YOKOGAWA

KBC A Yokogawa Company

Modular Procedural Automation (MPA) as Implemented by Williams

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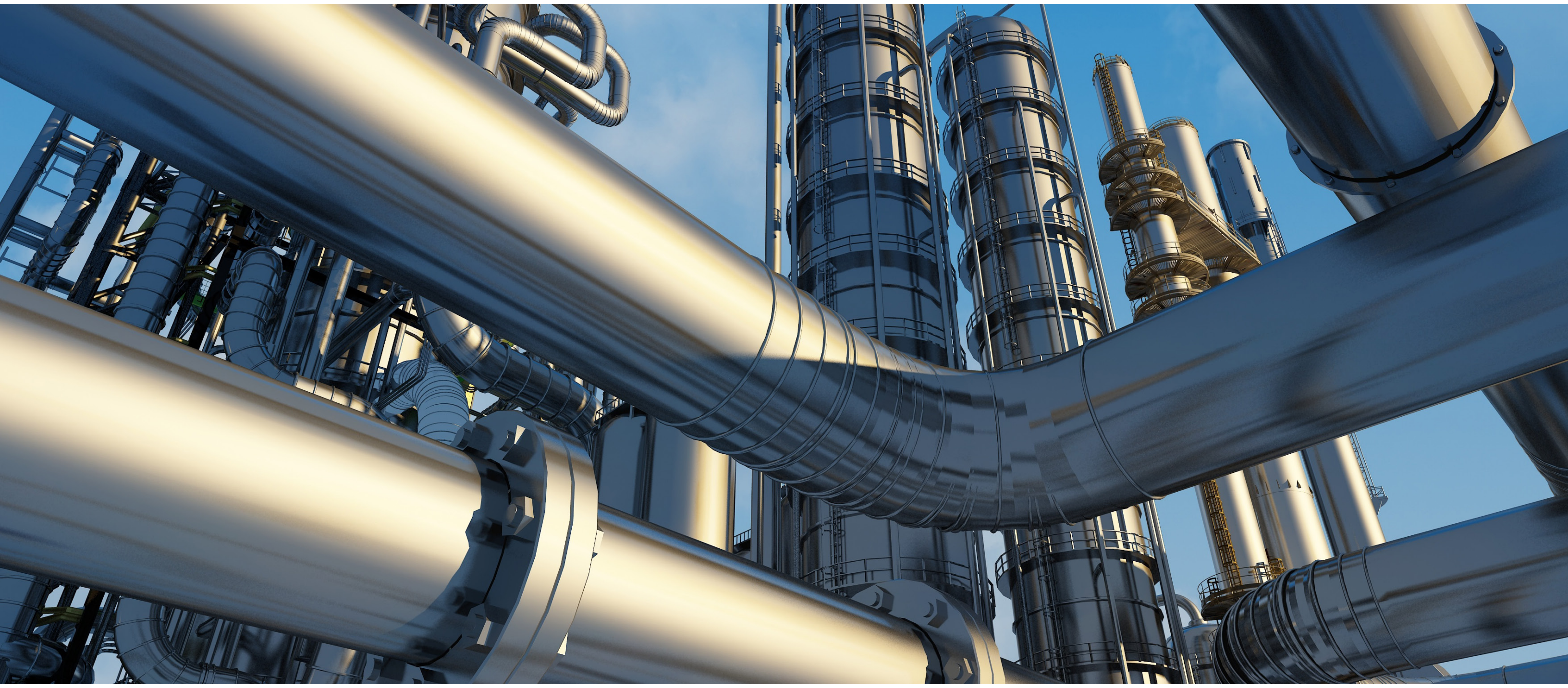
KEY TAKEAWAYS

- ✓ Modular Procedural Automation (MPA) is a consultative methodology to document and automate procedural operations in continuous processes.
- ✓ By standardizing and automating procedural operations based on the best practices of experienced operators, MPA enables safer operation and improved profitability.
- ✓ The Williams team successfully deployed MPA and met improvement goals for safety, operational consistency, alarm management and procedural automation.
- ✓ In day-to-day operations, MPA has proven to prevent operation errors and improve operator effectiveness.
- ✓ The team also successfully addressed the risks associated with an aging workforce.

Part 1 Introduction



> "Operations management at Williams initiated programs to make significant improvements in safety, operational consistency, alarm management and procedural automation.

