Strategies for Operational Excellence

Scalable Software for Visual Intelligence

An ICONICS White Paper

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1 About This Document

1.1 Scope of the Document

This document summarizes recommended approaches for applying software technology in automated operational environments that seek continuous improvement to approach a state of "Operational Excellence". Discussed are methods to increase coordination of business systems with real-time controllers, to create unified views of machine-controlled and business applications and to better integrate intelligent systems to manage operational incidents.

The intended audience includes Plant Managers, Operators, Manufacturing Executives, Process Engineers, IT Professionals, Maintenance Personnel and end users in manufacturing, public sector systems and facilities management. Also included is a discussion of how ICONICS scalable software products may be applied in a Microsoft framework as a strategy for coordinating disparate systems into a unified environment for visibility and control across business and operating systems.

1.2 Revision History

Version 1.0 – Dr. Habib Rehman, March 27, 2007

Version 1.1 – Russell Desjarlais, April 3, 2007

Version 2.0 – Mark Hepburn, April 23, 2007

1.3 Definitions

The following are acronyms used in this document, and are presented here for reference.

- BAS – Building Automation System
- CMM – Collaborative Manufacturing Management
- CRM – Customer Relations Management (software)
- DCS – Distributed Control System
- DMAIC – Defining, Measuring, Analyzing, Improving and Controlling
- ERP – Enterprise Resource Planning
- HMI – Human Machine Interface
- KPI – Key Performance Indicator
- MES – Manufacturing Execution System
- MROI – Maximum Return on Investment
- ODBC – Open Database Connectivity
- OEE – Overall Equipment Efficiency
- OEM – Original Equipment Manufacturer
- OPC – Open Protocol Communication (industry standard from OPC Foundation)
- PLC – Programmable Logic Controller
- RPM – Real-time Performance Management
- SCADA – Supervisory Control and Data Acquisition (software or system)
- SCM – Supply Chain Management (software)
- SNMP – Simple Network Management Protocol
- TCO – Total Cost of Ownership

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2 Introduction

2.1 Challenges and Goals

Organizations are faced with ever growing competitive pressures and must improve their operational performance in the face of continuous change in business and technological environments to succeed. Many technologies have been deployed over the years to improve production efficiency, quality and throughput in manufacturing and other distributed systems. Machine automation systems, process control systems, and building automation systems have been deployed widely over recent decades; much of it since the 1990's, based on computer-controlled systems that were based on proprietary technologies optimized for the subsystem. At the business system level, we have seen wide adoption of software to manage the financial and transactional elements of business. From customer relations management to enterprise resource planning to supply chain management to quality improvement, software systems are used everywhere.

Yet when we look at these systems we find that, in many cases, they remain disconnected from one another, many with proprietary communication protocols that make coordination difficult. As companies seek the next level of business performance, they must seek to improve their operational efficiency and coordination with business objectives.

All operations seek continuous improvement, but today's organizations face obstacles to unified visualization control of operations in a real-time business context, which is necessary to achieve Operational Excellence. There is wide disparity in context and communication protocols between machine and IT systems, proprietary protocols and isolation for system security and integrity.

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An ideal operation should have a unified "visual intelligence' system to reach any and all parts of the enterprise in real-time from anywhere with contextualized information, so that people are empowered to make smart decisions fast. Plant floor and business systems would be connected to present Key Performance Indicators (KPIs or "results") in real-time in a business context.

But the reality is that businesses have invested in a wide range of systems that were optimized to a specific function at the time of implementation, and the technologies deployed are very often proprietary to the extent that they have their own unique interfaces and communications technologies. It requires a great deal of effort and "middleware" or data replication to integrate the different systems. There are many barriers to achieving unified visual intelligence: technological, structural, human capital, business culture and concerns about data integrity and physical security that have caused people to isolate their real-time systems from business systems.

Such challenges might include the integration of multiple, disparate systems or alleviating everyday information technology bottlenecks. Some companies might find concerns over data and/or physical security to be a large problem, while large enterprises might be concerned over their strategy for global competition. Some organizations might be slowed by dealing with multiple vendors' proprietary formats while others might be at a standstill due to changing priorities within a corporate hierarchy.

