the systems that are to be used. The oil and gas company has very good routines for emergency handling, and it is important to develop these and make them even better.

Learn

Technology and scenarios are used for learning purposes. Sharing reports and experience is also essential and will be easier with the suggested establishment of a center where the different parts of the supply chain will be better integrated. Learning in the interfaces with the other departments related to logistical demands generated by different activities, uncertainties and the ability to question estimates made in other departments needs to be given strategic importance and resources and legitimize participation in learning activities.

6 CONCLUSIONS

The analysis shows that the anticipation of future risks is challenging for the logistics department as it is responding to all emergency events in the organization and hence needs to be on the alert at all times. Monitoring own activities and being able to get a quick overview on the logistics resources is essential to be able to respond when it is needed. Gaining competence and building relations in the normal operation is a basis for emergency handling as pointed out by the literature. Working on translating the activities in operation into logistical needs, increasing competence in the uncertainties and possible risks related to different activities will also enable a better logistical planning in the company. Integration of operational and logistical planning and building good relations during normal operation will also form the relations that will be used in emergency response. Developing resilience, then, will have trade-offs for both the logistical planning and as a consequence also for a more efficient resource allocation of the logistical resources.

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