

Bridging the Gap Between Data and Decision-Making Through Digital Transformation

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Companies in the hazardous industries have invested heavily in monitoring and gathering information about their safety critical equipment to inform themselves of the asset performance and maintain the best conditions for the production output of the asset and to improve process safety standards. The Industrial Internet of Things (IIoT) has enabled us to capture data to the nth degree, but our research shows that much of the information is sitting in databases that might not be immediately available to make the right business decisions at the right time. So how do we make sure the information related to Process Safety Management is seamlessly integrated into the existing business management systems?

Looking at the Purdue Enterprise Reference Architecture, we have seen a huge amount of investment in the Level 0 to 3 space, where we have gathered information and captured the data to make sure the manufacturing operations and controls are abundantly available. The key space where work is still needs progress is Level 4—Business Planning and Logistics. While process safety tools and techniques have enabled us to improve the design basis of our facilities and monitor Process Safety Management parameters, we simply do not provide adequate systems and solutions to help the business identify critical issues and make prompt, informed decisions.

Most Process Safety Management industry leaders (90 percent) believe risk awareness would be improved with access to real-time process safety risk indicators. Connecting process safety deviations and big data to daily operations without the use of advanced digital technology is difficult and time consuming. Three-quarters (73 percent) of industry leaders appreciate that digitalisation accelerates the ability to achieve Operational Excellence*. Leading companies have begun investing in connected technologies, but the reality is only 26 percent of companies who have implemented IIoT projects have succeeded in achieving their goals. So how can organisations bridge the gap between available data and informed operational and business decisions?

This presentation will explore how some of the leading organisations in hazardous industries are using enterprise platform solutions to better manage the plethora of available data and converting them into dynamic operational decisions. From a project implementation perspective, we will look at the steps that companies must look at to ensure a successful outcome is achieved for their digitalisation journey. Ultimately, the aim of a connected platform enterprise solution in the hazardous industries needs to provide the frontline and the boardroom a common view of information to make asset operations safe and productive.

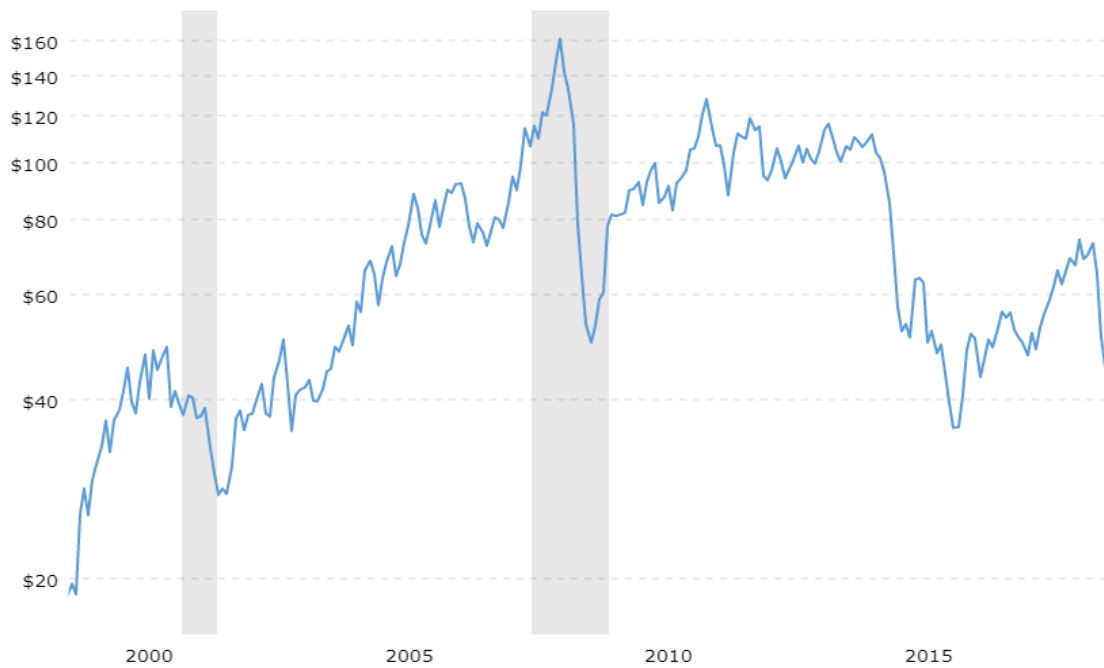
With the industry's leading Operational Excellence platform solution, organisations are now taking advantage of a clearer operational environment picture and, as a result, are making more informed decisions. For example, a leading Middle East organisation is now reporting \$6.5 million annual frontline savings, a 75 percent reduction in crew wait times, 50 percent reduction in supervisor wait times, and an incredible 47 percent annual reduction in downtime since deployment.