2.2 Strategies for Operational Excellence

Each organization has its own unique situation, based on its own evolution and market realities, but all operations have one thing in common: better coordination between business systems and production operations will result in improved overall performance. Today's operations are an amalgamation of manual and automated systems. The processes and procedures between demand and supply for any operations are many fold and complex.

Most substantial operations have invested in systems for automating production processes, and at the business layer for managing orders, inventory, design, human capital, quality, schedules, product and design. In the past decade, we have seen a great deal of investment in software at the business level, such as with ERP, SCM, CRM systems (SAP, Oracle, Microsoft, etc.). At the production control layer, we find many disconnected systems across an enterprise; systems that were developed or acquired at different times or from different vendors, many of which have disparate control and communication schemas.

Today's operations coordinate these systems in many ways, often with manual steps between the business and production systems, and in places with complex custom "middleware" code developed for a specific purpose at substantial cost of initial development and flexibility over the long run.

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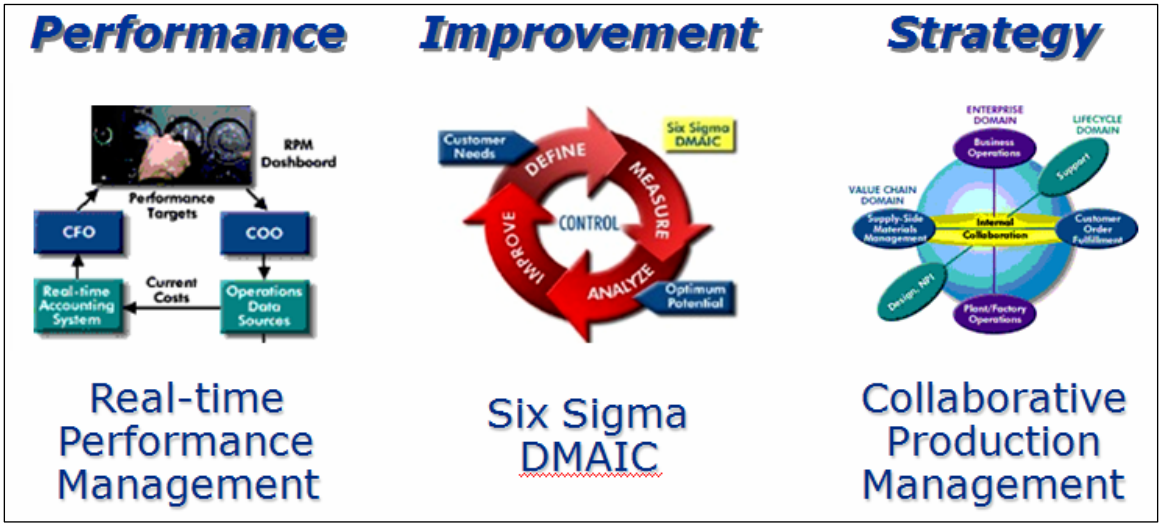
Strategies to improve operations have evolved over the years, and have come under various initiatives defined in different ways under various names and investment initiatives: Quality Improvement, Business Process Reengineering, Cost Reduction, TCO Reduction, Reliability Improvement, Downtime Reduction, Security/Safety Areas, Survival Amongst Competition, Six Sigma, Investment at the Business Layer in ERP Systems, Focus on Supply Chain, On E-Business, etc.

Three concepts continue to stand out as strategies for achieving operational excellence, around the areas of Performance, Improvement and Strategy:

- Performance: Real-time Performance Management (**RPM**), which provides a business context to production operations through visibility of "Key Performance Indicators" as they are happening, so that operations can be optimized around business needs, and operational issues can be corrected before they become financial ones.

