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ESSENTIAL PROCESS SAFETY MANAGEMENT FOR MANAGING MULTIPLE OIL AND GAS ASSETS

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The paper describes a tool and process that shows management where to make interventions that reduce the risk of having a major accident.

It indicates those areas that need immediate attention and those that need to be addressed in the future.

It allows these interventions to be tracked. It is designed to be used by all levels of management.

As context the paper briefly describes the journey of process safety management as a result of major accidents in the process industries. It describes it beginnings in Loss Prevention and shows developments into Process Safety Engineering together with the development of management systems which are designed to prevent and control the release of hazardous substances.

Parallel to this, it describes how an oil and gas contractor as a result of its international experience and the trend of asset owners to expand the responsibilities and services from their supply chain found itself in the position of being legally responsible for the operation of a number of substantial oil and gas facilities over a very short time frame.

Process Safety Management system key elements were apparent across these assets. However there was not a reliable and simple way of comparing each asset in terms of vulnerability to having a major accident.

This gap was identified as a business need. The potential liabilities both legal and financial resulting from major accidents are punitive. Senior management required to have visibility and be assured that their operations were being correctly managed.

The paper describes how the gap was closed.

The tool and process has been in place for over 4 years. It is a practical demonstration of Process Safety Management in the international Oil and Gas industry.

For the company concerned it is now an essential part of Process Safety.

THE NEED

During 2008 Wood Group PSN, an international oil and gas engineering services contractor became the Operator for 10 facilities in the North Sea. These are commonly known as Duty Holder contracts.

These types of contract place a legal requirement on the operator about how an asset is managed and operated. In the event of a major accident the liabilities for any company are considerable particularly in these types of contract; this became apparent due to a number of high profile incidents such as Grangemouth, Texas City, and Buncefield.

The risks associated with these contracts needed to be quantified and understood. As part of this process the then current management systems and associated processes and procedures were examined and evaluated.

It became apparent there was a need to capture the main threats associated with operating and maintaining oil and gas facilities and explain them in a simple and timely way in order that meaningful management interventions at all levels were possible in order to prevent major accidents.

THE IDEA

In Oct 2008 a conference on safety performance indicators was hosted by FABIG in Dyce, Aberdeen. A number of presentations made reference to James Reason's Swiss Cheese or Barrier model and related it to different indices which attempted to calculate a number based on breaches of the barriers.

They were all trying to quantify the cumulative risk or how the individual risks combined and interacted and used algorithms to predict an outcome. The results seemed complex, difficult to understand, and were not engaging. They appeared academic and not very practical.

The idea of a Vulnerability Index came from combining these ideas into a simple less mathematical model to get engagement and buy in by all levels of the organisation.

It proposed the use of diagrams to display combined risk as a picture of the individual risks in such a way as to concentrate on management interventions, in a timely way in order to prevent major accidents. A key point was to try to avoid the inevitable complexity and difficulty associated with predictive cumulative risk analysis.

THE PRINCIPLES

Oil and Gas installations and chemical plants do not have major accidents every day. There must something in place to prevent them happening. There must be barriers in place which if breached could result in a major accident. This is the basis of the barrier model.

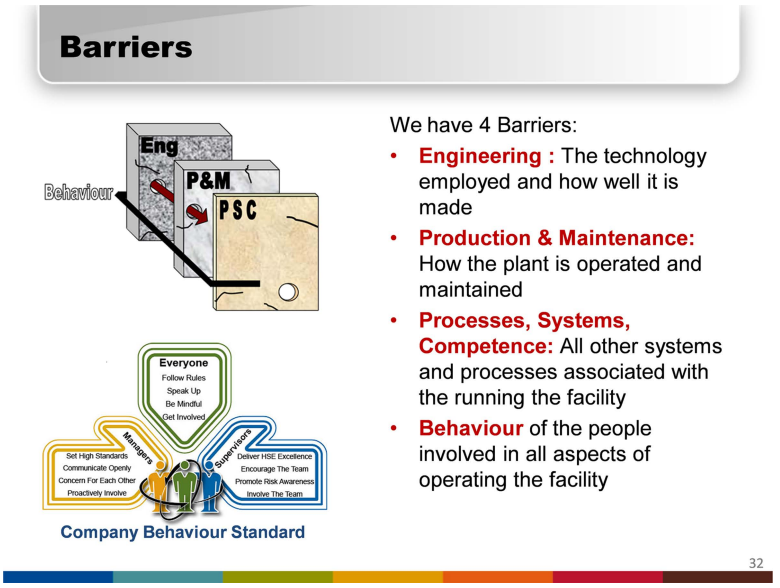


Figure 1.