Williams is an energy infrastructure company, which operates interstate gas pipeline, gathering and processing facilities across the United States. The combined capacity of the company's gas processing plants in Opal, Echo Springs and Willow Creek, Wyoming is approximately 2.3 billion cubic feet of natural gas per day. Highly skilled operations personnel oversee each plant on a 24/7 basis. The control platform is a Yokogawa CENTUM VP distributed control system (DCS), with four domains in operation across the three facilities.

In these operations, procedural activities are critical to achieving safety and efficiency. The procedural activities originated in many areas including manual standard operating procedures, legacy control systems and the tacit knowledge that operators have acquired through years of experience. Due to a high retirement rate in senior operations personnel, the company is losing significant and valuable knowledge. One result is a steeper, riskier learning curve for a new generation of engineers and operators.

Inadequate and inaccurate procedures could lead to operator errors. Since Williams has placed emphasis on optimal efficiency and safety in plant operations, it is critical that the company not only captures operational knowledge and best practices but also ensures consistent and accurate execution.

Operations management at Williams initiated programs to make significant improvements in safety, operational consistency, alarm management and procedural automation. The company also addressed increasing risks that resulted from the aging workforce.

AGING WORKFORCE

Management at Williams had long been concerned about maintaining safe and efficient operations when senior people retired. The company determined that plants rely heavily on experienced process operators to deal with standard operating procedures. However, given the demographic problems with aging workers and difficult to find replacements, this type of dependence was becoming more problematic.

OPERATIONAL SAFETY

Increasingly strict compliance requirements for all plants have made safety a more significant challenge. Williams management noted that safety continues to depend on operators. Since they are human, operators could interpret instructions or follow procedures in a different manner when under increased pressure. Williams strives to prevent significant incidents that result from operator errors, particularly when poor procedures comprise a root cause.

OPERATIONAL CONSISTENCY

While Williams had written procedures to meet industry regulations, their format made them difficult to follow and, therefore, they were underutilized. Reformatting the existing written procedures into checklists made the transition from hardcopy to modular, automated procedures easier since each step could be clearly defined. This transition helped drive consistency since the new procedures could capture operational know-how of experienced operators and incorporate it into the system, including on updated control system graphic displays. The consistency achieved led to quicker operational transitions, fewer call outs and fewer interlock conditions that would require equipment to be restarted.

ALARM MANAGEMENT

The Williams operations team determined that non-steady state operations generated excessive alarm reports. This was particularly the case during start-up, during process upsets in otherwise steady state operation and in transitions from one steady state to another. A separate problem was a mismatch between many alarm setpoints and the various operating states. For instance, alarm limits that were valid during one steady state operation were not appropriate during transitions nor were they in other steady states.

AUTOMATION OF MANUAL PROCEDURES

The Williams team also determined that manual procedures resulted in inefficiencies and even compromised the reliability of process equipment. Standard operating procedures allowed operators to make manual adjustments simply because they performed them infrequently.

Part 2 ISA106 Modular Procedure Automation

> *By standardizing and automating procedural operations based on the best practices of experienced operators, MPA enables safer operation and improved profitability.*

Modular Procedural Automation (MPA) is a consultative methodology to document and automate procedural operations in continuous processes. MPA is a proven methodology that captures, documents, and implements procedural knowledge gathered from the operations staff. It is modular and ensures standardized implementation to increase flexibility, reduce operation costs, and promote repeatability and re-use. Procedures are best described as pre-set tasks that are consistently completed in a specific order to achieve the desired result. MPA bridges the gap between the process control systems and plant operators by augmenting operator actions with electronic standard operating procedures that integrate with a DCS.

The purpose of the ISA-106 committee is to develop standards, recommended practices, and technical reports on the design and implementation of procedures for automating continuous process operations.

The system supplier, Yokogawa, has been involved in this standardization effort and has developed a MPA solution, which addresses all issues covered in the standard. MPA is Yokogawa's consultative methodology to document and automate procedural operations in continuous processes. It automates not only normal, safe operations but also addresses the far riskier changes of state such as start-up, shutdown and transitions between steady states. By standardizing and automating procedural operations based on the best practices of experienced operators, MPA enables safer operation and improved profitability.