- Improvement: Quality programs employing Six Sigma methods using the DMAIC model for continuous improvement. The DMAIC model is a structured process of **D**efining, **M**easuring, **A**nalyzing, **I**mproving and **C**ontrolling production to achieve a very low level of defects ... approaching the statistical six standard deviations (Sigmas) from the norm, which implies 3.2 defects per million opportunities, an admirable objective for many operations.

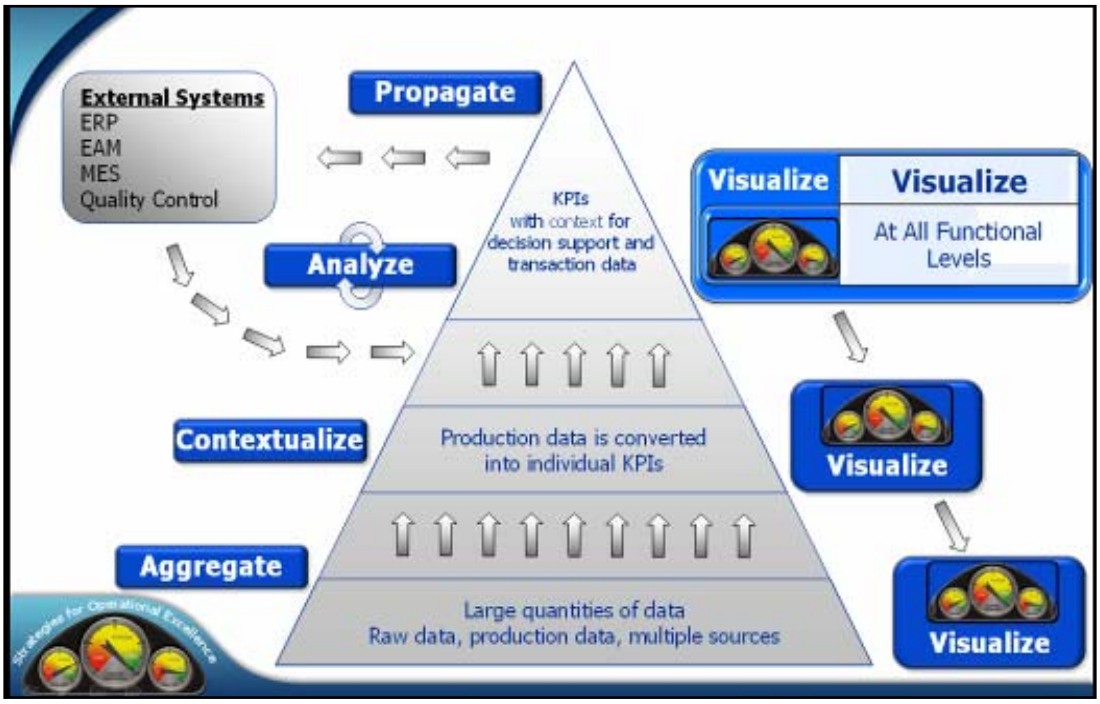
- Strategy: Collaborative Production Management (**CPM**) is an architecture that most efficiently connects multiple axes of a production operation as efficiently as possible through automation. Business operations are connected to plant operations, design, support, supply and customer systems in ways that minimize the effort and maximize the value between each area of the operation.



Source: ARC Advisory Group

The question remains how to best implement these concepts in each individual operation. What is the best way to coordinate existing assets in production equipment, control systems, supervisory systems and the enterprise level software used to manage business activities and finances?

