Process Solutions

Honeywell

Advancements in HMI Technology Drive Improved Operator Performance

Executive Summary

Control room operators are critical to successfully running industrial plants. However, operators who are heavily loaded may miss important changes in the process or overlook opportunities to improve efficiency, productivity and profits.

Thirty years ago, industrial facilities moved from individual panel boards to Distributed Control Systems (DCSs) to improve their operations. A similar transition is occurring today, as a new breed of Human-Machine Interface (HMI) delivers better information in better context, so operators can make smarter decisions and run closer to process limits for longer periods of time.

The latest HMI console technology provides significant improvements in terms of an operator's mobility and effectiveness. This includes the ability to identify and act upon alarms more quickly. Additional advancements in console design include enhanced ergonomics and better displays to simplify control system management, reduce operator fatigue and improve situational awareness.

With these and other key developments, the role of operations team members is changing from plant operator to "profit" operator. Personnel who have developed significant knowledge of the operation of manufacturing processes are the ideal candidates for controlling business variables given effective visualization tools. With advanced HMI solutions, operators can view real-time performance information for each critical business variable in a simple, prioritized and contextualized dashboard. This enables them to perform their normal functions with an understanding of the business impact of each action.

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Introduction

More and more to do and less time to do it in — there is no end to the increasing demands in operating an industrial plant. Nowhere are the challenges greater than in the control room: As more data are gathered and processed in real-time, the workers who interface with the information must make faster and better decisions.

Modern manufacturing plants require professionals who can run processes in the safest, most efficient way possible.

A key role for plant operators is ensuring companies realize the utmost value from production assets. In a highly competitive business environment, operators are asked to do more than just watch over production processes and respond to alarms. They are required to have a greater business focus, which means assuming responsibility for everything from quality to cost issues. Operators must ensure units remain within boundaries, production targets are met, and raw materials are not wasted.

Changing Operator Responsibilities

As demonstrated at manufacturing facilities worldwide, operator performance has a direct impact on profitability. But being an operator today is a lot like sitting in an economy-class seat on a completely full flight for 10 hours and then being asked to make a critical decision. Operators must deal with the fatigue from long shifts, constant distractions and stressful work situations (See Fig. 1).

Figure 1. As demonstrated at manufacturing facilities worldwide, operator performance has a direct impact on profitability.

Plant operations teams require more than just process data to perform at their best; they need an environment that helps keep them alert, allows them to move about more freely, and presents information more intuitively. According to Abnormal Situation Management (ASM®) Consortium research, diverse factors such as controlled lighting and reduced noise can influence situational awareness. A dark control room, for example, can significantly reduce the alertness of an operator over a 12-hour shift. Unnecessary foot traffic also increases the potential for distraction during abnormal situations.

The ability to improve plant efficiency and reliability depends on how well operators are able to identify problem areas with critical assets. This, along with performing root cause analysis to understand the underlying issues, rectify recurring losses, and applying proven solutions as broadly as possible across the entire plant, are essential to help sustain improvements over time.

Shifting from being purely functional to highly analytical, operators have become an increasingly critical part of an industrial firm's business processes. They have evolved into a multi-faceted employee, which has drastically increased the role's responsibilities. Operators must be able to reason, plan, and solve problems quickly, and use a variety of systems, devices and software tools to present data, collaborate, and automate advanced intelligent analysis.

Alarm management can be particularly challenging in process plants. Control rooms with poorly implemented alarm systems can experience thousands of alarms per operator, per day, and making sense of all this activity is a demanding task for operators running automation systems. If operators are plagued by nuisance alarms, they're probably not maintaining the plant at peak performance. Nuisance alarms include those that annunciate excessively or unnecessarily, don't return to normal after they've been correctly addressed, or are irrelevant to the current process state.

The ASM® Consortium has indicated the primary causes of major upsets or abnormal situations in industrial plants are 40 percent due to human error, 40 percent due to equipment failure, and 20 percent due to other factors. In addition, the studies show operating out of range causes equipment problems approximately 76 percent of the time. This is also a human error. ASM® researchers have concluded that human performance contributes to 70-80 percent of all abnormal situations at process plants.

Clearly, the success of any operator is dependent upon understanding plant issues and being able to quickly respond with the correct action to solve the problem. Operations teams must employ consoles with HMI graphics that are easily understood and indicate when conditions are changing, and provide quick, easy access to supporting documentation. Furthermore, they need an alarm system that is informational and timely.

