REUTERS EVENTS™

THREE PILLARS OF ASSET PERFORMANCE MANAGEMENT: PEOPLE, PROCESS & TECHNOLOGY

Reuters Event's in partnership with

YOKOGAWA

Yokogawa RAP Limited

https://www.reutersevents.com/events/downstream/

Table of contents:

OUTLOOK: ASSET PERFORMANCE MANAGEMENT

Asset-heavy industries face mounting pressure from tightening operating and capital expense budgets, as plant managers strive to improve safety and productivity while training and retaining experienced operators. These challenges are exacerbated by the COVID-19 pandemic and prompt a pressing need to optimize the allocation and maintenance of assets to maximize returns.

The potential savings in time, money, effort and, ultimately, lives offered by the digitalization of the chemical, petrochemical, oil and gas industries make a compelling argument to adopt cutting-edge technology into asset performance management (APM) strategies to achieve operational excellence.

Digital technology such as machine learning (ML), artificial intelligence (AI), Big Data, and the Industrial Internet of Things (IIoT) offer an array of tools to realize the optimization of asset performance including predictive maintenance that drives safer, more reliable operations.

Intensive manufacturing and industrial businesses are turning to digital APM strategies as they seek not only to optimize physical assets, but also organization-wide resources in a bid to increase reliability, minimize costs, and reduce operational risks.

Pressure to minimize workplace risks and improve safety intensified in August 2020 when more than 2,700 tonnes of ammonium nitrate (AN) stored at Port Beirut in Lebanon exploded in one of the largest non-nuclear detonations ever recorded. More than 200 people lost their lives.

Port Beirut was the latest in a history of major incidences, which began with AN blasts at the Oppau plant, Germany, in 1921, through to the explosions on the Piper Alpha off-shore oil platform in the North Sea in 1988. Notably, the release of toxins from the Seveso plant, Italy, in 1976, led to the Seveso Directive on technological disaster risk reduction that underpins many safety initiatives.

In 2018, Deloitte Insights conducted a survey on company investment in capabilities driven by Industry 4.0 to enable digital transformation (DX). Oil and gas leaders rated Big Data derived from APM programs as the most likely to provide the greatest business value.

However, the survey also found that although there was strong interest in DX, some organizations were still trying to strike a balance between improving their current

operations and the innovations offered by Industry 4.0. Although 94% of respondents understood the importance of DX, the strategic possibilities were not necessarily being fully explored as fewer (68%) saw DX as a path to profitability.

Deloitte extrapolated these findings to conclude that APM could deliver more than just improved maintenance. Connecting systems across an entire organization would reveal insights to optimize operations and safety, yielding better financial results. As the IIoT is pivotal to equipment reliability, APM strategies that connect multiple data points will play a major role in driving these improvements.

Allied asset-heavy industries are successfully applying DX to operations and employing data analytics to minimize downtimes and drive down maintenance costs. The US Nuclear Energy Institute (NEI) launched an initiative in 2016 to strengthen the nuclear power industry's commitment to safety and reliability while assuring future viability through efficiency improvements.

Nuclear operators embarked on DX journeys in which technological and operational changes that could enhance safety and efficiency were identified. APM programs integrating predictive analytics that drive condition- and value-based maintenance strategies were implemented and the widespread adoption of innovative tools that could reduce costs encouraged.

However, nuclear companies soon realised that digital opportunities reside not only in enhancing asset performance through predictive maintenance and asset strategy optimization, but also in operations optimization. In particular, on-site work execution involving complex processes had become increasingly cumbersome.

Investigations by the Electric Power Research Institute (EPRI) revealed that these complex processes had been created by the accumulation of checks and balances introduced to enhance safety on nuclear power plants. EPRI proposed that the digitalization of work would enable these processes to be carried out electronically in the field, thereby improving efficiency without compromising safety.

In 2020, EPRI published data that showed electronic work packages (eWP) are now a primary innovation tool for integrating work activities with basic plant work processes, eliminating several costly activities associated with paper-based procedures. Mobile work management platforms are now accepted by the industry, with more than half the US nuclear fleet deploying an eWP solution.

Implementing holistic APM strategies that streamline digitalization across an entire organization from on-site daily work processes to physical assets and knowledge management, will be pivotal to the successful and complete digital transformation of any business. Encompassing innovations from eWPs to Big Data analytics and cloud platforms in operations will be critical to leveraging data in the pursuit of operational excellence and securing profitability now and in the future.

OVERVIEW: THE FUNDAMENTAL PILLARS

Deloitte outlined the common challenges facing most asset-intensive organizations, including more stringent regulations, especially with regard to safety, as well as manual uncoordinated work processes and a lack of knowledge management systems.

These challenges could be addressed by broadening the scope of APM beyond maintenance to include the key business areas of the physical and mechanical, operational, as well as the environment, health, and safety (EHS).

EHS was particularly identified as needing a shift from compliance to prevention and APM was cited as a potential tool to minimize risk and improve safety. This would, in turn, lower insurance costs while strengthening the reliability of assets and, therefore, the reliability of operations.