MPA combines consulting expertise with best-practice procedure control capabilities to accomplish the following:

- Capture, optimize, and retain procedural knowledge and control in a process plant;
- Implement procedures at the appropriate levels in a plant control system to meet procedure reliability and flexibility requirements;
- Integrate procedures into the operator interface and alarm system for improved situational awareness.

Figure 1 - Automating procedures allows a process operator to address the single largest factor in plant trips and accidents: human error.

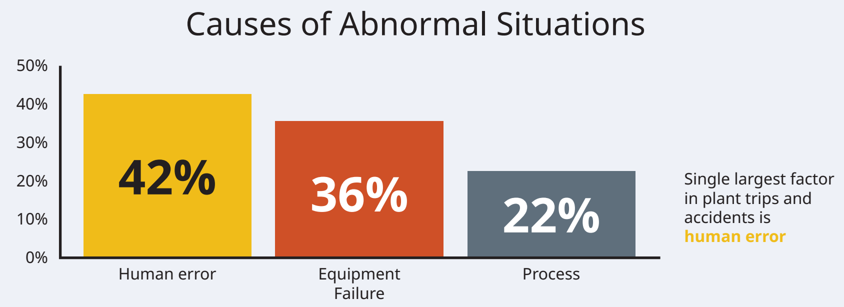
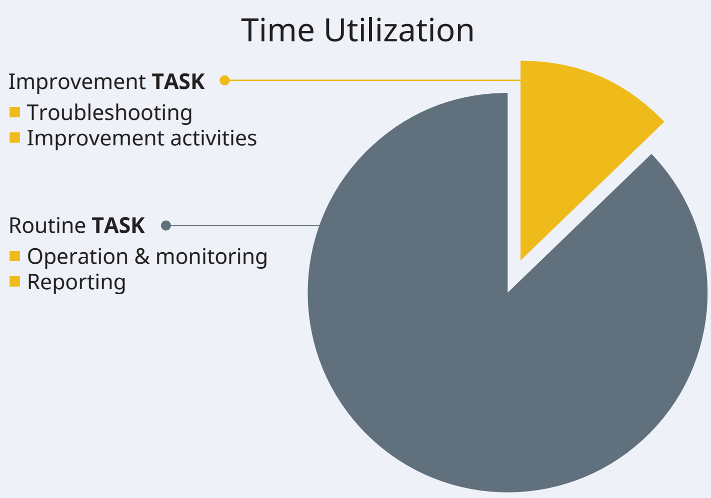


Figure 2 - Since routine tasks occupy the vast majority of time utilization, automating procedures can lead to much higher efficiency and provide more attention to process improvement activities.



Since Williams had prior success with Yokogawa's MPA implementation, the company decided to apply it to the new set of goals. The prior project successfully enabled operators to start stabilizer and TXP4 process units flawlessly, safely and without incidents.

