

## **Performance Indicators in major hazard industries– An Offshore Regulator’s perspective - Ian Whewell**

### **Background**

Much has been written about indicators of health and safety performance and a great deal of effort spent on developing meaningful and effective indicators which might predict likely outcomes. The UK government health and safety regulator, the Health and Safety Executive (HSE), has produced a definitive guide to the development of performance indicators for major hazard industries<sup>1</sup>. In addition the Offshore Division of HSE has been working with the offshore industry on the UK Continental Shelf (UKCS) to develop both effective cross-industry performance indicators and to improve the utilisation of indicators to monitor and control those risks which have the potential to result in catastrophic major incidents. This work in the UK with individual offshore companies is ongoing to ensure that performance is being adequately measured and monitored.

Despite this work it is clear that performance indicators are in many companies still not being used as effectively as they should be to control major accident risks. This was confirmed in a report published by HSE in 2010<sup>2</sup> where performance standards were reviewed as part of a project studying the management of corrosion risks. The report found that a significant proportion of the offshore installations covered by the project either did not have quantitative performance standards for all the equipment or effective performance indicators were not in use. There is a growing recognition that, despite serious catastrophic incidents, parts of the UK industry and the offshore industry world-wide are still not using performance indicators effectively to manage major hazard risks.

Let us be clear there is no ‘silver bullet’ which will ensure that catastrophic accidents do not occur in the offshore industry. However, properly selected performance indicators, whose data outputs are effectively monitored and which inform decision making, will make a significant contribution to reducing the risks of such an event occurring. There is much soul searching and argument as to whether indicators are ‘leading’ (i.e. pre-event controls) or ‘lagging’ (i.e. after things have gone wrong) which often diverts attention from their potential impact on performance. The reality is that performance indicators whether leading or lagging, however sophisticated and well- targeted will not, on their own, deliver improved safety standards nor effective control of major hazard risks in the offshore industry. The key to delivering improved control of major hazard risks is how industry leaders at Board and senior management levels utilise performance indicators, and how the data derived from their use informs decision-making at all levels.

## **Why Performance Indicators?**

In the very simplest of terms no business can survive and be successful without the ability to measure performance and predict likely outcomes. Extensive resources are expended to develop appropriate means of measuring financial performance and to ensure that financial risks are properly controlled. Yet for years many companies operating in the offshore and onshore major hazard sectors have measured health and safety performance using occupational injury data which means accidents/incidents involving injuries and fatalities. This is the offshore oil industry's equivalent of measuring the size of an iceberg by what can be seen above the water. If what can be seen above the water represents measured outcomes then the two thirds of berg that remain below the water represent the risks of major accident that are not being effectively monitored, and by implication, not adequately controlled. It is by understanding these risks and how they can be best managed and controlled, that meaningful indicators can be developed. It is essential that every company in the offshore industry develops a suite of performance indicators that directly address and monitor the major hazard risks.

## **What are the risks and what is meant by risk control measures?**

In identifying risks to be monitored by the performance indicators there is an essential need to differentiate between occupational risks and major hazard risks. I would not suggest that leading or lagging indicators should not be used to manage occupational risk as the control of these risks is a key responsibility of any employer. There is a clear and right societal expectation that injury and occupational ill health is not an outcome of working in any industry. However attempts to control occupational risks, even by using the most comprehensive occupational safety performance indicators, will not deliver effective control of major hazard risks. Indeed there is a probability, clearly demonstrated by events, that companies focussed only on occupational safety and personal injury can become complacent in the face of good personal injury performance and cease to drive for improvements which will impact on major accident risks.

I vividly remember, following a serious process incident resulting in a double fatality, the UK managing director of one of the major oil companies presenting the occupational accident data which showed a significant year on year reduction. To this he added the chastened comment that these data had provided no indication of the serious lack of control of major accident risks which led to the incident. This complacency, as in the case described, is often based on the naïve assumption that top events (i.e. fatalities) in the occupational field and major accidents relate directly to more minor events and even near misses. Thus if these can be controlled and reduced the most serious events will be also. This is the theory of the so called 'accident triangle,' which has been largely discredited for managing fatal accidents which themselves often have many of the characteristics of major hazard events. It certainly has no relevance to the control of major accident risks other than providing an

indicator of one limited aspect of the management of safety within the company. It can also lead to excessive focus on lagging indicators to measure performance.

The selection and use of performance indicators, therefore, to manage major accident hazard risk requires a different approach and must be based on each company's own processes and systems and on major accident risks and controls in that company. It is critical that there is, within the company, a very clear understanding of the risks to be managed. Without this understanding there is likelihood that the performance indicators used will at best be less effective and at worst irrelevant. To achieve the active commitment of those in key positions within any company the indicators used must be credible and clearly related to the management systems within the company. 'Off-the-shelf' indicators will often fail to carry the necessary recognition and relationship to company processes and procedures.