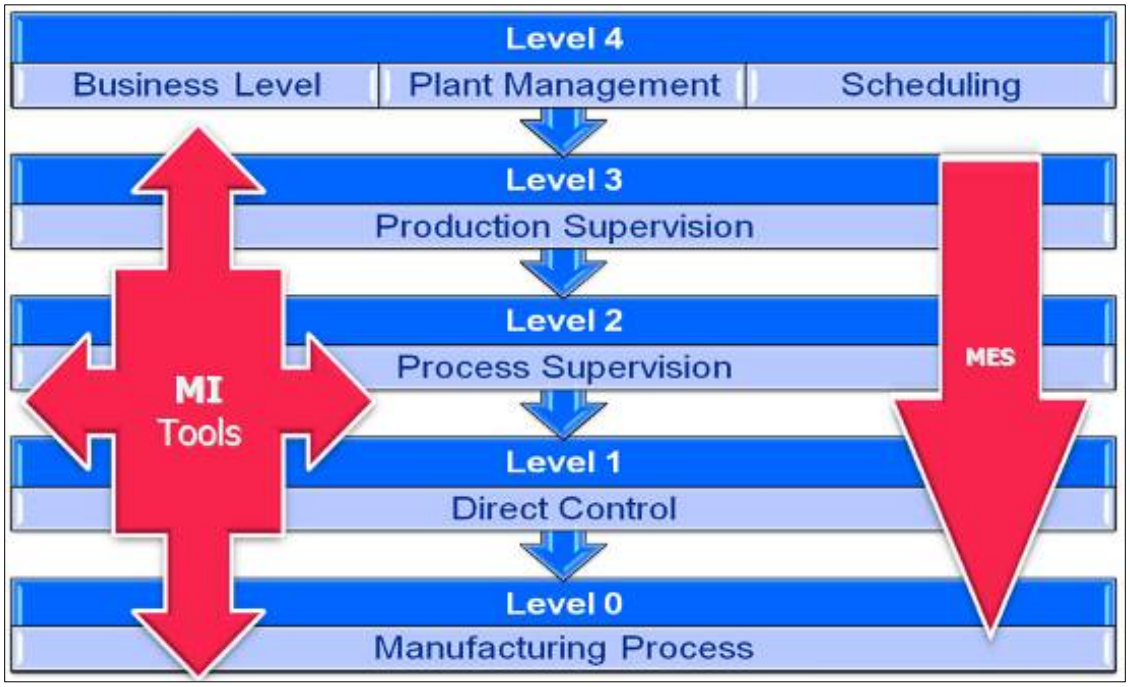
Production must be oriented around needs recognized at the business layer. A layer of applications often referred to as Manufacturing Execution Systems (MES) are deployed to push production needs to the operations, and eventually to the machine level. These applications are designed around the specific needs of each operation. In some industries where needs are similar, vendor-supplied software can be applied to push schedules and production requirements directly to the machine layer. In many cases, however, there remain manual processes along the way, because the systems are not readily integrated.



Visualization at all functional levels helps organizations see important, real-time data turn into key performance indicators (KPIs) to enable faster, results-based decisions.

Data must be aggregated from the operating systems and propagated to business systems in the correct context to coordinate with finance, customer and supply information. This data is often buffered through plant historians, and custom code is written to connect the information. New technologies allow direct connection of real-time information through open-standard protocols such as OPC and Web Services.

Manufacturing Execution Systems (MES) represent a structured, top-down approach designed for specific applications but have limited flexibility and adaptability for inevitable change brought on by market realities, business strategies and technical innovation. In comparison, Manufacturing Intelligence tools are less structured, and open for interoperability at all levels, communicating in all directions.



This Purdue Model of Corporate Operations shows how Manufacturing Intelligence (MI) tools can be applied broadly throughout the organization while traditional Manufacturing Execution Systems (MES) provide structured vertical industry application solutions.