Figure 1 shows the generic barriers selected. They are not site specific and can be applied universally.

The main technical barriers can be undermined by inappropriate behavior by individuals this is represented by the black band surrounding the technical barriers in Fig1.

When an event occurs against a leading or lagging indicator the impact on the barriers is determined using a simple Root Cause Analysis. This shown in Figure 2.

The barriers are not equal, some are more important than others. A calibration questionnaire is used to calibrate the barriers for a site based on the potential for a major accident.

The questionnaire consists of Density and Thickness questions which represent the respective material and thickness of each barrier. Figure 3. This gives the barrier weighting

Figure 4 shows a range of Lagging and Leading indicators. The subjects covered are wide ranging under general headings such as: Legislation, Hydrocarbon Releases, Management of Technical Change, Safety Case, Assurance,

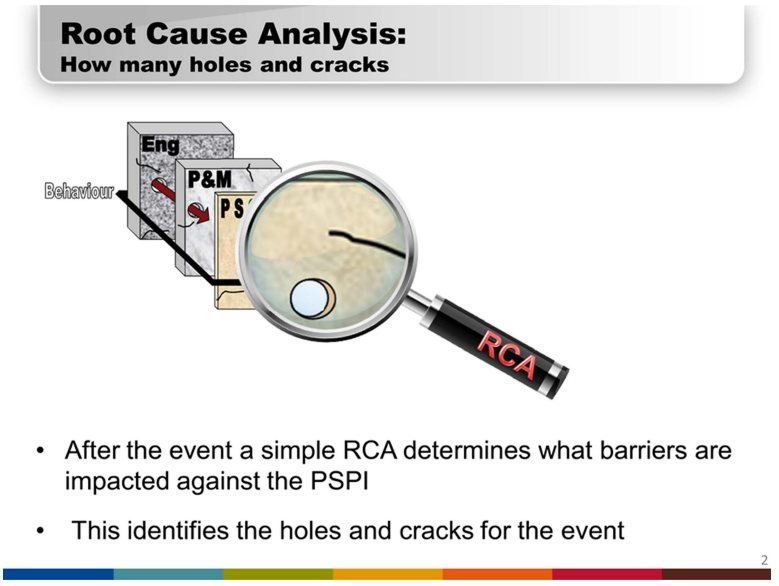


Figure 2.

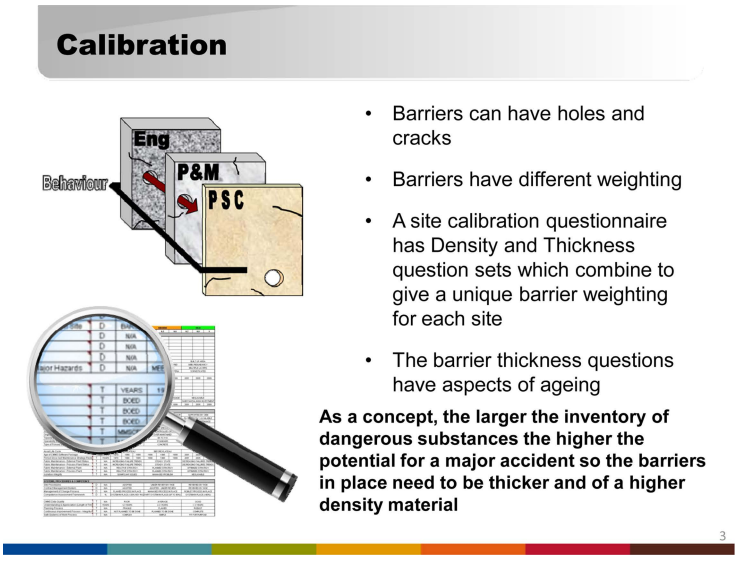


Figure 3.

