

Islands of excellence in oceans of mediocrity?

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At the IChemE Hazards27 conference, Mark Gallagher presented the Formula 1 story and the efforts to improve safety following the tragic loss of Ayrton Senna at the San Marino Grand Prix in 1994. At the lecture, Mark used a phrase '*if you want to swim in success you want to avoid having islands of excellence in oceans of mediocrity*'. This quote is the inspiration for this paper as well as providing the title.

The offshore oil industry involves hazardous materials, in hazardous environments, the use of complex systems and depends on fallible people. The many major accidents that have occurred highlight the risks associated with the industry and for many define its nature. As well as the tragic consequences for the people killed and injured, these major accidents have affected the industry's reputation. The industry also faces challenges from lower oil prices and environmental pressures and the risk of climate change that make reputation an important factor the further development of the industry.

Major accidents have had a major influence in the development of legislation and standards associated with the offshore oil industry and there seems little doubt that the consequential improvements in design and operation have led to a reduction in major accident risk. The development and application of technology has arguably also contributed to risk reduction, although challenges in implementation of new technology should not be underestimated. The industry has an ambition and a moral responsibility to continuous improvement and reduction in risk. In addition, an acceptable level of safety is a key element in the companies 'License to Operate'. To this end, it would seem that the companies have an incentive to share experience and learn from each other. There should be obvious benefits in the exchange of best practices that would lead to continual improvement in safety performance and reduction in risk.

The authors are consultants working in the offshore petroleum industry in Norway with experience from both onshore and offshore operational and management positions. They have worked with many operators and contractors and have had the opportunity to experience different ways of working and different cultures. They have built up a view on what seems to work and what does not. After listening to Mark Gallagher and reflecting over his thoughts on 'islands of excellence' and 'oceans of mediocrity' they have considered the following questions.

- Are there differences between the operators that indicate 'islands of excellence' and 'oceans of mediocrity'?
- How can these differences be recognized?
- What are the key factors that characterize these differences?
- What do these differences mean for how the industry could improve?

In this paper, the authors will consider these questions, present their observations and reflections and provide some ideas on how to improve performance and reduce major accident risk.

Why are Islands of Excellence and Oceans of Mediocrity not desirable?

Mark Gallagher made the statement in the context of the safety for people involved in Formula 1 and the prevention of driver fatalities, Ref. Gallagher. In Formula 1, safety is not considered a competitive factor and all participants have a responsibility to contribute with experience transfer and sharing of best practices. It is not acceptable that any participant has lower standards and poorer safety performance than the others. It is also not acceptable that the participants with higher standards and better safety performance do not contribute to improving the standards and safety performance of the others.

Any participant that makes significantly more progress within safety than others implies there are barriers to implementation of improvements and the process of sharing and learning is not functioning effectively. In Formula 1, these barriers could result in fatalities. In the authors view the message in Mark Gallagher's statement is if islands of excellence are being created then the industry is not being successful in its ambitions. Another implication of Mark Gallagher's message is that achievement of excellence across Formula 1 requires continuous improvement for all participants. The intention is not to average our safety performance across the industry.

In Formula 1, there had been a gradual reduction in driver fatalities from the inaugural season in 1950 until 1986 that indicated improvements were being made, see figure 1. In the period from 1986 to 1994, there were no driver fatalities. This was due to a focus on driver safety and in particular the implementation of precautions to prevent fires. Roland Ratzenberger's death during practice and Ayrton Senna's fatality, both at the San Marino Grand Prix in 1994, shocked the racing world and the public. This was the time of 24-hour newsreels and Senna's crash was shown repeatedly on TV, and this enhanced the public concern. The teams (Formula 1 Group), the regulator, FIA (Federation Internationale de l'Automobile) and drivers got together and agreed a way forward on prevention of fatalities within Formula 1. Performance standards were developed for the cars, the tracks, the drivers and the emergency services and measures were put in place to achieve these. There was clear engagement of all the stakeholders in Formula 1 and a focus on sharing of safety improvements. There were no Formula 1 fatalities from 1994 to 2014 although there were serious crashes that drivers survived. The tragic loss of Jules Bianchi following a crash at the Japanese Grand Prix in 2014 was a reminder of the hazards of Formula 1 and the danger of complacency. It was also a reminder of the need for continuous improvement. No one stays excellent by standing still.