Keywords: Digital Transformation, Operational Excellence, Process Safety Management, Industrial Internet of Things (IIOT), Dynamic Process Safety

The Need for Data Consolidation for Seamless Operational Decision-making:

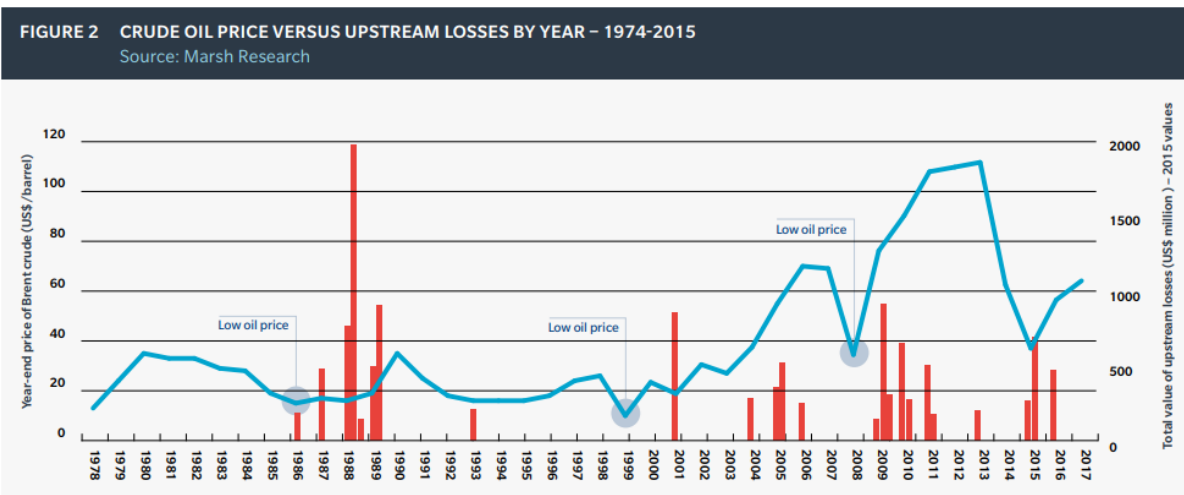
Companies in hazardous industries have invested heavily in monitoring and gathering information about their Safety Critical Equipment to inform themselves of asset performance, maintain optimum production conditions and improve process safety standards. The details of the parameters are well-documented and guided by process safety manuals within the company. Regulatory bodies and engineering institutes provide timely guidance to the industry to understand the constant changes required to improve safety standards. Organisations have to keep up with the changes while maintaining production and profit levels for the shareholders *and* keep investing in the teams or departments responsible for managing these new standards to ensure the entire organization is following suit.

In the past two decades, we have seen high fluctuations in oil prices, which, as the 24th Marsh report from risk and management company Marsh & McLennan shows, has a correlation in the number of incidents we have seen during this period. Constant fluctuations mean that companies find it harder to invest in a consistent Process Safety program that is sustainable and has the right calibre of people to manage and carry forward the processes.



Source: WTI Crude Oil Prices in \$ inflation adjusted (1999 – 2019)¹

The impact of this is that we have seen a fluctuating pattern of number of incidents and losses in the market. The 25th edition of the Marsh report² outlines the most significant losses in the hydrocarbon industry between 1978 and 2017, covering the costs of property damage, debris removal and cleanup costs all of which have been adjusted for inflation to 2017 levels. The report looks at the upstream sector for the total value of losses and, when juxtaposed against fluctuating oil prices, shows a clear relationship between every significant dip in oil price to a subsequent series of losses in the upstream sector.