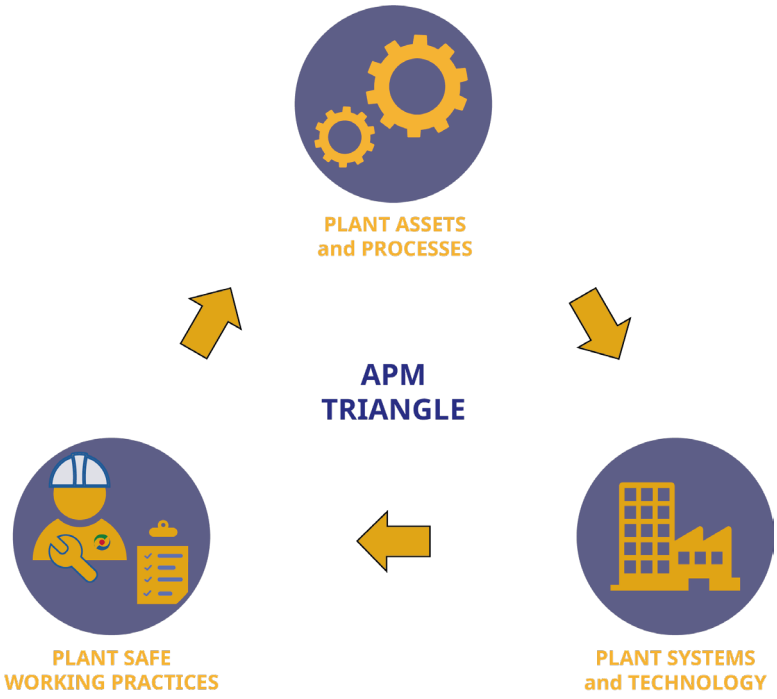
As APM strategies continue to evolve, Yokogawa has brought together its expertise from Yokogawa RAP Limited and KBC to develop a holistic approach to the digitalization of APM that brings together the people, processes, and technology aspects of operations to provide an effective mechanism for optimizing asset management:

People, who drive and manage the solution. They are responsible for creating and sharing knowledge on APM within the plant and across industries and making informed and timely decisions that ultimately affects risks, costs, and performance.

Processes, that can reflect and influence best practices and regulations, ensuring the right instructions, escalation procedures, and discussions are implemented for safe and efficient work.

Technology, that provides additional intelligence leveraged for efficiency improvements by ensuring connectivity and understanding, especially for areas that are difficult to access or comprehend.

Yokogawa's APM solution is founded on a culture of safety and reliability, which delivers consistency in work processes, continuous improvement, and technology integrated across plants and entire organizations. The benefits of deployed digital tools are realised through synchronizing the digitalization of each aspect of operations.



DX solutions such as cloud platforms manage data to enhance the efficiency of assets and exploit improvement potential. RAP (Risk Assessment Processes) is deployed to enhance safety at work while the RAP Cortex stores institutional knowledge. Robust training programs ensure competency in the workplace, keeping worker morale high and safety incidences low.

Innovation and leadership will underpin the digitalization of asset-heavy industry, as businesses undergo a culture shift to embrace a safer, technology-driven work environment. This whitepaper examines Yokogawa's DX strategy through the prism of its three-pronged APM solution.

YOKOGAWA

INNOVATORS
YOKOGAWA ELECTRIC CORPORATION JAPAN

Yokogawa is a leading provider of industrial automation solutions that combine cutting-edge technology and engineering services to deliver operational safety, reliability, efficiency, and quality in the field. Its suite of asset management solutions targets common challenges facing downstream industry now grappling with a new era of technology.

Yokogawa promotes a DX approach to addressing these challenges within the context of production activities. Integral to that approach is its APM solution, which facilitates the monitoring and analysis of asset performance across the entire plant and promotes the goal of DX in achieving profitable and sustainable operations.

Implementing APM offers the opportunity to accelerate digitalization of any plant, which potentially generates more trusted data that enables swifter and more sound decision-making. It also offers a broadened view of optimization, extensive use of automation, and a greater number of empowered people working across the business.

People

Within APM, Yokogawa strives to achieve the best from all assets, balancing business needs, risks, and costs to deliver optimal performance. Without a culture that supports, promotes, and ultimately delivers a safe and reliable performance, this can never be achieved because there will be adverse impacts on people's lives, as well as on the business.

A culture of safety and reliability is founded in organizational alignment of and commitment to achieving safe and reliable operations, as well as always striving for improvement. Such a culture is underpinned by consistent messaging and communications from top management throughout the organization so that reliability and safety excellence are seen as the norm.

It has to be led by top management and accompanied by a process of accountability that provides support while reinforcing the organization's requirements and expectations. Senior management are responsible for building the culture because without a demonstrated commitment to safety and reliability, it is hard to gain organization-wide support. Nevertheless, everyone must be on board and must actively work together to strive for safety and reliability excellence.

There are a number of challenges to overcome including historic work practices that

may involve taking unnecessary risks. For example, there may be pressure to complete tasks as quickly as possible to minimize losses but which result in taking potentially hazardous short cuts. Cumbersome processes that make safely controlling work difficult to achieve will not deliver the required level of reliability. In addition, third party organizations, such as external contractors working on the plant, might not be familiar with or fully committed to on-site requirements.