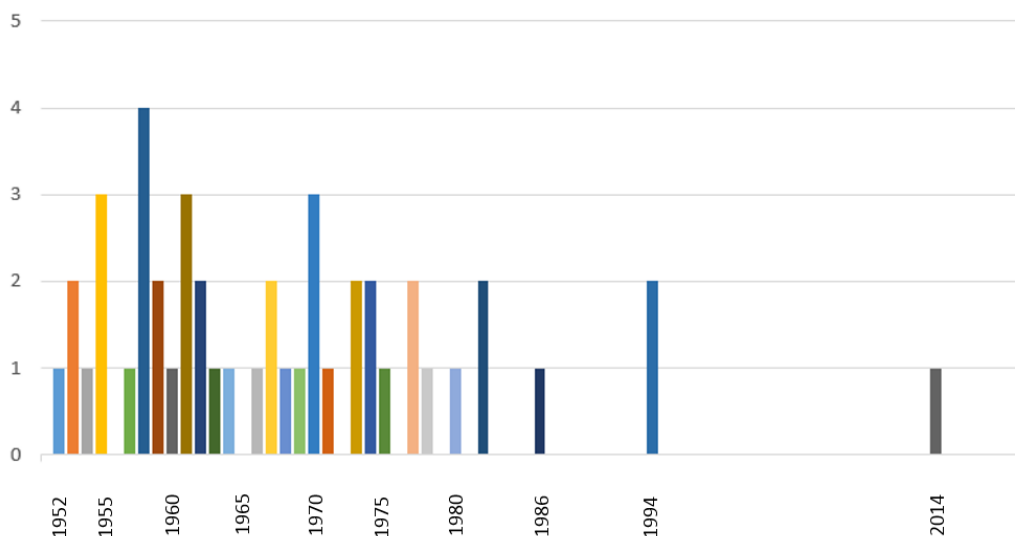


Figure 1 Formula 1 driver fatalities annual basis

Are there ‘islands of excellence’ and ‘oceans of mediocrity’ in the offshore petroleum industry in Norway?

The authors have worked in the offshore oil industry for a total of over 80 years and have experience with operations, engineering, drilling and management positions both onshore and offshore. Mike Pollard has mainly worked within Drilling and Wells and Graeme Dick in Operations and Field Development. During the past two decades, the authors have worked as consultants and have worked directly and indirectly with many of the operators and contractors working in Norway and the industry regulators. The authors are currently working on learning from major accidents through their company Reflekt AS. The experience of working with different operators has given them an insight into the operator cultures and their attitude to learning and experience transfer. Reflection over this experience has been valuable in being able to see the characteristics of what works and what does not work.

The Norwegian Petroleum Industry

The petroleum resources on the Norwegian continental shelf belong to the state and the exploitation of these resources is executed by the King through the Petroleum Act. After opening an area for petroleum activities, the State issues licences with the right to explore and potentially develop any resources. The State nominates one of the licensees as the operator and the operator takes on the responsibility for all activities and for compliance with the relevant laws and regulations. The other licensees have a ‘see to it’ duty to ensure the operator carries out all activities in a prudent and compliant manner. Guidelines for how the licensees should fulfil their ‘see to it’ duty with regard to major accidents, have been developed by the Norwegian Oil and Gas Association, Ref. Norwegian Oil and Gas Association.

Norway aspires to be a world leader in HSE in the petroleum industry and this objective has recently been emphasized in a White Paper on HSE in the Petroleum Industry in 2018, Ref. Norwegian government. The culture in the Norwegian petroleum industry is characterized by openness and a high level of trust between the participants. The regulatory framework is based on functional requirements and the industry is expected to establish standards, guidelines and practices that achieve these requirements. The Petroleum Safety Authority (PSA) is the main regulatory authority and the PSA also has a coordinating role for all the other authorities involved the petroleum industry, e.g. Norwegian Environment Agency, Civil Aviation Authority, Norwegian Maritime Authority. The PSA carries out audits and investigations and reports from these are freely available on the PSA website. The PSA has main issues that they promote each year and that are selected for their relevance to the industry at that time and reflect the desired government focus. The Norwegian Oil and Gas Association is the branch organisation for the industry and has established a number of forums for experience transfer and learning. The Working Environment Act in Norway requires participation from the employees in matters related to safety and the working environment and emphasizes that the employees shall have a real influence. The authorities, the industry and the employees have established a three-party collaboration that has focus on safety performance and the development of regulations. This three-party collaboration can be compared to the three-party collaboration in Formula 1 that was the driving force for the improvements made after 1994.

