Agility and Resilience in Offshore Operations

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Abstract. Today's need to optimize offshore oil and gas production and maximize overall recovery, while safeguarding cost, safety and environmental aspects calls for efficient utilisation of available resources. To handle the uncertainty created by the dynamic and stochastic nature of offshore operations we suggest a development to support resilient and agile qualities in an organisation. We describe these two concepts and relate them to maintenance and modification activities in offshore operations by giving examples from work practice in an onshore operation centre. We look at how the work is organised, the use of quarterly and bi weekly plans and describe how an unexpected problem with a separator at the installation is handled onshore. Further work is suggested to include a methodological and analytical tool to measure resilient and agile capabilities and capacities in an organisation.

1 INTRODUCTION

A vast amount of Maintenance and Modification (M&M) activities are carried out on offshore installations throughout a year. Planning of these activities is characterised by a high degree of uncertainty. Limited resources, system failures, unscheduled maintenance, unpredictable weather as well as subsurface surprises causing interruptions to drilling are some of the factors that make it difficult to complete work according to a predefined plan. This paper discusses deviations to scheduled activities that influence the production rate negatively and unexpected tasks requiring ad-hoc planning and work in order to maintain production rates.

The major part of offshore operation is assumed to be associated with routine tasks, where deviations are easily tackled using standard operating procedures and positive or negative consequences have a minor impact. A small amount of the operation is assumed to be associated with high uncertainty tasks, with a potential for negative or positive effects on the business objectives. In planning and handling deviations to such high uncertainty tasks, the ability to be resilient and agile becomes important. We regard this

as a core capability of the key persons and business processes of an organisation utilising Integrated Operations as a means to achieve their business objectives.

The paper starts by describing planning in offshore operations. It relates resilience and agility to maintenance and modification activities and gives examples of these abilities from an onshore operation centre with a major oil and gas company operating at the Norwegian continental shelf. The collection of data has followed an ethnographic tradition (Hammersley & Atkinson 1995), we observed activities in an onshore collaboration room in addition to informal interviews of key personnel and document studies. The paper concludes by indicating areas for valuable further work within the field of planning and changes to plans for concurrent operation in offshore oil and gas production.

2 PLANNING IN OFFSHORE OPERATIONS

Our study focuses on minor modifications and maintenance tasks performed in parallel with normal operations and production offshore. Modification jobs that are executed in large scale campaigns or project periods where production is shut down are not discussed here. The planning of minor modifications and maintenance jobs is initially done with a long-term perspective which is proactive and in preventive nature, but the plan is to a large degree influenced by corrective tasks and unplanned events changing the original schedule. It is not unusual that these changes happen on a daily basis.

It might be possible to handle some of these changes by creating redundancy in the system e.g. by a high degree of slack in plans or a general overcapacity in the supply chain. This is undesirable due to the cost and physical constraints. The solution may lie with improving the use of the shared resources and to build an organisation capable of handling the inevitable performance variability. This requires work processes and capabilities that are able to find solutions to deviations, as well as maintaining an overview of the actual situation and utilise available resources by managing alternative tasks suitable for that resource.

One of the challenges in the planning process is that most jobs require contribution from several departments and disciplines. The maintenance department itself includes several disciplines, in addition to the drilling, procurement and logistic departments involved. The challenge is to coordinate activities and resources between these departments in an integrated planning and operation context. Inadequate integration of different plans results in an insufficient overall picture of the jobs that need to be carried out. We suggest a formal integrated planning process bringing departmental plans into one integrated plan. This plan should be continually updated and managed by a dedicated planner in an onshore operations team in order to have a single point of contact to handle deviations and “optimise” the use of available resources. The ability to continuously reschedule the original plan in order to satisfy the changing needs of the installation is the core of what we have called Integrated Planning (IPL).

The concept of Integrated Operations (IO) describes a change in work processes in the petroleum industry enabled by the use of information technology (OLF 2006). The benefit of IO is described as increased production, lower operating costs, longer field lifetimes and improved exploitation of the oil and gas resources on the Norwegian shelf. We regard IO as a means to improve decision making through new ways of working utilising real time information to collaborate across social, professional, organisational and geographical boundaries. IO is thus an enabler for more resilient and agile operations in the offshore industry.

3 THEORETICAL PERSPECTIVES

The terms resilience and agility are found in several contexts. We relate the concepts to challenges in planning and concurrent operational changes to plans in offshore operations.

3.1 Resilience

Traditionally, resilience as a concept has been used in crisis management (e.g. McManus 2007) or organisational safety studies (e.g. Weick and Sutcliffe 2007; Hollnagel et al. 2006). Weick & Sutcliffe (2007: 71) describes three characteristics of resilience: the internal and external ability to absorb strain and preserve functioning despite the presence of adversity, the ability to recover or bounce back from unexpected events and the ability to learn and grow. McManus et al.(2007) claim that resilience is a function of an organisation's situation awareness, management of keystone vulnerabilities and adaptive capacity in a complex, dynamic and interconnected environment.

