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Integrated Operations—Observations From More Than 40 Field Evaluations

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Abstract

Integrated Operations (IO) have provided increased value to the oil industry in recent years and several fields have documented beneficial results from ongoing IO initiatives. Each field has various challenges related to optimising the field management, but there are also similarities. To clarify where the potential of increased values are, numerous field evaluations have been conducted. The background from more than 40 of field evaluations has lead to some interesting observations. This paper will describe the procedure in a field evaluation and how the key aspects are identified. Five central observations will be discussed in detail.

Introduction

Integrated Operations is often described as the integration of people, process, and technology to make and execute better decisions quicker. It is enabled by the use of real-time data, collaborative technologies, and multi-discipline work flows. IO has contributed to adding value in the oil industry over the past several years [1, 2]. Beneficial results from ongoing IO initiatives have been documented in terms of increased recovery, increased and accelerated production and reduced costs [3]. Each field is managed differently and faces different challenges, and thus it is important to identify where the greatest potential for improvement is when it comes to implementing IO initiatives. It is then adequate to perform a field evaluation that point out these areas, which in this paper is referred to as *critical key aspects*.

During the last few years, Epsis has participated in evaluations of the potential of Integrated Operations in more than 40 oil and gas assets. These assets are located in different geographical regions covering the North Sea, the USA, South America and South East Asia, as well as spanning a large variety of field types (onshore/offshore, field in production (i.e., brown fields/fields) in the project phase (i.e., green fields), oil/gas). Mature onshore fields with more than 10 000 wells, high technology offshore fields and remotely controlled sub sea development are examples of the many different characteristics. A geographical overview is shown in Figure 1.

The evaluations have been accommodated to each field and have consisted of analyses of IO initiatives (both in progress and planned), IO implementation recommendations as well as assessing the value of implementing IO (i.e., creating IO business cases. A common feature for all of the evaluation is that key aspects for potential improvement have been identified. To conduct such an evaluation, the asset teams carry out a brainstorming session to make a list of important challenges concerning management of the field. Subsequently, these challenges are grouped into key aspects and finally the key aspects are ranked by each of the team members individually. A scoring system analyzes the individual ranking and a total field score is created – the critical key aspects are identified by those key aspects receiving the highest scores. As the scoring of critical key aspects is performed the same way in more than 40 field evaluations this forms a solid background material for some general observations.

The efforts in IO have generally been focused on better collaboration by means of technology and new work processes, and have been introduced on different organisational levels. This paper outlines where the people managing the field on a day-to-day basis see the largest potential for improvement. The analyses are based on results from 32 evaluations represented by 19 offshore fields and 13 onshore fields – of those 27 are oil fields and 5 gas fields – 26 brown fields and 6 green fields. Field evaluations where less than 5 members of the asset team have ranked the key aspects have not been included; hence only 32 of the 43 field evaluations Epsis have been part of conducting has been included in the analysis.

