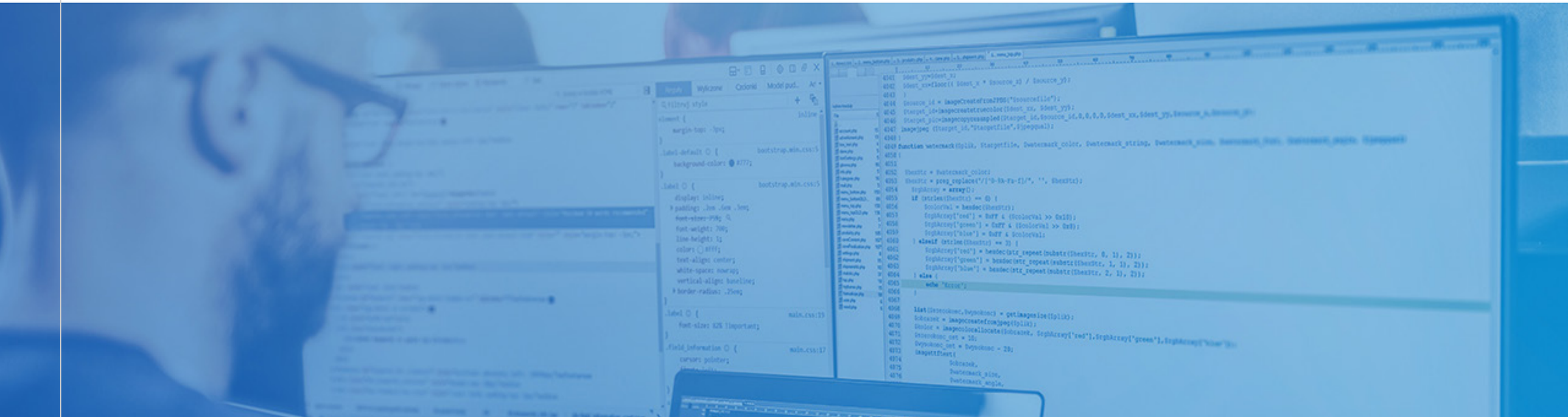
Rapid Application Development:

Just in time data access and application building for iterative, manufacturing, and plant operations



What is RAD?

Manufacturing has changed.

Manufacturers have always wanted to increase productivity and remain competitive. However, important changes to how you do that have occurred. The industrial world has evolved significantly and the single purpose operation that made the same product over and over again for years is shifting.

The demand for customization and short runs requires just in time manufacturing that can reconfigure equipment, processes and maintenance procedures with great agility. While this demand started years ago, thin margins are putting urgent pressure on manufacturers to increase their focus on building agility into their operations.

The modern demand for more agile manufacturing brings with it hidden costs to the business — including overtime fees, under trained staff, documentation needs and even custom scripting. The costs can add up quickly both in terms of time & resources.

A new approach, referred to as Rapid Application Development (RAD) is no longer just a desire, it is mandatory way of overcoming these hidden expenses.

Rapid Application Development is the quick development of customized solutions and efficient human-computer interfaces (HMI) applied to the automation space through tighter integration with SCADAs and GE Digital products. RAD is used to provide easier and better connectivity, configuration & build tools, deployment & security. This leads to an overall improvement in operational agility. Visualization and data integration capabilities are the foundation for making this a reality. The result is more consistent visibility across all different types of users and personas. It's so logical, it sounds easy, but it's not.