A key aspect to achieving an innovative, engaged, and empowered working environment is making sure people feel listened to and respected. Decision-making must be delegated to the right organizational levels, thus empowering the workforce to drive performance in the right direction. This needs to be done within parameters and constraints, as defined by business processes, but it is important to delegate responsibility to those best placed to carry out specific tasks wherever possible.

Recognition and positive constructive feedback are critical to ensuring everyone understands how their performance contributes to business successes. Space must be made for generating and developing new ideas that can realise future improvements, from upgrading the seals on a pump to modifying work processes or systems to deliver greater efficiency.
Safe and reliable processes are a business requirement to prove operations are sustainable. A reliable plant or operation will, by definition, provide a safer work environment for all. Everyone returns home from work without injury or harm, and there are no safety impacts on neighbours or surrounding communities.

Processes
Effective APM processes achieve better reliability, safety, and, ultimately, profitability. They are a vital part of asset management and define the way in which different scenarios are approached and managed, facilitating compliance with defined expectations. This drives consistency across people and teams to ensure that activities are completed safely.

A clear and well-defined work process should provide the steps required to complete tasks in a safe and effective manner by preventing unsafe actions that result in accidents and incidents. Continuous improvement ensures that current people, processes, and technology are in line with the requirements and demands of today and, to some extent, the future.

Training and knowledge sharing sit alongside continuous improvement. An effective

training program must deliver the required skills that can be applied to achieve the desired performance. Assessments ensure the necessary competencies have been gained, and refresher courses reinforce behaviour and performance expectations. Knowledge management is an ongoing challenge, but there are effective ways to capture and share knowledge and experience. For example, the intuitive Yokogawa RAP (Risk Assessment Processes) Control of Work (CoW) application incorporates the learnings from hundreds of thousands of work activities to support safe and efficient control of work.

Digital tools provide an efficient mechanism for applying the right processes, standards, and asset strategies to quickly assemble all necessary information for the safe control of work. Wearable technologies can help the user to visualize different aspects related to a given job, such as technical data and drawings, whilst being hands-free and contributing to safety and execution efficiency.

Outdated processes negatively impact risks, costs, performance, and even morale. Learning from mistakes and understanding the reasons why performance may not have met expectations has always been one of the best ways of driving continuous improvement. Where appropriate, root cause analysis should be performed in the aftermath of any incident or unexpected event and the right improvements can be developed to prevent reoccurrences.

Technology

Technology complements the APM paradigm by making strategies more data-driven and risk-based. It enables comprehensive decision-making processes because it brings together a wealth of data that humans may not be able to access under normal circumstances. It is critical to ensuring APM strategies are effective, especially now the market is moving towards more connectedness and almost instantaneous feedback.

Technology augments the value of the other two pillars. It connects the right people to the right data at the right time, providing additional intelligence and oversight to make informed decisions. It ensures asset and process knowledge continuity when subject-matter experts retire from or leave the company.

Workers are freed from repetitive, low-value tasks and/or labour-intensive activities, which increases speed, efficiency, safety, and accuracy. Instead they can undertake the high-value tasks that drive continuous improvement and, with the assistance of technology in tracking down and eliminating causes of failure and ineffectiveness in the

process, engage in safer, faster, and more secure work.

APM strategies are optimized by having access to as much relevant data as possible. Therefore, technologies related to data ingestion such as the IIoT, integration using cloud platforms, processing including ML and AI, and visualization using digital twins, will lead and drive DX for APM.

Alongside this access is technology that facilitates the understanding and manipulation of that data in order to develop the actual strategies. Although this is not as easy as it seems, technologies based on domain knowledge of APM in the form of asset or strategy libraries and process logic will definitely be an advantage.

Based on the data received from, for example, assets and processes, ML and analytics are applied in the following ways: to predict failures before they occur; estimate remaining useful life; detect signs of anomalies in the risk, cost, and performance ahead of time; and to make models and simulations for further analysis. ML and analytics buy users time to make informed decisions.

Overall, safety is one of the most important risks to consider. There is a direct connection between reactive maintenance and safety incidents. When reactive maintenance is performed, maintenance workers tend to hurry to prevent further damage. This leads to unnecessary risks, human error, and increased maintenance costs. By effectively using data and technology to develop optimized strategies, users can be assured that their assets are working reliably to design and expectations. This ensures safe maintenance work.

Nevertheless, technology is not necessarily the next step and it is still important to have the right processes, risk mitigations, and resolutions in place before its application. Implementing technology can be challenging due to: the cost and complexity to implement, maintain, and scale; the complexity in matching the technology to existing work processes; and change management in terms of users fully understanding, using, and benefiting from the technology.

YOKOGAWA RAP Ltd
Mark Breese CCHEM MRSC
Head of Sales

Yokogawa RAP came into being after Yokogawa acquired RAP International in 2019. It is recognized as a leading software provider in the field of CoW. RAP provides an innovative and intuitive gateway to a safer workforce culture by offering an intelligent alternative to merely digitizing a paper-based CoW system.