It is therefore essential when performance indicators are adopted that there is:

- An understanding which 'barriers' are critical.
- An understanding of the process.
- An understanding of the hazards.
- An understanding of the risks.

The barriers concept James Reason<sup>3</sup> describes as a Swiss cheese, with the risk controls of people, plant and processes shown as slices of cheese, with holes representing the failures or weaknesses in each of the protective barriers in place. In the model the coincidental failure of several barriers designed to prevent the event escalating to a major outcome is shown as the holes in the barriers lining up to give clear line of sight to allow the escalation. As Texas City, and indeed Deepwater Horizon, show no single failure ever caused a major accident. Such catastrophic events can always be traced to multiple failures either in plant, people or processes.

In the development of meaningful performance indicators it is essential that there is an understanding of how the barriers are maintained, how effective they are, how they interact and critically what company systems are in play to defeat barriers. So if a company is to have effective and relevant performance indicators it is essential that its managers have both the knowledge and understanding of risk and know how to use them. Only with knowledge of the process hazards and risks, and effective meaningful management intelligence in the form of appropriate metrics or performance indicators, can management at the most senior level have confidence that major hazard risks are being adequately controlled. But that brings us to one of the key questions at the heart of effective leadership in major hazard industries. The decision on this influences the culture and determines the likely success in effectively managing major hazard process risks.

## What to measure?

The obvious answer is to measure what matters and what really influences the safety of the plant. It is surprising, however, that this advice is too often ignored as the UK Regulator the Health and Safety Executive (HSE) found in its review of the management of installation integrity<sup>4</sup>. In that review the availability of information was not the issue for most companies. Indeed the dilemma was information overload and the accuracy of the information. Modern maintenance management systems produce vast quantities of data much of which are at levels of detail which are not appropriate as high level indicators necessary for senior management to manage the process safety risks effectively. Senior management cannot see every measure but by selecting the most critical and ensuring the data is accurate and timely, process safety performance can be effectively monitored.

Measuring performance relies on standards of performance being fit for purpose. Ironically modern high hazard companies have developed highly sophisticated systems for dealing with plant and equipment not functioning as designed or with excursions from 'steady state'. Examples are manifold but include the use of inhibits (which inhibit the responses of safety instrumented systems) or overrides on control panels, operational risk assessments, engineering exceptions, corrosion limits, allowable leakage rates, deferred maintenance, temporary repairs, backlogs of maintenance, ratios of planned maintenance to corrective maintenance. From day one the plant and equipment is not as designed. This is reality and is the reality that must be managed. However this reality must not be confused with acceptance that these exceptions do not matter. They provide very clear indicators of the health of the process plant and of the management systems. Thus in deciding what to measure, those key barriers or risk controls must be recognised and defects identified and recorded. Performance standards and variations from these standards can provide key indicators which can be used by senior management to "take the temperature" of safety performance and may include:

- Safety critical backlogs (i.e. backlogs of maintenance which are deemed critical to the safety of the plant)
- Temporary repairs
- Levels of deferred maintenance
- Number of safety instrumented system inhibits or overrides in use on the control panel
- % of equipment within 10% of corrosion limit
- % of the maintenance not completed on time

Failures (lagging indicators) while they will not always paint the full picture of performance also have their place and should not be ignored. Of course whatever is measured should be kept as simple as possible to ensure clarity and must measure what is actually happening not what it is believed should be happening.

There is, however, no single indicator which is individually predictive of a major hazard event occurring. As I have already said major hazard events are invariably the result of

multiple failures of control and in any one event the critical failure path is complex and will differ from the next event. Certain indicators do paint a picture of the state of the plant and are usually predictive of poor control of risk. For example an installation with a poor record showing numbers of hydrocarbon leaks from plant and equipment certainly would be viewed by the regulator with concern. This situation would require action to identify the underlying failures leading to the leaks. In deciding on appropriate performance indicators it may not be possible to measure directly so other measures or surrogates need to be adopted. For example the number of inhibits on the system is a good indicator of the level of equipment not functioning as designed. Whatever decisions are made on the selection of performance standards and indicators the workforce must clearly understand what is important and the best way of achieving this is by measuring what is important.