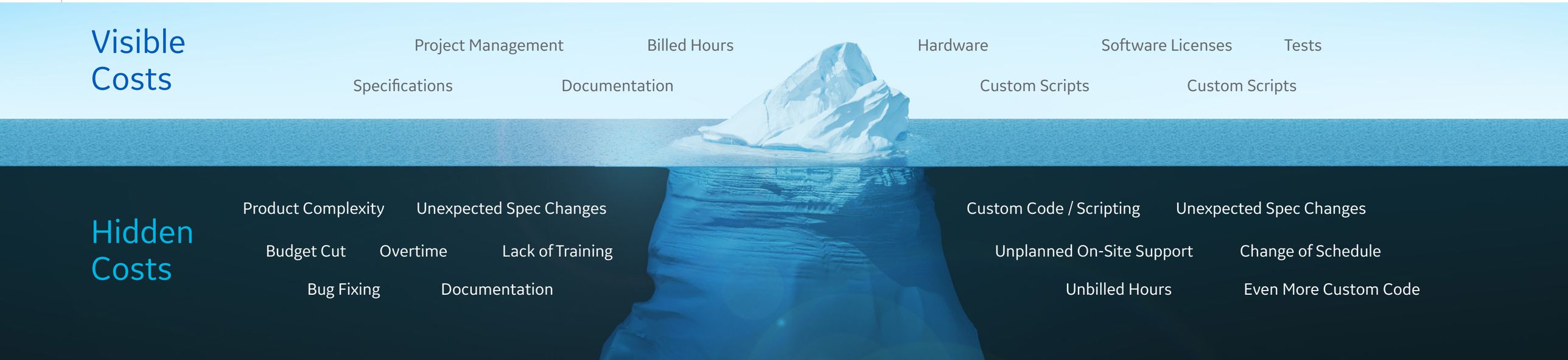
Consolidating data across different levels of the organization to achieve RAD in a secure manner is challenging due to the time series nature of the data that is collected and utilized for analysis. We have to collect massive amounts of information, but also make it possible to act quickly when circumstances demand.

Overcoming this challenge is worthwhile because the benefits are significant both in terms of shrinking time to value, but also in reducing total cost of ownership. In fact, engineers can experience up to a 40%* faster build/ deploy time.

This happens because:

- A structured asset model mapped to SCADA database speeds up configuration time
- Smart objects & predefined templates allow for efficient HMI out of the box
- Modern technology including Docker, HTML 5, OPC UA, MQTT allows for simplified connectivity & centralized development & deployment