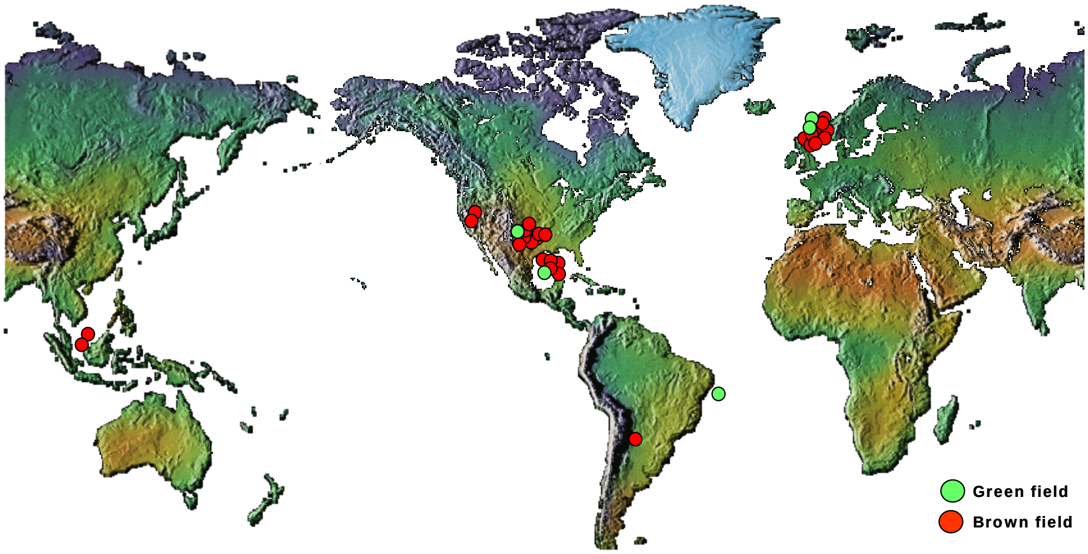

Figure 1. Geographical overview of the field evaluations

Field Evaluation Process

A field evaluation process has been developed to assess how IO can contribute and also identify where the greatest potential for implementation is. The field evaluation is conducted by a team of typically 2-6 people; some of these have been from the oil company and some from consulting companies. Some of the assessments have also been conducted without oil company team members on the evaluation team. However, it is important that all the team members conducting the field evaluation have experience, knowledge and understanding of how a field is operated (reservoir and well flow, process plant, drilling, operation and maintenance IT, HES and economy etc.). Information and background material about the field (Field Development Plans, Long-term asset plans, operational plans, reservoir management plans, documentation of work processes, IT structure, reports, maps etc) gives valuable initial grounding for the evaluation team.

As the onsite part of the assessment begins, an overview over the main challenges or key aspects is made in a brainstorming session lead by the evaluation team; a representative cross section (typically 8-16 persons) from the asset team takes part in the identification and ranking of the key aspects. The advantage of doing the process this way is that everyone's opinion is equally important. Also, by managing the process with personnel not usually in the asset team, a value neutral process can be conducted. Thus, it is easier to communicate the outcome back to the asset team, and easier for the team to use the results, than if a fully asset team internal process was conducted.

The process of identifying the critical key aspects is carried out during three sessions:

1. Brainstorming
2. Grouping
3. Ranking

The key elements of each of the steps are discussed in the subsequent sections.

Brainstorming

The brainstorming session is conducted with a cross section of the asset team. The session is used to identify an asset's critical key aspects. The aspects of an asset management process define the issues of importance for the asset performance in terms of:

- Increased reserves
- Increased daily production (accelerating production)
- Reduced operation and drilling costs
- Improve HSE and fulfil authority and management requirements

The key aspects are used to identify the areas of highest potential to create increased values for an asset.

The brainstorming session provides a long list of challenges or key words; typically between 50 and 100. These key words are often either the same aspect, linked to each other or at a different detail level. Thus, it is sensible to organize the list into some key aspects.

Grouping

After the brainstorming session the long list of challenges/keywords is sorted into a shorter list. This is executed in a large group session or in smaller groups, where the asset team sorts the long list into typically around 15 key aspects. Each key aspect is given a numbering letter and a name, with the key words from the brainstorming listed beneath indicating the specific meaning. For example, “Data” as a key aspect can have a different meaning for different field evaluations; it can e.g. be the organizational elements of Data that has been discussed or it can be Data from a technology perspective. It is thus important that the asset team both recognize and understand the meaning of each key aspect from the brainstorming session and relate to the concrete meaning they had in mind. This is essential if the results of the scoring sessions are to give a realistic picture of the criticality of the different key aspects. Figure 2 shows an example of key aspects and some key words characterizing the key aspect.

A Voidage management
- gas and water monitoring
- pressure monitoring

B Data structure & accessibility
- common database
- visualization

C Lost production
- Record and analyse lost production data
- Learn and improve to avoid losses

D Start-up after shut-in

E Maintenance
- preventive maintenance
- condition-based monitoring

Figure 2. Example of an organized long list

Ranking

The key aspects are ranked relative to each other to identify the most critical key aspects; a process which is conducted individually by each of asset team members. Each key aspect is compared to every other key aspect and gets a score. By calculating all the scores for all the key aspects, all the key aspects may be ranked. The ranking is done my evaluating all the pairs of key aspects and assess whether one of the key aspects in the pair is of more or much more importance or if the key aspects are of equal importance. A spreadsheet tool has been developed to do the ranking. The calculation procedure gives each of the key aspect a relative score between 0% and 100%. 0% indicates that the key aspect has received no scores (i.e., been considered to be of lower importance than all other key aspects) while 100% indicates that this key aspect is the most important one. The only way the 100% score can be calculated is that that key aspect is much more important than all the other ones and that all the other are of equal importance.