RAP puts risk assessment at the forefront of the permitting process and is supported by a vast knowledge base of potential hazards and mitigating controls. CoW comprises the risk assessment of any work activity, the creation and issue of a permit, and the management of any associated process or other forms of isolation.

The Yokogawa RAP system is based on millions of hours of permitting, risk assessment, and isolation, and with all the insights gained held within the RAP Cortex. Users have instant access to a wealth of knowledge and experience, which is in a language-independent format that can be used to keep an entire workforce safe.

People

Effective and efficient APM cannot be achieved without a culture of safety and reliability. This is because at the core of that culture is an acceptance that consistently doing things in the right way is the most efficient way, rather than working to a reliable methodology every now and again. However, such a culture needs to come from and be driven by top management so that everyone believes it is important. There also has to be a commitment to putting the tools, equipment, and support in place to make it easy for people to follow the culture and not take short cuts.

Although top management has to communicate the direction of the business to the workforce, it also has to listen to what is happening on the shop floor and act on any concerns. People need to know their voice is heard and understood, so getting this culture and environment right is about ensuring everyone is involved and that they believe the business is going in the right direction.

Once the safety aspect is right, the reliability with which consistent quality is produced follows. Operations and the business cannot move forward until they have got those fundamentals right because these underpin the choice of tools used to engage a workforce to work to a consistent methodology. The consistency is down to the people

doing the work and their culture; it is down to the production processes used on a daily basis; and it is down to the machinery, systems, and software that support and maintain that consistency.

The barriers to implementing an effective culture of safety and reliability are namely fear of change and education. However, these can be overcome if people are actively involved so they understand the new way of working and can buy into it. The benefit is that consistency in an organization makes it more profitable. This is because it is more efficient and has a work force that is engaged and generally happier to go to work. People know their company is keeping them safe by doing more than just putting a poster on a wall.

Processes

A clearly defined work process is not necessarily described to the nth degree of detail, but it is easy to understand and follow in a safe manner. Because it is easy to follow, people tend not to take short cuts and instead operate in a safe and efficient way. The two go hand-in-hand: the clearer and simpler the process, the more chance people have to produce the right output, which should also include going home after work safely.

Digital tools are critical to safer work processes, but it has taken a lot of time for industry to move away from paper-based systems. The Piper Alpha and Seveso incidents were probably the initial triggers to make this move, followed by the Seveso Directive. However, the industry did learn from these incidents and started to do things differently, but it is still on that journey to bring people into a digital era away from disparate paper solutions.

Unless organizations work more intelligently, they are doomed to continue having major incidents. Incidents such as the 1921 AN explosion at the Oppau plant are still being repeated almost 100 years later as shown by the AN explosion at the Port of Beirut. It is critical they learn from mistakes but unless there is a mechanism to deal with them intelligently, the industry will not improve.

This is one of the main advantages of using RAP, as its icons are an example of working more intelligently. Each icon represents huge amounts of paper that used to be necessary to, for example, define a confined space in which people were working such as its location, how it is manifested, and what activities are to be undertaken within it. One click on the icon and the space is defined. This is continuous improvement because any learning is automatically applied the next time that icon is used.

The RAP Cortex is a knowledge base that stores and shares risk assessment learnings from the workforce and work processes. It has millions of hours of knowledge available on risk assessment at all levels of APM down to prompting workers to check for cabling on floors that could be a trip hazard. Large scale risks such as potential explosions are normally well documented, but true institutional knowledge lies in sometimes overlooked processes that make all the smaller cogs turn. The Rap Cortex makes this sort of institutional knowledge easy to pass on.

Technology

There are two technology innovations that are leading the improvement of APM. One is software that is driving people to move away from a paper-based solution. Previously much of this work required a wet signature, which is why it stayed in a paper-based system for so long. Nowadays, there is a lot more trust in electronic signatures, particularly as iris and thumb print scans can be used.

The other innovation is wearable technologies that allow workers to be in the field and simultaneously access the computer systems. These wearable technologies could be mixtures of monitors, augmented vision, or as simple as carrying a tablet so there is no need to walk back to the office in order to access the computer and carry on with the task.

The next great step will be integrating these technologies to create an interconnected or truly integrated worker, as opposed to just connecting people. An 'interconnected worker' has multiple connections in and out of the job they are doing. They can be taking instructions on a tablet, while assessing Information appearing as an overlay on a wearable device such as glasses. The interconnected worker can also simultaneously be another device. For example, if they are wearing a site helmet that is monitoring temperature, they can create a temperature map of the site as they walk around.

Data and technology can optimize asset reliability and safe maintenance strategies by speeding up the flow of information. For example, if a worker is in the field confirming an isolation they put a Lock Out Tag Out (LOTO) tag in place and scan it. The system then knows it is in place and can read from a data historian to confirm the flow has stopped because the pressure has decayed. Alternatively if it has not decayed, an alarm can alert the worker that there is something wrong with that process equipment because there is still a flow.