Verification, and Process Safety. Currently there are 35 indicators monitored. These are called Process Safety Performance Indicators and they are split into lagging indicators which result in holes or leading indicators which result in cracks in the barriers when there is an event against them.

On a weekly basis all the site holes and cracks are collated in the tool and using a simple equation that takes account of the site calibration generates the Vulnerability Index for that week. Figure 10 shows the trend of the index for different sites over a year.

An increasing VI trend means there are more holes and cracks in the barriers and they are consequently weaker and less able to prevent a major accident. A decreasing trend means the reverse.

ASSET INTEGRITY IS A STATUS

When there are simultaneous holes in each of the technical barriers or if the behavior barrier is breached then Asset Integrity status has not been achieved. This is shown in Figure 5.

This simple measure of asset integrity is used in senior management reports.

DASHBOARD

Senior management need to be assured that a site management is making effective interventions to prevent major accidents. Their dashboard is based on a traditional sports car design with warning lights and a tachometer. See Figure 6.

The lagging indicators show asset integrity status are displayed as a line of warning lights. The cracks or performance against the leading indicators are shown as the tachometer. More cracks in the barrier mean the rev counter needle starts to approach the red sector which means change up a gear or the engine can get damaged in other words fix some of the cracks.

The trends for the site are also displayed to the right in Figure 6.

The engine behind the dashboard in the tachometer is the Vulnerability Index.

Asset Integrity management is all about managing the cracks to prevent there being holes.

SITE VIEW OF ASSET INTEGRITY

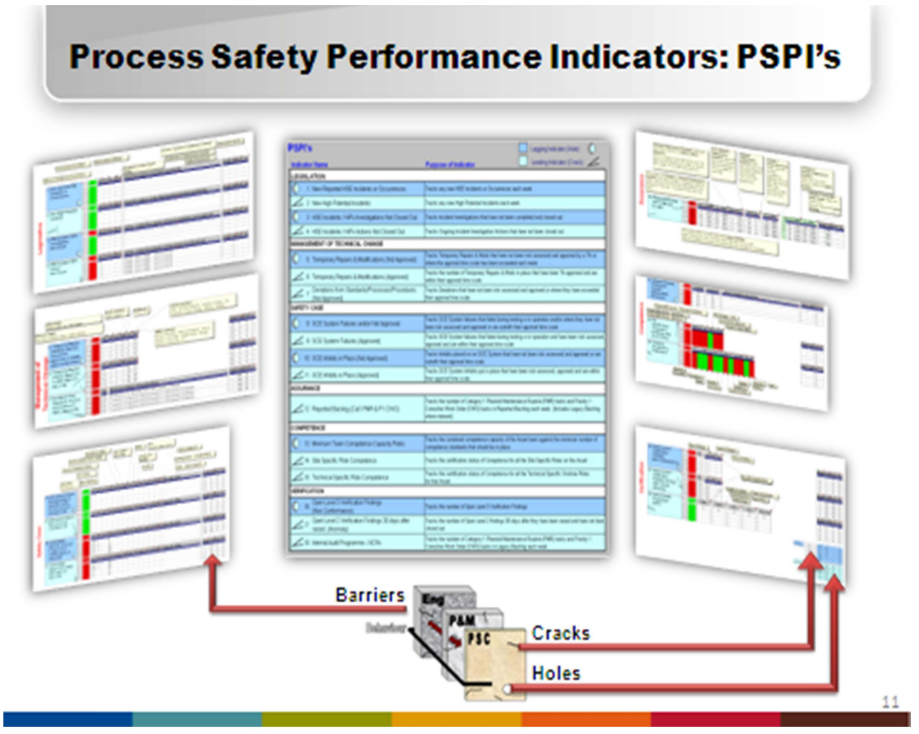
Figure 7 shows a standard Risk Assessment Tool. The darker colours mean an event has either a more severe consequence or is more likely to happen. The tool is used to display the combination of both these attributes against PSPI events; these are displayed as a colour.

The tool in Figure 7 is used in the site view shown in Figure 8. The magnifying glass is focused on all the holes and cracks in a particular module on a large offshore oil platform and their severity or colour.

This information is used by site management to decide when to make an intervention such as shut down a process, replace temporary repairs, or take mitigating measures to risk the risk.