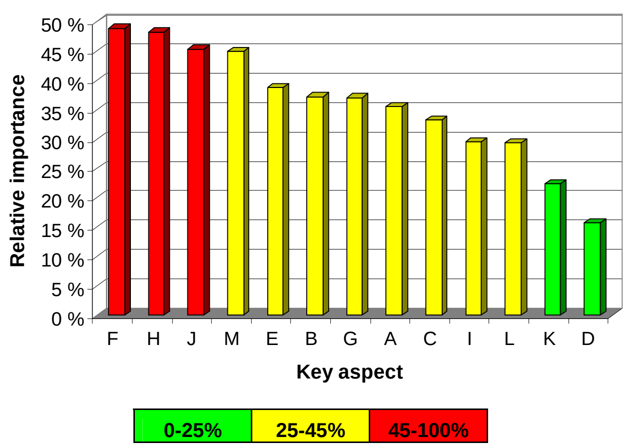

Figure 3. Key aspects are ranked as critical, average important and less important

A key aspect is considered to be critical when the score is 45% or more (red colour); typically 20% of the key aspects will be defined in this category. A key aspect with average importance is scored between 25% and 45% (yellow colour). Key aspects scored below 25% is categorised as less important (green colour); typically 20% of the total aspects. The ranking of the key aspects is illustrated in Figure 3.

Sometimes the scoring of a key aspect is polarized in the asset team. This means that it is ranked as very important by a significant part of the asset team, less important by another significant part and by very few (or none) ranked as average important. Figure 4 shows the number of scorers that score a key aspect to be critical, important and less important. As can be seen from the figure, every key aspect has at least one green (less important) key aspect and one red (critical) key aspect. This illustrates that all the key aspects identified and scored are of some importance within the asset team.

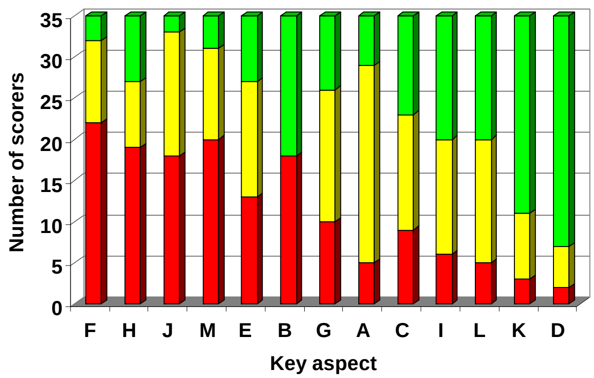

Figure 4. The key aspect B has a polarised score

An illustration of polarization is key aspect B in Figure 4. For this key aspect, half of the asset team scores is to be a critical key aspect while the other half regard it as of little importance. In some cases this is due to the asset team misunderstanding the meaning of the key aspect, but usually such a polarization emphasises different opinions on the importance of the key aspect; either organisation-wise or discipline-wise. The opinions may differ between asset team members working onshore or offshore, or between management and employees. It is important to be aware of this polarization so that the asset team can have a discussion and get a common understanding of the importance of the key aspect.

The categories

All critical key aspects from the assets in this analysis have been categorised into different categories. This is done to highlight which areas the asset teams consider to have the highest value potential for improvement. The critical key aspects have been divided into seven different categories with five basic production system categories:

- *Reservoir Management*
- *Production Optimisation*
- *Field Operation*
- *Drilling and well operations*
- *Maintenance*

The basic production system is here defined as the system where the hydrocarbons flow from the reservoir through the production and processing system to the natural off take. In addition activities directly related to create and maintain this system are included. There are also two additional enabling technology categories:

- *Competence, work processes & collaboration*
- *Data management*

Results and Discussion

The distribution of the critical key aspects resulting from the 32 assets included in this study is shown in Figure 5. As is shown in Figure 5, 29% of all critical key aspects identified would fall within the category *Reservoir management* whereas only 4% would fall within *Drilling and well operations*. Of the 32 assets included, 19 were offshore fields and 13 onshore. In Figure 6 we show the distribution of critical key aspects divided into offshore and onshore assets.