The climate change debate and Norwegian ambitions for reduction in CO₂ emissions has created a focus on the petroleum industry and this will influence the future development. Any serious incidents that occur in the future could have an enhanced effect due to the pressures from the climate debate.

Measurement of Safety Performance

Measurement of safety performance may be objective or subjective. Objective assessment assumes some sort of quantifiable methodology, for example Performance Indicators (PIs). Subjective assessment assumes a qualification or judgement that could be based on different methods, from a systematic approach to little more than a gut feeling.

In Norway, the RNNP (Risk Level in Norwegian Petroleum Industry) process was established in 1999 and is used to measure the level of risk in the Norwegian petroleum industry. The RNNP is organised through a collaboration between research

institutions, industry, the workforce and the regulators. PSA is responsible for the process and collates information from the industry on an annual basis. The RNNP reports cover the risk to people and the risk from acute discharges. The risk to people includes major accident risk using a quantitative measurement based on defined situations of hazards and accidents (DSHAs) and working environment risk based on questionnaire-based surveys, interviews, fieldwork and other studies. The RNNP provides information on the trend in industry risk and can be used by individual companies to assess own absolute and relative performance, see figure 2.

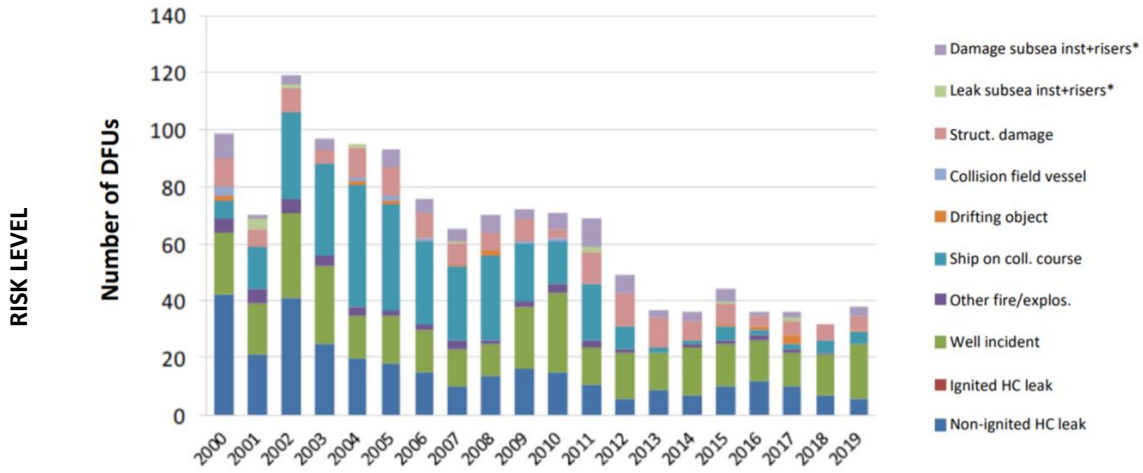


Figure 2 Overall major accident risk levels in the Norwegian offshore petroleum industry

One measurement that is used to establish the risk level is the number of hydrocarbon leaks with major accident potential. Shown in dark blue in figure 2. In Norway this is defined as a leak greater than 0.1 kg/s, see figure 3. Norwegian Oil and Gas Association has carried out analyses of the causes of hydrocarbon leaks including a recent study in 2018, Ref. Norwegian Oil and Gas. This study provides some insight into differences between the operators.