This paper uses the concept as described within the resilience engineering tradition (Hollnagel et al. 2006) where resilience is seen as the ability within an entire organisation to respond, monitor and anticipate threats to normal operations. This capability makes it possible to predict, plan and produce a wanted outcome during continuous operations. It also facilitates adjustment of functionality prior to or following changes and disturbances. The properties of a resilient system include a buffering capacity, flexibility, tolerance, and an ability to manage margins. According to this perspective variability in a system is regarded as an advantage, thus resilience is achieved by controlling variability rather than by constraining it.

3.2 Agility

The term agility is found within at least two domains; manufacturing and supply chain management (e.g. Preiss 2005; Goldman et al. 1995; Iskanius 2006; Shari & Zhang 1999) and network centric warfare (Alberts & Hayes 2004). The main content of the definitions is the capability to respond to changing environment and be able to benefit from it. It is a strategic willingness and objective to embrace changes and actively seek out the opportunities within a change.

Preiss (2005) understands agility as a response to business challenges profiting from changing customer and market requirements. Agility is seen as a comprehensive response to an industrial change that has made a mass-production system inadequate. Goldman et al. (1995:3) say that "Agility is a comprehensive response to the challenges posed by a business environment dominated by change and uncertainty". This requires manufacturing, and especially lean manufacturing, to cope with changing customer demand and increased demand for customisation of products in addition to a focus on reducing waste to a minimum. According to Shari & Zhang (1999) agility has two main qualities; the ability to respond to change (anticipated or unexpected) in proper ways and in due time and the ability to exploit changes and take advantage of them as opportunities both tactically and strategically.

Alberts & Hayes (2004) define agility as a complex capability comprising the following elements: robustness, resilience, responsiveness, flexibility, innovation and adaptability. The elements are influencing each other and they are overlapping and dependent. Agility is found on both individual and organisational levels. In their perspective, the agile capability relies on advanced ICT network for information sharing, collaboration, decentralised problem solving and ability to self synchronise to the overall "organisations" current state of operations.

3.2 Agility and Resilience in Offshore Operations

We see agility as the individual and organisational capability to detect deviation from agreed plans and to exploit the opportunities arising from a deviation in a timely and resource effective manner, hence generating added value. This may involve activities like information gathering and enhancement, creating situation awareness, solution finding, resource allocation, decision making and task implementation. We understand resilience as an organisations ability to anticipate, monitor and respond to an unexpected event minimising the effect of this on other activities. This is a form of damage control. The organisation is able to perform the majority of its planned activities despite the presence of adversity and is able to recover or bounce back from the event.

Achieving both agile and resilient planning and operation involves some similar tasks like information gathering and enhancement to achieve a shared situational awareness as a foundation for decisions related to managing deviations. While implementing the decisions, similar resource evaluation and allocation will be utilised. The major difference between the two is in the objective of the solution being sought. The resilient operations will focus on minimising the effects of a unwanted situation where as the agile operations will focus on exploiting the opportunities arising from the deviation. This difference in objective is likely to lead to different solutions being selected given the same deviation. For instance: a resilient organisation may choose to postpone a task due to lack of material and leave the resources idle where as the agile organisation will try to come up with alternative tasks that can be performed by the available personnel.

4 ONSHORE OPERATION CENTRE

The onshore operation centre supports the offshore production and maintenance department. It is responsible to plan and coordinate maintenance- and modification tasks performed offshore. Several different disciplines are placed in the centre. Among these is operation maintenance lead, mechanical as well as automation and electric maintenance leads, installation manager, safety lead, technical support representatives from contractor and a bed planner. The centre has in addition a dedicated planner responsible to coordinate and integrate the different plans.

The centre consists of an open office landscape in conjunction with a collaboration room as well as some traditional cell offices and meeting rooms. The collaboration room has advanced videoconference and ICT solutions for real-time interaction and decision support. It is used for different purposes throughout the day, both pre-scheduled meetings with the offshore crew and ad-hoc needs.

The centre has a planning structure consisting of biweekly and quarterly operative plans as well as more long-term strategic and tactical plans that make the basis for the operative plans. The quarterly plan shows the scheduled work orders for a three month period. It presents a principal work schedule and shows priority of activities, their status and dependency on other activities. It is continually updated reflecting offshore notifications of work to be done. The biweekly plan divides the work orders given in the quarterly plan into more detailed tasks. The schedule of the tasks is laid every second Monday and valid from the following Thursday in order to follow offshore shift rotations. When the plan is handed over to the responsible shifts offshore it is “frozen”. This implies that the onshore organisation will not initiate any changes to the plan in the two weeks it is effective but has a support function, responding to the needs or changes brought up by the offshore organisation. The offshore organisation is thus responsible for the reprioritizing of the jobs in the plan caused by unforeseen events or jobs requiring longer time than planned. The result is that some of the scheduled tasks on the plan will not be done during the two weeks giving room for unplanned tasks. Most of the jobs that are not performed as planned are rescheduled in the quarterly plan.