The results presented in Figures 5 and 6 above allow for a number of observations and comparisons. The assets included in this study are geographically scattered, widely different in size and maturity and covering both onshore and offshore assets, but all evaluated using the same methodology hence allowing for a rather unique comparison.

Value proposition

All assets included in the study identified critical key aspects where Integrated Operations could provide substantial additional value. Taking the diversity of assets into consideration it is not obvious that a small, mature onshore gas field would benefit from Integrated Operations. This observation shows that the underlying technical challenges are similar irrespective of size and age. It also shows that the issue of “information overflow” – merging competence, work processes and information is a more general challenge and not something that is particulate for new, large offshore developments. Several fields included in the evaluation had already documented results of implemented IO measures showing increased recovery rates, increased and accelerated production and reduced costs.

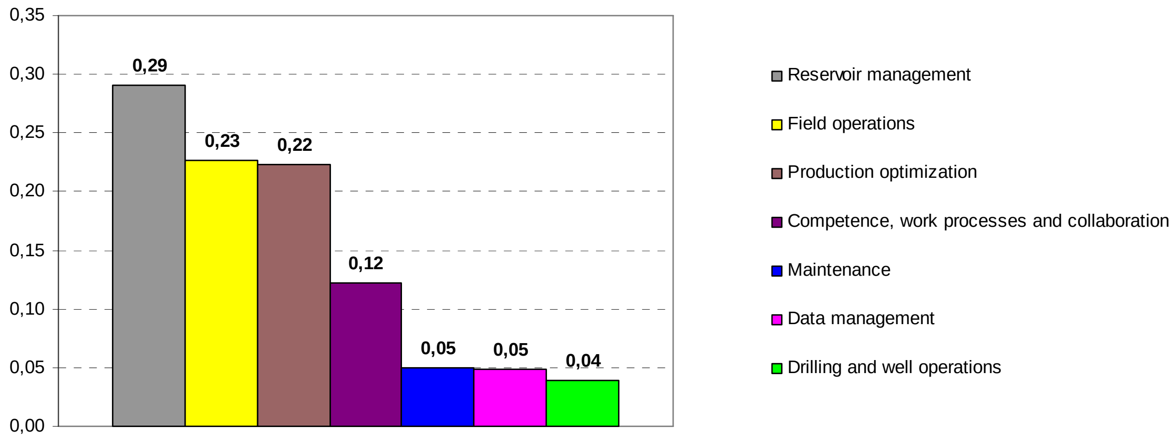

Figure 5. Relative distribution of critical key aspect

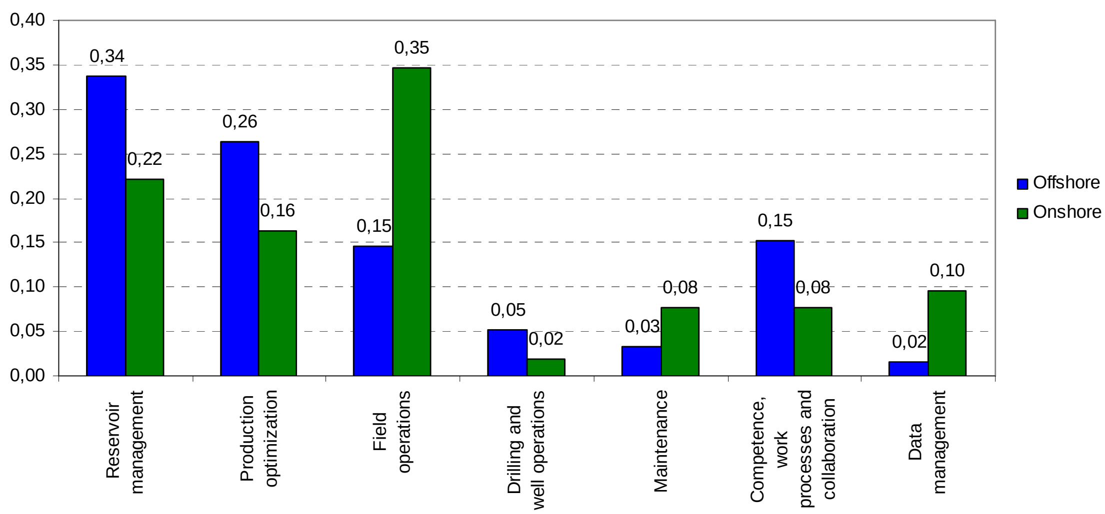

Figure 6. Relative distribution of critical key aspects onshore fields vs. offshore fields