Source: Marsh and McLennan Report – March 2018 - The 100 Largest Losses 1978-2017

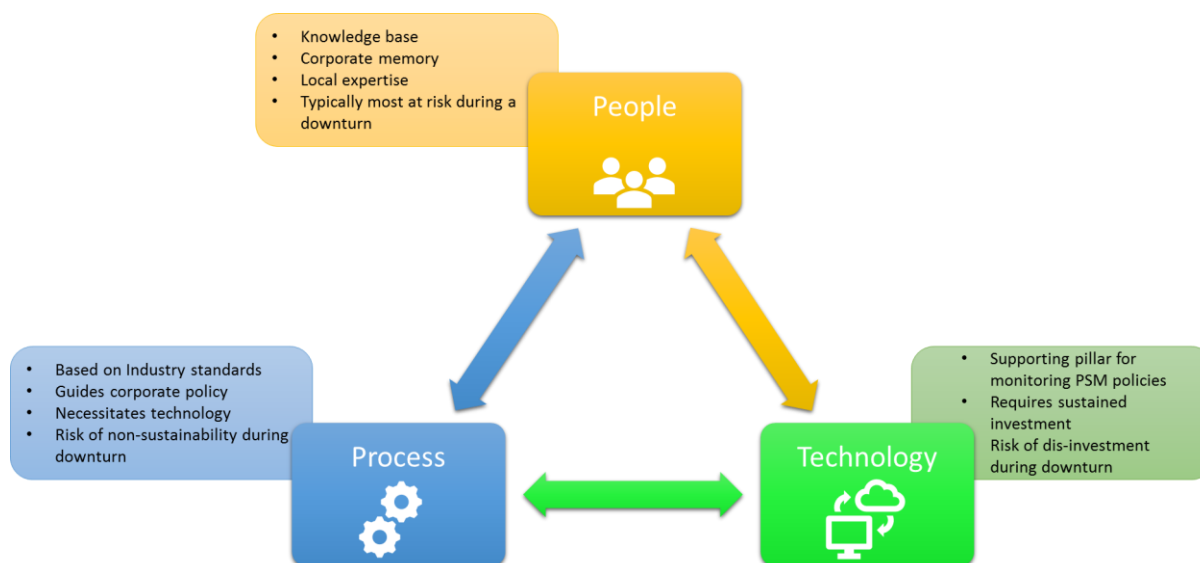
“The Effect of Low Oil Prices on Upstream Assets: In the upstream sector, lower oil prices have led to the divestment by some of the oil majors of mature assets that are no longer giving a high rate of return on investment, as they develop projects in newer oil and gas producing regions. In many cases, this has led to older assets being taken over by smaller organizations, sometimes with limited previous corporate experience in the oil and gas sector. It is important that these new entrants maintain the competency to understand the risks associated with the assets that they have acquired.”²

¹ <https://www.macrotrends.net/1369/crude-oil-price-history-chart>

² Marsh and McLennan Report – March 2018 - The 100 Largest Losses 1978-2017

The Relationship Between People, Process, and Technology and the Oil Price Downturn

In every sector during a downturn, cost-savings programs are put in place. This leads to loss in necessary skilled manpower and expertise in implementing and sustaining any existing systems that have been implemented to continue Process Safety Management programs.



In 2018 Petrotechnics Ltd. completed a Process Safety Management and Operational Risk Management survey³ where senior managers and leaders in the fields of process safety, Operational Risk management, asset integrity, Environmental Health & Safety, and loss prevention from global Oil & Gas companies participated. Part one of this report explored the industry response to how far the oil price downturn and the subsequent impact on corporate budgets has affected safety performance.

The survey provided real-world insights on how the price of oil continues to be a contributing factor to Process Safety risk: 72 percent of survey respondents believe the oil price has had a moderate or significant impact on Process Safety risk while only 15 percent feel it has had little impact.