This has not been possible before. The worker would have had to go out onto the site, closed the valve, walked back to the monitoring room, and checked whether there was still flow. They would not have had confirmation there was a problem until much later in the work process. Therefore, interconnected data allows faster access to that data without having to go back and sit in front of a terminal in the office. This, in turn, facilitates faster more accurate decision-making.

The RAP Cortex supports workers in quickly covering the risks that are prevalent in an activity without having to consult the experts. These experts can then take a step back and become the auditors or assessors of the work that has been carried out rather than themselves having to carrying it out on the front line. Thus, significantly more work can be done because the workers who would not normally be involved in the process have been empowered to be part of it.

The experts can advise and guide, supporting the rest of the organization to get better at the processes, which results in improved safety and efficiency. The maintenance pile starts to diminish and it becomes possible to stay on top of requirements, keeping the plant in service. Operators can start to listen to the advice of an APM system and, for example, if it advises that a pump is inefficient and should be changed, there is now time available to look into the problem.

For certain technologies there is a lack of common architecture, which presents challenges to their implementation. Although wireless technology has improved, there are still different operating systems. There is also a cost aspect. Giving every single person walking round a site an intelligent helmet, for example, would be cost prohibitive. The key is matching the spend to the gains based on the augmentation that the business gets from truly integrating that workforce using the technology at hand.

KBC (A YOKOGAWA COMPANY)
Dave Loubser
Senior Staff Consultant

Founded in 1979, KBC is a wholly-owned subsidiary of Yokogawa Electric Corporation. KBC offers services to clients in the energy and chemical industry that deliver operational excellence. Its focus is asset modelling and performance, and its expertise is founded in the domains of process simulation, automation, and real-time data management.

KBC's DX solutions deliver sustainable autonomous operations for improved profitability, higher capital efficiency, and reinforced licence to operate (LTO). Subject matter consulting, software services, and cloud computing are packaged to address the key areas of concern common to most operating companies.

The digitalization of business processes within a plant significantly reduces the number of unexpected events and attains excellent levels of safety, reliability, compliance, and environmental compliance. Assets run with extraordinary efficiency in terms of energy and process yield, as all possible improvement mechanisms are constantly exploited.

People

Without a culture of safety and reliability, it is not possible to achieve whatever APM goals have been set. Operational discipline drives both safety and reliability, as it boils down to everybody doing the right thing the right way every single day. This must be supported by the leadership team who are seen to be 'walking the talk' because they espouse and are actively seen supporting those qualities. Just as important is making sure the roles and responsibilities towards safety and reliability are extremely well-defined and communicated widely.

Overall, the creation and nurturing of a safety and reliability culture can only come from senior management. Nevertheless, the whole facility's culture must be fully supportive of safety and reliability. Safety must permeate through every single activity and task executed on the site right down to the basic tasks that the point of manufacture staff, i.e. the operators and maintenance technicians, routinely execute every day. Even though they may have done a particular task a thousand times, they must still consider what they are going to do, how they are going to do it, and what they need to know or do if something goes wrong.

Situational awareness is also very important. Point of manufacture staff must be aware of their surroundings and what is going on around them because every single day on the plant is a different day: the weather is different; the operating conditions of the plant might be different; and there may be other workers on the plant doing something close-by that could impact their safety.

Typically, a lot of the barriers to implementing a culture of safety and reliability are internal. They are usually a lack of communication and motivation within the organization and staff. Much of that motivation revolves around the way in which the leadership team actually behaves. Other barriers include poorly defined or undefined roles and responsibilities as well as a lack of operational discipline and a history of bad practices. One of the main keys to successfully building a culture of safety and reliability is an effective change management program. More often than not, it's the people's behaviour that must change so they execute tasks differently i.e. safer, more reliably, and more cost effectively. However, changing the way people work can be difficult and this typically does not happen overnight. There is normally a level of resistance, so there must be buy-in from senior management supported by a comprehensive well defined change management program to help overcome barriers to change.

The obvious benefit is ensuring and maintaining the safety of everybody on the site. Another important benefit is the sustainable operation of the facility and maintaining an LTO. Safety and environmental legislation in many countries is rapidly tightening up and it is increasingly difficult to maintain an LTO if there are continual safety and environmental exceedances and incidences. Therefore, without safety there is no LTO and, in turn, no longer a business to run.

The leadership creates an innovative working environment filled with engaged and empowered people by setting an example. It must also make sure the staff are involved at every level of decision-making that support safety and reliability. To avoid resistance, everybody needs to be involved and their views on how to actually implement any new initiatives listened to and understood. This must be followed by actively soliciting ideas from the staff and providing them with practical and useful technologies that will support safety and reliability.

Process

Within a three-pronged APM strategy, the people will drive the activities and tasks, the work processes will provide the structure and the guidance, and the technology will provide the means to achieve the end goal. Work processes provide a guide that ensures

whatever is being done in the refinery or plant and at whatever level, those functions and tasks are all executed in the same way. That has the result of increasing safety and increasing reliability.

Digital tools such as RAP that support the real-life application of safety and reliability will impact on the safety of work processes. In addition, wearable technologies will provide instant, seamless access to data needed to support the execution of tasks.