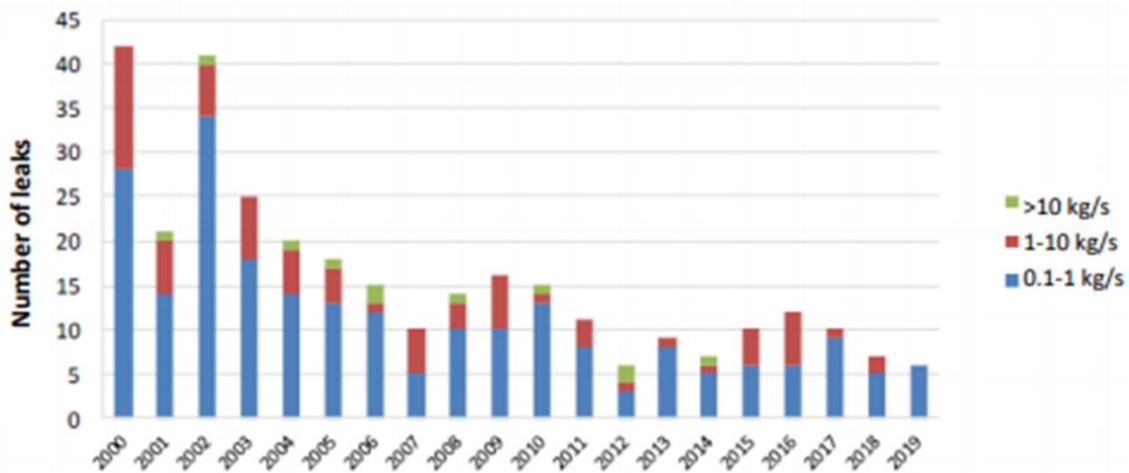


Figure 3 Hydrocarbon leaks with major accident potential in the Norwegian offshore petroleum industry

The RNNP also uses information on well control events in the determination of risk levels, see figure 4. Well control has a special focus in Norway as there have been recent well control incidents that under slightly different circumstances could have led to a blowout and potentially a major accident.

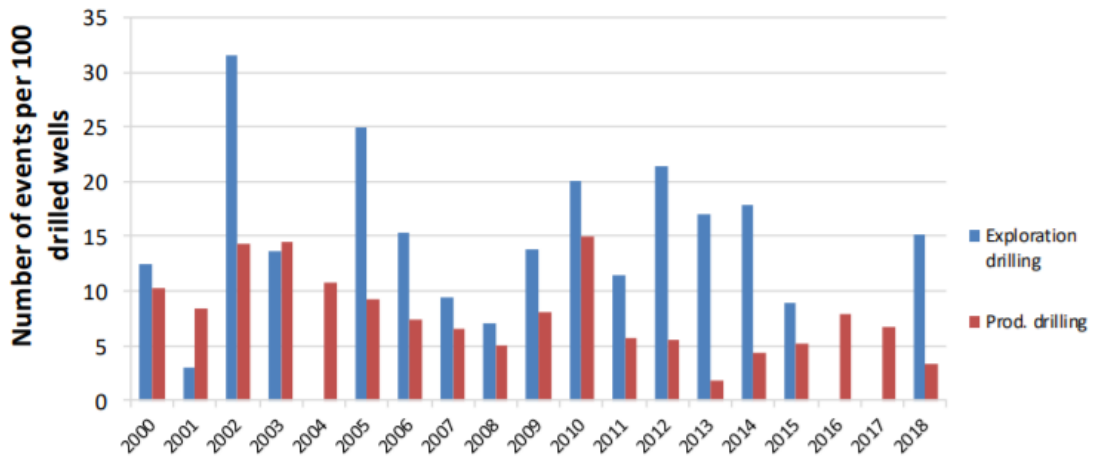


Figure 4 Number of well control events per 100 wells drilled

Individual operators have established their own PIs for safety performance and have tried to achieve a balance of leading and lagging indicators. ‘Leading’ indicators are intended to predict future safety performance. ‘Lagging’ indicators measure actual safety performance and are the basis for tracking whether improvements are being made. The operators also use internal audits, surveys, questionnaires etc. to form a subjective view of their safety performance and to identify areas for improvement.

Hydrocarbon Leaks

Hydrocarbon leaks with a major accident potential are defined in the RNNP as leaks with a leak rate greater than 0.1 kg/s. A analysis on the causes of hydrocarbon leaks was carried out by Norwegian Oil and Gas in 2018, Norwegian Oil and Gas. The analysis covered the period 2012 to 2017 and included an overview of the number of leaks per operator normalized for the number of installations the operator has responsibility for, see figure 5.

