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White Paper

High Performance HMIs Key to Next Level User Experience & Operational Efficiency

Contents

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1. Scope

A brief but thorough explanation of high-performance Human-Machine Interface (HMI) design concepts, this whitepaper explains what defines a high-performance HMI, why industry standards were established, and how these HMIs enhance user experience and operational efficiency. This document also provides essential considerations and constructive recommendations for designing and deploying high performance HMIs.

2. Defining High Performance HMI

A high performance Human-Machine Interface or HMI is an advanced but user-friendly graphical representation (interface) of an industrial process, designed so operators can more quickly and easily understand operational statuses and thereby more efficiently monitor and control these complex processes. High-performance design principles focus on displays that convey only the most relevant information. Navigation and layouts are structured to provide a clear system overview, with a hierarchy that allows users to drill down into deeper levels of detail. This outcome happens through simpler designed graphic displays with standards-driven recommendations for navigation, presentation, and monochromatic color schemes that provide clear and actionable information.

Operators therefore do not waste time or make mistakes interpreting operational displays. What results is much more efficient operations, and if you look at some of the key characteristics, you'll understand why.

Some of the key characteristics of high performance HMIs include the following:

- **Intuitive design:** Interfaces are designed to be simple and easy to use, resulting in better operational monitoring and control.
- **Contextual information:** Operational information is presented logically and contextually, so operators can more quickly and thoroughly understand the status.
- **Trend visualization:** Real-time data and historical trends are displayed for enhanced operational analysis and decision-making.
- **Alarm management:** Alarm indicators are simple, clear, and prioritized, so operators can promptly respond to the most critical alarms for improved alarm management.
- **Customization:** Displays can be customized to suit specific processes and user preferences for heightened operational visibility.

Now you know a bit more about high performance HMIs, but to understand why this is the HMI of today, we'll look at its history and the International Society of Automation (ISA) standardization.

3. A Bit of HMI History

HMI systems are integral to industrial automation as these systems are fundamental in understanding what's going on with processes. Obviously, knowing the statuses of your operations helps you to improve overall operational efficiency and reduce downtime. And with the continued progress in computing technology, HMI systems have evolved from basic indicator lights and control panels to more advanced sophisticated systems.

For example, distributed control systems (DCS) are commonly associated with continuous process and batch manufacturing operations. Historically, the scope of a DCS was provided by a single supplier and included field devices, I/O modules, controllers, operator interfaces, and operations management. Displays for DCS operator interfaces were often based on engineering schematics such as piping and instrumentation (P&I) diagrams. These displays provide an accurate systems representation but still require involved operator training to effectively run a system and experience to identify and triage critical issues.

This evolution has continued, especially given the increased complexity of industrial processes and the increased need for improved operator interfaces. However, the advancement in HMIs has not always been that helpful to the operators. Let us explain.

Probably based on the concept that “more is better”, the advanced HMI systems evolved to have designed displays with excessive objects, color, and information that were messy and confusing. Instead of helping operators do their jobs more effectively, these designs hindered them, often overwhelming them with multiple confusing alarms that had no prioritization.

Undeniably, HMI design needed to change from the crazy busy displays to displays that presented relevant, actionable information simply and clearly. What was needed were HMIs that could enhance interaction between operators and complex systems by providing intuitive, contextualized information more efficiently. Recognizing this, the International Society of Automation (ISA) began developing formal design standards.

> In the words of a Gold Certified System Integrator of Mitsubishi Electric Iconics Digital Solutions
>
> **“The beauty of high performance HMIs is how they emphasize minimal use of colors to avoid the “Christmas tree effect”, a name for the phenomenon that occurs when there's so much color that you don't know what to look at first, especially in an alarm situation.”**

4. The ISA-101 HMI Design Standard

As mentioned above, many HMIs were poorly thought out, ending up with unnecessary graphics and colors that distracted operators. Rather than giving them situational awareness of the processes, these designs got in the way of the intended purpose, which was to give operators the information they needed to stay on top of operations. To get a handle on HMI design, the International Society of Automation started work on a standard in 2003.