* GE customer interviews, based on Web HMI application experience

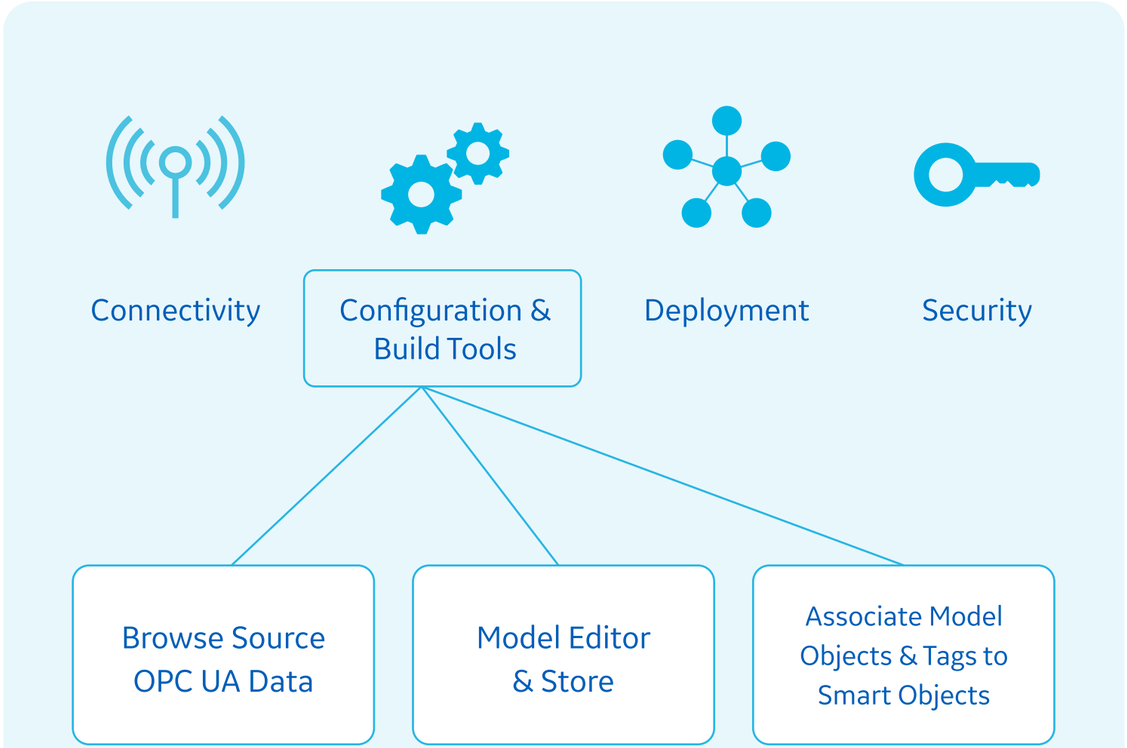


GE Digital's RAD Vision: Faster time to value, lower total cost of ownership

At GE Digital we take our responsibility to help your organize step progressively towards more agile operations very seriously. For the most progressive that journey is well under way, and for others it's just beginning. We're proud to be leading the charge by building the technology, processes and expertise needed to create the manufacturing operations of the future by bringing together disparate data sources and multiple software tools into a centralized hub.

Our goal is to help all plant users go beyond traditional HMI/SCADA activities and improve user experiences by providing access to data enabling customers to leverage that data in new and significant ways.

We're not going to do this alone. We believe that an open ecosystem not only honors the needs of today's multi-vendor investments but provides the most flexibility for the future across all four critical capabilities users running and managing the plant have to master. Connectivity, configuration, deployment and security.