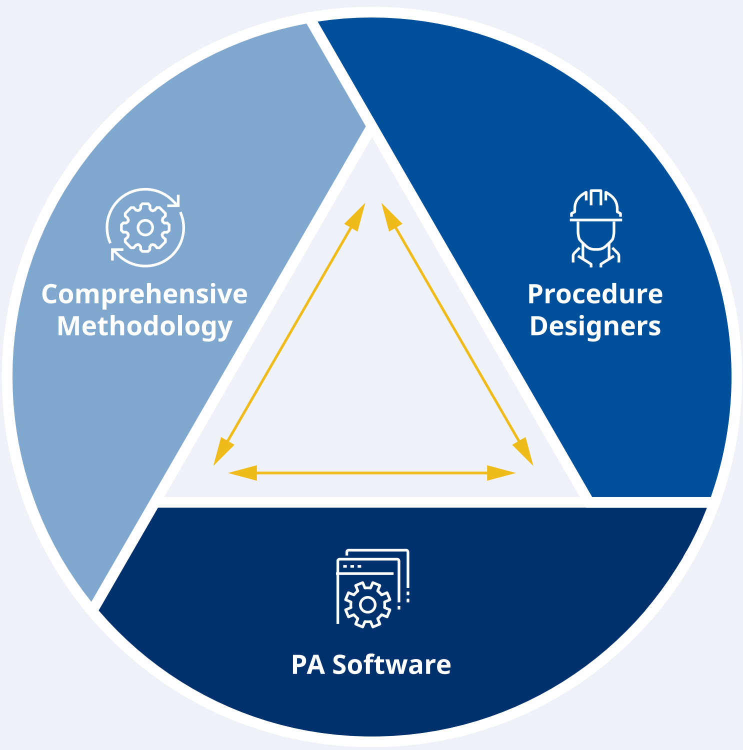
MODULAR PROCEDURAL AUTOMATION – EXAPILOT IMPLEMENTATION

Exapilot is Yokogawa's MPA software. The Williams team deployed Exapilot for the design, development, implementation, testing and commissioning of manual operation procedures in the Opal plant. Exapilot offers a highly flexible automation solution for manual procedures and provides users an environment to examine and verify control procedures in trial mode before deploying them. Other features include plant optimization functions, energy saving designs, and online operation support through standard libraries in the software.

Exapilot is designed for operators. It does not require engineering expertise, experience with a distributed control system (DCS) or programming experience. Operators are able to implement and maintain the system.

Exapilot is also control system agnostic and platform independent. There is only one software application for operators to learn and maintain. The same application can work in multiple plants, even if they use different control systems.

Figure 3 - Procedural automation software is backed-up by a comprehensive methodology and tools that simplify procedure design.



MPA MEASURES FOR SUCCESS – THREE COMPONENTS

Three key components of a modular procedural automation project are identification, evaluation and estimation.

Identification

This is essentially a gap analysis. Yokogawa provides a service in which automation, control and manual intervention gaps are analyzed using operation data collected by the DCS. This has traditionally helped end users realize the need for procedural automation.

Evaluation

Yokogawa conducts a study by interviewing all stakeholders, particularly operators, process engineers, and controls engineers, in order to understand the operation philosophy and identify the areas in which to consider automation of procedures.

Estimation

Yokogawa estimates the cost and return-on-investment for the potential procedural automation candidates. This allows end users to decide whether to budget and proceed with the project.

Part 3 Application Solution Examples

ALARM MANAGEMENT

The Williams team felt that procedure automation could be the solution to alarm management issues that arose during non-steady state operations. Working with Yokogawa subject matter experts, the Williams team observed that the alarms causing problems fell into two categories: static alarms and dynamic alarms.

STATIC ALARM SUPPRESSION

Static alarm problems occurred during start-up, process upsets in otherwise steady state operations and in transitions from one steady state to another. If operators were able to suppress certain alarms under those conditions, they would not encounter an excessive number of alarm reports. An alarm overload significantly increases the probability that an operator would fail to react to a given alarm. The Williams team identified many alarms that actually presented no conditions that were worthy of alerts during transitions. Using MPA, the team mapped suppression of those alarms into the standard operating procedures. Based on the operation phase, Exapilot instructs the DCS to suppress specific alarms.