OVERALL MANAGEMENT OF ASSET INTEGRITY

The combination of the dashboard which is driven by the Vulnerability Index and the site view mean senior management get assurance and visibility that the site management are making effective interventions to prevent major accidents and site management get a tool which tells them where to make the interventions.



PSPI's

Lagging Indicator (Hole)
Leading Indicator (Crack)

Indicator Name	Purpose of Indicator
LEGISLATION	
1 New Reported HSE Incidents or Occurrences	Tracks any new HSE Incidents or Occurrences each week
2 New High Potential Incidents	Tracks any new High Potential Incidents each week
3 HSE Incidents / HiPo Investigations Not Closed Out	Tracks Incident Investigations that have not been completed and closed out.
4 HSE Incidents / HiPo Actions Not Closed Out	Tracks Ongoing Incident Investigation Actions that have not been closed out.
MANAGEMENT OF TECHNICAL CHANGE	
5 Temporary Repairs & Modifications (Not Approved)	Tracks Temporary Repairs & Mods that have not been risk assessed and approved by a TA or where the approval time scale has been exceeded each week
6 Temporary Repairs & Modifications (Approved)	Tracks the number of Temporary Repairs & Mods in place that have been TA approved and are within their approval time scale.
7 Deviations from Standards/Processes/Procedures (Not Approved)	Tracks Deviations that have not been risk assessed and approved or where they have exceeded their approval time scale.
SAFETY CASE	
8 SCE System Failures and/or Not Approved	Tracks SCE System failures that failed during testing or in operation and/or where they have not been risk assessed and approved or are outwith their approval time scale
9 SCE System Failures (Approved)	Tracks SCE System failures that failed during testing or in operation and have been risk assessed, approved and are within their approval time scale
10 SCE Inhibits in Place (Not Approved)	Tracks Inhibits placed on an SCE System that have not been risk assessed and approved or are outwith their approval time scale
11 SCE Inhibits in Place (Approved)	Tracks SCE System Inhibits put in place that have been risk assessed, approved and are within their approval time scale.
ASSURANCE	
12 Reported Backlog (Cat1 PMR & P1 CWO)	Tracks the number of Category 1 Planned Maintenance Routine (PMR) tasks and Priority 1 Corrective Work Order (CWO) tasks in Reported Backlog each week. (Includes Legacy Backlog where relevant)
COMPETENCE	
13 Minimum Team Competence Capacity Roles	Tracks the combined competence capacity of the Asset team against the minimum number of competence standards that should be in place.
14 Site Specific Role Competence	Tracks the certification status of Competence for all the Site Specific Roles on the Asset
15 Technical Specific Role Competence	Tracks the certification status of Competence for all the Technical Specific Onshore Roles for that Asset
VERIFICATION	
16 Open Level 3 Verification Findings (Non Conformance)	Tracks the number of Open Level 3 Verification Findings
17 Open Level 2 Verification Findings 30 days after raised (Anomaly)	Tracks the number of Open Level 2 findings 30 days after they have been raised and have not been closed out.
18 Internal Audit Programme - NCRs	Tracks the number of Category 1 Planned Maintenance Routine (PMR) tasks and Priority 1 Corrective Work Order (CWO) tasks in Legacy Backlog each week.

Figure 4.