The ISA is a globally recognized organization dedicated to advancing the understanding and application of automation technologies. The organization’s primary purpose is to develop and disseminate standards, guidelines, and best practices that promote the effective design, implementation, and operation of automation and control systems across various industries.

With this standard, the ISA wanted to:

- Emphasize design consistency
- Enhance usability and operator performance
- Reduce human errors
- Address alarm management challenges
- Adapt to technologies
- Improve training and onboarding
- Boost industry collaboration and knowledge sharing
- Assist compliance with regulatory requirements

In 2015, they published the ISA-101 HMI Design “Human Machine Interfaces for Process Automation Systems”. (You can download a copy here.)

5. Customer Value of High Performance HMIs

High performance HMIs are not just technology for technology’s sake. This HMI system is the outcome of a fundamental commitment to progress, efficiency, and continuous improvement. The system was designed to better equip and support operators in their daily tasks, ultimately delivering tremendous value to the customer. So, what kind of value are we talking about?

High performance HMIs offer crucial advantages over traditional HMI systems, some of which include:

> **Customization:** High performance HMIs are customizable, allowing operators to configure displays relevant to their tasks and preferences. This flexibility enhances user experience and adaptability.

Enhanced situation awareness: High performance HMIs provide relevant contextual information allowing operators to quickly recognize and understand the status of the operations. This level of operational visibility improves response time to critical situations and improves decision-making.

Reduced information overload: High performance HMIs present information concisely and clearly to reduce information overload. By minimizing the interface to only show the most relevant operational details, operators can efficiently focus on critical information and tasks.

Historical data and trend analysis: High performance HMIs display real-time data and historical trends that allow operators to analyze operational patterns and thereby identify potential issues before escalation. This capability promotes proactive rather than reactive decision-making in addition to improved maintenance planning.

Effective alarm management: High performance HMIs have the capability to prioritize alarms based on set conditions, so operators can respond to these based on severity. This capability also prevents alarm overload to ensure that attention is directed to the most important events. Operators can therefore quickly identify and respond to critical issues.

Reduced downtime: High performance HMI technology provides top level situational awareness and alarm management to operators, giving them the ability to quickly respond to issues to reduce downtime. This capability not only reduces the number of operational malfunctions and failures but also saves a substantial amount of money.

Improved operator efficiency: High performance HMIs provide the necessary tools for operators to effectively monitor and control operations, so they can make informed decisions for process optimization. The result is increased operator efficiency.

High performance HMIs offer significant advantages over traditional HMI systems as shown above. But there's more. These systems also offer increased integration with advanced technologies such as touchscreens, connectivity, and mobile solutions for a more modern and connection operational environment.

Moreover, the intuitive and user-friendly interfaces of these HMIs are easy to learn and navigate, consequently easing the training and onboarding of new operators. At the heart, high performance HMIs allow for increased overall operational excellence, which is a goal shared by all industrial and infrastructure organizations.

6. The Arguments for the GENESIS High Performance HMI

So far, we've defined high performance HMI and given its history, the ISA standard, and the customer value. You should now understand the argument for these design philosophies. The next step is to present solid arguments for choosing one extremely powerful high performance HMI: **GENESIS from Mitsubishi Electric Iconics Digital Solutions.** Let's get started.

GENESIS is an advanced visualization and automation software platform that delivers scalable, data-driven monitoring and control for industrial, infrastructure, and building applications. Designed with flexibility at its core, GENESIS combines intuitive high-performance graphics, deep connectivity, and enterprise integration to support smarter, faster operational decisions.

7. ISA Standards Deployment or Customer Preference Deployment

First, GENESIS can be deployed to the letter of the ISA standards as necessary, but it can also be tailored to customer preference. Below are three examples that demonstrate this capability and that align with high performance philosophies.

1.1 Oil & Gas Example

As previously noted, adherence to high performance philosophies and standards is quite common in process industries such as Oil & Gas. In this industry, it is usual to see large, complex systems that are geographically distributed. The objective of applying high performance philosophies is for the user experience to start with a system overview and enable more granular information and data through intuitive navigation. The display layout should convey the appropriate level of data and information along with directing user attention to areas requiring the most focus.

