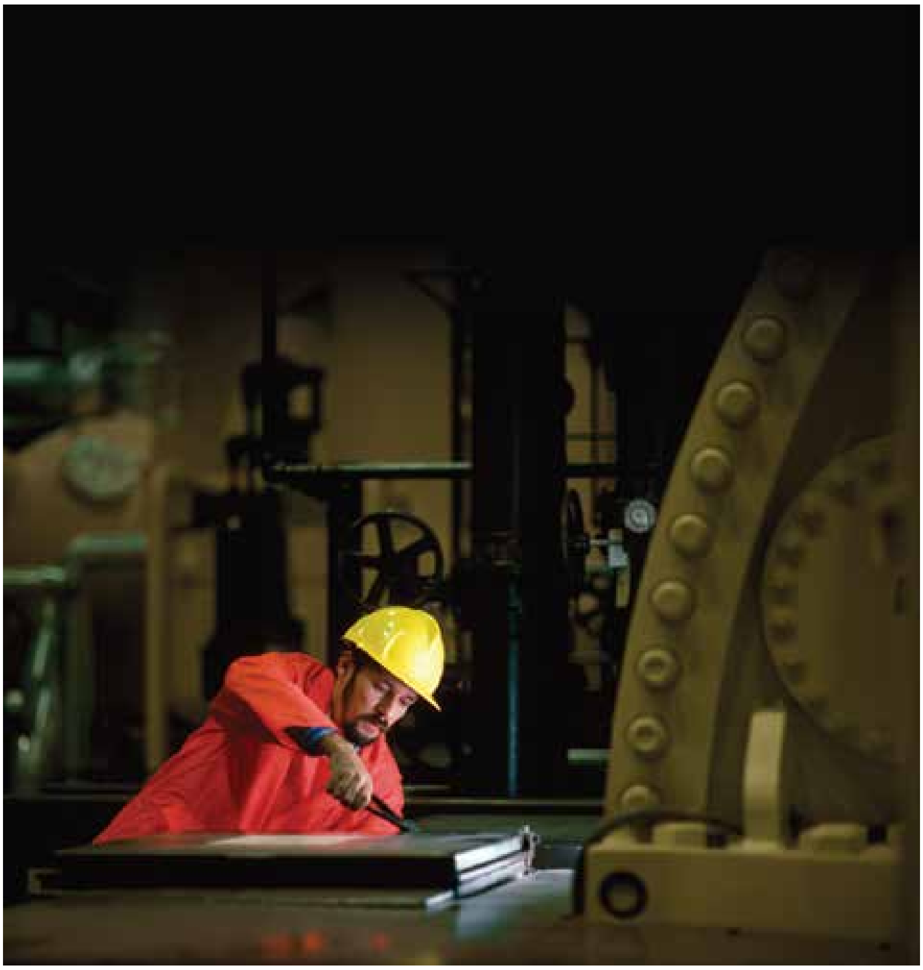
Applying automation diagnostics for predictive safety management

Your plant is telling you what's wrong. Are you listening?



Industrial automation – raising the red flag

Automation technology developed for industrial applications is continuously being improved to achieve end-user requirements for efficiency and safety around the world.

In the case of predictive maintenance, it is relatively easy to calculate the expected financial impact of a single or cascaded failure in an industrial operation and then formulate an economic cost. However, since future events could jeopardise the safety of personnel and the surrounding community, the need arises to forecast such events with actionable precision. Preventing a failure event is always better than dealing with the consequences that can ensue after such an event. Thus, one of the best practices available is to have access to credible, dynamic asset information and the means for predicting future failure events with considerable accuracy.

Predictive safety management can be achieved by monitoring online devices and identifying any shifts or changes in key operating parameters that can indicate potential safety issues. In the case of rotating equipment, changes in these parameters may even cause secondary collateral damage. With the understanding that risk mitigation, reduced downtime and cost savings can be achieved by predictive safety management, it must be viewed as a direct profit-impacting function by operators. In addition to these bottom-line benefits, operations personnel can also use dynamic asset information to implement steps and adjust existing processes to avoid future safety events.

The current situation and risks

Today's industrial environment still views preventive maintenance as the primary remedy to keep a plant and its operations in top condition and considers it the preferred method for mitigating risks. However, this method depends on strict adherence to the scheduled plans and trusts that the existing process will be effective in averting any major safety mishaps. For many end users who have adopted automation diagnostics, either the asset information is used as historical offline data that is seldom analysed, or the operating staff shuts off or bypasses most of the advanced features of expensive state-of-the-art automation tools, defeating the very purpose for which the tool was intended.

A simple survey of plant engineers and management typically will reveal that installed automation systems are being used at only 35% of combined capacity and capability. Capacity in this case is the utilisation of the computer resources, memory and computation time of the system; while capability refers to applying the available functionality built into the system.