Yokogawa is rolling out the Field Assistant, an intrinsically safe tablet application that provides an instantaneous and seamless connection to on-site information systems. For example, if an engineer in the field needs access to process data, they can access the data instantaneously without the need to return to the office. This short cuts that whole decision-making process and increases efficiency.

Learning from previous mistakes is an integral part of continuous improvement and is invaluable in ensuring that history is not repeated. First of all, there needs to be an effective and structured Knowledge Management System (KMS) in place, which properly documents and manages all the facility's acquired knowledge. Secondly, a knowledge and skills capture process needs to be instituted, as this provides from which situational exercises can be developed. Situational exercises that cover the most critical processes and equipment are usually developed to enable the outcomes to be shared across the organization. This formalises and facilitates the lessons learned from the mistakes that have been made.

Situationals are most valuable when training operators on how to respond to unplanned events. The Situationals can be communicated across the organization ensuring that the response from each department, or even each shift, is exactly the same. This prevents people making incorrect assumptions about how to troubleshoot the problem, which can sometimes lead to equipment damage resulting in downtime which could extend for days and maybe months.

KBC's approach is to ask its clients to identify those processes in the refinery that are the most vulnerable and those that contribute most to the bottom line. The typical incidents that have occurred in those processes are then listed and ranked according to risk and the Situational exercises are developed. Once the Situational exercise has been developed and validated it is communicated across the organization and plant. This usually results in safer, quicker response times as the operators are responding in the correct manner, and are executing a set of the tasks that prevent having safety and reliability issues.

An effective training program is developed on a foundation of a training needs analysis, which define the roles and responsibilities, detail the competencies needed and identify the behavioural indicators used to demonstrate the competencies for all the major and critical job positions in the facility.

KBC calls these Job Performance Profiles (JPPs). The competencies in the JPP represent the knowledge, skills, and attributes that each employee should have to be successful in their job position.

From there, a training master plan can be built for particular job positions along with the knowledge and skills needed to execute their functions. In order to support that plan, a training workflow is built accounting for the start, finish, and various checkpoints along the training pathway where competency is assessed.

The training plan and workflow provide a highly structured guide on how to execute the training. In order to manage this a training management policy is developed which functions as the umbrella that covers everyone's roles and responsibilities towards training, from the refinery manager down to every last employee on the plant and also sets clear standards for training quality assurance measurement.

The actual training can be delivered using self-study combined with some classroom and on-the-job training. Technology can help advance training and virtual reality (VR) type applications can accelerate the program. The operator or a maintenance technician can put on a VR headset that can immediately immerse them in the plant and simulate executing a task.

VR allows users to do things that ordinarily cannot be done on the plant. For example, if one of the tasks is to shut something down and start it up again, the trainee can be walked through the exact procedure of executing the task using VR. Therefore, when that person has to execute that task in reality, they are familiar with the equipment and how to interact with it.

This application of VR makes that whole learning process a lot easier and inspires self-confidence. There are a whole host of benefits and although it is currently prohibitively expensive to build these applications, it is going to get cheaper and there will be more of this kind of training in the near future.

Technology

Technology helps drive an APM strategy and facilitates decision-making. Until AI technology catches up, humans are still going to have to do a lot of the analysis, and it will remove the drudgery of trying identify what should be looked at and what should be ignored. Technology also offers the structure and discipline for task execution, as well as the automation of repetitive tasks. It can provide and display risk, reliability and optimization data to allow for more informed and rapid decision-making.

If set up correctly, ML takes away the whole task of gathering the right data, as well as making predictions about the functionality of plant assets. Process parameters around a specific piece of equipment can be run through predictive cycles, within which algorithms determine the likelihood of premature failure if the equipment continues to operate within those parameters. It is also possible to evaluate the design and operating parameters for equipment to determine their best operating point.

Cloud platforms could be instrumental in improving APM strategies. They ensure the right people have the right access to all the information and, instead of gathering information, people can do the analysis using their knowledge and experience. This adds a lot more value and, once again, shortens the decision-making time. However, the technology has to effectively manage massive amounts of data to prevent over-analysis of non-essential information.

The typical challenges faced when implementing technology are cost and resistance from the client due to past experiences. In their past there has possibly been a mismatch between the technology required and that which has been provided. This can happen when clients do not engage the people who are going to use the technology. Therefore, if technology is to maximize the people and process elements in APM, it must be fit-for-purpose and the staff who are to use it must be involved from the beginning of the acquisition and implementation process.

HUNTSMAN
Enriching lives through innovation

CASE STUDY

HUNTSMAN CORPORATION

Huntsman is a global chemicals company that works to deliver the building blocks for numerous consumer and industrial products that are part of everyday life. The corporation is comprised of four divisions, each of which has in-depth expertise in specific chemistry and technology that underpin their place as leaders in the markets they serve:

Performance Products:	**amines, maleic anhydride, and carbonates**
Textile Effects:	**dyes, textile chemicals, and digital inks**
Polyurethanes:	**methylenediphenyl-based polyurethanes**
Advanced Materials:	**epoxy, acrylic, & polyurethane-based polymer resin systems**

Huntsman has a structure that operates under five pillars, which are incorporated into the company-wide management of safe and efficient operations: People (leadership and culture); Asset health; Operational excellence; Supplier reliability; and performance management.