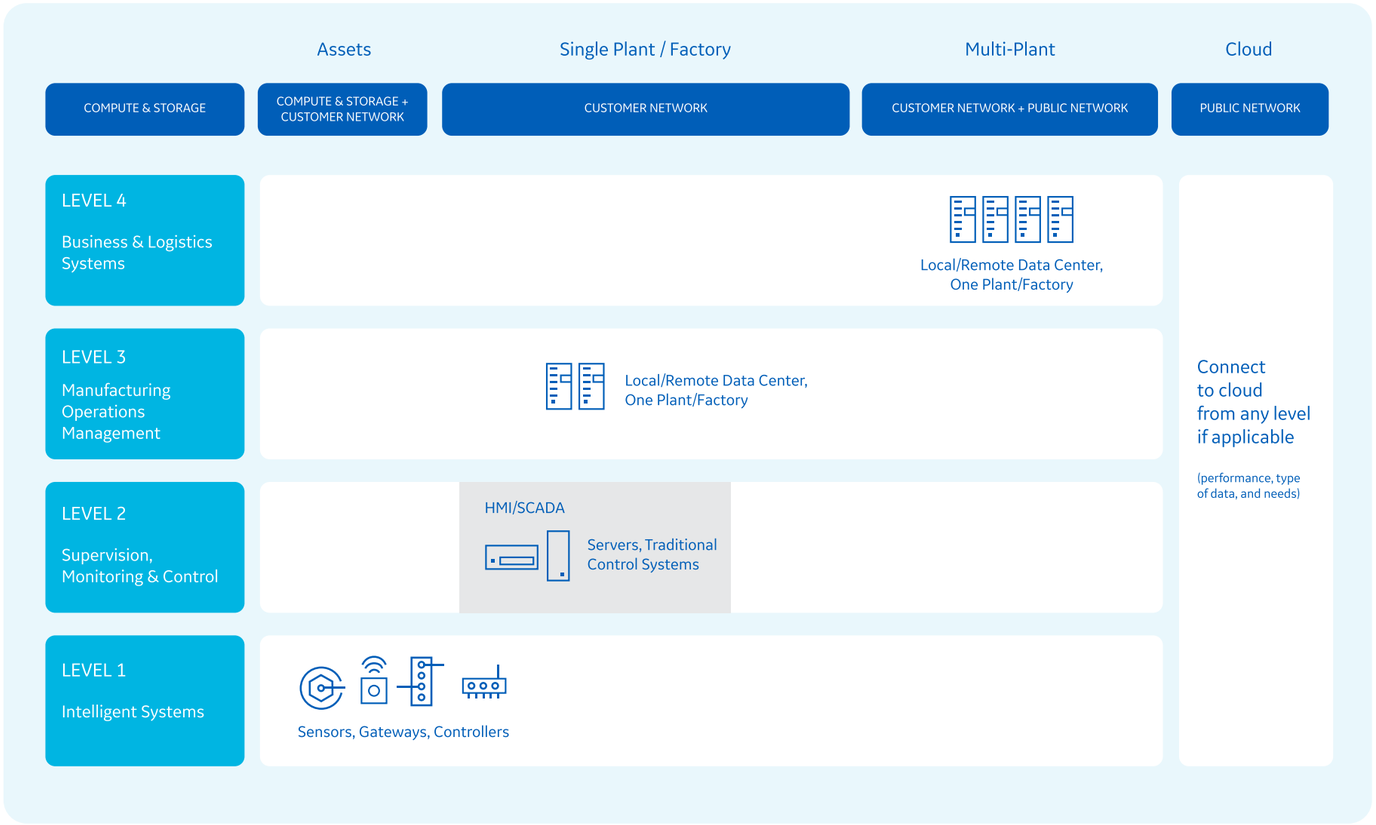


Connectivity: Connecting information across the enterprise

Connectivity across the enterprise is both essential and complex. You need to go beyond notifications and monitoring systems. Share data via centralized computing systems for analysis to maximize value from all the data that can now be collected.

Our goal is to provide common tools for a single application across all four levels of operational maturity:

1. **Intelligent equipment** – sensors, gateways, controllers
2. **Supervisory and Control Systems** – human-machine interfaces optimized for alerts and action
3. **Manufacturing Operations Management** – local or remote data centers consolidating plant level information
4. **Business Systems** – data centers consolidating information from across plants for a holistic view and operation of the business



This model ensures that you don't have to know what you need in advanced. Instead, you can maximize connections across devices, users, and locations as needed by the operation

Configuration: data modeling and tag management

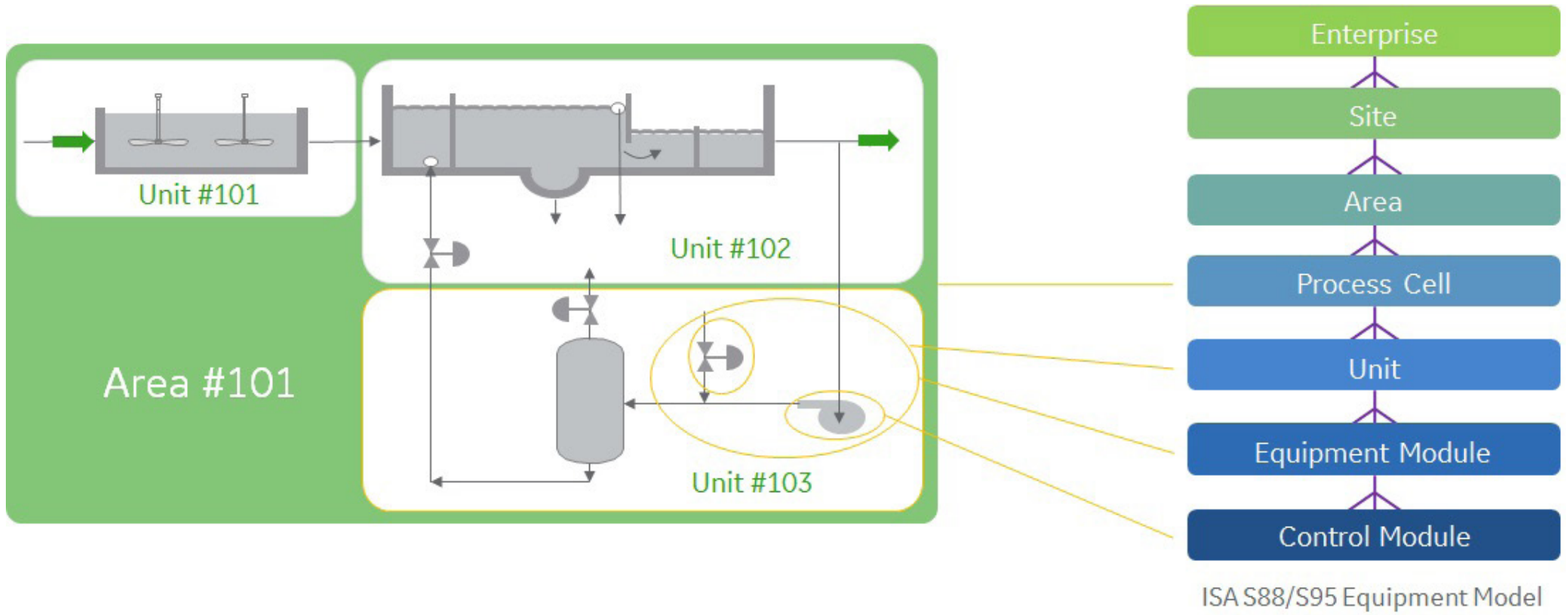
Every application and user have unique needs for their role.