In other operations, a considerable amount of time and budget are dedicated to reactive maintenance. Using this method, operators not only abruptly pull work force away from the job at hand, but they also expend resources and lose valuable production time to such nuisances. If the event is a hazardous safety event, then operators may have to summon professional help from outside the organisation, resulting in an even larger blow to the company compared to in-house remediation. While this reactive method addresses the current problem, it significantly impacts the productivity and profitability of the enterprise in a major way, never allowing plant personnel to get ahead of their safety issues. Reactive maintenance may appear to be the least costly option, but it does not achieve the goal of detecting performance degradation, thus leaving in place a risk of future safety events and further perpetuating the reactive maintenance cycle.

Safety events, apart from ultimately eroding the bottom line, tend to distract end users and their customers from the primary focus of their business and, in many cases, can result in heavy fines and negative publicity. While some safety incidents can be as minor as an isolated, temporary disruption, they can also result in a facility's complete shutdown in extreme situations. Enterprises that implement a reactive approach to maintenance are at risk for safety events that may result in extreme loss. They are not always able to foresee which incidents will result in a minor hazard from those that fall into the more extreme end of the hazard spectrum. By implementing preventive maintenance methods, operators can minimise their risk for safety incidents, thereby lowering their risk for extreme loss.

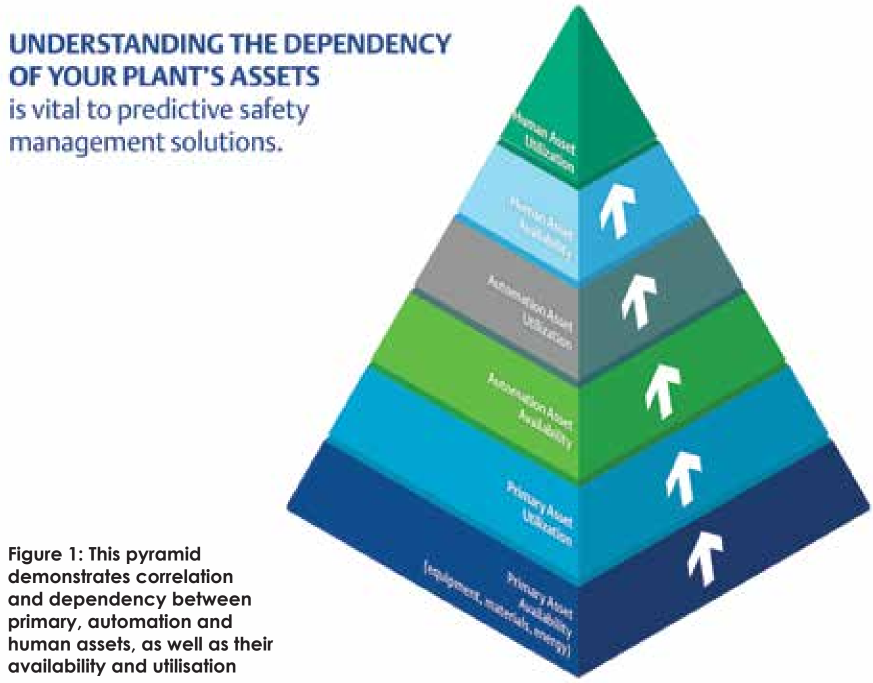


Figure 1: This pyramid demonstrates correlation and dependency between primary, automation and human assets, as well as their availability and utilisation

Preparing to implement a predictive safety management solution

Before devising viable solutions for predictive safety management, end users must first implement and achieve efficient asset management, as well as identify and leverage operational excellence tools that are uniquely suited to their business.

Assets in the industrial operations environment can be divided into two broad groups: primary assets and supporting assets.

Primary assets are the key components that are required for manufacturing the plant's products, and include raw materials, physical equipment and energy in various forms. Physical equipment includes vessels, piping, valves, and pumps, but excludes automation equipment. This distinction is important because valves and pumps can be operated manually in a process without an automation system. Therefore, automation systems are classified as supporting assets.

Supporting assets are the components that improve the efficiency and effectiveness of the plant's primary assets when deployed in unison, as applicable. These are the automation systems, information systems and human assets. Supporting assets include distributed control systems (DCS), programmable logic controllers (PLCs), safety systems including safety instrumented systems (SIS), human-machine interface (HMI), advanced process control, multivariable predictive control (MPC), production planning and scheduling, batch management, enterprise resource planning (ERP), customer relationship management (CRM), and supply chain management systems.

The significance of supporting assets is in their utilisation and impact on primary assets: they allow users to eliminate counterproductive reactive maintenance processes from their operations.

Implementing effective asset management and operational excellence are vital prior to applying dynamic asset information for predictive safety management because both components play a significant role in collecting useful asset information. Basic measurement and control activities need to be constantly improved to gather real-time, meaningful data; otherwise, users will find themselves in situations where their data is not adding value to their operations.

Operational excellence refers to the achievement of higher levels of performance.

Four types of operational excellence are common, with aspects converging and overlapping with each other in a typical plant setting.

1) Human performance excellence relates to empowering personnel across the enterprise to perform at top-quartile levels (within in the top 25% of peer companies)
2) Control performance excellence is comprised of applying control theory to control both efficiency of the operation and profitability of the business
3) Asset performance excellence maximises the financial value provided to the business by each major asset in an ongoing and continuous manner
4) Safety and environmental performance excellence involves dealing with the primary real-time variable constraints on profitability with respect to the impact on operational and business performance.