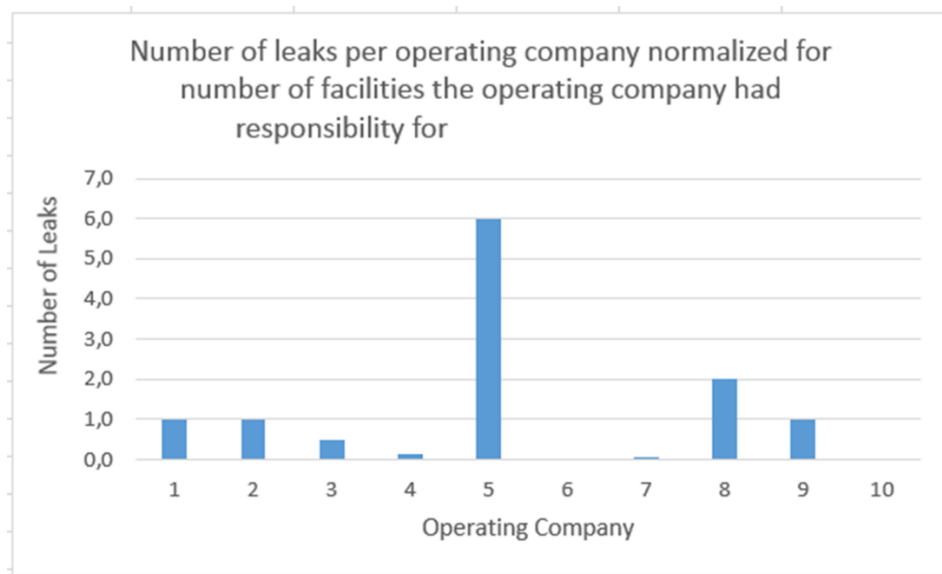


Figure 5 Hydrocarbon leaks per operator

Learning

Learning is a key factor in improvement, and it is appropriate to consider the processes for learning that are in place and how effective these are. Successful learning at the operator level will arguably lead to the operator making improvements and perhaps achieving a status of an island of excellence. Successful learning at the industry level will hopefully lead to avoidance of islands of excellence since there will be experience transfer and sharing of best practices that will tend to bring all operators to the same level. Learning at the operator level and the industry level are both essential to achieve the ambitions for safety.

Learning is a change process and is neither positive nor negative, since people (and organisations) can learn both good and bad things. Positive learning is the key to improvement in performance and prevention of incidents and accidents. Peter Senge in his book the Fifth Discipline described five disciplines important for a learning organisation, Ref. Senge. One of these is mental models, *deeply ingrained assumptions, generalizations, or even pictures of images that influence how we understand the world and how we take action.* Learning can be considered as the creation of new understanding or mental models that is

different from a previous understanding or mental model. Learning is therefore not just the acquisition of new knowledge but also the creation of new mental models that will in turn influence the way people think and the actions that are taken by the people involved. Learning is a challenging process and is more than just communication of information. The context of the information, the relevance of the information to ongoing activities and the time required to handle the information are all important to create a satisfactory learning process. A safety flash on an incident can be sent by email in a couple of minutes and the email itself is documentation that something has been done. Sending the email is, however, no guarantee that learning will take place.

The authors have considered the different sources of learning used in the petroleum industry. One source is through major accidents, and their aftermath. Learning from major accidents often results in the development of regulations and industry-wide standards and there is a requirement that this learning be implemented across the industry by all operators.

Learning from incidents, accidents and near misses is a continuous opportunity. There is an expectation that the operators will investigate, identify causes and implement mitigating actions. Also, that they follow up whether the actions have had the desired effect. For the international operators, information from a significant number of internal incidents and accidents can be a good source of learning, and most have an intention to do so. For smaller operators, the amount of information on own incidents may be limited giving them an incentive to learn from other operators' incidents.

There appears to be varying degrees of success of this learning, based on several factors including a clear learning process. In Norway, information is often made available to the industry in the form of investigation reports, and safety flashes, etc. Successful learning from information supplied by others requires much more effort as the information is often technically based and focused on facts, rather than associated cultural issues. These cultural issues, 'the way we do things', is valuable learning, as the involvement of people, and how they act is relevant to the cause of incidents, and how they escalate.

Learning from success, either from own experience or from the experience of others, would seem to be sensible approach to improvement since repeating success should be feasible if the companies understand why they were successful. Learning from success demands a proactive approach since it is not being driven by the negative consequences of accidents and incidents. Processes for learning from success are not so well established as processes for incident and accident investigation since there is not the same tradition for this type of investigation.

In order to assess the operators' approach to learning the authors have developed a learning model, see figure 6. The authors will use this model to assess the difference in operators qualitatively.

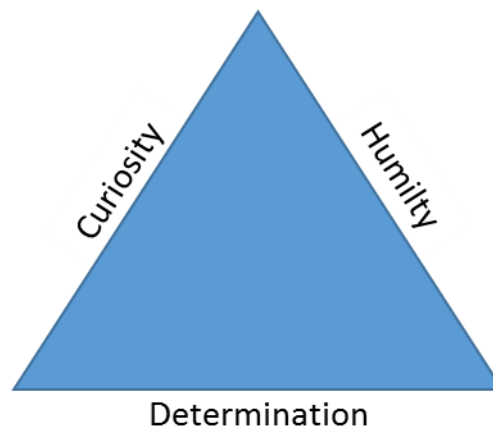


Figure 6 Model for learning

Curiosity is the interest to inquire into what can be learned and who can be a good source for the learning. The source of learning does not necessarily have to be the best since there are opportunities for learning from everyone. Learning should not be restricted. Companies can learn from the failures of others and they can learn from the success of others.