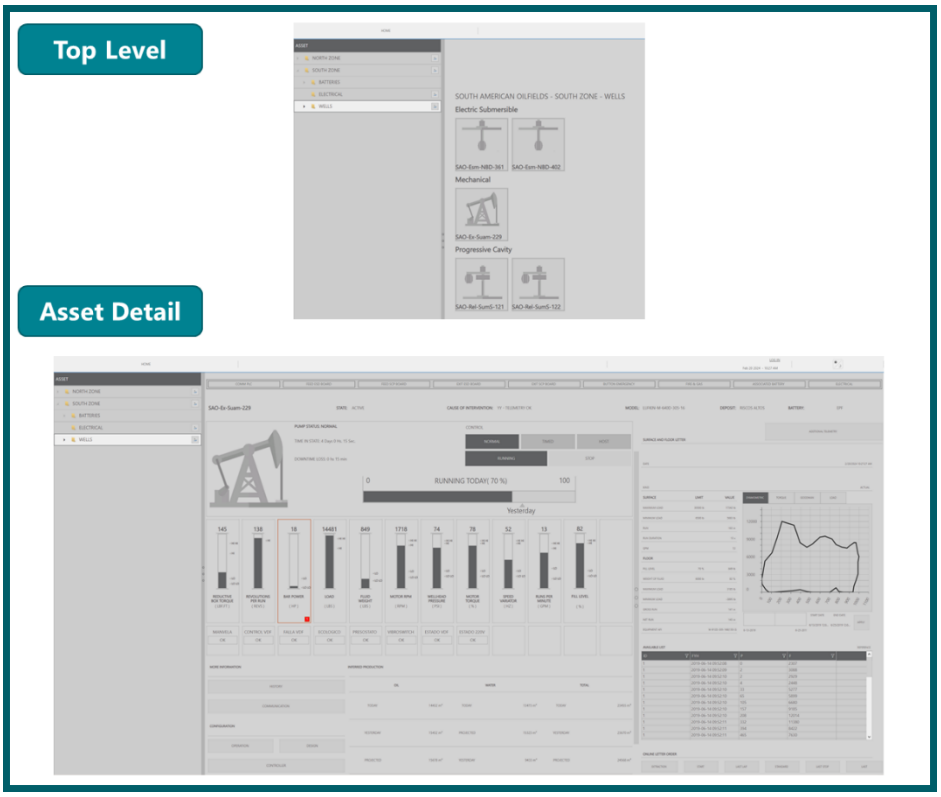

Figure 1. A hierarchy of displays utilizing consistent grayscale coloring.

The demo example seen above In Figure 1 is modeled after a production system and shows a hierarchy of displays utilizing consistent grayscale coloring. This system provides supervisory control for many geographically distributed assets from a central operations center. The project structure enables intuitive navigation, combines data and information, and allows users to access increasing levels of detail. As an example, the well overview display includes current values, operating ranges, a performance summary, and alarming with colors and severity levels to draw operator focus to areas requiring immediate attention.

1.2 Water & Wastewater Example

As noted above, adherence to high performance philosophies and standards is solely at the discretion of the end user. A common practice among infrastructure providers, such as municipalities, is to implement projects that combine high-performance graphics for operators with more visually detailed displays for supervisors and customers. The displays are intentionally designed to serve different audiences. The example in Figure 2 below provides a before and after representation of high performance philosophies applied to a graphic intended for operator control.