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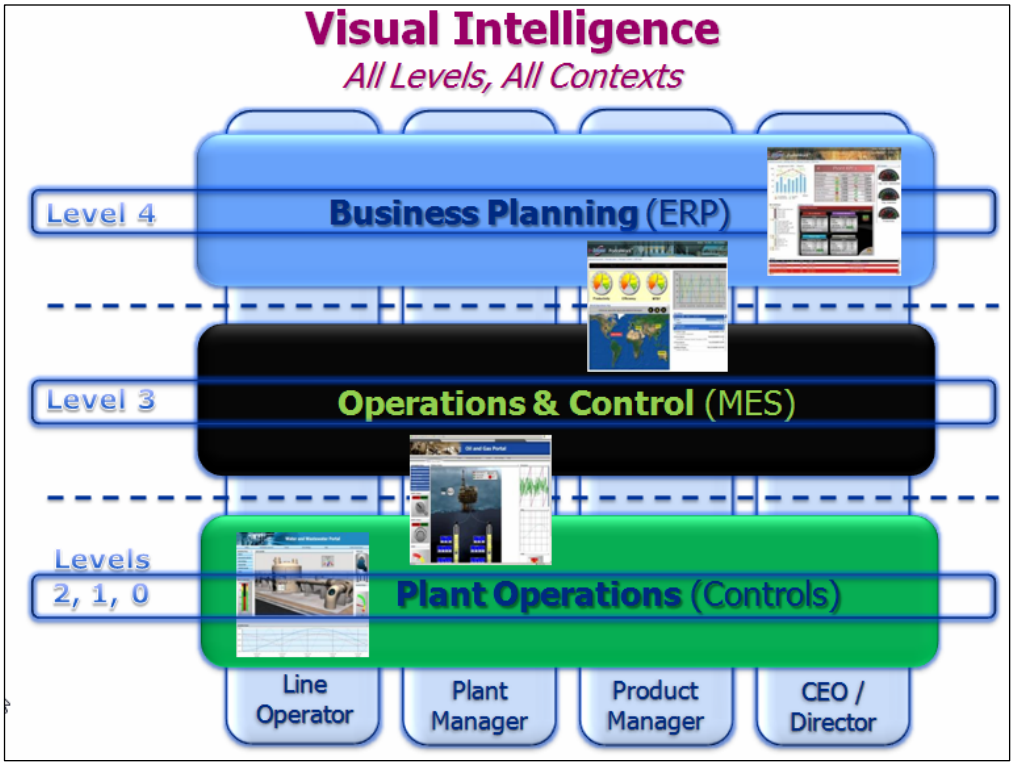
3 Maximum Return on Investment (MROI)

Integrating systems within and across each layer of the enterprise can be complex, but today there are real economical practicalities with the advent of open-standard communication protocols and fast, cost-effective distributed PC-based computing systems. These make it possible to create unified visualization and control systems in manufacturing, process control, building automation and public sector systems.

ICONICS recommends that those involved with operations make a conscious strategic decision to select open-standard hardware and software platforms, thereby empowering their organizations to choose best in class hardware and software components, those best suited and most economical for the job at the time of evaluation.

The greatest benefit occurs when necessary information is available to people at all levels at all times. An approach that takes full advantage of the Visual Intelligence model, whereby business level context is available in real-time at the operation level and real-time operations information is contextualized at the business level, is key to achieving operational excellence.



Visual Intelligence solutions cross all levels of corporate operations and provide benefit throughout the organization, from the line operator to the CEO.

Through focus in the following areas, customers can achieve Operational Excellence with minimum investment:

1) **Visual Intelligence around KPIs** contextualized in a financial framework with connections to real-time data and business systems. With custom graphics capabilities provided in a natively Web-based framework such as the GENESIS system from ICONICS, users can quickly understand and act on large distributed data sources, from wherever they may be. Analytics and Workflow tools can be added to shape data into actionable information.

2) **Interoperability** using open standard protocols compliant software and hardware. By adopting communication and database standards that leverage Web communication technologies, such as OPC and Web Services, companies can assure integration between systems with relatively ease.

3) **Security** harmonized between control systems, HMI and business systems. This is effectively accomplished with process and production control systems that synchronize with user based rights management systems at the IT level, typically managed by human resources departments. Examples include ICONICS security synchronization with Microsoft Windows and Active Directory security.

4) **Collaborative, Web-based User Interfaces** including portal technologies.

5) **Analytic tools and Workflow** to help people make smart decisions fast, and to mechanize processes between real-time machines, MES and IT applications.

6) **Intuitive Common Framework** adopting highly developed and intuitive software platforms that take full advantage of Web technologies. graphical user interfaces and provide tools that are familiar to knowledge workers. The Microsoft platform is extremely rich in all of these regards and, with the advent of Microsoft Office SharePoint Server 2007, an outstanding integration platform.