Transformation of the HMI

The transformation of the plant HMI is similar in magnitude to moving from panel boards to a DCS with new context-based visualization technology. Modern operator consoles require less process manipulation and logging, and provide the tools for more business decision-making.

The Early Years

In the beginning was the push button, and with the push button were the lights and switches. And then hardwired devices appeared and became electronic panels. Soon, the Cathode Ray Tube (CRT) with monochromatic screens and rudimentary text-based displays dominated the plant control room. Operator terminals provided some control functions, but weren't user-friendly. It was a text-based environment that had to be programmed to obtain any kind of visualization (See Fig. 2).

Figure 2. Early control room panel boards featured mechanical pushbuttons and an array of warning lights.

Emergence of the PC

During the 1980s, introduction of the DCS revolutionized the process control world. Attention shifted from hardware to software, a device became a system, and the job of the operator interface began to grow exponentially. HMI systems initially ran on proprietary equipment; soon, however, interoperability became mandatory.

The big game-changer came late in the 1990s with the introduction of control software for the Personal Computer (PC). There was also the release of new hardware, as well as the advent and industry-wide adoption of the open system.

Most recently, Thin Clients appeared in Programmable Logic Controllers (PLCs) and DCSs. This technology enabled better visualization of operations and delivery of reliable information to higher-level analytic applications.

Other Significant Developments

Obviously, many other developments have influenced the path of HMI technology: increased processor capability, Ethernet, and the Internet. They have allowed operators to become intimately involved in plant operations. State-of-the-art HMIs can access data from multiple sources and reach out to remote spaces (See Fig. 3).

Figure 3. Modern HMIs have allowed operators to become intimately involved in plant operations.

On the hardware side, the transition from hardwired devices to the electronic terminal was instrumental in setting the stage for advanced capabilities. Incremental, yet essential changes took the industry from CRTs to Liquid-Crystal Displays (LCDs) to Light-Emitting Diode (LED) backlit screens. Increased processing power also has allowed HMI systems to do so much more.

With greater connectivity, barriers in the plant and across the enterprise were broken down. Facilities eliminated islands of automation, moved to a distributed environment, and involved more people in the decision-making process. Using the operator's HMI to make business decisions based on large amounts of available data and deliver cost-effective solutions to the operation led to fundamental changes in work processes.

Latest Technology Advancements

Today, the automation industry is rethinking the overall purpose and functionality of an operator HMI. That means looking not just at the traditional role of visualization, but also at data transformation and the real relationship between the machine and the human.

In many ways, the revised notion of a control room isn't limited to the control room at all. This concept is illustrated through technologies like wireless, which extend the control room to the field

Perhaps the greatest change to the operator console, however, will come not from the device, but from the people. The manager doing a weekly or monthly review has his finger on the pulse of the profitability of the plant, but it is the operator who sees things in real-time on his or her console who has the better view. The modern HMI can collapse the decision-making process, taking it down to the level of the worker — the one with the greatest influence.

Listening to the Voice of the Customer

To drive continued advancement in HMI technology, automation suppliers like Honeywell Process Solutions have assigned researchers and designers to study human factors with plant operators around the world. This includes observing operator behavior and collecting insights on HMIs during process startup, when facilities are in abnormal modes of operation, when plant trips occur, and when multiple operators use stations (see Fig. 4). The resulting feedback has led to significant enhancements to operator console design.

Figure 4. Automation suppliers like Honeywell Process Solutions have studied human factors with plant operators around the world.

Much of the work on human interface solutions is centered on improved ergonomic design and better displays to simplify control system management. HMI designers are also focused on delivering new tools that help operators engage so they can leverage analytics and intelligence for critical decision-making. Automated analytics are equivalent to encapsulating the knowledge of a process engineer into the software to enhance the ability of operators to respond to real-time data. Operators also need the ability to respond to real-time data made available through mobile computing, instant connectivity, and knowledge sharing software for faster, more focused reactions.

New Ways to Interact with the Process

While graphical representations of Process & Instrumentation Diagrams (P&IDs) are commonly utilized for process industry HMIs, this approach has drawbacks. It has often led to numerous displays, deep navigation structures and a large number of graphics that are never or rarely used. This can make it difficult for operators to find needed information when time is critical, such as when an alarm sounds. Due to the sheer amount of information and unnecessary clutter on graphics, it has sometimes been difficult for abnormal situations to really stand out.

