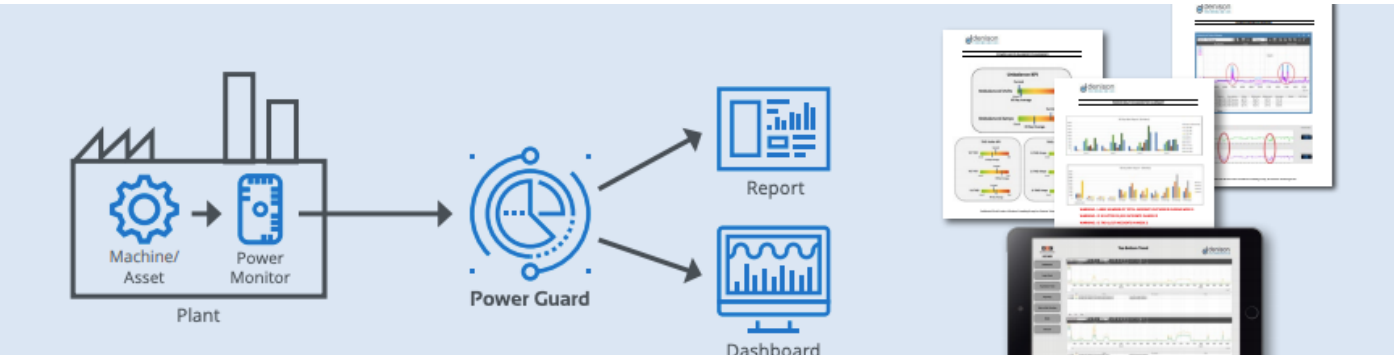
The Human Machine Interface

Where Kaizen Meets Kanso in Advanced Manufacturing



Delivering the ISA 101 Standard HMI

Kaizen. A guiding principle in Japanese culture translated as "constantly improving" our lives and our processes. Kaizen is based on the principles of gradual, constant improvements that may be small individually but are impactful when taken together.

Zen Buddhists practice the art of kanso, or simplicity. Engineers refer to the KISS principle: Keep It Simple, Stupid. We act on and purchase the "why," not the "what." Communicating complex solutions simply is an art form, often misunderstood or discounted.

As advanced manufacturing technologies are being delivered at warp speed, mere mortals are being bombarded with increased complexity and noise. Billions of sensing devices are being deployed in the world, from our toasters to our plant floors. Data rates are doubling every 11 months. And don't forget our children need to be picked up at car pool. So, as technologists and designers, it's even more critical now to be reminded of kaizen and kanso - always striving to deliver better and simpler solutions for maximum utility and ease of use.

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Cloud computing and cloud-based technologies address both kaizen and kanso - offering both efficiency and simplicity at the architectural level. Cloud computing offers fewer boxes on the plant floor reducing both CapEx and OpEx. Cloud-based software-as-a-servcice (SaaS) solutions can be customized, designed, and delivered rapidly, often at substantially lower costs. Cloud computing almost takes on an ethereal, angelic resonance compared with today's plant environments, often described as "smokestacks of data orphaned on the plant floor." Hardware gateways provide the necessary connection, bridging the OT and IT domains. Architecturally, as we deliver the IIoT, the industry has made great strides in kaizen, and we continue to do so as we build software as a service rapidly in the cloud.

World-class designers understand it is easy to create a different thing but it's very hard to create an impactful thing. Perhaps nowhere is kanso more imperative than the human-machine interface (HMI). Why? Because if we are unable to present data in a format that is recognizable, pleasing to the eye, and easily understood, we have failed to deliver value from that data. Creating a simple, easy to navigate HMI is critical to achieving kaizen.

Humans must be reminded of certain truisms. For example, neuroscientists know there are 100 billion neurons in the human brain and we can place about 30,000 of them on the head of a pin. Placed end to end the neurons in just one person's cortex would stretch 100,000 miles, enough to circle the earth 4 times. Our brains are capable of processing upwards of 30 billion bits of information per second, using effectively 6,000 miles of wiring. The hardware and wiring of our brains is absolutely amazing.

Yet we can only store three or four topics in our working memory. We often lose attention after ten minutes to a verbal presentation - seeking instead to find pleasure, find the nearest exit, or create an excuse to leave. Difficult to operate processes are frustrating, particularly when we are simultaneously bombarded with competing tasks, priorities, and deadlines. In such cases, us mere mortals might seek to reduce the pain by deferring critical plant maintenance tasks.

But yet presenters often deliver dissertation-length, bullet-point laden PowerPoint presentations believing the audience actually wants to read the eye charts and not actively engage with them. And many HMI designers continue to try to impress plant floor operators with displaying too much information in techie eye-charts without concern for the user experience. Have we accomplished kaizen and kanso in either case? No. Most likely the listener will seek to reduce the pain - and not use the system.

If we can't represent critical plant floor data in a recognizable, easy to use format, then chances are the designer did not understand the user or the context of the data. Understanding user needs/wants/behaviors as well as the context of the data is therefore critical to proper HMI design.

The ISA 101 HMI committee has taken great care and effort to address the design, implementation, operation, and maintenance of HMIs for process automation systems. Starting in 2015, the initial working groups focused on delivering the HMI philosophy, style guide, and design guide. Topics addressed include usability and performance, mobile platforms, and the concerns of designers, integrators and operators. The ISA 101 standard, recently adopted by ANSI, has addressed human factors such as the use of consistent colors, consistent process objects, and context of data.

Taking a more holistic perspective, the ISA 101 committee included a discussion of an HMI lifecycle approach much like ISA 84 for safety systems and ISA 18.2 for alarm management. Very kaizen-like in approach, the HMI style guide focuses on small changes that increase HMI effectiveness, such as color navigation and object animation. For example, it is recommended to use a gray background that both minimizes glare as well as provides a low-contrast depiction of the data. Bright colors should be used only to highlight alarm and abnormal conditions.

As the industry designs and delivers the next generation HMI, we must do so thoughtfully and remind ourselves of the principles of kaizen and kanso - focusing on how we can make technically challenging continuous improvements while representing and communicating outcomes simply.