




*Make the Invisible Visible™*

A collection of light blue line-art icons representing various electronic devices, including desktop monitors, laptops, tablets, smartphones, and AR/VR headsets, scattered across the left side of the page.

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

An ICONICS Whitepaper  
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## Scope

A brief but thorough explanation of high performance Human-Machine Interface (HMI) design concepts, this whitepaper explains what a high performance HMI is, the drivers for establishing industry standards, and how these HMIs deliver the next level of user experience and operational efficiency. This document also provides essential considerations and constructive recommendations for designing and deploying high performance HMIs.

## 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. Also, high performance design principles focus on displays that convey relevant information so have navigation and displays structured to provide a system overview with a hierarchy that allows drilling into further levels of granularity. 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:** Simple and easy to use and understand interfaces are designed 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 International Society of Automation (ISA) standardization.

## 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. But 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 effectively, these designs hindered them, often overwhelming them with multiple confusing alarms that had no prioritization.

It became clear that 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. It also became clear that HMI design standards/guidelines were needed. This is where the International Society of Automation (ISA) stepped in.

Quote by an ICONICS Gold Certified System Integrator

“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.”

## 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](#).)

## 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. It was developed to better equip and aid operators for their jobs and in turn adds 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.

# The Arguments for ICONICS GENESIS64 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: **ICONICS GENESIS64**. Let's get started.

## ISA Standards Deployment or Customer Preference Deployment

First, GENESIS64 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.

### 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 enables a user 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.

### Water & Wastewater Example

As noted above, adherence to high performance philosophies and standards is solely at the discretion of the end user. It's common for organizations providing infrastructure, such as municipalities, to implement projects that include high performance graphics for operators and more elaborate displays with colors and animation to provide view-only status to 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.

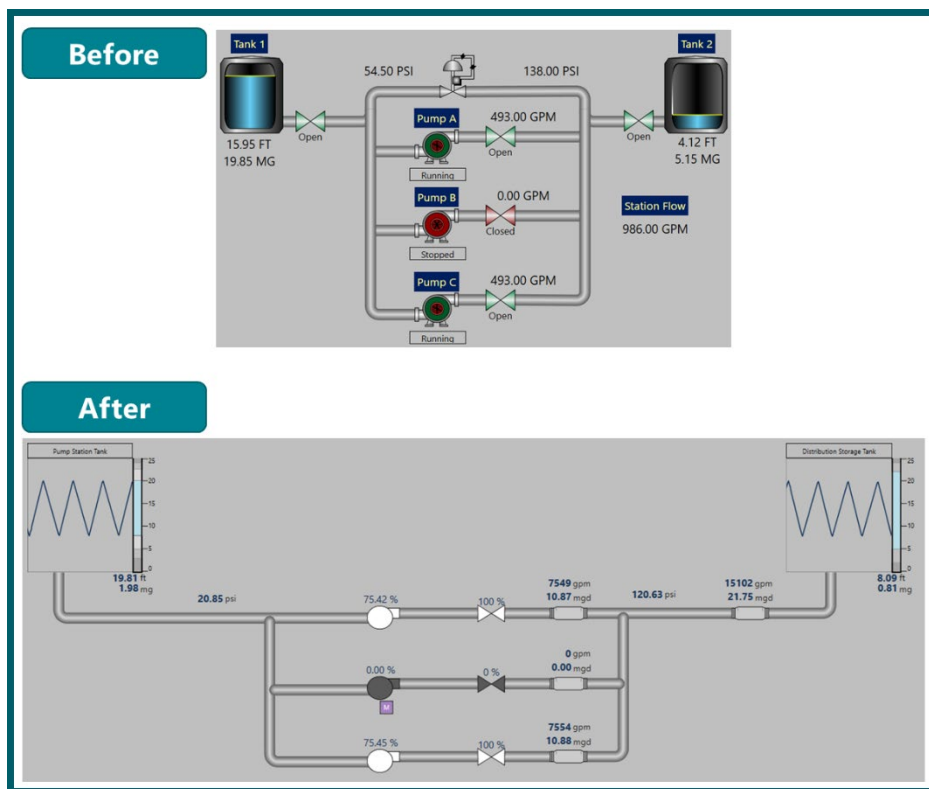


Figure 2. A before and after representation of high performance philosophies applied to a graphic intended for operator control.