Curiosity is also a factor in learning from non-accidents and successful operations. Non-accidents occur when the outcome of the activity seems positive however, there may have been near misses and/or indications of problems that should be addressed. Learning from success is also important since understanding why success occurs is an important factor in repeating that success. Investigations into non-accidents and success is a sign of curiosity.

Humility is a quality that removes barriers to learning and opens up for listening with interest. It is also important for developing an intention to improve as it presupposes an acceptance that there is a potential for improvement. Humility also leads to an acceptance that others have something to offer and may be better in certain areas.

Determination is an important factor since real change in an organisation is normally a long process and requires the management to have staying power. The identification of any improvement measures is only the start of the improvement process. Implementation of actions and follow up that the actions have actually had the desired effect requires determination.

Determination is important since there may be need for significant resources that have to be fought for in the budget process. Determination is also important to overcome, resistance to change. When considering that learning requires a change in mental models of the people in the organisation the changes required can be complex and this complexity should not be underestimated.

Achieving continuous improvement requires the management and the organisation to have determination over time to see changes through while still searching for further improvement. Sustainable improvements in any organisation can be a long haul.

An effective learning process requires these three qualities of curiosity, humility and determination in an organisation as well as systematic processes for the accumulation and application of learning.

The influence of major accidents on the development of laws, regulations and standards in the offshore petroleum industry

Major accidents have had a significant effect on the offshore petroleum industry in the North Sea through the development of laws, regulations and standards in the UK and in Norway. The development of safety therefore has not been a gradual process through continuous improvement, there have been step changes defined by major accidents.

The Sea Gem disaster in the UK Southern North Sea on the 27th December 1965 was a major influence on the development of the Minerals Working (Offshore Installation) Act of 1971. The Act led to the development of prescriptive regulations, mandated the role of the Offshore Installation Manager (OIM), established the certification of offshore installations, required the use of standby boats for the offshore facilities and mandated training and emergency response exercises.

The Ekofisk Bravo blowout in Norway 22nd April 1977 led to regulations on rest and restitution, improvements in oil spill contingency and mandated lifeboat capacities. The UK Burgoyne Committee review set up as a result of the Ekofisk Bravo blowout recommended that the role of the government was to '*set objectives designed to achieve a uniformly high standard of safety throughout the industry*'. This was more in the spirit of the UK Health and Safety at Work Act in 1974 and the functional regulations later implemented in Norway. The Burgoyne Committee recommendations were however not implemented in the UK offshore petroleum industry at the time.

The Alexander Kielland tragedy 27th March 1980 formed the basis for the Petroleum Law and new safety regulations in 1985, the coordinating role for the Norwegian Petroleum Directorate (NPD)* in regulation of the industry and the strategy for the involvement of the industry participants. The strategy of the authorities setting functional requirements for the industry and the industry developing standards to achieve these requirements, was implemented fully at this time. Note that functional requirements for the industry were implicit in the internal control regulations prior to 1985.

The Cullen inquiry into the Piper Alpha disaster 6th July 1988 led to the Offshore Safety Act and the Offshore Safety Case Regulations in 1992. This effectively implemented the EU Seveso 1 Directive from 1982, the UK Control of Industrial Major Accident Hazards (CIMAH) Regulations from 1984 and the recommendations from the Burgoyne Committee on goal setting regulations.

The Macondo well blowout in the Gulf of Mexico 20th April 2010 led to the EU Directive 2013/30 Safety of Offshore Oil and Gas Operations that in turn led to a revision of the Offshore Safety Case Regulations in the UK in 2015. This revision put more emphasis on the environmental impact of the industry.

While major accidents have had a significant influence on the development of Laws, Regulations and Standards, the focus in the offshore petroleum industry in Norway is continuous improvement. The PSA has made continuous improvement in safety a requirement in the HSE regulations. The operators are required to improve safety performance and reduce risk levels irrespective of their absolute and relative performance.

*The NPD had responsibility for the regulation of both resource exploitation and HSE and working environment. In 2004 these roles were separated. The NPD retained responsibility for regulation of resource exploitation and the newly established PSA became responsible for regulation of HSE and working environment.

Are there Islands of Excellence and Oceans of Mediocrity?

The authors will now attempt to answer the following four questions.