However, you don't have to configure a new application or data structure for each function. Data modeling reduces rework by shortening cycle times and allowing work to be duplicated or reused.

For example, the ISA 95 standards can be used to provide guidance for the engineers who want to create an equipment model. The model helps break the physical world into more manageable pieces by defining levels. It starts at the Enterprise level, then the Site, Area, Process Cell, Unit, Equipment Module & Control Module levels (see image). There is great value to structure data coming from a plant with complex infrastructure or a manufacturing facility. Through authorization and visibility rights the model can be collapsed and adjusted to the user's need. i.e. define only the number of levels required for that specific user's application.

The OPC UA communication protocol supports this structured approach. The latest instance of the OPC Foundation, unlike its predecessors, comes with an information model, which makes it a true interoperability standard for the Industrial Internet.

In the context of a RAD implementation, the automation system will be able to map the model defined at the asset / unit level using OPC UA and aggregate the data in a common model that can later be used as the basis to automatically generate HMI mimics and the navigation in context for the Operators.



ISA S88/S95 Equipment Model

In addition to data modeling, data visualization makes it easy for an operator to set user permissions and make data connections within the confines of their role.

Let's consider a simple example - access to equipment logs used for troubleshooting.

Your equipment operator in one plant only wants to see alerts for problems on the equipment they are responsible for, but you have many operators with similar roles across locations. In this case you might set up a threshold alert. But instead of writing code for each operator, you instead match the equipment to the operator and write code that applies to all people with that role. That's pretty straight-forward. What if access to the logs of equipment in other plants could help the operator locally address a problem? With the right data model, the equipment could recognize others who had the same problem, and proactively communicate the known resolution.

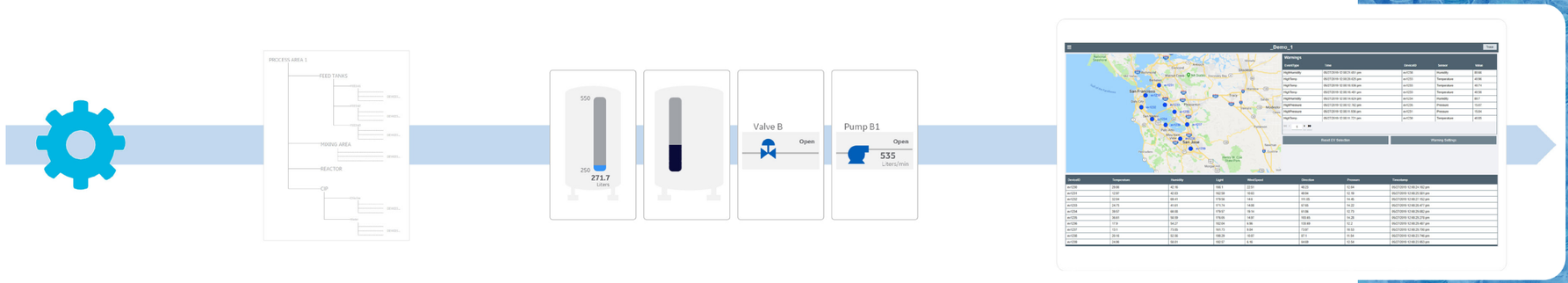
Although this is a simple example, it demonstrates the power of data modeling and simplified tag management.

Deployment: Technologies and standards that enable RAD

A critical part of the RAD foundation is the ability to quickly build targeted apps for an immediate need and deploy those apps and the contained visualization as needed. Several technology advances; MQTT, HTML5, Cloud, ISA 101, ISA 18.2, make it far more efficient than in the past.