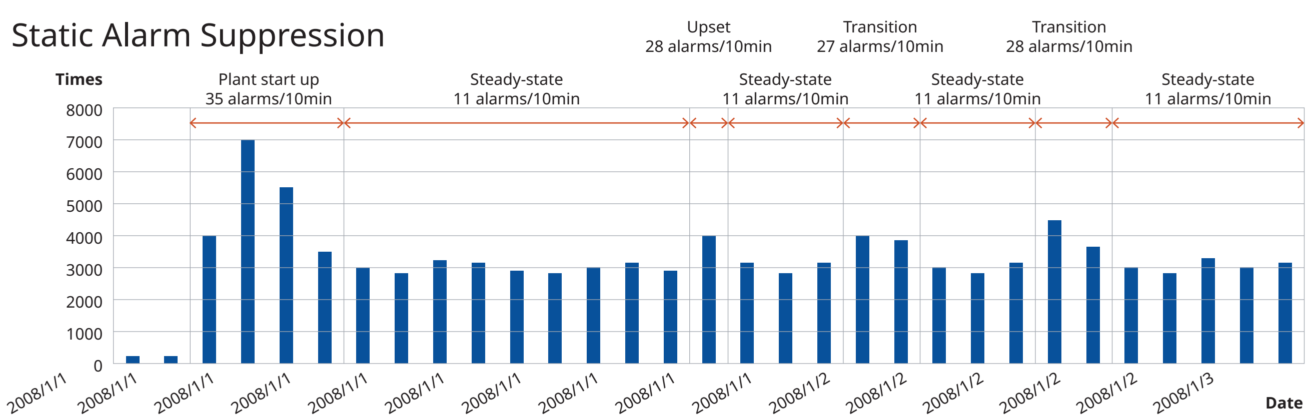


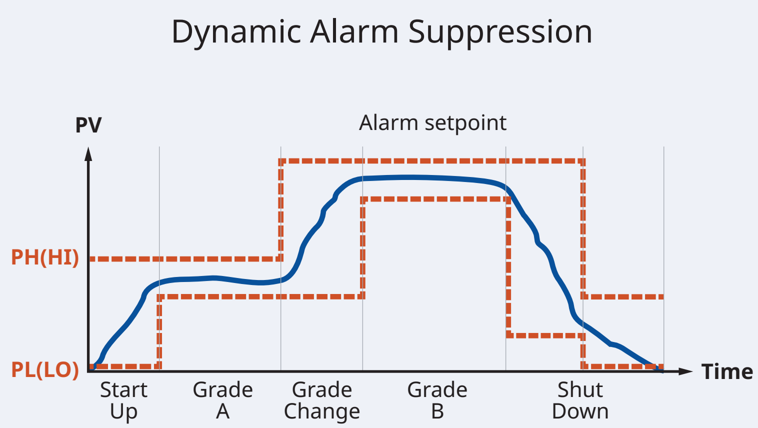
Figure 4 - By suppressing alarms that did not actually require operator action during transitions, Williams was able to minimize the chances of operator overload by reducing the number of alarm reports.

DYNAMIC ALARM SUPPRESSION

The Williams team also identified a separate class of alarms that the system should never suppress under any circumstances. However, these alarms each used a single set of limits, which were appropriate to steady state operations but not during transitions. The Yokogawa subject matter experts advised that the system could apply multiple sets of alarm limits in a manner that depended on the operation state. The Williams team further determined that, in some cases, one steady state required a set of alarm limits that differed from another steady state.

In a manner similar to that for static alarm suppression, the Williams team mapped the various sets of alarm limits for dynamic alarm suppression into new operating procedures and used Exapilot to command the DCS to apply them based on the operating state.

Figure 5 - For certain alarms, Williams determined that alarm setpoints (high and low alarm limits) should vary in conjunction with such operation states as start-up, shut-down, transitions between steady states and across various steady states.



AUTOMATION OF MANUAL PROCEDURES

The Williams team further determined that MPA could be the solution to problems in which manual procedures resulted in inefficiencies and even compromised the reliability of process equipment. Since these were infrequent operations, standard operating procedures had allowed operators to make manual adjustments.

For example, operators noted that using manual adjustments of stabilizer feed flow rate on an infrequent basis resulted in a wide variation in the time the stabilizer column required to reach normal loading conditions. Since there were multiple cases of such infrequent manual operations, Williams prioritized their procedural automation decision criteria using the "SORES" classifications:

S

Safety

Quantification of unsafe incidents or accidents to improve safety and reliability of operations

O

Optimization

Quantification of lost opportunities to prevent operation errors and improve product quality

R

Retention

Ensure experienced operators 'know-how' is maintained in the implemented procedure flows

E

Efficiency

Quantification of repeated identical operations to reduce operation hours while maintaining safety

S

Standardization

Quantification of errors caused by inconsistent operation to standardize operating procedures and operation methods regardless of the operator skill levels

Part 4 Automation Case Study

As illustrated by three cases herein, operators had realized that manually adjusting the stabilizer feed flow on an infrequent basis resulted in variations in the time the stabilizer column needed to reach normal loading conditions:

- Case-1 = 38 minutes
- Case-2 = 15 minutes
- Case-3 = 44 minutes

In addition, each start-up operation compromised the reliability of the process equipment.