- Are there differences between the operators that indicate 'islands of excellence' and 'oceans of mediocrity'?
- How can these differences be recognized?
- What are the key factors that characterize these differences?
- What do these differences mean for how the industry could improve?

The offshore petroleum industry consists of several different areas, for example, exploration, drilling, field development and operations. The operators need to have competence and experience in all these areas and need to organize this competence and experience for effective planning and execution of their activities. Some operators may be considered better than others in some of these areas, and one operator will not necessarily be best in all the areas. The authors' assessment of difference should be seen in this context.

The principle of functional regulations and the operators' role in fulfilling the regulations can arguably lead to differences between the operators. Whether this difference is significant and whether prescriptive regulations would lead to less difference and better safety performance is not covered in this paper.

The difference between the operators can stem from the message from top and the priorities that are set by senior management. Senior management from the operators give presentations at Forums and Conferences and often emphasize the importance of the tone from the top. All the operators promote safety as the highest priority, and this is understandable with respect to the expectations from the stakeholders in the industry and the ambitions the industry has set itself. The operators have of course other priority areas, for example, cost cutting (focus following the oil price fall in 2014/2015), innovation and digitalisation and simplification. These priority areas become particular to the operators and influence the focus for the organisation and the behaviours of the people in the organisation. These priority areas can dominate the development of the company culture.

The information from the RNNP indicates that, although progress has been made, the petroleum industry in Norway still has room for improvement see figure 2. The trend for hydrocarbon leaks, see figure 3 and an analysis of the causes of hydrocarbon leaks, Ref. Norwegian Oil and Gas, indicates there is room for improvement and that there are differences between the operators on hydrocarbon leak prevention. The trend in well control incidents, see figure 4, does not show a significant reduction. It should also be noted that there have been several well control incidents that under slightly different circumstances could have led to a blowout.

The frequency of hydrocarbon leaks described in figure 5 indicates that there are differences between the operators with respect to hydrocarbon leak prevention.

PSA audits of the industry still find deviations from the regulations and that some operators are not following up actions identified in audits. This point was made by the Auditor General in a review of PSA in 2019, Ref. Office of the Auditor General. The Auditor General's review of the PSA was mainly based on activities that had not been successful. Experience from PSA audits indicates that the challenge of following up and closing out actions from audits is not only related to the operators responsible for the activities covered in the Auditor General's review. The authors view is that some operators do manage to close out PSA observations from audits better than others mainly due to focus from senior management.

Some operators do use the PSA audits, and the opportunity for dialog with the PSA representatives, to seek information on other operators that are good in the areas of improvement identified. These operators have a start point for learning and access to the experience of others. The open culture in Norway makes it easier to have a productive dialog with the PSA representatives and seek their professional opinions.

The authors have also considered their own experiences with working with the operators to make an assessment on the differences between the operators and the operators' culture with regard to learning. The model described in figure 6 was used to structure this assessment.

There are operators that have management and employees that seem to be more curious than others. They often ask questions about how things are done in other operators and other companies and seem to be genuinely interested in opportunities for improvement. This can be seen through participation in working groups and conferences and in general discussions. One characteristic of these people is their confidence in the subject material. They are better placed to be curious because they are confident of their own abilities and able to ask the right questions. In these operators, curiosity seems to be encouraged by the management. These operators also display a higher level of consistency between the management and the employees which indicates communication lines are working well within the operator.

There are some operators that appear more self-assured than others and create an impression of not being receptive to other ideas and ways of doing things. The impression created that 'our way is the only way' is a barrier to learning. This hinders dialogue by discouraging people to speak up and contribute.

In the main, the operators are open to share their experiences, both positive and negative. Information is made available and representatives from the operators are willing to spend time talking about the experiences both in formal and informal settings and this is generally encouraged by the senior management. Most of the international operators are also willing to share international experience, some however are not. Sharing of experience is mainly related to incidents and the findings from the investigations into incidents however many operators are also willing to share experiences from external audits including audits from PSA.

Norwegian Oil and Gas has established learning and experience transfer processes that include 'Sharing to be better' for well control incidents. Norwegian Oil and Gas produces information sheets on all hydrocarbon leaks with major accident potential that are available on the Norwegian Oil and Gas website. These processes make information for learning available to the operators and some operators are better at using the information than others, for example, the use of data sheets from hydrocarbon leaks in the planning of activities.