### **What to do with the data?**

If performance indicators are to be used effectively to manage major accident risks then how the data are managed and used is critical. Having identified and selected key performance indicators and carried out the collation of the data produced, too frequently companies fail to effectively use those data to deliver effective management information at the highest level. Unless at Board and senior management level there is recognition and an understanding of the significance of the data and *the data drives decision-making* then its collection becomes an ineffectual exercise and leads to cynicism at plant level. Data from effective performance indicators *must* be used as a vehicle to drive improvement and the role of the Board and senior management is vital in achieving this.

That is not to say that at Board level there is a need to regularly view all performance indicators in use. However the data reaching Board level must reflect the criticality of the performance measures and the use of 'dashboards' or 'traffic lights' to summarise data has been found to be particularly effective. However it is essential the senior management is able to convincingly demonstrate an understanding of the significance of the data. There is an expectation by the HSE that all oil industry leaders must know that their company measures major hazard performance using meaningful and effective indicators. They should be able to demonstrate that they understand the role of major hazard risk controls and the significance of key performance indicators. In addition, to achieve a convincing safety culture at all levels in the company, they must acknowledge their responsibility for the effective management of major accident hazards.

There must also be a recognition that the culture of the organisation is important in ensuring that Board level data is accurate and reflects reality, not what the Board or senior management would like reality to be. The involvement of the workforce in developing and delivering effective performance indicators and the systems to support them must not be underestimated. A poor culture of involvement and failure to secure commitment will result in data which are at best incomplete and at worst irrelevant to managing the risks. Too

often the data will be delivered to meet the expectations of senior management that all is well.

For example, where management information systems indicate performance by using traffic light reds, ambers and greens, the expectation may be that everything should be green. There must be recognition, however, that nothing is perfect and 'greens are not always good'. Indeed, too perfect a performance should always be viewed with caution. However, to promote honest reporting it is essential that the culture is one of accepting that bad news is as important to managing safety as good news. The culture must be one of being prepared to reward honesty, however unpalatable the bad news message is to receive. Without this the risk is that however effective the performance measurement and indicators are in theory, they will not deliver improvement and control of major hazard risks.

### **Maximising the Benefits**

With some exceptions companies in the worldwide offshore industry, despite their common business goals, can be very introspective and, with the exception of occupational safety data, share little data with each other. They often convey an inherent reluctance to expose performance in other aspects of health and safety to public gaze. This introspection is frequently carried forward within individual companies which, possibly driven by the structure of their business, seem to lack effective arrangements for sharing good practice and comparing performance in different parts of the business. Even where such arrangements are supposed to exist, the UK regulator's experience is that different parts of a company are not good at sharing data and spreading good practice. It is essential that this type of culture changes if the offshore oil and gas industry is serious about reducing the risk, in the future, of catastrophic events such as Macondo.

Cross-industry sharing of data with the benefits that brings is beginning to take place in some parts of the world. It is unfortunate that the US industry still appears to continue to operate with little common cross-industry sharing, and to lack the will to commit itself as a whole to delivering the type of common commitment seen for example in Norway and on the UK Continental Shelf (UKCS). There is no doubt that, whilst challenging to industry culture, the benefits of benchmarking performance and sharing good and best industry practice greatly repay the initial efforts to deliver it. Whilst performance indicators and performance standards do need to be developed on a company and process specific basis the selection of a few key indicators agreed across the territory specific continental shelf can deliver real improvements in performance. Meeting the challenge of sharing the data and then benchmarking against the best performers is a real driver for change and improvement in performance.

## **The regulator's experience on the UKCS**

The regulator has a key role to play in ensuring that, not only are relevant and meaningful major accident performance indicators developed and adopted by offshore oil companies, but that the data produced are used effectively by the company. In particular the regulator must ensure that these data are seen by Board and senior management levels and action taken in the light of them. For many years, in addition to using regulatory powers to influence individual companies, the UK regulator has also been working with the offshore industry in general to improve safety performance. A key player in this dialogue has been a cross-industry organisation 'Step Change in Safety'<sup>5</sup>. This organisation funded by Oil and Gas UK (the UK offshore industry trade association) consists of senior managers from the full range of companies operating on the UKCS together with representatives of the Trades Unions, the Regulator and, most recently, the workforce. It carries the authority and commitment of the Board of Oil and Gas UK to deliver continuous improvements in offshore safety on the UKCS.

Monitoring the use of performance standards and indicators has always been a key aspect of the regulator's intervention approach. In recent years, however, following Texas City and the HSE report on installation integrity, the UK offshore industry's approach to performance indicators has come under a particularly fierce spotlight. Both of these events highlighted the still less-than-adequate approach of many companies in the UK offshore sector to the matter of how performance indicators were being used. It was clear that there was still a deep rooted culture of focusing on occupational performance and much of the safety performance measurement data reaching Board level was restricted to occupational health and safety performance. What was needed was a radical change in approach, and acceptance and recognition by the industry that much more focus on major hazard risks was needed. Also the industry needed better tools to deliver improved major hazard performance.