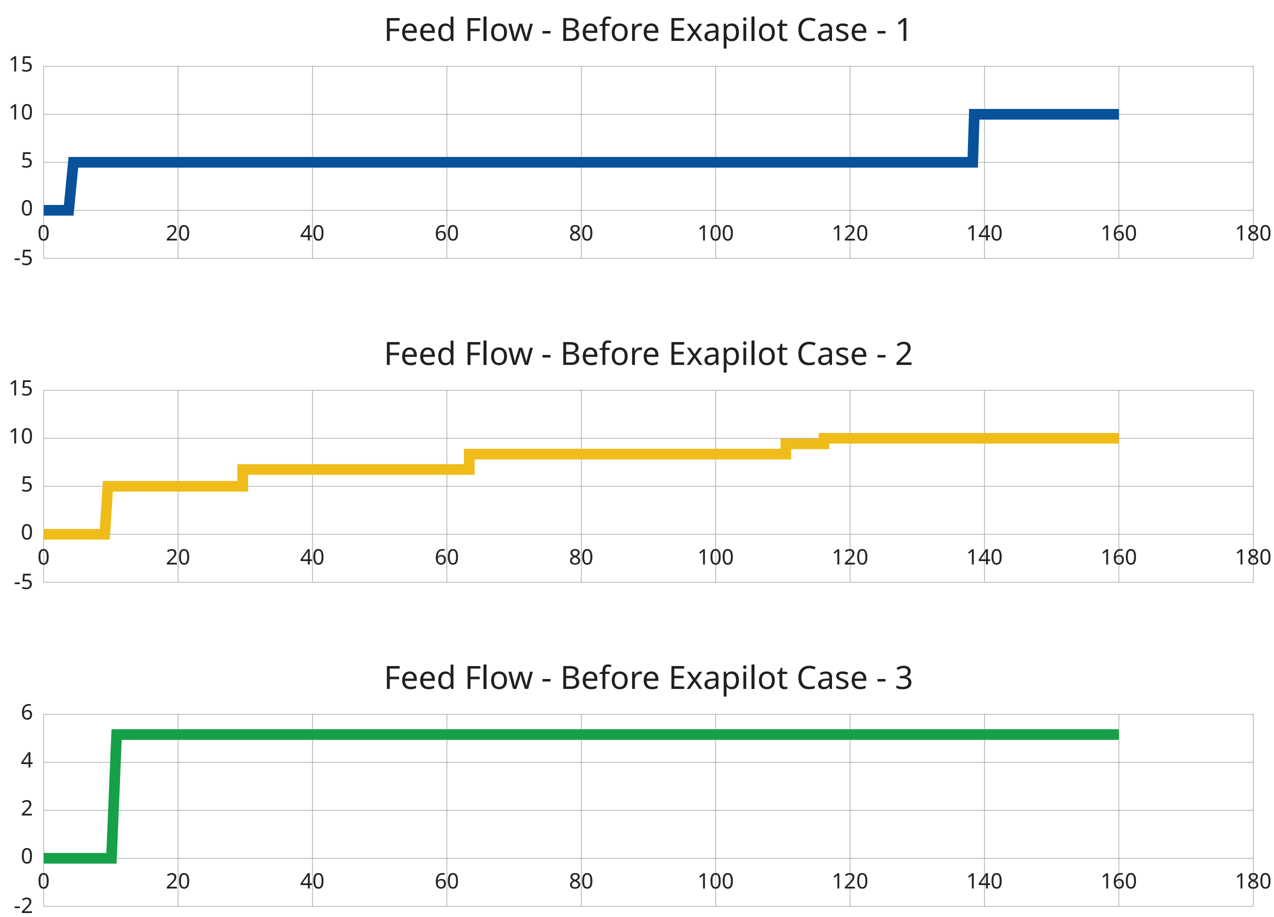


Figure 6 - Prior to MPA, infrequent step change adjustments to the stabilizer feed flow resulted in inefficiencies.

After the Williams team applied MPA, Exapilot automatically adjusted the stabilizer feed flow based on operating conditions. This is evident from the slow ramp of the feed flow valve. MPA reduced the times required for the stabilizer column to reach normal load variations as follows:

- Case-1 = 17 minutes
- Case-2 = 12 minutes
- Case-3 = 16 minutes

The company also realized improvements in production and process equipment reliability.