Plants are now finding that operation from boundaries is a better approach to maintain safety and efficiency while extracting utmost value from production processes. Instead of just presenting data, this involves presenting information in the context of alarms and operational limits. The information is considered from the perspective of how it is used, more so than on which P&ID it resides or where

it is physically located. A new generation of advanced compact shapes on the HMI extracts and delivers information in a very concise and readable format. This eliminates unnecessary navigation through multiple screens, keeps the operator continuously aware of the state of the plant, and improves overall operational insights.

In addition, control room consoles equipped with a simple color-coded light bar indicating alarm type and severity are preferable to forcing operators to deal with the distraction of multiple horns signaling abnormal conditions.

Additional Key Capabilities

Other important new capabilities in operator HMIs includes: pan-and-zoom displays, priority-based alarming to help keep the focus on the most important alarms, and integrated trending and "tag banding" to ensure operators can be as proactive as possible.

Some of the most significant innovations in HMI technology will liberate operators from their chairs by allowing them to move about the control room more freely. When paired with wireless-enabled mobile technologies, these solutions make it possible to view the same displays on hand-held devices in other areas of the plant.

Honeywell's Innovative Approach

In 2002, Honeywell set a new benchmark for industrial automation by introducing the Experion® Process Knowledge System (PKS), the first enterprise-wide DCS designed to unify people with process, business requirements and asset management. The latest Experion release, Experion PKS Orion, combines this approach with the newest in Universal Channel Technology, a complete portfolio of turnkey Experion Virtualization Solutions, and a superior HMI with Experion Supervisory Control and Data Acquisition (SCADA) and Experion Collaboration Station.

Introduction of Experion Orion Console

Honeywell recently announced the Experion Orion Console, employing advanced display technology designed to help plant operators solve process issues while working on a platform that allows them to stay mobile. The console features include a large, flexible, ultra-high definition display that provides clear status assessments of process operations with one glance for better and more-informed management. This flexibility also enables operators to customize displays for context-specific process issues and incorporates advanced alarm management and pan-and-zoom capabilities. Limits and targets are directly integrated into overview displays, enabling operation of the process closer to the optimum and allowing operators to increase the scope of their responsibilities.

In addition, the Experion Orion Console has a mobile tablet that makes operations staff more versatile in terms of where and how they interact with the process.

Figure 5. The Experion Orion Console is designed to help operators solve process issues while working on a platform that allows them to stay mobile.

Other advanced features include:

Improved Ergonomics: The new console is designed to comply with the latest ergonomic guidelines relating to monitor location, seating position, and desk height. It provides adjustment for optimum viewing angles, support for sit/stand and sit-back modes of operation, and accommodates single or multiple operators.

Single Visual Workspace: Traditional systems arbitrarily divide up the plant and process into small discrete displays that can fit on a single screen. As an alternative, the Experion console incorporate two larger, ultra-high definition screens with thin bezel displays for a more optimized screen arrangement.

Integrated Limit Displays: Operating limits and targets are directly integrated into the overview displays, allowing operators to run the process closer to boundaries and view status information in a single glance.

Orchestration: Predetermined sets of displays can be invoked as needed to deal with different context-specific process issues. This solution assists inexperienced personnel in becoming familiar with common tasks through intuitive navigation, and ensures a very "learnable" system for new hires on the operations team.

Operator Touch Panel: Using an operator touch panel allows direct changes to process values faster than with a traditional mouse and keyboard.

Ambient Alarm Lighting: An optional alarm light will change color and intensity to provide an indication of standing alarms and their acknowledgement status throughout the control room. This can supplement or replace audible annunciation using subtle fixed (not flashing) illumination to avoid adding to control room noise and disruption.

Conclusion

The need for improved productivity, efficiency and safety in the process industries is more prevalent than ever: customers, shareholders and business partners demand it. Because the HMI is the operator's window to plant processes — and profitability — an effective operator interface is critical to business success.

There is currently a shift in the way automation suppliers and their customers think about HMI solutions for the plant operations team. The focus is now on increasing operator effectiveness over a greater scope of responsibility by enabling faster response, reducing fatigue, and increasing situational awareness. The latest technology enhancements encompass everything from consoles, user interfaces, process graphics and alarm management, to wireless-enabled mobile devices and even the ergonomics of control room furniture.

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