- MQTT is about IIoT connectivity. MQTT and OPC UA deliver connectivity (and security as far as OPC UA).
- HTML5 is a widely used software standard stack, when combined with responsive design tools, it allows the screens to be available from a large number of devices: from desktops running a compatible web browser, to smartphones and tablets, including some low footprint devices used in plants like dedicated operator displays.
- ISA 101 & 18.2 are two ISA standards. ISA 101 is set of recommendations for the design of HMIs. Our visualization objects are based on these recommendations. ISA 18.2 is dedicated to alarm management. Some of the features of our HMI/SCADA follow the ISA 18.2 recommendations.

Using these technologies to create templates that are optimal for user interaction shortens development cycles significantly and reduces the burden on hard to find IT resources.



Security: Using standards to drive secure connections

Security is an essential element for all RAD implementations.

Let's look at smart home devices as a model for our enterprises. Consider a smart hub device like Google Home or Amazon Echo. Consumers connect multiple applications to those devices and use them for central control. Perhaps they have a doorbell with a camera in it, and lights that are controlled by the hub. Maybe even temperature control through a smart thermostat. In order for the smart hub to work it has to recognize the device and integrate it with the application to control the camera on the doorbell, the temperature on the thermostat or the light bulb in the lamp. You want the hub to collect and share information, so it must recognize those devices, and it can visualize the lamp for example in the hub interface. However, you don't want just anyone turning on the lights.

Our industrial operations operate in a similar context. We want data to flow in real-time across the operation, but we need to limit the actions that can be taken with that data to relevant, authorized applications & employees.

Interoperability through the industry standard OPC UA is the key to provide secure agility. With OPC UA the system itself can easily discover OPC UA compliant equipment, configure it and ensure it is securely managed.

Better engineering and operations outcomes

When deployed correctly, using RAD will deliver faster time to value and lower total cost of ownership across the operation because auto generation & self-assembly, modeling and code free design significantly reduce build, deploy and connectivity times and costs. Best of all, RAD reduces maintenance costs by reducing the amount of time needed to maintain applications and HMIs. One of the biggest contributors is the ability to build responsive design interfaces that allow information to be consumed across any device — smart phone, tablet, PC, or display, with a single code base. This approach ensures anyone who needs to access information on-site or remotely can easily do so without requiring a new interface. Lastly, digital tools natively improve compliance with standard operating procedures because notifications, workflow and alerts are built into the system and can't be overwritten.

When you have a centralized application, everyone has a single source of truth and better collaboration across functions becomes a natural part of the organization's workflow.

Faster response for operators, faster development for engineers

40% ↑
Faster development

35% ↑
Improvement in alarm resolution

80% ↓
Less time navigating

40% ↑
Faster identifying critical data

Operations Hub: Iterative development made practical. Enabling optimizations through the learnings of all on the plant floor