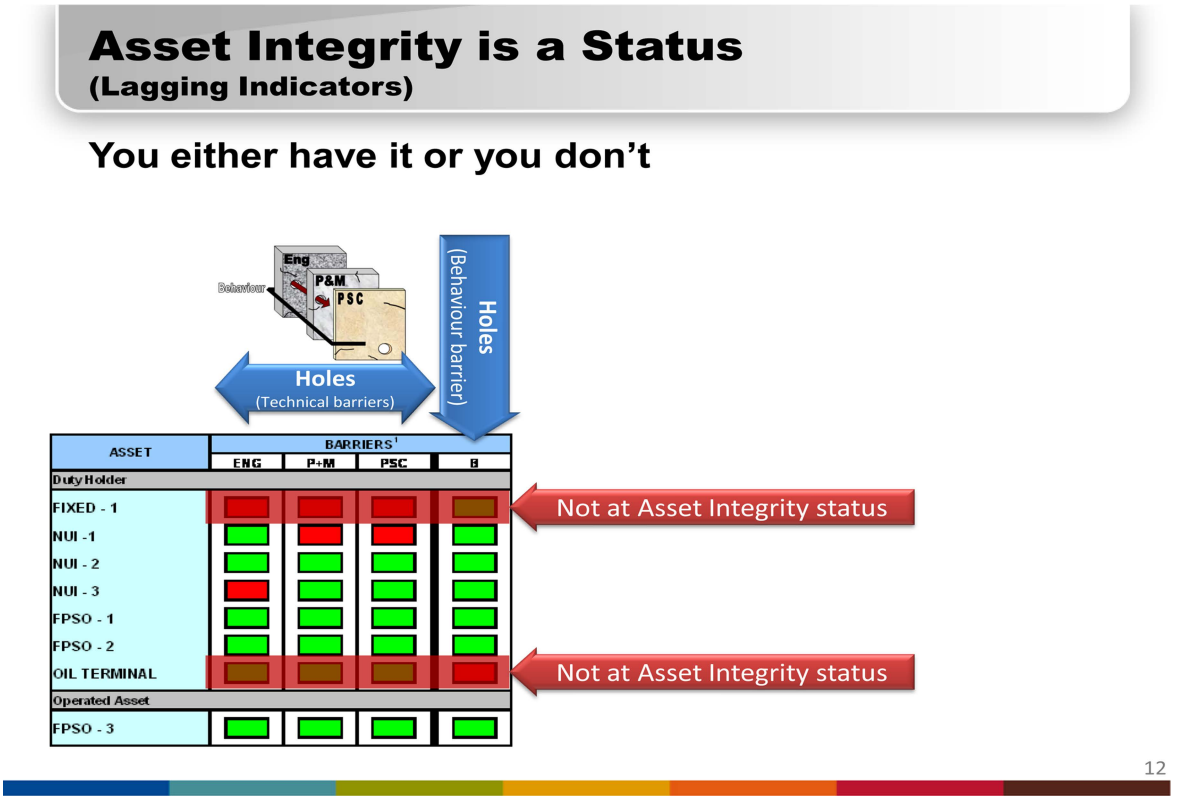


Figure 5.