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4 Resource Optimization

One area of focus towards achieving Operational Excellence is resource optimization. Most plant personnel consider equipment as their critical production resource. As operations continue to improve, they must place emphasis on reducing downtime, increasing asset utilization, better deploying personnel and delivering ever-better quality, all in the context of dynamic business objectives.

However, many lack systems to accurately collect data from varied data sources and to analyze it in real time for most effective utilization of equipment and human capital. By deploying Visual Intelligence solutions with role-based Key Performance Indicators, employees at all levels may be empowered to quickly analyze a given situation, make an informed decision and then take the appropriate corrective measures to then reduce downtime, increase production, etc.

Connecting "islands" of data and hardware through Manufacturing Intelligence and Visualization leads to higher ROI and Overall Equipment Efficiency (OEE).

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5 Open Standards

Open standards are also worth considering as part of an Operational Excellence course of action. Many companies have already invested heavily in various software applications for plant and business operations. Similarly, huge investments are made in PLCs, controllers, field devices, instrumentation and more within the manufacturing industry.

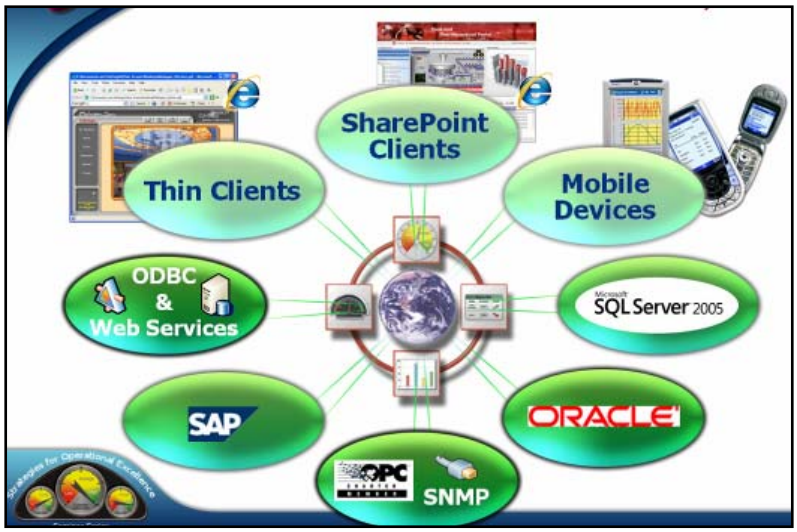
Many of the software applications are isolated and do not exchange information with other applications. In many instances, manual data entry is carried out for integration. One brand of PLC might not communicate with another, creating data gaps and barriers.

Solutions able to link various islands of information and brands of hardware, as well as automate the exchange of information among software, hardware and devices can certainly maximize the return on existing investment.

Such integration can result in full utilization of what is already at the facility without requiring hardware or software replacement. Today this is entirely possible with standards based on Web and network technologies such as OPC from the OPC Foundation, ODBC connections, SNMP Web Services and the new OPC-Unified Architecture (OPC-UA) standard, which employs Web Services to enable direct communication across all layers of the enterprise.

5.1 SNMP Devices

ICONICS provides a built-in connector to monitor various plant devices that support SNMP. The manufacturing industry is poised for Fast Ethernet adoption. Many PLCs presently support Ethernet, as equipment such as routers, UPSs, servers, printers and data acquisition modules have for years. By using the SNMP connector in ICONICS products, customers can monitor this wide array of equipment. Another benefit is immediate notification via SNMP to maintenance personnel for quick action, helping to provide resource optimization and maximum return on investment.