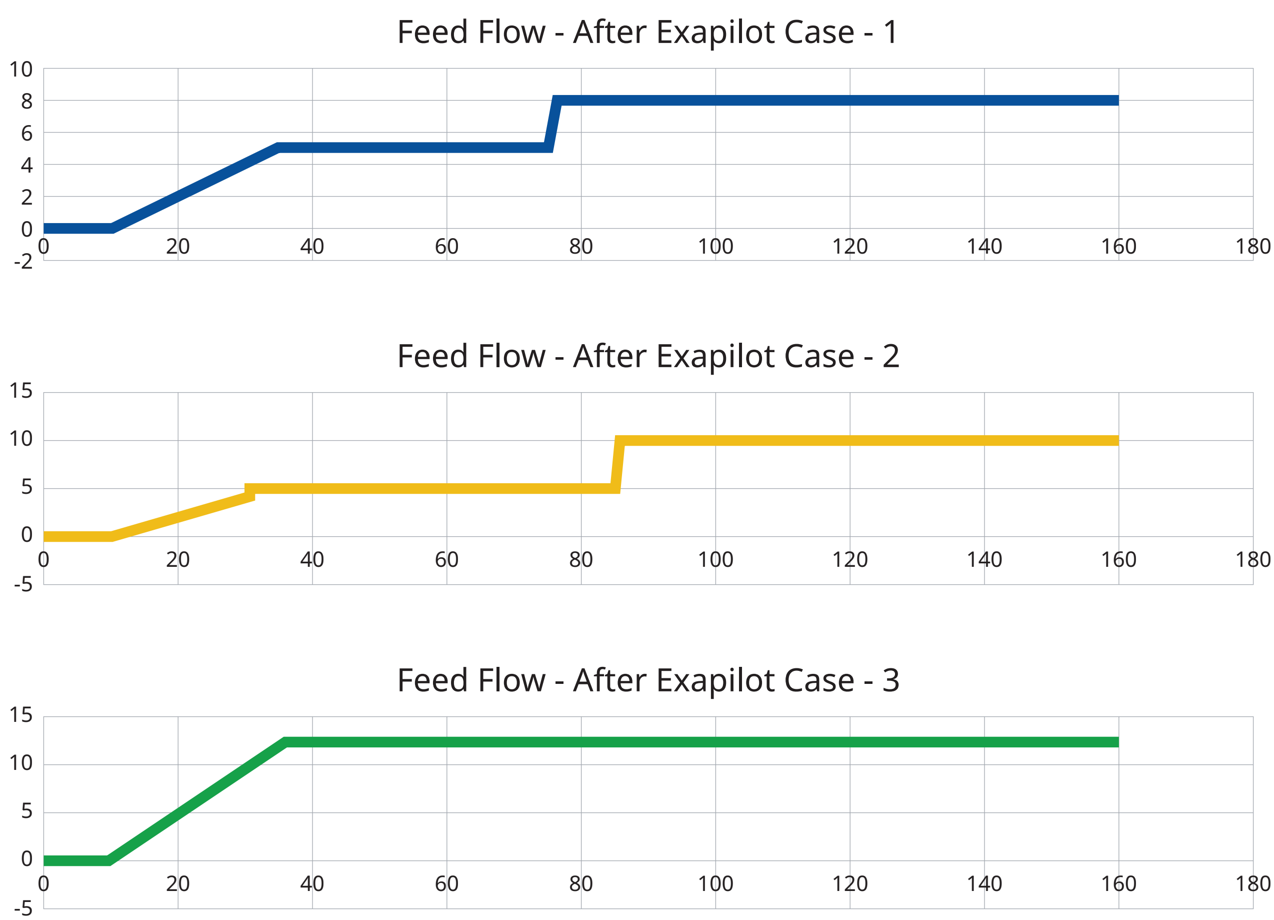


Figure 7 - Automatic adjustments by Exapilot, evident from the gradual ramp of the feed flow valve, resulted in improvements in production and process equipment reliability.

Part 5 Conclusion

In consultation with Yokogawa subject matter experts, the Williams team successfully deployed MPA and met improvement goals for safety, operational consistency, alarm management and procedural automation. The team also successfully addressed the risks associated with an aging workforce. KPIs accomplished included significant reductions in the number of operator actions, number of alarms per operator and time-to-stability during transitions in the process. The company also realized an increase in productivity and reduction in operating costs. Less tangible but critical was improved safety.

In day-to-day operations, MPA has proven to prevent operation errors and improve operator effectiveness. Procedure automation also ensures that experienced operators 'know-how' is maintained in the implemented procedure flows and provides opportunities for operators to obtain further knowledge about the plant processes.

"In day-to-day operations, MPA has proven to prevent operation errors and improve operator effectiveness.