The subsequent approach by HSE was twofold. First HSE inspectors focused on the way companies were using performance data, and in particular how that data was being used by management at Board and other senior levels. Top managers were expected to be able to describe their methods of monitoring performance and Boards were expected to be seeing major hazard performance data, not just accident and ill health data. A particular focus was maintenance backlogs and safety critical backlogs. Roughly comparative data on this simple indicator was shared by inspectors within HSE allowing pressure to be brought to bear on poor performers. However because companies used different methodologies to identify these data such direct comparisons were not always possible

Second to address the comparative performance issue at the same time as inspectors were challenging companies to develop improved performance indicators for major hazard risks, the HSE began to work with Step Change to see if it would be possible to develop some simple high level performance indicators to be used across the industry for benchmarking performance. The industry was already using one (lagging) indicator as a surrogate for the control of major hazard risks. This was unplanned hydrocarbon releases, which were part of

the regulator's statutory reporting requirements but which had been further refined and categorised into minor, significant and major releases. Individual company performance in the hydrocarbon releases of significant and major categories was compared by the regulator, and companies were advised where their comparative performance lay.

The major change, however, as the result of the lessons learned from Texas City and the installation integrity report, was that the industry agreed to adopt two additional key performance indicators(KPIs). These were backlog of safety critical maintenance and findings from the verification of safety critical plant and equipment which were outstanding after a set period of time. The latter KPI arose from the statutory requirement in UK regulations for the integrity of safety critical plant and equipment to be verified both at design and subsequently on an ongoing basis by an independent competent person i.e. a person independent of the company's organisational structure. (The full background and developments of these cross-industry KPIs can be found in SPE 140687 Asset Integrity Key Performance Indicators – A Cross Industry Approach, Robert Paterson, Oil and Gas UK).

Collection of these data has been going on since 2008, with the greater part of the UK offshore industry taking part by 2009, allowing trends to be identified and, most importantly benchmarking of company performance. In a revolutionary development companies on the UKCS agreed to share their performance data with each other and to share good and best practice both in dealing with these 'common' KPIs and in the development of company specific performance indicators. This work was also supported by a series of key training sessions run by the Step Change Organisation for directors and senior managers to help them gain a better understanding of major accident hazard risks and the use of performance indicators. This training was very well received with take up by all major UK offshore companies.(Significantly it was found many of the most senior managers lacked a background on process and production meaning that their experience of the major accident hazard risks was limited). The training package was so successful that it has been made available to other offshore regimes.

The effect of this cross-industry approach to data collection has been significant. Not only can individual companies 'benchmark' their own performance against industry norms but the poorest performers, highlighted by the sharing of data, have been able to learn from those with improved performance. In addition, the regulator has been using the raised awareness of major hazard KPIs to press for improvements in individual companies. In particular the regulator, by inspection and enforcement, can ensure that every company has a meaningful suite of major hazard KPIs and that the outputs of the data collection are being used by management at the most senior level within individual companies. Where data are recorded using common criteria (as with the agreed industry KPIs) individual company performance can be compared to an industry 'norm' by regulators at intervention visits and performance challenged. The result is, I believe, that the UK regulatory regime, along with other regimes with a flexible goal-setting approach to offshore health and safety, is better able to meet many of the challenges inherent in regulating major accident hazard risks within the offshore oil and gas industry.



HSE continues to work closely with the Step Change in Safety organisation to develop cross-industry initiatives. HSE Inspectors will continue to challenge the effectiveness of performance indicators with individual companies and to ensure that they are being used effectively by management, at the most senior levels, to manage the offshore major hazard risks.

1. *Developing process safety indicators: A step-by-step guide for chemical and major hazard industries* HSG254 HSE Books 2006 ISBN 978 0 7176 6180 0  
[www.hse.gov.uk/pubns/books/hsg254.htm](http://www.hse.gov.uk/pubns/books/hsg254.htm)
2. *External corrosion management Inspection project: A report by the Offshore Division of HSE's Hazardous Installations Directorate* [www.hse.gov.uk/offshore/corrosion.htm](http://www.hse.gov.uk/offshore/corrosion.htm)
3. Reason, James (1990-10-26). *Human Error*. Cambridge University Press. ISBN 0521314194
4. *Key Programme 3: Asset Integrity Programme A report by the Offshore Division of the Hazardous Installations Directorate* <http://www.hse.gov.uk/offshore/kp3.pdf>
5. Step Change in Safety <http://www.stepchangeinsafety.net/>