In the current evaluation the participating asset member where asked to identify and prioritize the key aspects that could provide additional value. They were, however, not asked to assign a quantitative value to specific critical aspects. In a recent study commissioned by OLF [3] the value potential related to the implementation of Integrated Operations to the Norwegian Continental Shelf was investigated. This was a quantitative study where the actual value increases were estimated. The OLF report concludes that implementing IO could represent a total value of NOK 250 billion. The OLF study also gave a distribution of this value potential in terms of categories. In Figure 7 we show the distribution of the value potential of implementing IO based on a brown offshore oil field, according to the OLF study. Figure 8 shows the distribution of critical key aspects resulting from assets team evaluations of brown offshore oil fields. The overall similarity of the two is striking in particular since the methodologies are quite different. The categories *Reservoir management* and *Production optimization* have the largest critical key aspect distribution (about 2/3 in total) and also have the largest value potential (more than 80% in total).

The fact that two different approaches come up with such a similar picture of the value potential will in our mind strengthen the credibility of both approaches. The asset team members have demonstrated a solid understanding of where the additional value could be generated and the value estimates given in the OLF study are in line with the opinions of the various asset team members.

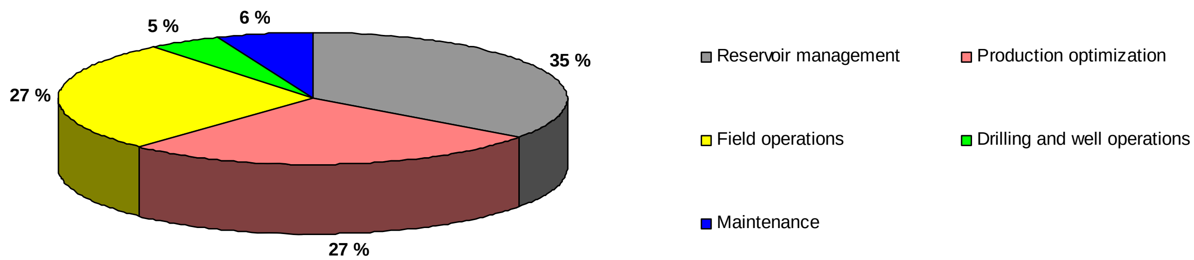

Figure 7. The value potential distribution

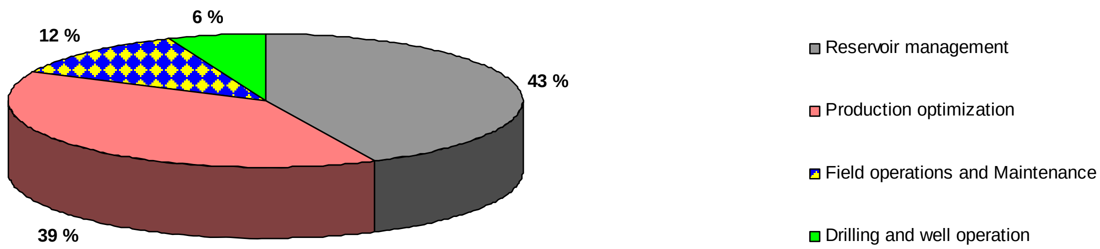

Figure 8. The critical aspect distribution

Basic production system vs. enabling technologies

The value potential of Integrated Operations is to a large extend related to improvements in the basic production system and approximately 80% of the critical key aspects shown in Figure 5 above are directly related to the basic production system. This is not surprising – it reflects the value proposition as well as the fact that an asset team's primary focus is on challenges related to short and long term field optimisation. An asset team is by nature a technology organization having skilled engineers and geoscientists. Even if their daily work can be hampered by lack of integration or operational issues, they have a clear understanding where the real value resides. The fact that the value generated from implementing Integrated Operations to a large extend coincides with the asset team's primary focus does not necessarily imply that IO is seen that way. Integrated Operations involves a change process and the transition that IO represents in terms of collaboration and new work processes can be regarded as an enabling technology rather than a way of improving the basic production system. Integrated operations represent a challenge to the traditional way of executing the operations and as any profound change process it will require a strong management attention to secure sufficient push in the change process. The asset organizations natural tendency to give priority to issues that directly influence the basic production system can result in a change process that is inadequate to release the actual value potential from implementing IO either because it becomes too slow or too "half way". Strong management involvement is one of the characteristic for the fields that have successfully implemented IO.

Competence, work process & collaboration – the key enabler