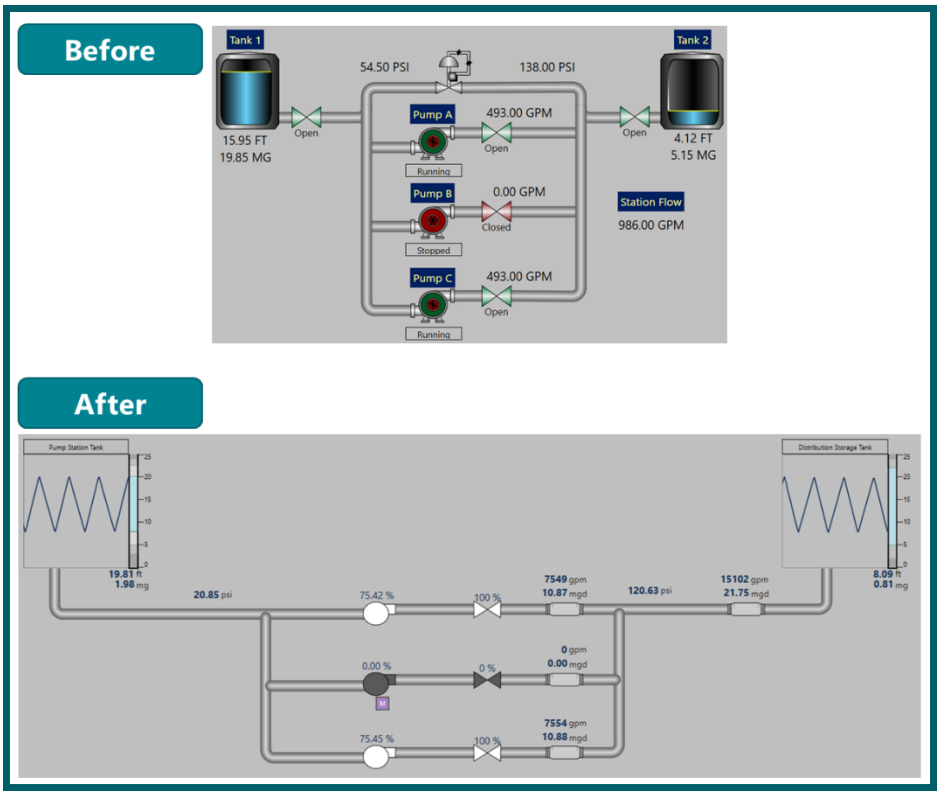

Figure 2. A before and after representation of high performance philosophies applied to a graphic intended for operator control.

While there is consistency with colors, the “before” image may confuse operators or distract them from urgent matters requiring more immediate intervention. The “before” image also lacks contextual information such as the full range of tank levels and anticipated range under normal operating conditions. Gray scale colors for states such as open/closed and running/stopped provide better ergonomics. If there is an error state such as a valve that failed to open or close or a motor overload fault, alarm indicators with severities aligned with the criticality of the error state would draw attention to the highest priority focus areas.

1.3 Data Center Infrastructure Management (DCIM) Example

A non-process example of high-performance design philosophies can be seen in the online data center monitoring demonstration from Mitsubishi Electric Iconics Digital Solutions. Data center operations need the ability to monitor, control, and optimize electrical power, environmental conditions, and mission critical systems. The underlying devices and systems come from a variety of suppliers, and therefore a “single pane of glass” providing a holistic view is critical for avoiding major disruptions in service, enabling troubleshooting, and supporting continuous improvement (Figure 3).

Figure 3. A "single pane of glass" providing a holistic view of a data center's operations.

Systems users frequently support multiple facilities and may not always be actively monitoring status. A typical scenario involves a facilities manager being notified of an operational abnormality in a critical system, such as a computer room air conditioning (CRAC) unit. In this case, the manager would access the monitoring application to view the asset's status, as illustrated in the summary display, and assess the operational impact shown on the floor plan.

While this data center example does not follow the ISA standard to the letter, it shares many of the same principles as the previous ones. Each example focuses on delivering an intuitive user experience for navigation, presenting data and information clearly, and providing access to detailed insights through alarms and historical data. The ability to define, build, run, and sustain these operator-centric experiences is what makes GENESIS from Mitsubishi Electric Iconics Digital Solutions a best-in-class platform for real-time visualization, monitoring, and operational intelligence.