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.



## Data Center Infrastructure Management (DCIM) Example

A non-process example of high performance philosophies is highlighted in ICONICS Data Center Infrastructure Management (DCIM) online demonstration (iconicsdemo.com.). 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. It would be typical for a facilities manager to be notified of an operational abnormality in a critical system such a computer room air conditioning unit (CRAC). In this case, s(he) would access the DCIM application to see the asset’s status as illustrated in the summary display and assess the operational impact as illustrated by the floorplan.

While the DCIM example does not follow the ISA standard to the letter, it shares common aspects with the prior examples. All the examples focus on enabling an intuitive user experience for navigation, presenting data and information, and enabling access to greater granularity with alarms and historical data. The ability to define, build, run, and sustain these types of operator centric experiences are what makes ICONICS GENESIS64 a best-in-class platform.

## High Range of Connectivity

Besides being able to meet client requirements around performance-based HMI configuration, GENESIS64 provides an extensive range of connectivity to a variety of different devices and data sources. GENESIS64 has native platform capabilities to connect to devices using standard protocols such as OPC UA, BACnet, SNMP, and Modbus. Additionally, GENESIS64 has native platform features enabling integration with web services and databases. Integration options are further expanded through a strategic relationship with Takebishi which enables connectivity to devices ranging from sensors, industrial controllers, robots, barcode scanners, machine tools, and various types of meters for over 100 vendors.

## Asset Modeling Capability

GENESIS64 can abstract a heterogeneous install base of devices and data sources through an asset modeling capability. Asset models created in GENESIS64 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.

## Seamless UX Development to Web Delivery

GENESIS64 utilizes connectivity and modeling in GraphWorX64, the graphic development environment where displays are built and data is visualized in a variety of different formats, including HTML5. GraphWorX64 can be used to build and deliver high performance HMI experiences on desktop with a seamless user experience to web. For process industries and scenarios requiring one line type schematics, GraphWorX64 can import a variety of CAD files, and it offers a native piping tool that accelerates development of displays tailored to customer preferences. GraphWorX64 also enables displays that are accessible on an operator workstation, in a control room, or on a mobile device allowing you to visualize your operations displays on large screen monitors/TVs or on smaller screens on personal devices.

### Quote by an ICONICS Gold Certified System Integrator

“ICONICS 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.”

## 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 ICONICS GENESIS64 does.

What’s more, GENESIS64 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.

## 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 GENESIS64 – It can be deployed to the letter of the ISA standards as necessary, but it can also be tailored to customer preference, and it has a high range of connectivity, asset modeling capability, seamless UX to web delivery, in addition to being highly flexible and scalable.

But equally important, ICONICS 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.

## Contact One of Our Experts

Your next step? Contact one of our experts to learn more about how you can achieve that next level user experience and operational efficiency with ICONICS software suite and GENESIS64. Visit [iconics.com/contact](https://iconics.com/contact) to find a local representative or industry expert and request a complementary consultation today.



ICONICS, a group company of Mitsubishi Electric Corporation, serves as the software center of excellence for Mitsubishi Electric's Factory Automation Systems Group. Its visualization, analytics, mobile, IoT, and cloud solutions improve productivity, reduce integration time and operating costs, and optimize asset utilization. ICONICS solutions, combined with the knowledge and industry expertise of Mitsubishi Electric, maximize value to the customer by monitoring and controlling automation processes. ICONICS award-winning software boasts over 375,000 installations in Factory Automation, Process Automation, and Building Automation customers in over 100 countries worldwide.

ICONICS is leading the way in cloud-based solutions with its HMI/SCADA, analytics, mobile and data historian to help its customers embrace the Internet of Things (IoT). ICONICS products are used in manufacturing, building automation, oil and gas, renewable energy, utilities, water and wastewater, pharmaceuticals, automotive, and many other industries. Delivering information anytime, anywhere, ICONICS' solutions scale from the smallest standalone embedded projects to the largest enterprise applications.

ICONICS promotes an international culture of innovation, creativity, and excellence in product design, development, technical support, training, sales, and consulting services for end users, systems integrators, OEMs, and channel partners. ICONICS solutions are installed in 70 percent of the Global 500 companies around the world, helping customers to be more profitable, agile, efficient, to improve quality, and to be more sustainable.

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