The Performance Products division replaced paper-based processes with RAP and found greater consistency and reliability in its operations:

- Hazards and controls for activities, tools, conditions, and the workplace are now all stored in a comprehensive knowledge database.
- Defined icons prompt the assessor to identify potential risks and recommends mitigating controls issued on the final permit-to-work.
- Risk assessments can be stores and reused, offering not only consistency but also the opportunity to refine the assessments and integrate learning from experience of performing the task.
- RAP stores corporate learning from incidents and events, which allows internal messaging for any of the tasks, tools, or conditions. It also integrates any learning after completion of a task, which can be used to improve risk assessments for future activities.

John A Peoples
Global EHS Manager
Performance Products

John Peoples has achieved success in managing behavioural-based safety and safety management systems. He is an experienced chemical plant manager with a proven track record in operations, as well as environment, health, and safety issues. Peoples has been working hands-on with integrating RAP into the culture and operations at Huntsman, especially in achieving Zero Harm.

A culture of safety and reliability comes from the leadership. If they are not seen acting as role models, coaches, and people who challenge the status quo, then cultural change will never happen. There are people on the shop floor who are committed and enthusiastic about moving forward, but the stumbling block is at the top where there are different priorities. In contrast, leaders that truly show that desire and vision for change will drive reliability and beneficial continuous improvement.

Built-on that, there needs to be consistency and accountability. A common view is that the people at the sharp end are accountable rather than highlighting that managers need to be accountable. However, if accountability is built within the culture, there will definitely be a focus on operational discipline and consistency in doing the right thing the right way every single day.

The main benefit of imbuing operational safety and reliability is the resulting consistency. However, one of the hidden benefits of RAP is it provides a corporate memory. People's experience and knowledge of the different activities necessary for different situations are built into RAP. Therefore, it gives that assurance that workers no longer need to rely on someone else's recall.

RAP also supports the retention of institutional knowledge. The issue of losing key people from the workforce is still a concern and succession planning is pivotal to safeguarding against the loss of knowledge. The RAP system has a wealth of knowledge due to so many people with years of experience imparting their knowledge, which is very helpful when organizing work.

Within this safety culture is a journey towards an awareness of the part an individual plays in, for example, achieving zero harm (ZH). ZH is achieved when there are no injuries, no major incidents, and good working assets so there are no unsafe releases to the public and neighbouring communities. However, some people believe ZH is impossible and conversations to contradict this are difficult.

There has to be a day-by-day approach. People need to realise that if they carry out the work by following the rules and their training while using RAP to guide the activities, then ZH is achievable. The management team review and audit while having conversations with staff on whether practice is meeting expectations. Most of the time the right thing is being done the right way, which can be reinforced and appreciated.

Taking a workshop approach that engages small groups and teams in delivering training sessions on ZH has worked well. Performance Products advocates less listening to instructors and looking at presentations, and more open workshops in its training programs. However, the challenge is seeing the enthusiasm and momentum manifested in the workplace. Focus can quickly shift to other priorities, especially if the leadership do not show that passion and commitment to the momentum gained from the training. People who live in the past and still believe, for example, that the greatest focus should be on production are barriers to implementing this culture. Despite talking about not getting hurt, not having incidents, and not having releases, cost remains the focus.

These barriers can be broken down by having more meaningful key performance indicators (KPIs), which assist with the management of safe systems of work and lead to more compliance and understanding of the necessity for consistency.

The only way the culture can be nurtured is if it becomes the topic of conversation. This is achieved by encouraging visible leadership and showing the same enthusiasm and attention to detail, while checking on the levels of supervision and management. RAP keeps that rigour going and maintains it as a living breathing system so high standards and best practices are adhered to.

RAP is also a great example of where clearly defined work process frameworks impact on safety because it adds that consistency and repeatability, giving more assurance that things are consistently being done the way that is expected. Huntsman is also looking at introducing wearable technology such as hand-held tablets in the field to minimize risk. Mobile technology such as tablets also facilitate social distancing and could provide a solution to the current challenges of issuing permits at offices and people visiting sites before, during, and after they start work.
Other benefits that can be realised from the continuous improvement of processes

revolve around customer satisfaction and the way the outside world perceives Huntsman as an organization. Huntsman strives to be a company that people want to do business with and to work for, and in the last two years there has been intense focus on not repeating the same types of incidents.

Money has been spent more appropriately and that reliability has been improving. Part of this process has also uncovered hidden assets with greater reliability and more throughput in operations realised by using operators' past experience and sound analytical reviews. Huntsman now has a site that is outstripping its past performance because previously hidden assets have come to light.

CONCLUSION: FUTURE STRATEGY FOR ASSET PERFORMANCE MANAGEMENT

Digital transformation is necessary if asset-heavy industry is to remain competitive and secure a viable future. Safety of the workforce and neighbouring communities is paramount not only to lower costs associated with major incidences, but to maintain engaged employees who will be the main drivers behind the processes and technology deployed to achieve operational excellence.

