GE Fanuc's solutions for Automation and Intelligent Production Management

Giulio Capocaccia

GE Fanuc Automation Solutions S.A.

Zone Industrielle, L-6468 Echternach, Grand Duché de Luxembourg

giulio.capocaccia@gefanuc.com

From the plant floor to the ERP connection, GE Fanuc provides complete solutions for improving the control and the performance of industrial applications. This article presents GE Fanuc's vision of automation and Plant Intelligent Production Solutions. Two of the major product lines that support this strategy are presented: Proficy and PACSystems. Some examples of actual implementations are also described.

1 Introduction

Today's industry has become more and more demanding. More sophisticated processes coupled with an increased pressure from the regulation authorities have turned industrial automation into a real challenge for manufacturers and companies like GE Fanuc.

Back some years ago, the problem for a production manager was "how do I make my product?" In the recent years, the focus has moved to the quality, traceability and conformance to regulation transforming the question into "How safe or good is my product?"

Another important factor is the ever-increasing demand for speed, agility and responsiveness in production operations. More flexibility is required in order to make different products with the same piece of equipment. On the other hand, how to produce more without investing in new machines or new lines? In short, how to improve the efficiency of the production plant?

GE Fanuc's answer to this increasing demand from manufacturers for more flexibility and agility from their plant management systems is the Proficy suite of software and the PACSystems family of controllers.

2 From PLC's to PAC's

For many years, Programmable Logic Controllers (PLCs) have provided end-users with highly reliable services. They have however reached their limits. Engineers working with PLC's are looking for greater functionality and improved control with higher communication capabilities. While not issues in the past, these controllers are built on proprietary architectures, and are designed for programming and implementation in a specific application. Communication beyond the plant levels of the enterprise—the device, control and supervisory tiers often require a generational upgrade.

The answer is called PAC (Programmable Automation Controller). It offers significantly more flexibility, openness and performance. PACs allow users to make a leap in capability without re-engineering. Featuring a portable control engine that sits on top of the operating system, PACs also give users the ability to maximize the benefits of their application and optimize their industrial control platform.

2.1 PACSystems - Setting new standards for Programmable Controllers

The PACSystems concept is a real breakthrough by completely redefining the PLC

concept. The new PACSystems RX3i and the PACSystems RX7i both feature a single control engine and universal programming environment, which provides application portability across multiple hardware platforms to deliver a true convergence of control choices. The RX3i offers a high level of automation functionality in a compact, cost-effective package.

This same control engine provides high performance on several different platforms, allowing OEMs and end users to choose the exact control system hardware that best suits their needs. Through this innovation, the PACSystems family addresses major engineering and business issues - such as higher productivity and communications openness. This flexible technology can help users boost the overall performance of their automation systems, reduce engineering costs, and significantly decrease concerns regarding short- and long-term migration and platform longevity.

2.2 PACSystems features and capabilities

PACs are defined by the following features and capabilities:

- Multi-domain functionality—including logic, motion, HMI and process control—on a single platform;
- A common development platform for the design and integration of multi-domain automated systems;
- Allowing OEMs and end users to deploy multiple control applications on a single platform;
- Facilitating open, modular control architectures that enable highly distributed automated plant environments;
- Employing *de facto* standards for network interfaces, languages, etc., to allow data exchange as part of networked multi-vendor systems

From an applications standpoint, while traditional PLCs are strong in discrete control but can be weaker in other areas, users can develop and implement discrete, process and motion control applications from the PAC's single platform with equal agility and reliability.

3 Redefining the industrial software scope and capabilities - The Proficy suite

GE Fanuc's vision of Intelligent Production Management materialized into the Proficy suite of software. From the HMI/SCADA to the global Proficy web Portal, the suite features all the necessary modules that will contribute to the successful deployment of the Plant Intelligence concept. Modules are focused on specific production requirements and can be implemented individually or as part of an overall solution.

In the following sections, we will be looking at some of the issues faced by the industry such as data capture, efficiency calculation, traceability and see how they can be addressed using various Proficy modules such as Proficy Historian (Plant Data Repository), Proficy Plant Applications (the MES layer) and Proficy Portal (Web Real Time Information Portal).

Figure 1

3.1 A layered Approach for a Seamless Integration

Based on software standards, GE Fanuc's software is open and easy to interface with all the layers of the plant systems. Proficy allows for a layered approach when implementing a software solution.

Each of the layers in the figure below can easily be interfaced to the sub-layer with minimal changes.