Most of the operators have a focus on information that is relevant to improvements. There are however differences in how they use this information to actually achieve improvements. Some operators recognize the challenge in learning and the need to change the mental models for their personnel. They accept that learning requires change and that change requires a significant amount of effort and participation from the people involved and determination from the management. Some operators however seem to struggle with the implementation of improvement measures, and this is reflected in recurrence in incidents.

The incidents that are normally used in experience transfer and learning between the operators tend to be incidents with serious consequences or potentially serious consequences. There are, however, many incidents with less serious consequences that

have a significant learning potential and could be useful for experience transfer. There is no resistance to doing this rather a convention that it is more important to focus on the 'serious' incidents. It is also more likely that serious incidents have been the subject of an investigation.

Some operators are more systematic in the follow up and closing out of actions and verifying that the actions have had the desired effect. Some operators have a tendency to close out actions before the measures are completed and the intentions satisfied.

Most of the operators have a focus on Life Saving Rules (LSRs). These LSRs have been developed following investigations into serious incidents that have led to fatalities in the industry and the learnings from these incidents. Some of the operators are more systematic in the follow up of LSRs and have established prescriptive processes to ensure compliance. These operators promote zero tolerance and use deviations as a way of measuring the effectiveness of the LSRs. The authors view is that the operators that are more systematic in their approach achieve better safety performance through the LSRs.

Some operators recognize that continuous improvement is a long-term project and needs a continuous focus from the management and active participation from the workforce. They also recognize that learning is a key factor in continuous improvement and learning means change. The authors view is that these operators seem to be more successful with safety performance.

Conclusion

The RNNP measurements of risk level in the Norwegian petroleum industry indicate that there has not been a significant reduction in risk level over the past six years. Serious accidents, including fatalities, and incidents with a major accident potential still occur and further efforts are required to address the causes of these and further reduce risk levels.

There are differences between the operators working in the Norwegian petroleum industry both on a quantitative and qualitative basis that indicate there are opportunities for industry learning that should lead to improvements in safety and reduction in risk levels. The characteristics of curiosity, humility and determination do distinguish the operators that have better safety performance. The authors also see a relationship between hydrocarbon leaks and learning. The operators that display the qualities of curiosity, humility and determination do seem to have less hydrocarbon leaks and consequently a lower major accident risk.

Norway is well placed for continuous improvement as there are institutions and forums in place to facilitate learning and experience transfer. The operators, the regulator and the employees are involved in these and there is an openness in the discussions and a willingness to share experience.

The impression from the Formula 1 experience in 1994 is that the manufacturers, the regulator and the drivers cooperated to become the driving force for change and had the necessary mandate to make the changes. There is a three-part collaboration between the operators, regulator and employees in the Norwegian petroleum industry that could become a driver for the changes required to achieve improvements, however this collaboration doesn't seem to have the necessary mandate. There is a stated ambition to be a world leader in HSE so there is a good incentive for a collaborative initiative to achieve further improvements in HSE.

The authors view is that the operators need to further develop their learning processes and move from transfer of information to changing the mental models of the people in the organisation. This requires a recognition that the learning process is complicated and resource and time consuming. The qualities of curiosity, humility and determination should be encouraged to facilitate the learning process. This investment is however worthwhile, and some operators have come further than others in this area.

The authors view is that the operators need to be more systematic in their follow up and control of actions identified from investigations and audits and demonstration that the actions have achieved their desired effect. This is an opportunity for learning since some operators manage this better than others.

The authors view is that the operators need to develop processes for the effective learning from success. Repetition of success is an important factor in performance improvement since it highlights what works rather than identifying what doesn't work. A proper understand for the reasons for success is a prerequisite for being able to repeat it. SINTEF in Norway has developed a guideline for learning from successful operation, ref. SINTEF.

The authors view is that there are signs of Islands of Excellence and Oceans of Mediocrity in the Norwegian Petroleum Industry and there is therefore a potential for experience transfer and improvement in safety performance. The RNNP information also suggests that there is a potential for further reduction in major accident risk. The open culture and already established collaboration between the industry stakeholders should give a good basis to achieve the success that Mark Gallagher indicates in his statement.

The Norwegian petroleum industry has experienced major accidents and the Alexander Kielland disaster in 1980 did have a significant influence on the development of the industry. The Norwegian petroleum industry has arguably not had the 'Ayrton Senna' moment that has required the operators, the regulator and the employees to come together and drive the changes required to further reduce the risk level. The question is whether such a moment is required or whether the changes can be initiated proactively. Will the Norwegian offshore petroleum industry be subject to hindsight bias and foresight blindness?

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