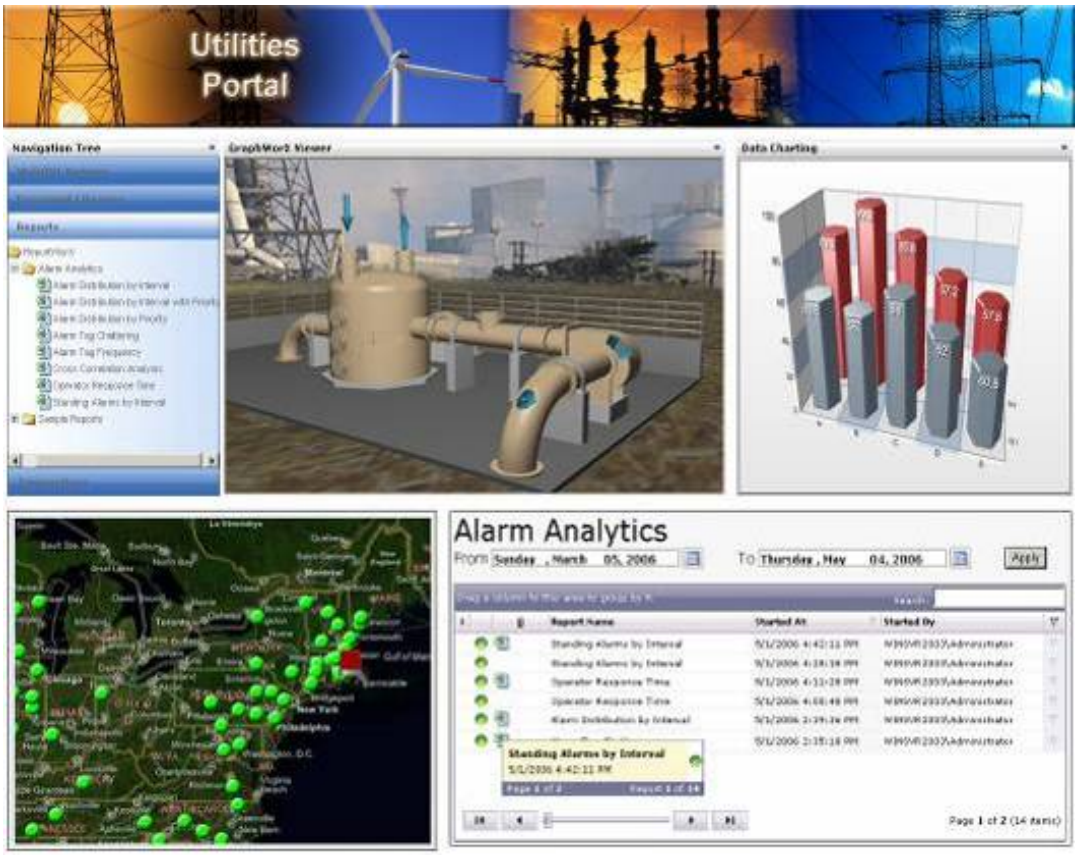


Open standard connectivity within ICONICS solutions allow visualization of data sources from anywhere, including most popular business applications.

6 Collaborative Personal Portals

ICONICS highly recommends portal technology to create corporate portals to show KPIs, OEE data, real-time plant information, alarm notifications, business information and other shared documents. Such portals can link to various third-party PLCs, controllers, devices and business applications, capturing data and turning it into useful information.

The user level at login is determined and role-based information is displayed for quick diagnostics and action. This approach provides an optimized way of creating flexible, user configurable, shared sources of information, using existing equipment and software components based on industrial standards.



Integration with SharePoint Portal Server strengthens real-time collaboration and visualization via dashboards, such as those in ICONICS PortalWorX.

7 ICONICS' Approach for Operational Excellence

ICONICS has been very active in supporting OPC Foundation activities and standards. The OPC Foundation has laid out various standards like OPC Data Access, OPC Historical Data Access, OPC Alarm & Event and OPC XML. The organization is now working on OPC Unified Architecture. (NOTE: For more information on these standards, visit www.opcfoundation.org or www.iconics.com.)

OPC architecture provides an excellent, secure and convenient way for applications to exchange data and information. OPC Data Access Servers provide universal connectivity to various hardware controllers, PLCs and DCS systems. Thus, by using OPC technology, you may read data from one brand of PLC and write to another with zero programming required.