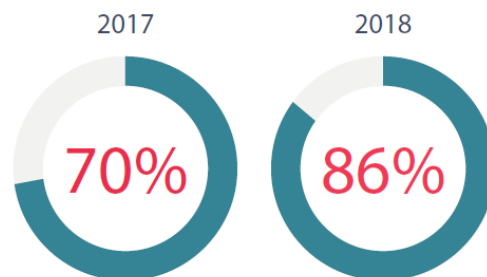
Looking at the people, process, and technology relationship, all three require equal investment with a focus on sustainably to improve the process safety performance within an organisation. A significant outcome noted within the survey is that when asked about the key factors that influence safety performance, just 4 percent of the respondents selected “Technology.” It was no surprise that 59 percent of respondents cited “Senior Leadership” as the main factor, and 54 percent said “Organisational Culture.” As important as people and corporate leadership are toward Process Safety Management performance, it is also vital to have the right technology in place to control, monitor and sustain safety standards.

Over the years, technology has evolved to help companies achieve their goals of identifying multiple variables that need monitoring, hence the increase in solution providers offering various tools to gather this information. But, as the survey shows, technology is often an afterthought that is later assigned to a team to identify the possible solutions that can be implemented within a certain budget with a tight time frame. Corporations focus heavily on people management and are forced to adopt policies as guided by engineering and Process Safety Management bodies like the U.K.-based Health and Safety Executive agency (HSE), the U.S. Occupational Safety and Health Administration (OSHA), etc.

But when it comes to technology, there is no guiding principle when it comes to knowing what works best and most of all what is the best way to implement any new Process Safety Management solution. System integrators are necessary to select the technology and implement it within an organization; however, they will still be guided by the organization’s needs. The Industrial Internet of Things (IIoT) has enabled us to capture data to the nth degree, but our research shows that much of this information is sitting in disparate databases that might not be immediately available to make the right business at the right time. How do we make sure important information related to Process Safety Management is seamlessly integrated with existing business management systems?

³ Process Safety and Operational Risk Management survey 2018: Part One

Technology is the most important tool to implement process safety policies in any plant or asset. However, the Petrotechnics survey shows a disturbing area of growth—the increasing disconnect between the intent of process safety design and what happens on the ground. One way to look at it is that the policies are designed based on the industry directives, but when it comes to the on-the-ground implementation, the true benefits are not realised. Petrotechnics found that technology often takes a back seat in process safety policy implementation even though it is the most important tool available is one aspect of this. There is also a gap between what is monitored in the field and how the data is processed to make informed decisions.



In 2017, 70% of survey participants said they believed there were gaps between how process safety was intended and what actually happens at the plant or asset.

In 2018, the number has risen to 86%.

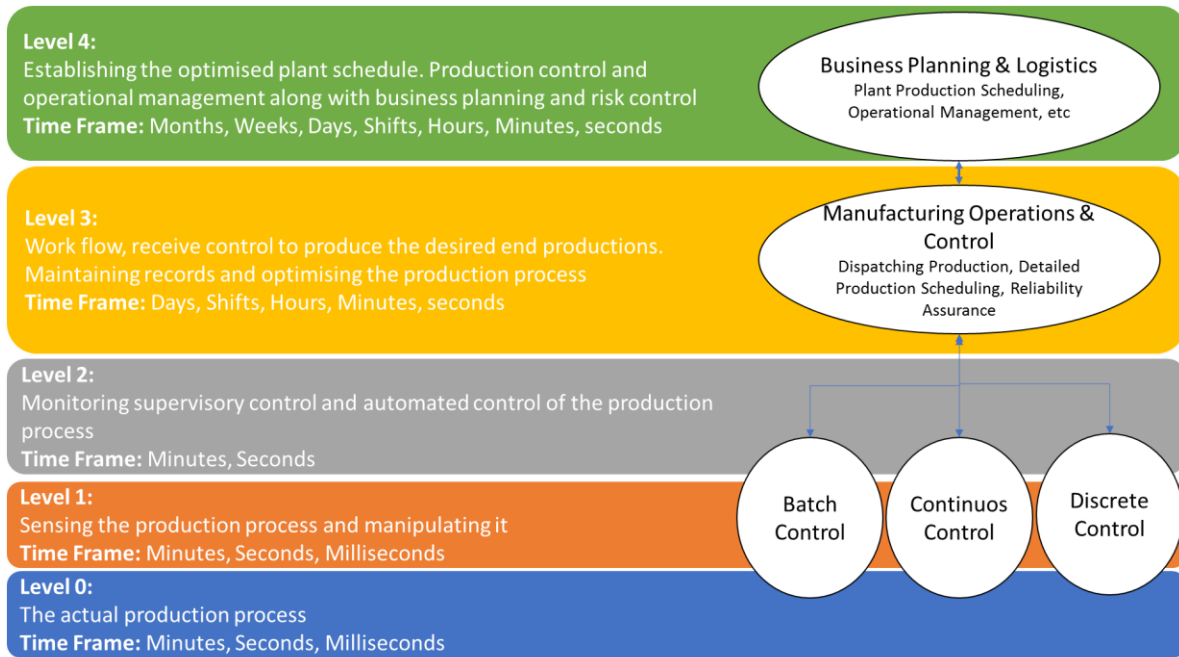
Source: *Petrotechnics - Process Safety and Operational Risk Management survey 2018: Part One*