A holistic APM program offers greater connectivity across an entire organisation and optimum reliability, efficiency, and profitability. Sound change management from leaders that involve staff at all levels will be critical to that program's success, especially as the technologies that power APM will continue to advance and must be embraced and understood to achieve optimal performance.

Yokogawa casts APM as the future of the industry because it ensures that value is realised across multiple areas for customers. Any strategy must also follow the sequence of building a foundation and culture on people before optimizing the processes and leveraging the right technologies. The key is to strike a balance among the three pillars by understanding their relationships and interactions before devising APM that best fits each customer's unique situation.

APM strategies must support cost reduction efforts through optimized maintenance strategies that meet organizational goals, increased asset reliability to expand profitability, increased visibility of risks that affect worker safety and efficiency, as well as retention of domain knowledge. Based on this premise, APM is moving towards a future of increased connectivity between assets (people, process, technology), sensors, advanced analytics and intelligence, as well as enterprise data management. Similarly, Yokogawa RAP envisages a future of asset performance in which people are

totally in tune with the plant and workers are truly integrated or interconnected with the information that is flowing around them. They are able to work in the safest possible way, which results in working in the most efficient way and working in the most efficient way will bring profitability into the business.

Although all three pillars have to grow together, there is an importance attached to processes that are battling to achieve the last nth degree of whatever is required. At the same time the technology that supports these processes is becoming more complicated and precise every day. However, people do not tend to grow at the same rate as processes and technology, so the key will be giving the human element intuitive controls to continue to be an interconnected part of the system.

KBC, along with Yokogawa, must continue to collaborate to develop products and solutions that will support clients to improve safety and reliability. It is tracking Yokogawa's APM strategy, which aligns with ISO 55000 for asset management. This is a holistic standard that incorporates everything within the plant perimeter, from physical equipment to whether the business has a viable financial plan through to training the people who run the plant and quality assurance methods for the products.

KBC's approach is to provide clients with asset management and other technologies that will allow them to increase safety and improve reliability and, therefore, reduce operating risks and operating costs. Together with Yokogawa, KBC is constantly listening to its clients while watching moves and developments in the marketplace. This ensures the products developed will help clients to improve safety and reliability while staying ahead of the curve.

Overall, any APM strategy must place the safety of workers, neighbouring communities, and the surrounding environment front and centre. Everyone must buy into a culture of safety and reliability with the leadership taking an active and visible role in promoting that culture. Only from that position of safety can reliability grow and operational excellence be achieved.

Although safety is strengthened by digitizing paper-based work process, space should be left for human intervention and discussion to deliver on a commitment to continuous improvement. Technology that supports workers to undertake tasks more efficiently is a powerful adjunct, while robust knowledge management and training programs will mitigate against the loss of experience.

Technology including the IIoT and Big Data that integrates all aspects of an asset-heavy business will be instrumental in advancing the model of an interconnected worker who can operate within and interact seamlessly with their surroundings. This level of safety, reliability and efficiency can then be leveraged to exploit the benefits of APM and optimize operational performance.

REFERENCES

The Seveso Directive, 2012: Technological Disaster Risk Reduction. Available at: https://ec.europa.eu/environment/seveso/

Deloitte Digital, October 2018: The Industry 4.0 Paradox. Overcoming Digital Disconnects on the Path to Digital Transformation. Regional analysis: Americas. Available at: https://www2.deloitte.com/us/en/insights/focus/industry-4-0/challenges-on-path-to-digital-transformation/summary.html

Deloitte Insights, February 2019: Asset Performance Management. Driving Value Beyond Predictive Maintenance. Available at: https://www2.deloitte.com/us/en/insights/focus/industry-4-0/asset-performance-management-equipment-reliability.html

Nuclear Energy Institute, Nuclear Costs in Context: White Paper. October 2020. Available at: https://www.nei.org/resources/reports-briefs/nuclear-costs-in-context
Nuclear Energy Institute, March 2018: Delivering the Nuclear Promise, Forward Strategy. Available at: https://www.nei.org/resources/delivering-the-nuclear-promise/forward-strategy

EPRI, Technical Report 3002005363, November 2015: Improving the Execution and Productivity of Maintenance with Electronic Work Packages: A Mobile Work Management Initiative. Updated May 2020, Technical Report 3002018163. Available at: https://www.epri.com/research/products/000000003002005363

International Organizational for Standardization, 2014: ISO 55,000 Asset Management. Overview, principles, and terminology. Available at: https://www.iso.org/standard/55088.html

ACRONYMS

AI	artificial intelligence
AN	ammonium nitrate
APM	asset performance management
CoW	control of work
DX	digital transformation
EHS	Environment, Health, and Safety
eWP	electronic work packages
EPRI	The Electric Power Research Institute
IIoT	Industrial Internet of Things
ISO	International Organization for Standardization
KMS	knowledge management system
KPI	key performance indicator
LOTO	lock out tag out
LTO	license to operate
ML	machine learning
NEI	Nuclear Energy Institute
RAP	Risk Assessment Processes
VR	virtual reality
ZH	zero harm