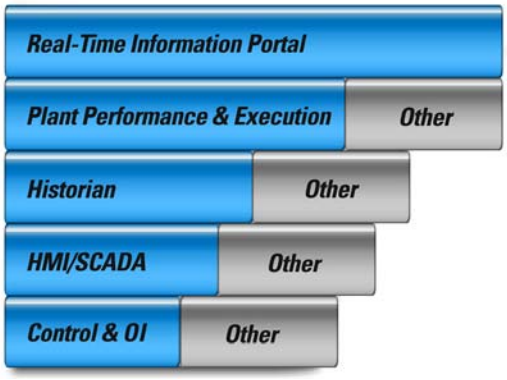


Figure 2: A layered approach

For example, the Proficy HMI/SCADA iFIX and CIMPLICITY sit on top of all popular controllers on the market. The Proficy Historian connects to all the HMI/SCADA packages. The result is a better protection of our customer's investments.

3.2 Following the standards

The utilisation of standardized and configurable components is the key to a successful implementation of a global solution.

At the plant level, the Proficy Batch Execution module follows the ISA S88 standards for batch allowing for a structured and modular approach to implementing this type of application. It uses the plant hierarchy model defined by the S88 and detailed in the ISA S95. This very same model is used in the Profiy Plant Applications modules. Data structures is entered once and made available to the different modules that need it.

4 Transforming data into valuable information

Can you figure out the huge amount of data generated by a production facility over a period of one year? Even if today's technology would provide the tools for capturing and storing these data, it would not help much. The challenge here is to turn this torrential flow of data into *information*.

Companies must be able to capture it from a broad number of sources, aggregate it in a common format, and make it available to software applications that can interpret it, giving it meaning and value. For example, while a packaging line with three bottle-filling lines generates data about the status of each line, it is not until that data is analysed over time that the extent of unscheduled stoppages can be determined on any particular machine, leading to better informed business decisions on preventative maintenance and capital spending on new plant equipment.

5 Better, faster data

Creating an "intelligent plant", requires more than capturing data and implementing applications to interpret it. The piece to this puzzle that many manufacturers have lacked until now is a single, central repository for the massive volumes of historical data emanating from operations systems throughout the plant. It is called "plant-wide" historian.

To enable all manufacturers to gain the benefits of plant intelligence, GE Fanuc has introduced Proficy Historian, a plant-wide data historian that can be cost-efficiently scaled to meet the needs of large, small and medium-sized plants. It can serve up this data to a wide variety of applications at the operational and business levels of the enterprise.

6 How to improve the efficiency of manufacturing processes?

Very few plant managers have an accurate measurement of the actual efficiency of their production line. If they can access the figures, they seldom have the right tools that would help to drastically increase the overall efficiency of their plant. The metric used to measure this efficiency is called OEE (Overall Equipment Effectiveness). The first application of OEE can be traced to the late 60s in Japan. This was first used in the semi-conductor industry.

Since then, manufacturers in other industries throughout the world have embraced OEE methodology to improve their asset utilisation. Implementing an adequate OEE system brings

immediate financial benefits to manufacturing operations.

6.1 Reducing Downtimes

Downtime Event Analysis is an important element in the overall OEE evaluation of a production environment. The Efficiency module of Proficy Plant Applications allows the user to track downtimes, event the shortest ones and most of all provides drill-down facilities that help find the root causes and thus correct the problems and reduce the downtimes.

6.2 An example in the food industry

At a food manufacturing facility, GE Fanuc's OEE system helped supervisors to detect that operators of a particular production line were deliberately and prematurely slowing down the bottleneck machine. This was done to keep the machine from automatically slowing when a fault was triggered by surge bins being filled whenever downstream machines were delayed.

If proper settings had been maintained, the bottleneck machine would have operated at rated speed until the surge bin buffer zones filled with stock - which the downstream machines would eventually consume, thereby catching up with the line-limiting machine as designed.

Tampering with the machine speed changed this process. With the OEE system, management was able to detect the tampered settings, view the production conditions and understand what was happening without human intervention

7 Traceability

From the 1st of January 2005, the 178/2002 EC Regulation applies in Europe for the food industry. It defines traceability as follows: “Traceability means the ability to trace and follow a food, feed, food-producing animal or substance intended to be, or expected to be incorporated into a food or feed, through all stages of production, processing and distribution.” [1]

7.1 What is required?

Tracing individual product lots through a single linear production line is relatively easy. The problem is more complicated when it comes to tracing raw material or intermediate products combined into several lots of finished products flowing through a complex flexible set of production lines.

Complete traceability can only be achieved if the relevant data is recorded all along the processes and stored in an intelligent manner. It must contain process parameters such as temperatures and weights but also alarm information and manual inputs from the operators. Other key information includes order number, recipe, equipment characteristics, etc … Traceability can later be used to determine the origin, processing and final destination of individual products.