8. High Range of Connectivity

Beyond meeting client requirements for performance-based HMI configuration, GENESIS offers extensive connectivity to a wide range of devices and data sources. The platform natively supports standard protocols such as OPC UA, BACnet, SNMP, and Modbus, and includes built-in features for integration with web services and databases. Connectivity is further expanded through a strategic partnership with Takebishi, enabling communication with more than 100 types of devices—from sensors and industrial controllers to robots, barcode scanners, machine tools, and meters.

9. Asset Modeling Capability

GENESIS can abstract a heterogeneous install base of devices and data sources through an asset modeling capability. Asset models created in GENESIS projects enable consistent taxonomy and provide organization and metadata that can be used in smart symbol objects and displays and that standardizes alarming and historization.

10. Seamless UX Development to Web Delivery

GENESIS combines powerful connectivity, data modeling, and advanced visualization capabilities within a unified development environment. Displays can be built and viewed in multiple formats, including HTML5, to deliver high-performance HMI experiences across desktop and web. For process industries and applications requiring line-type schematics, the platform supports importing CAD files and includes built-in tools for rapid piping and layout design. Users can access these visualizations from operator workstations, control rooms, or mobile devices—scaling effortlessly from large-screen displays to smaller personal devices for complete operational awareness.

> In the words of a Gold Certified System Integrator of Mitsubishi Electric Iconics Digital Solutions
>
> **“The GENESIS software suite is intuitive and user friendly, very much like Microsoft tools. Since most people are familiar with Microsoft, almost anyone from your operations team can make simple changes to your system which means you won’t have to call a system integrator. This saves you time and money.“**

11. Flexible & Scalable Architecture

If your organization needs a high performance HMI and will therefore select and invest in one, then the selected product and supplier should offer deployment scalability and flexibility. And GENESIS by Mitsubishi Electric Iconics Digital Solutions does.

What’s more, GENESIS can be implemented architecturally in small systems on single computers with a limited number of devices and tags. Additionally, platform components can be distributed across multiple virtual machines and hosted in the cloud to enable scale for a large number of clients, alarms, and historical data points. The platform can also be deployed in a number of different architectural configurations to support high availability, redundancy, and client load balancing.

12. Conclusion

The main design objective of high performance HMIs is to help operations teams do their job with more accuracy, efficiency, and ease. If we look again at some of the key characteristics of these HMIs—intuitive design, contextual information, trend visualization, alarm management, and customization—you can see how high performance HMIs can be instrumental to running your industrial operations at the highest level. There is eloquence and beauty in simplicity, and this is true for high performance HMIs.

We’ve also presented our compelling arguments for choosing GENESIS. The platform can be deployed in full alignment with ISA standards when required or tailored to customer preferences. GENESIS offers extensive connectivity, advanced asset modeling capabilities, and seamless UX-to-web delivery, while remaining highly flexible and scalable.

Equally important, Mitsubishi Electric Iconics Digital Solutions has been in the business for more than 35 years and therefore has a proven track record. We have the expertise, experience, and technical support to get your facility and your team operating at optimal level. Ultimately, we do standard high performance HMIs extremely well. It’s what we do.

13. Choose Your Next Step: Download the Brochure or Talk to an Expert

Want to learn more? Download our GENESIS brochure to explore how Mitsubishi Electric Iconics Digital Solutions empowers organizations to achieve next-level user experiences and operational efficiency.

Ready to take the next step? Contact one of our experts to discuss your specific goals or request a complimentary consultation with a local representative.

About Us

Mitsubishi Electric Iconics Digital Solutions, headquartered in Foxborough, Massachusetts, is a global leader in industrial automation, smart and sustainable buildings, and digitalization software. Our advanced HMI, SCADA, and Smart Building solutions enable businesses to visualize, monitor, and optimize their most critical assets and spaces. With installations in over 100 countries and adoption by more than 70% of Global 500 companies, we drive operational efficiency and continuous improvement across industrial manufacturing, infrastructure, and built environment sectors. Backed by cutting-edge technology and deep industry expertise, we deliver flexible, scalable, and high-performance software solutions. As a testament to our excellence, Mitsubishi Electric Iconics Digital Solutions has been recognized as a seven-time winner of the Microsoft Partner of the Year award.

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