ICONICS GENESIS32™ OPC Web-enabled HMI/SCADA suite components such as DataWorX32™ help to bridge various OPC Servers and provide OPC Data Redundancy over the firewall via TCP/IP and Soap XML. OPC Servers also provide great ROI by communicating with old PLC models and I/O controllers, reducing the need for additional hardware platform investment.

ICONICS covers industrial automation needs within Manufacturing Intelligence, HMI/SCADA and Universal Data Connectivity. A combination of solutions can help lead to better achieving Operational Excellence.

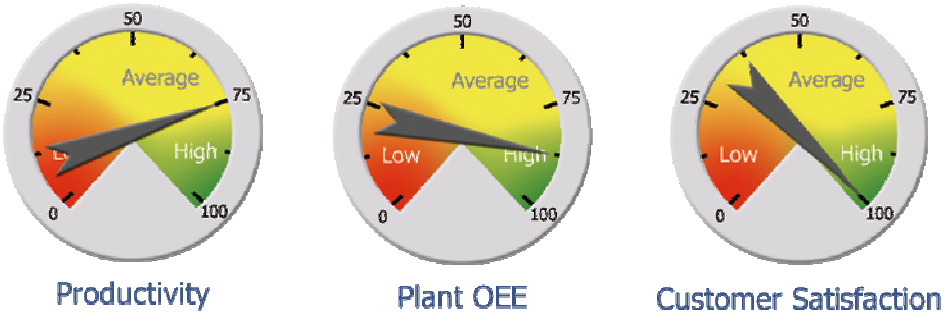
8 Conclusion

Manufacturers should consider utilizing Manufacturing Intelligence for real-time data collection and connectivity at the plant floor, establishing operational context and exposing manufacturing information to the rest of the enterprise through interoperability. With a very simple approach and adoption of open standards, users can achieve maximum integration and reap the great benefits of Operational Excellence.

This is essential to Lean Manufacturing, providing the tools to measure KPIs and OEE that drive operational efficiency. To meet these needs, ICONICS offers the BizViz™ Manufacturing Intelligence/Business Visualization solution. By leveraging a large HMI software installed base, ICONICS is a formidable player in this emerging market.

8.1 ICONICS and Operational Excellence

Founded in 1986, ICONICS is an industrial automation software company providing visualization of both real-time and historical data from the manufacturing floor to the enterprise. ICONICS focuses on two complementary offerings, the GENESIS32 HMI/SCADA Automation Visualization Suite for real-time manufacturing data and the BizViz Enterprise Manufacturing Intelligence/Business Visualization Suite for bridging the plant floor to the enterprise through reporting, wireless, mobile and data-mining portal technologies based on Microsoft .NET and Share Point Server. ICONICS BizViz falls into this emerging new category defined as Manufacturing Intelligence for achieving Operational Excellence.



ICONICS' Manufacturing Intelligence solutions help to achieve Operational Excellence with measurable performance increases throughout an organization.

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About ICONICS

ICONICS is a leading provider of award-winning enterprise manufacturing intelligence and automation software solutions.

ICONICS' solutions deliver real-time visibility into all enterprise operations and systems, helping companies to be more profitable, more agile, and more efficient. As a Microsoft Gold Certified Partner, ICONICS designs its solutions from the ground up to take maximum advantage of Microsoft .NET and SharePoint Portal Server technology, offering an unprecedented level of performance and ease of use.

Our award-winning GENESIS32 and new GENESIS64 automation software solutions can improve productivity, reduce integration and operating costs, and optimize your asset utilization, giving your organization a competitive edge. All ICONICS products are based on "open standards," using OPC-to-the-Core technology leveraging proven architecture and lower TCO of mainstream Microsoft platform, and connect to your existing infrastructure. We have more than 225,000 applications running worldwide serving top manufacturing companies.

ICONICS' BizViz suite of products provides real-time manufacturing intelligence from the production floor to the boardroom, turning real-time information into your competitive advantage.

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GENESIS32™ — *Connect, Analyze & Visualize*

BizViz™ — *Manufacturing Intelligence*

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