One of the key aspects of data management and analytics is gathering the right information. The past three or four decades have been spent developing tools to help collect data and identify the minutest data point possible. This information is passed along to the control room where the user is bombarded with information on dashboards with flashing lights and warning beeps omnipresent.

The catastrophe at a refinery in Milford Haven is an example where alarm rationalisation was not carried out and the warning signs for the disaster were drowned out from the plethora of alarms in the control room that impeded the operators' ability to understand the true criticality of the situation.⁴ Over the years we have seen companies go through an exercise of better planning in the control room and providing just enough information to the operator. Organisations have invested in supervisory control and data acquisition (SCADA) systems and instrumentation to gauge the levels required to be kept under control limits. Industry has captured the metrics required to run a plant or an asset to the required levels of safety.

Looking at the Purdue Enterprise Reference Architecture, Petrotechnics have seen a huge amount of investment in the Level 0 to 3 space. Organisations have gathered information and captured data to make sure the Level 3: Manufacturing Operations and Controls are abundantly available. The key space where work is still progressing is Level 4: Business Planning and Logistics.

⁴ <http://www.hse.gov.uk/comah/sragtech/casetexaco94.htm>



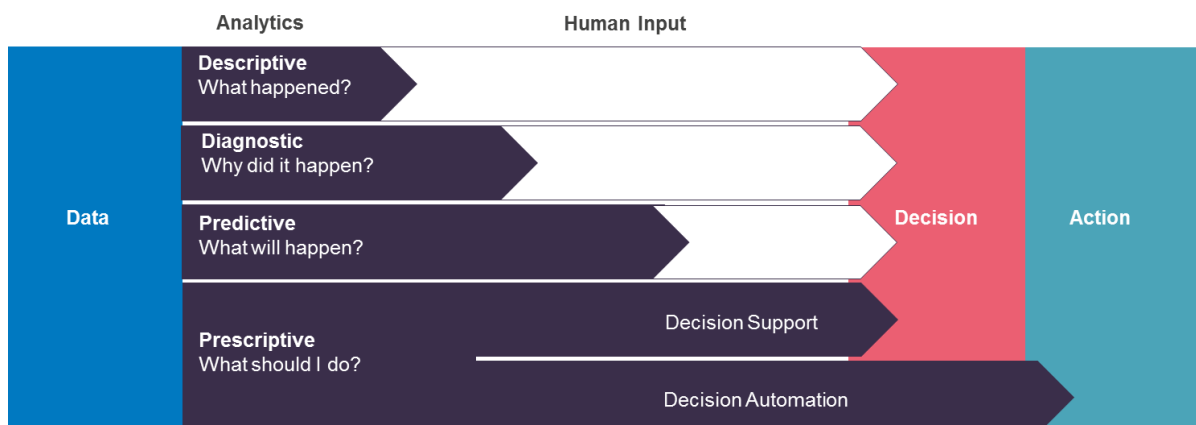
Source: Purdue Enterprise Reference Architecture

However, each process safety parameter within Level 0 to 3 is monitored within its own confidence level. And the monitoring and control is also managed in siloes. The problem with this is that any aspect that falls outside the control limits can come together at an uncertain time in the future to cause a failure to the asset and potentially turn into a catastrophe. It is therefore important to bring together all the information to make the data meaningful and provide both immediate operational information to manage the asset safely with the business intelligence necessary to plan effectively for better Process Safety Management implementations in the future.