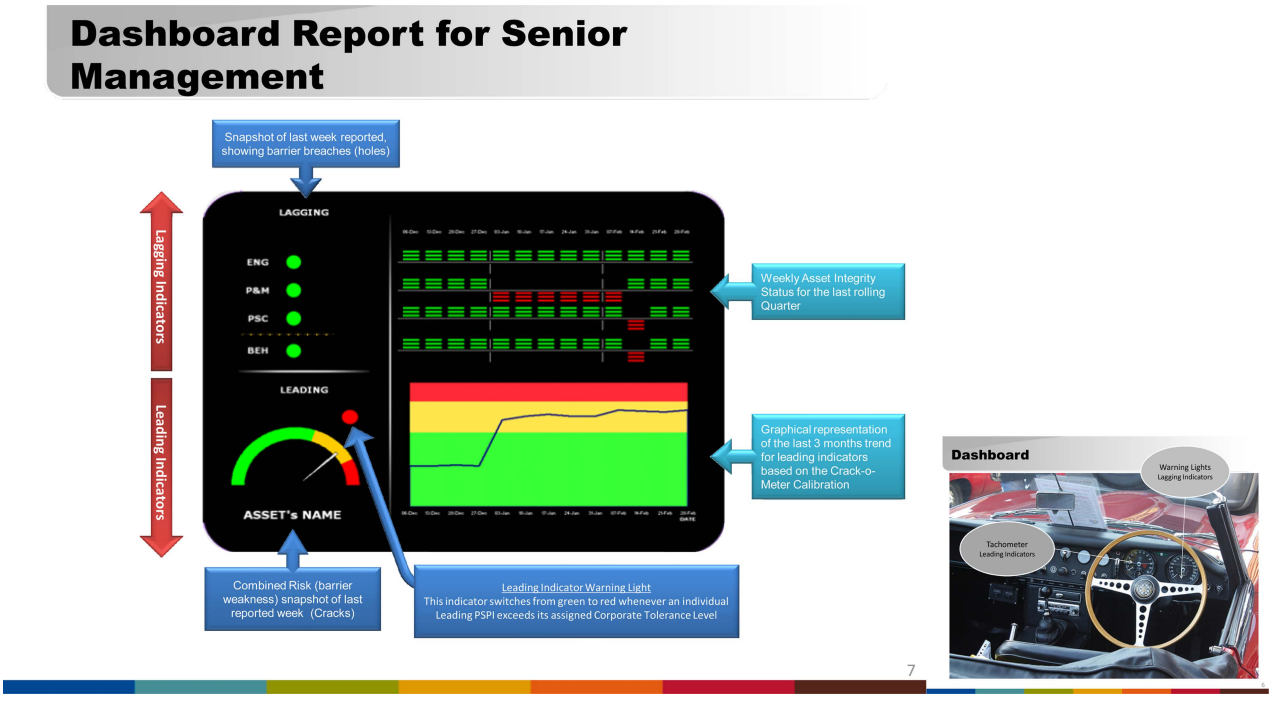


Figure 6.

Combined Risk Assessment Tool

Risk Assessment Matrix (RAM)

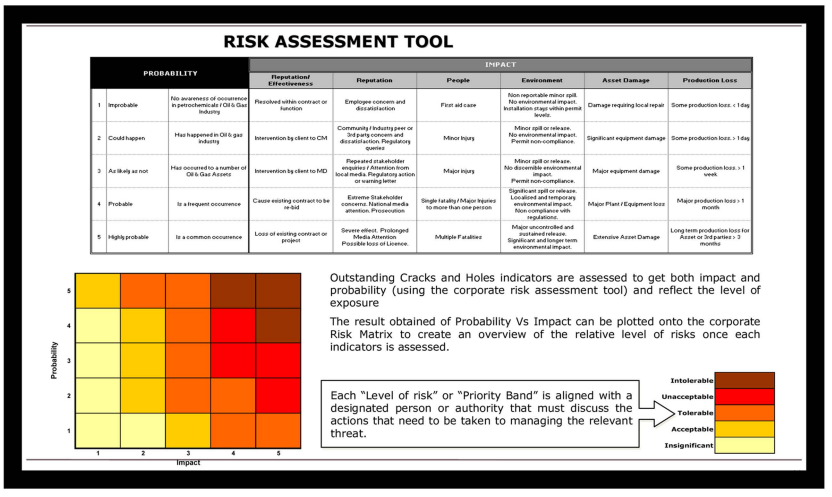


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Figure 7.

View of Combined Risk for all levels of Management

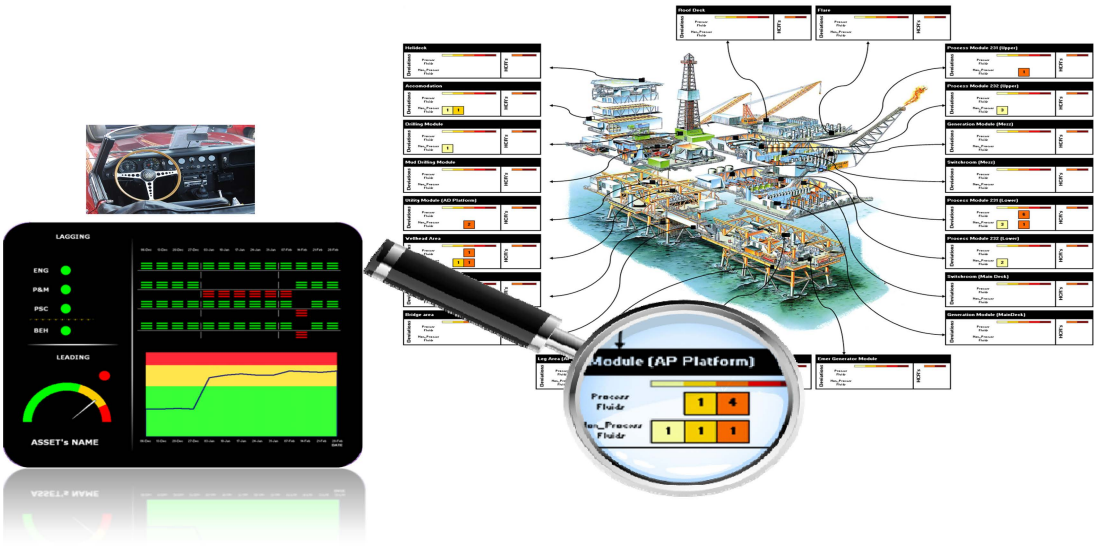

Figure 8.