4.1 Planning and flexibility

The scheduled load of the biweekly plan is at 70% of available capacity within each discipline. The remaining work hours accounts for the unforeseen events or notifications that must be handled during the two weeks. The flexibility that this gives the offshore organisations is appreciated. It gives room to execute tasks that must be done immediately or doesn’t require onshore planning. This incorporated buffer makes the system more resilient by giving it the ability to anticipate, monitor and respond to deviations from agreed plans, minimising the negative effect on other activities.

Generally 80% of the scheduled activities are performed during the two week period, but there are slight variations between the different shifts in plan attainment. Some of the shifts are able to complete jobs that are not highly prioritised but can be done as a result of available resources. This indicates a difference found either in individuals or teams to see new possibilities in a situation and grasp the given opportunity to complete several jobs including unscheduled tasks. It is a dynamic quality that is typical with an agile organisation.

The onshore operation centre is aware of the difference between the shifts and plans the work orders in the quarterly plan accordingly. Jobs requiring specific abilities are scheduled with the crew that is known to have the required capabilities. The performance variability between shifts is seen as an advantage rather than a weakness. This is in line with a resilience engineering perspective that regards variability as an asset. Rather than constraining variability it is controlled by adjusting the schedule to the abilities of the different crews.

4.2 Malfunctioning separator

Our fieldwork consisted of observations of work practice in the onshore operations centre. During one of our visits one out of two separators on the installation had recently failed, reducing the gas production capacity. The running dialogue that was kept between offshore and onshore personnel revealed both resilient and agile capabilities in the organisation. It functioned as a first stage failure evaluation but also gave room for further planning and problem solving.

The morning meeting between offshore and onshore organisation aims to go through last the 24 hour period notifications, clarifying and distributing actions to the offshore personnel. The separator incident was the main theme during this morning meeting. Time was spent discussing last night's attempts of locating the failure. Already planned tasks had to be re-prioritised, involving re-scheduling of the quarterly plan to create room for separator maintenance. Updates of the plan took place real-time in the collaboration room, using different decision support tools. These activities gave room for agile qualities. Even if the main focus was on fixing the separator, the team tried to see what other tasks could be executed in the same period of time. They used a priority list related to the different future projects in order to reschedule the quarterly plan with regards to limitations but they also discussed what possibilities lay in rearranging jobs and using unavoidable down time in order to execute several jobs simultaneously.

At short notice, the vendor that delivered and installed the separator participated in one of the meetings between offshore and onshore personnel. This made it possible for the offshore management to give the status and key issues they had discovered directly to the vendor. It illustrated resilience capabilities by efficient response in order to minimize the effect of the disturbance.

The role of the dedicated planner is an asset in supporting agility and resilience in the team. Even if formal decisions lie with the disciplines and the offshore installation manager, the planner role plays an important part in the decision making process and the ability to manage margins while maintaining production. We observed how the planner participated in the ongoing problem solving and kept track of changes and managed the discussions between offshore and onshore personnel. He focused on the customer demand of the offshore organisation in order to respond to changes in their schedule. The role of the planner enables search for opportunities within a change and should be regarded as an important resource in an agile organisation.

The dedicated planner usually managed the meetings, and put together tasks to be performed based on the earlier discussions. It was of particular interest to see how he used mind-map to guide the discussions and brainstorming/ problem solving process. This process of collaboratively gathering, sharing and verifying information enhanced the shared situation awareness of the team. It gave room for rapid resource allocation, decision making and task implementation when establishing the solution space.

Most of the activities that we observed took place in the collaboration room. The room seems to be an important tool in creating shared situation awareness. The use of advanced videoconference and other ICT solutions for real-time interaction and decision support makes is possible to share a vast amount of information between offshore and onshore personnel. For instance, both parties viewed the same photograph of the crack in the separator in order to visualize the problem and get a shared understanding of the problem at hand. Both resilient and agile management of deviations require situation awareness.

Even if previous planned actions were postponed, and the production was reduced because of the failed separator the system as a whole was able to continue. During the separator malfunction they also experienced problems in drilling. The ability to maintain at least some production despite several disruptions shows resilience. The organisation did not lose focus on its main objective and the stressful situation remained under control.

5. CONCLUSION & FURTHER WORK

This paper has pointed to some of the abilities in offshore operations planning that support agility and resilience. Based on this insight, a logical next step is to create a basis to measure the resilient and agile capabilities and capacities of an organisation, as well as the value of utilising the agile and resilient capacities in operational situations. In order to do this we need to develop a tool that makes it possible to compare research and verify findings.

The study presented here will be used as a starting point in the development of the tool. What needs to be done in future work is to refine our understanding of the agile and resilient concepts and define these into specific, observable parameters that can be used as an analytical basis. We seek to develop this into a method where the different parameters come in as a basis to measure a current state with respect to agile or resilient capabilities and capacities, indicating the value of these in a given operational situation. The goal is to test the analytic tool in several cases in order to compare it to actual practice.

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