While process safety tools and techniques have enabled us to improve the design basis of our facilities and monitor Process Safety Management parameters, companies often do not provide adequate systems and solutions to help the businesses identify their critical issues and make informed decisions quickly. We know, for examples, when a motor needs maintenance and we know by vibration levels when bearings need to be replaced. But some companies are often unable to predict when the asset is potentially going to be exposed to a situation that may lead to a fire ignition or a risk of loss of containment.

The type of information the business is seeking is now more accessible, and the potential to implement solutions to monitor equipment and operations for potential hazards is becoming a reality. All of this is enabled by massive investments in monitoring technology by industry-leading vendors. But more importantly, IIoT has enabled experienced software companies to bring all the disparate information together on a single platform to provide a unique view of the current status of the plant. A better way to visualise risk exposure to your asset in a predictive nature is now possible.

Looking at the Gartner model for Decision Automation, IIoT is now enabling companies to be more predictive about risk in their plant or asset. The aim of every organization today needs to be to use data and then get to a stage where analytics can be prescriptive enough to require minimum human input or the data gives strong guidance for decision-making.



Source: Gartner Report September 2015 – Journey to Decision Automation

According to the 2018 Process Safety and Operational Risk Management Survey, 90 percent of PSM industry leaders believe risk awareness would be improved with access to real-time process safety risk indicators. However, the on-the-ground reality

is different as only 40 percent of respondents say they believe that companies have effective systems in place for monitoring and managing impaired process safety barriers in real time. Only 36 percent of respondents say they believe effective systems are in place for monitoring and managing deviations from management system requirements.

Leading companies have been investing in connected technologies, however, it has not been a straightforward process for many organizations, and many leading consulting companies and system integrators are still trying to define the best way forward to adopt new technology and implement it. No wonder Cisco Systems Inc. found that only 26 percent of companies who tried IIoT projects have succeeded in achieving their goals.⁵ It is a challenge, but by applying strong project management principles and a strong change management strategy, the goals of a connected enterprise are achievable.

The effective use of digital technologies in the oil and gas sector could reduce capital expenditures by up to 20%; it could cut operating costs in upstream by 3 to 5% and by about half that in downstream.”⁶

How Can Digital Transformation Bridge the Gap Between Data and Decision-making?

The real world of operations is neither simple nor static. In the real world, when our well-designed and well-specified processes and equipment enter service, they are almost immediately subject to change. Day-to-day operations are characterised by a changing dynamic where there are multiple sources of potential risk which typically change daily, hourly and sometimes by the second, such as:

- **Process safety barrier impairments** where deviations could include damage and failure to physical barriers such as corrosion, mechanical failure, temporary repairs, procedure deviations and deferred inspections, testing or preventive maintenance.
- **Operational activities** including monitoring equipment at startup or shutdown.
- **Operator actions** such as hydrocarbon sampling, filter change out, “pig” launching and receiving, etc. Excursions outside safe operating limits. Temporary defeats to safety systems. Process isolations which do not meet company standards. Periods of instability on the processing plant
- **Working in and around the live plant** introduces immediate hazards, such as ignition sources from hot work, breaking flanges, heavy lifting, excavation work and more. These activities are typically risk-assessed and controls put in place (such as gas testing while conducting hot work) which can mitigate or minimize the risk, but cannot fully eliminate it.
- **Simultaneous operations** compound Operational Risk when teams operate in the same or nearby areas. Some activities may be managed separately from plant operations, such as construction, project work, subsea, drilling or well service. It is essential that rules are defined for work coordination; however, residual risks will always remain and, more importantly, they will place work crews, especially those unfamiliar with the plant, in potentially hazardous territory.
- **Environmental conditions** such as temperature extremes, wind, visibility, precipitation and electrical storms add risk potential and can compromise work programs.
- **Human factors** such as competence, lack of experience, discipline, fatigue and distraction can compromise the quality of decision-making at the frontline. With this array of potential risk sources, decision-makers are faced with many questions, but information and data systems and approaches to managing risk are not set up to offer real-time insights to support critical operating decisions.