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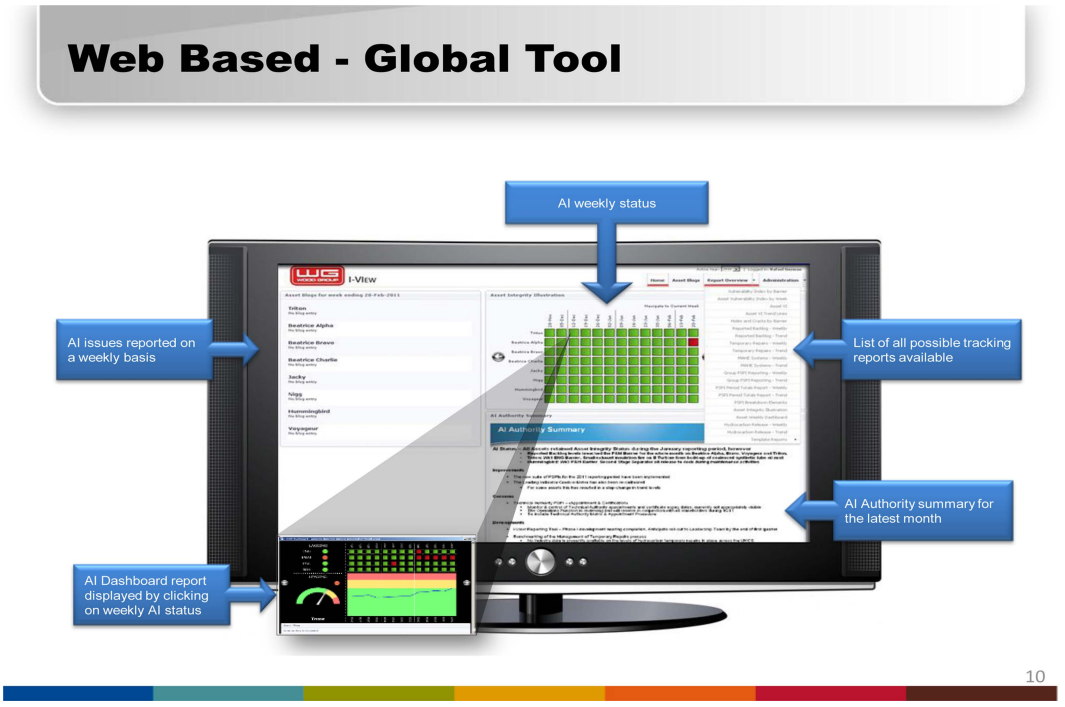

Figure 9.