One of the perhaps more surprising findings in our study is the high score for the category *Competence, work processes & collaboration.* As is seen from Figure 5 this category scores twice as high as categories like *Data management* and *Drilling and well operations*. Even if the daily operations have a considerable focus on drilling operations and data management often is a time consuming exercise it is evident from our study that for the E&P – industry at large, the scarce availability of key competence is seen as a significantly more critical key aspect for realizing the value potential of the assets. This criticality goes along two different dimensions: (i) By nature a substantial part of harvesting the value of an asset calls for interdisciplinary collaboration, e.g. reservoir engineers and geologists must collaborate with drilling if they want their downhole targets to be optimised. A traditional, sequential way of working can be seen as either to competence consuming or too slow. (ii) The more pronounced the scarcity of competence becomes the more important it becomes too utilize the available competence better. Collaboration is seen as a way of obtaining more effective use of available competence by "bringing the problem to the expert rather than bringing the expert to the problem." Interdisciplinary work processes and collaboration are both in essence a response to the challenge of making necessary decisions in an environment where access to the competence necessary is limited. *Data Management* and *Drilling and well operations* occupies a substantial part of the daily operations. Consequently when asset team members are interviewed they will always come up statements like “60-80% of an engineer’s time is spent on finding and preparing data” and “we under-utilize available data”. Even so, when the same asset team members evaluate the criticality from a value perspective *Competence, work processes & collaboration* is seen as significantly more important.

Drilling and well operations as a category has a relatively low score considering that the costs associated with this activity amounts to 50% or more of the total cost. However, the challenges in this discipline is seen as more of an operational challenge and cost issue than as critical for realizing the value potential. This view is consistent with the findings in the OLF report discussed above.

Onshore fields vs. offshore fields

The overall distribution of critical key aspects does not vary dramatically between offshore and onshore fields, showing that the challenges related to exploitation of oil and gas fields are of a common nature. As is seen in Figure 6 onshore fields are, however, more concerned with surface field operations whereas offshore fields have a larger focus on subsurface aspects, i.e. production optimization and reservoir management. This difference is not surprising since offshore fields in general have limited availability for new wells and at a high cost whereas onshore fields tends to have a complex and distributed surface process structure that is more difficult to optimise and more easily becomes a bottleneck for production. This is consistent with the fact that *Drilling and well operations* has a higher score for offshore fields than onshore ones, as is also shown in Figure 6.

Data management

Data management has a significantly higher score for onshore fields than for offshore ones. This finding is not intuitive since offshore fields in general have more complex instrumentation than onshore ones. One could hence expect *Data Management* to be more of a challenge for offshore fields than for onshore ones, i.e. the other way around. Many of the onshore fields are, however, old fields with a large number of wells combined with old instrumentation, insufficient database systems and inadequate IT - infrastructure. Hence, even though the data intensity is higher for an offshore field the total *Data Management* burden becomes more of a problem for onshore fields.

Conclusion

The study resulted in five central observations. (i) Every field evaluation identified critical aspects where Integrated Operations could provide substantial value. (ii) Approximately 80% of the critical aspects are directly related to the basic production system. (iii) The category *Competence, work processes & collaboration* are seen to be the key enabler. (iv) Onshore fields are more concerned with field operations, whereas offshore fields have a larger focus on production optimization and reservoir management. (v) *Data management* is a more significant challenge for onshore fields than for offshore fields.

Acknowledgement

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