There is increasing focus and attention on the potential for new digitalisation strategies to deliver increased value and sustainability in the energy and petrochemicals sector. Over 73 percent of industry leaders recognise the power of digitalisation to accelerate and provide sustainable Operational Excellence.⁷ A reduction in operating costs, broader operational efficiencies and fundamental transformation of the business are what is expected. The promises of data connectivity and analytics suggest continuous uptime, rapid response to risk exposure, incremental revenue gains, opportunities to better utilize assets, coordinate with operating and business needs and improve the efficiency of field service groups.

The challenge is: How do organisations boil down the changing conditions on an asset to a single view of risk exposure? How do companies quantify the Operational Risk within their assets? Is there a way to visualise or predict a hazard in the near or long-term future? How does technology help us achieve this? A new approach to managing the cumulative impact of all these dynamic Operational Risks is to model their impact on process safety barrier groupings and associate them to the major accident hazards under management. Technology is the enabling factor where IIoT and big data help pull information together in a common platform. This simple, elegant approach enables operators to predict and better manage the outcome. This could lead to postponing a particular activity or accelerating maintenance to address the deviations or nonconformances on the

⁵ <https://newsroom.cisco.com/press-release-content?articleId=1847422>

⁶ <https://www.mckinsey.com/industries/oil-and-gas/our-insights/the-next-frontier-for-digital-technologies-in-oil-and-gas>

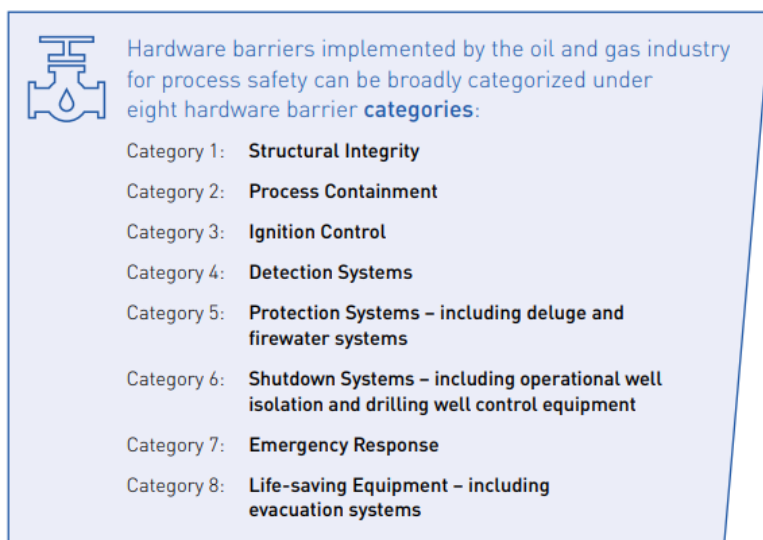
⁷ Operational Excellence Index 2017 - <https://www.petrotechnics.com/insights/operational-excellence-index-2017-survey-report/>

facility. Also, converting all the performance deviations and nonconformance after an Operational Risk assessment to a common “language” of risk and representing them visually is where technology helps achieve the goals. Examples include:

- Performance standard failure
- Verification inspection finding
- Overdue safety-critical maintenance
- Override of a safety-critical system or device
- Management of hydrocarbon leaks
- Temporary equipment
- The absence or inadequacy of a control system(s)

Hazardous industry operators are moving toward a fundamental barrier model based on multiple layers of protection/mitigation. The idea is simple: If you have impairments in several barrier groups, risk increases because a major accident is more likely to occur. They provide the opportunity to allow everyone from the boardroom to the frontline to see and manage all Operational Risks across the enterprise consistently.

The process safety barrier model advocated by the International Association of Oil & Gas Producers lists eight hardware barriersto process safety in its Report 544.



Source: IOGP Report 544⁸

In many ways, the dynamic nature of the frontline is ripe for technology to better support decision-makers. In fact, according to a recent Verdantix study, Operational Excellence and Industry 4.0 strategies are among the top factors triggering Operational Risk management implementation today. In the study 7 out of 10 (73 percent) of respondents said they consider digital technology valuable, if not essential, for effective Operational Risk management. An emerging category of Operational Risk Management enterprise software seeks to support safe and

effective operational decisions by providing critical innovations⁹, including:

- An enterprise ORM approach to Barrier Management, Permit to Work, Management of Change, Incident Management, Risk Assessments, and Process Safety Management, which are all accessible via desktop web applications and mobile devices for use in the field.
- Wearable technology as a source of data for use in the field.
- IIoT as a source of data from critical devices in the field.
- Advanced modelling capabilities to create dynamic “digital twin” asset models.
- Advanced analytics from big data to provide actionable insights on Operational Risk status and trends.