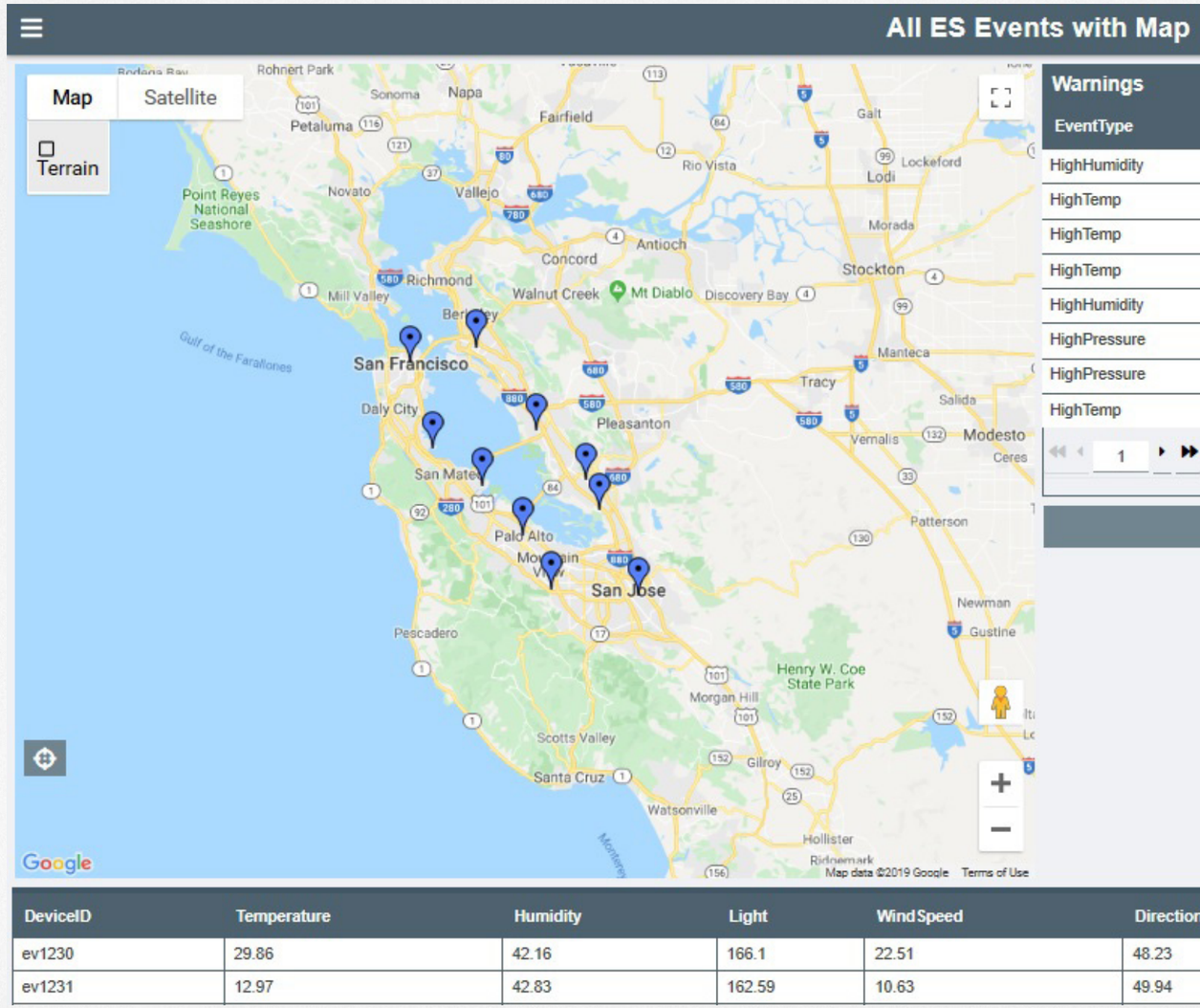
Operations Hub was designed specifically to serve the needs of an open ecosystem, making interfaces more intelligent, and connecting heterogeneous data sources to improve performance, improve collaboration, find optimizations through data analysis and reduce human error.

Systems integrators and in-house engineering teams can leverage powerful, code-free development tools to quickly assemble Web-based applications, enabling connectivity with GE Digital software and common IIoT sources, such as databases and control systems, and delivering high performance displays for the operator.

The code-free tools allow multiple, non-developer users to simultaneously contribute to creating custom displays, which reduce costs and speed development. This substantially decreases time to create a view to monitor abnormal situations by putting the build tools in the hand of all. Also, Operations Hub makes more information available to more users by providing easy access to both IT and OT data sources in a contextual format. This enables everyone in the plant to do richer analysis across a greater set of contextual information driving more informed decisions and improved operational efficiency.

Operations Hub delivers a foundation for insights into operations and productivity, a critical step in the journey towards successful digital transformation of one's organization.

FIND OUT MORE



About GE

GE (NYSE: GE) is the world's Digital Industrial Company, transforming industry with software-defined machines and solutions that are connected, responsive and predictive. GE is organized around a global exchange of knowledge, the "GE Store," through which each business shares and accesses the same technology, markets, structure and intellect. Each invention further fuels innovation and application across our industrial sectors. With people, services, technology and scale, GE delivers better outcomes for customers by speaking the language of industry.

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