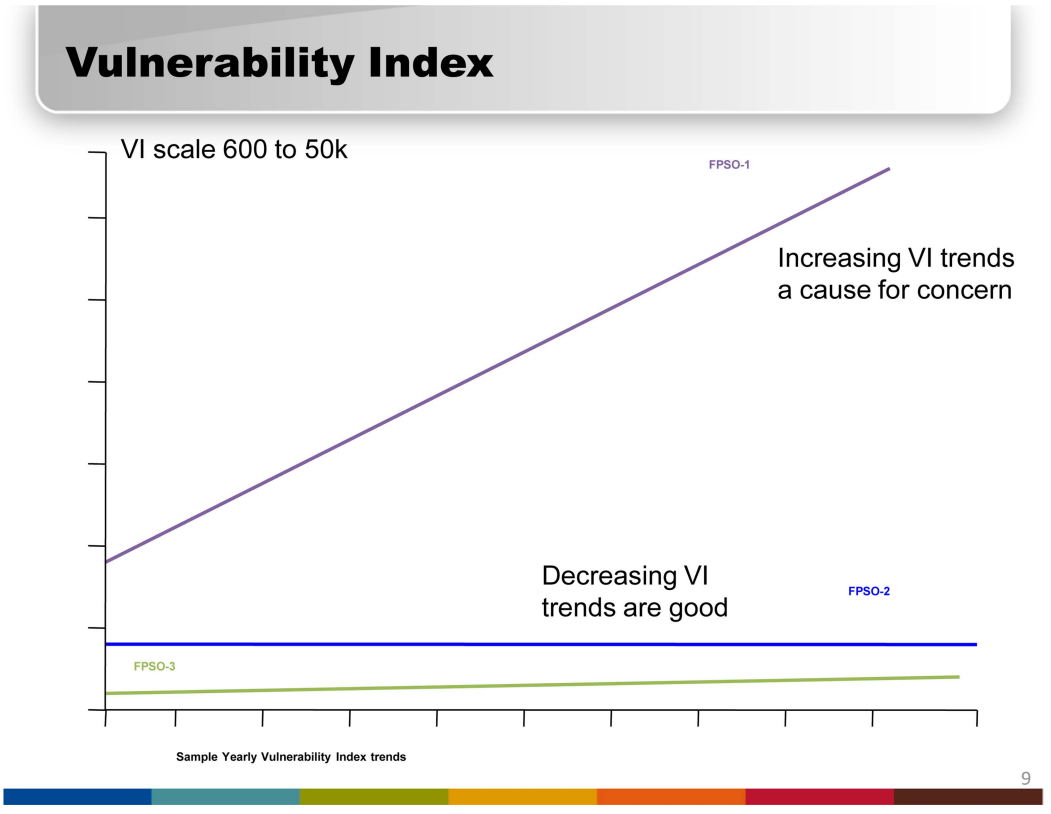

Figure 10.

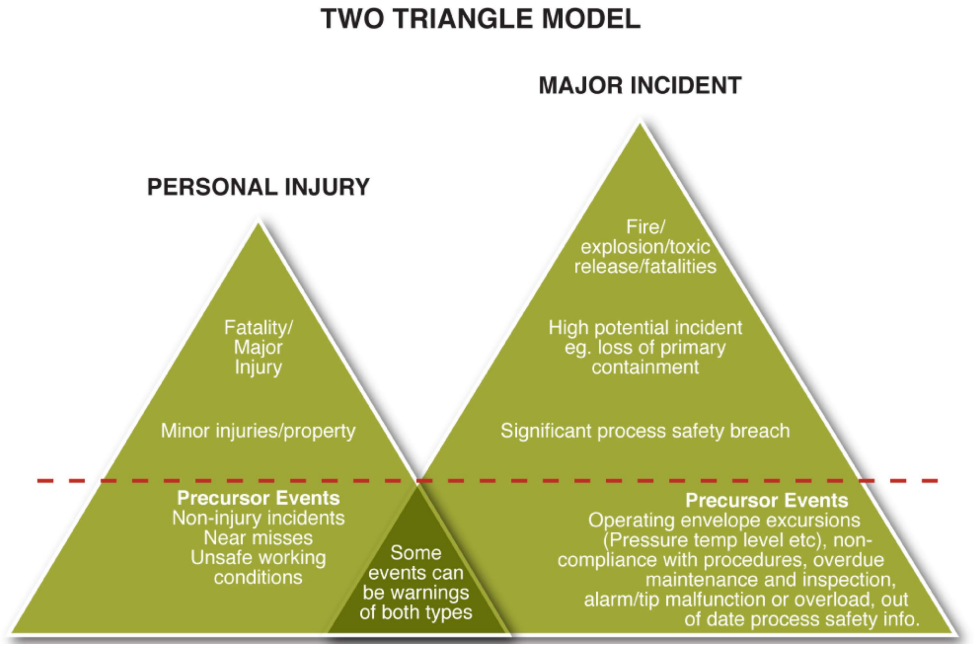

Figure 11.

Figure 12.

CONCLUSION

This tool and process together with the company Senior Management Safety course has raised the awareness of Asset integrity and Process Safety Management in the company. Occupational Safety was already well catered for in the company but now both aspects of the safety triangle can be demonstrated as being are managed see Figure 11.

Thus the company can justifiably make the claims as shown in Figure 12.

The tool and process is now in use internationally using a web based platform Fig. 9 across a wide range of different assets ranging from onshore oil terminals and gas plants to large fixed oil platforms and FPSO.