A production process usually consists of a series of sequential production steps. All steps are identified and recorded within the execution of the production run. The ability to determine all the individual raw materials used in a particular product is called backwards tracking. If, on the other hand, it is necessary to determine in which products a specific raw material was used, this is called forwards tracking.

7.2 The Proficy solution

The genealogy tree within the GE Fanuc product Proficy Plant Applications allows both forms of tracking to be carried out very rapidly.

Proficy Plant Applications provides the genealogical method used to track a product and its raw materials. It could be compared to a family tree, in which the relationship between parents and children can be seen at a glance. In the same way, the genealogy tree shows the branches of all the products, resources and raw materials used in production.

Similarly, the relationships can also be seen between a product, its origin and its destination. The life of a product is also complemented by its special, characteristics, its quality and the processing parameters it was subject to. It is

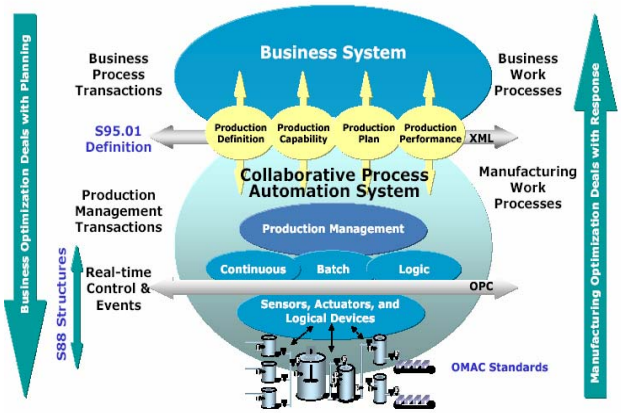
possible to obtain this information at any time, irrespective of where a particular product is located in the manufacturing process.

GE Fanuc is able to offer an integrated solution, which not only allows to comply with these directives, but also makes considerable improvements in overall production quality and helps to avoid waste. This means that the end customer can be provided with a flawless analysis certificate for each finished product supplied.

8 Connecting to the ERP

The implementation of expensive IT infrastructures and supply chain management systems has helped increase the productivity of the overall production process. However, the gap between the plant floor and the ERP systems is difficult to fill.

The lack of connectivity is one problems. An ISA standard [2] addresses the Enterprise – Control System Integration problem. Based on the work of the ISA, the WBF (World Batch Forum) has generated a set of standard XML schemas to be used to exchange information between ERP systems like SAP and industrial systems like Proficy.



Standards Enable Enterprise Asset Optimization

8.1 A successful integration of Proficy Plant Applications with SAP

A large dairy company invested in the use of standardised solutions and seamless integration from sensors to ERP systems. Focus lied upon genealogy, registration of energy use and efficiency. Proficy Plant Applications was the choice.

The company's demands were:

- Collection of Batch data for quality control, genealogy and process measurements.
- Short-term and long-term reports on production costs with possibility of analysis.
- Short-term and long-term reports on energy consumption with possibility of analysis.
- Better use of the production capacity with a more dynamic planning (better overview of stops in the different parts of the production facilities)

All information reports should easily be accessible to the people it concerns.

In order to avoid complications with other ERP systems, the S95-system from World Batch Forum with XML schemas were chosen as standard for information transfer to SAP.

The Proficy Plant Applications modules provided the MES (Manufacturing Execution System) part:

- Complete genealogy through all tanks and processes.
- Measurement of the consumption from the different tanks
- A family tree to show energy costs per produced unit

In order to properly record the cost for different products, it was important to be able to measure the energy consumption per batch. All types of costs related to each individual batch, the energy consumption in each unit for each batch had to be made available. A common energy model needed to be used for distribution of cost and the cost for waiting time needed to be distributed in a correct manner.

At the end, complete traceability of lots – equipment and processes was achieved with

real-time cost monitoring and control, and improved energy management.

The estimated ROI (Return On Investment) was less than ONE year for this customer.

9 Conclusion

Proficy itself provides the clear metrics that allow manufacturers to justify their choice and demonstrate incredibly fast returns on investments. With Proficy, GE Fanuc is putting the power of plant intelligence within the reach of all manufacturers, no matter what their size or industry.

With its manufacturing intelligence vision and outstanding offering, GE Fanuc can deliver the seamless, knowledge-based infrastructure that brings together business and manufacturing for improved performance across an entire enterprise

10 Literature

[1] Regulation (EC) No. 178/2002 of the European Parliament and Council, Article 3/15

[2] ISA-dS95.01-1999 Enterprise - Control System Integration - Part 1: Models and Terminology