Applying asset information to achieve predictive safety management

Once the basic measurement and control platform is devised, installed and operating well, then the same technology can be applied for advanced regulatory control strategies. Most automation systems provide basic measurement and control functions and are capable of executing advanced regulatory control that includes predictive control strategies. In most cases, no

AUTOMATED DATA HELPED IDENTIFY AN OBSTRUCTION IN A VALVE BEFORE A SAFETY EVENT OCCURED
by ploting valve activities from inside the pipeline.

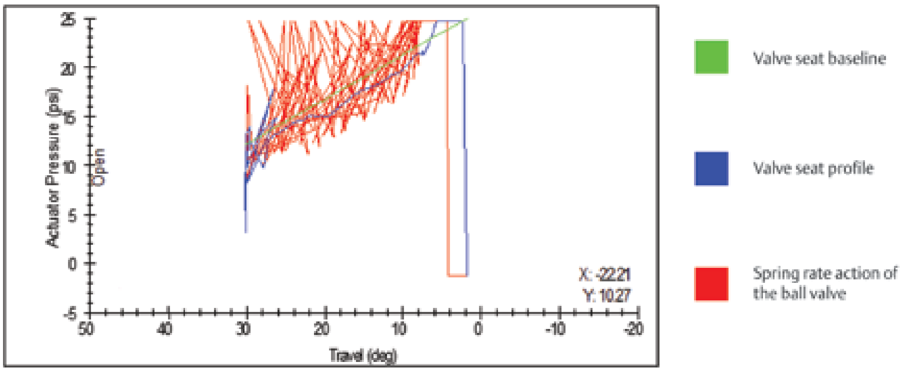


Figure 2: This chart shows valve activities inside a closed pipeline thanks to valve positioner software and a graphic user interface (GUI), two tools that help warn operators of a potential safety incident and enable predictive safety management

additional capital outlay is required.

As plants operate, process dynamics change, calibration of the numerous instruments may shift, and control parameters likewise are adjusted. Newer automation systems provide automatic dynamic control tuning features. Various methodologies exist for predictive safety management based on the primary aim of the organisation. These methodologies and tools include MPC, loop management software, Supervisory Control and Data Acquisition (SCADA) systems, and others.

- **MPC** involves effectively measuring many process variables based on a dynamic process model to control the outcomes by simultaneously managing these variables.
- **Loop management software** keeps all process loops efficient via automatic continuous loop tuning.
- **SCADA systems** extend the monitoring and control capability beyond the confines of a traditional plant infrastructure such as cross-country pipelines or large petrochemicals complexes.

Challenges with Implementing Automation Diagnostics

In today's industrial plant environments, facility leaders manage and optimise their operations based on several key factors, including the nature of their business, the magnitude and multitude of safety threats inherent in operating their business, and implementing whatever best practices their budget and operational philosophy allows. Moreover, the methodologies and tools may have shortcomings as well. For example, MPC is vulnerable to errors and spurious data leading to erratic conclusions, loop management systems may be slow in gathering data, and SCADA systems rely heavily on electronics, making them vulnerable to harsh weather conditions.

Hence, a 'one-size-fits-all' solution is not viable for most industries or all end users. Due to the complexity of the process industries, few (if any) golden rules exist to help operators draw parallels and customise solutions to address their unique needs and applications, making it difficult for users to implement effective predictive safety management. Additionally, since no single solution exists to resolve all safety management issues, more than one technique may be required in various stages to yield a productive predictive model.

A real-world scenario

Early identification of diminishing performance serves as key information that signals impending safety events and, thus, enables suitable preemptive responses to address the hazard, saving precious lives and resources.

In situations involving critical valves, such as emergency shutdown valves (ESDs), reliability of the valve on demand is of utmost importance, because a failure would result in the process reaching an unsafe state. As media is transferred via enclosed piping for processing, untoward incidents could be developing inside the pipe with operators unaware until it results in a major event. If operators are not forewarned well in advance that a safety hazard exists, then its remedial steps are quickly ruled out. This dangerous scenario can be mitigated by automated data acquisition assimilated by the positioner software that plots the feedback of valve activities from inside the pipeline onto a graph (Figure 2) via a graphic user interface (GUI). This is active data that is relayed online and visible in an easy-to-understand format.

Moving forward

Efficient asset management and advanced operational excellence, coupled with predictive safety management tools for critical operations and processes, can minimise and even eliminate safety incidents. A current industry trend is the use of automation resources and techniques to forewarn end users about impending events by gathering active data from the primary plant assets and its timely analysis to install mitigation plans. Most automation equipment and software solutions are capable of advanced applications and higher-level functionality, but they are seldom deployed in real-world industrial settings. The quote attributed to Benjamin Franklin, one of America's founding fathers, that dates back to the 1700s, "An ounce of prevention is worth a pound of cure," holds up well, even today. ▮

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