Today’s technology can provide a single shared view of the risk exposure to the asset. It can also provide information on when the asset is exposed to a potential major hazard, intelligence on which specific area within your asset has a higher chance of

⁸ Standardisation of Barrier Definitions – IOGP Report 544

⁹ Verdantix, 2018, Smart Innovators: Operational Risk Management Software, August 2018, London, UK

an incident occurring and a clear visual representation of which Process Safety Management barriers within the asset has been impaired. This information is vital for operational decision-making and is the missing link in the industry. It eliminates the siloed nature of decision-making and everyone in the organisation is singing from the same song sheet. The right technology solution and the correct understanding of the principles that govern Operational Risk at your asset can bring in many benefits.

The ‘Prize’ of Digital Transformation Is Big

The below case study shows a leading Middle East company is using the power of connected technology to manage real-time critical equipment status and view its impact on the risk exposure of the asset.

A major national oil company is building and will operate a world class refinery in the Middle East. Currently in the greenfield phase, the operator has commissioned a significant Industry 4.0 initiative to develop and deliver a technology-driven approach to integrate a suite of business systems to better support asset and operations processes and management. The operator has a sophisticated safety management system and clear corporate standards and practices. The operator wishes to make a real-time view of operational and process safety risk as a central element of decision-making from plant startup onwards.

The operator is implementing an Operational Risk Management solution to manage all permitted activity and all deviations on the facility. The technology will integrate with three other business systems to deliver a real-time view of the risk status associated with critical equipment:

- **Data historian** for near real-time status of critical equipment (this data historian is itself tracking the operational DCS and critical alarms systems)
- **Maintenance Management System (MMS)** for inspection and maintenance records and associated plans and schedules
- **Operator rounds system** – for capturing physical condition of the plant in near-real time, especially during job walks

Since the project is still in the design phase, the project team was able to access design package materials from the Engineering, Procurement and Construction contractors responsible for each refinery unit to identify the critical equipment. This includes bringing together a variety of information in useful formats:

- From design phase Hazard and Operability (HAZOP) and asset integrity studies
- Health parameters associated with specific items of identified safety critical equipment
- Critical equipment types/categories mapped to the fundamental process safety barrier model
- Records representing all critical equipment was set up in the Operational Risk Management software
- Through integration, the Operational Risk Management software “listens” for the health of critical equipment, based on the above parameters, from three sources:
 1. *Near real-time status from the data historian*
 2. *Inspection records for critical equipment from operator rounds and the inspection management system*
 3. *Deferred planned maintenance for critical equipment from MMS*
- Nonconformances are mapped to the fundamental process safety barrier model

The integration described provides a combined real-time view of all equipment risks and all activity risks on the barrier model, highlighting Major Accident Pathways (MAH) pathways.

Another leading Middle East organisation is now reporting annual frontline savings of \$6.5 million, a 75 percent reduction in crew wait times, a 50 percent reduction in supervisor wait times and an incredible 47 percent reduction in annual downtime since deployment.¹⁰ These are benefits reaped based on selecting the right technology to support the implementation process throughout the organization. It is also important that the selected technology be easily digestible and produce the right results for the people to then continually sustain the benefits. Many times the right technology, even after implementation, fails because the metrics to measure results were not set correctly at the outset or senior management did not adjust the expectations once the digital transformation project was underway. To ensure the right technology solutions are implemented and operationally beneficial, organisations need to complete a thorough evaluation and answer a few questions beforehand:

- What is the desired outcome of the technology implementation?
- Will both frontline and senior management read from the same playbook?
- Will the organisation capture the right data from the assets to make informed decisions?
- Where can organisations implement technology to get fast results now and gain momentum in the future?
- Has the project been given enough time to succeed?

¹⁰ Petrotechnics Ltd. Client Case Study: The Value of Digital Operations

With a sharp strategic approach using the expertise of the right people and the guidance of the right processes, the appropriate technology will help bridge the gap between data and on-time critical business decision-making.

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