

Process Control And Data Acquisition And Its Direct Impact On Plant Wide Operational Excellence

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ABSTRACT

Achieving, or striving for, Operational Excellence utilizing integrated process control and acquisition systems throughout the plant has become a reality. Extrusion manufacturers are faced with antiquated systems that are not conducive to providing real time information. There are many challenges for engineers, IT personnel and supervisors in connecting systems on the plant floor. HMI (Human Machine Interface) systems and their open architecture have matured and companies are employing them as enterprise plant wide systems. On behalf of Bulk Chemicals Inc. we would like to demonstrate our approach and how this can be accomplished.

The advent of sophisticated process controllers and PC-based data acquisition computer systems has offered the opportunity for what we at Bulk refer to as “Total Process Management Systems” (TPM). Integration of these systems across a plant-wide platform allows management to recognize that each and every process can provide a vital link to real-time data which is critical in the move toward Real-Time Performance Management (RPM). The possibilities are endless!

The information age has arrived and applying mature technology to ensure processes are controlled and, most importantly, Quality is maintained is the purpose of every HMI and process control system.

INTRODUCTION

Using a personal computer to provide Real-Time plant floor data has taken major steps in recent years. The advent of Supervisory Control and Data Acquisition (SCADA) systems has helped the primary objective of providing a graphical interface for individual plant systems. The ability to meld many systems across the manufacturing floor is a fairly recent offering geared toward Key Performance Indicators (KPI) in achieving Manufacturing Excellence. This presentation is twofold: firstly, to provide a concise methodology to establish the requirements and implementation of such a system; and secondly, to describe the details of its function. The off-the-shelf design approach of choosing components and integrating them into an HMI or SCADA package is the engineering design technique we wish to tout.

PROCESS CONTROL TECHNIQUES

Control systems in an extrusion manufacturing environment has gone from relay logic to sophisticated Programmable Logic Controllers (PLCs). It is this quantum leap in technology that has inspired engineers to provide connectivity solutions when designing manufacturing solutions and systems. Although it is the heart of any system, the rationale for process control will not be covered, but rather the techniques used to connect these systems to provide floor personal, supervisors and management with the information necessary to provide a path toward Manufacturing Excellence.

Providing a process control solution for any system, whether it is a parts washer, cooling tower, extrusion press, etc. is only the start. The ability to communicate with these process controllers is paramount in designing Manufacturing Intelligent solutions. Taking this design approach is the building

block to plant-wide information systems. Having the ability to “talk” to each node of a plant-wide system then becomes mandatory.

DEFINING MINIMUM REQUIREMENTS

While defining the requirements for a PC-based HMI system, one must first understand what most operators’ desire. During the conceptual design of our first data acquisition system installation, we conducted a poll. Almost all operators and supervisors expressed their desire to have a simple means of gathering process data, displaying it in an easy to read fashion, alarming the processes that are out of tolerance, logging the data for future reference, and ensuring what is actually happening. The latter is the most difficult to achieve.

In today’s environment, designing and employing connectivity requirements is important. Data availability is a building block for monitoring KPIs (Key Performance Indicators). Manufacturing Intelligence provides a common basis for using information from the plant floor to enterprise systems and business partners. This typically requires the coordination of manufacturing and process control sources and platforms. Designers also have to recognize that connectivity of each and every process is essential for an enterprise to achieve Operational Excellence.

WHAT DATA NEEDS TO BE COLLECTED AND HOW DO WE DO IT?

The data collected as part of a SCADA system for any manufacturing process is process dependent. For instance, our expertise started with the parts washer, because we are a chemical company. There is a strict Standard Operating Procedure the operator must abide by to ensure this process will yield satisfactory results. Logging, or collecting critical data is important to the end result. Titrations, temperatures, line speed, chemical concentration, liquid level, riser pressure, rinse purity, and many other process variables must be checked. Manual checking is mandatory, but providing an automated avenue for data collection should be explored. The ability to watchdog these process variables using sensors connected to Integrated I/O and ultimately connected to a P-C for analysis is fairly straightforward.

But, this is just one single system in a manufacturing cycle. Post parts washer systems, such as dry-off ovens, paint application, and paint curing are critical in the cycle also. So, it is important we also collect information which can be used to verify these processes are also compliant. As with the washer, sensors are used to monitor, log, alarm, and collect specific process data such as oven temperatures in different areas and pressures in the painting process. Connect this to the same P-C as we used to collect the washer system data and we now the beginnings of a multi-process SCADA system. The data flows into one database. The data can then be analyzed using standard SCADA tools. These include trending, alarming, reporting and melding the information collected to the parts flowing through the processes. The data collected can be stored almost indefinitely because of the advancements in P-C hardware.

In today’s manufacturing environment the use of PLCs to drive and control various manufacturing systems, such as extrusion presses, washer systems, cooling towers, waste treatment, etc make the data collection task much easier by connecting multiple systems across a manufacturing floor to one SCADA system. Achieving this connectivity is simple with PLC, but difficult with older equipment. The techniques for connecting multiple systems is discussed in detail further in this document. Our experience and delivered systems are customer driven. You, the customer, often have ideas how the manufacturing process can be improved using automation and data collection. Providing the connectivity to these systems is an integrators task.

CHALLENGES AND GOALS WHEN STRIVING FOR OPERATIONAL EXCELLENCE

Today, many organizations are faced with growing competitive pressures to improve their performance in the face of continuous change. This is true, especially in the technological environment. Over the years there have been many technologies deployed to improve production efficiency, quality, and manufacturing throughput. Included in these are machine automation systems, process control systems, and building

automation systems. Unfortunately, many of these systems are based on proprietary technologies which makes it very difficult to deploy a common connection. Software systems are used everywhere, from customer relations to resource planning, to supply chain management and finally to quality improvement. Yet, when we look at these systems we find they are mostly disconnected from one another. Primarily, this is due to communication protocols that make coordination difficult and sometimes impossible.

An ideal streamlined operation leaning toward operational excellence should have a unified visual intelligence system to reach any and all parts of the manufacturing process. This empowers people to make smart decisions faster and based on results not predictions.

Hardware Requirements

There are several hardware requirements to ensure that data collected is indeed accurate: a good reliable personal computer, process controllers from reputable manufacturers, PLCs with common connectivity, etc. Almost all of the equipment purchased in the last decade is PLC driven. All PLCs have communication ports, but not all conform to the same protocol. In these cases, hardware devices called protocol converters are used to achieve a common connection method. This in most cases is Ethernet and as most know is the data highway used by almost all company networks. Control systems connected to Ethernet via protocol converters are then visible across a network. After visibility is achieved, data acquisition is the next step.

We typically recommend that those involved with equipment procurement make a conscious strategic decision to select open-standard hardware and software platforms. This makes connectivity from a hardware standpoint much easier.

Software Requirements

Similar to hardware, there are a multitude of software packages available. When integrating multiple hardware systems across a common communication system choosing the right software platforms is paramount. There are SCADA products on the market that permit communication to many different hardware systems. This is provided by a software driver called OPC, or commonly known as Open Process Control. There are industry standards and a foundation to ensure hardware and software compliance. These OPC servers run concurrently on a P-C and allow data to be collected from multiple different hardware platforms. The beauty of OPC is it has become an industry standard and almost all hardware manufacturers have OPC servers which serve up data to SCADA software packages. The data is then stored in a database for historical recording. The databases utilized can be Microsoft Access to SQL Server to Oracle to Excel! All SCADA software companies now comply with OPC standards which make it much easier to archive and use the data collected effectively.

Software SCADA products are now very standardized. In choosing a package there are some requirements you should keep in mind. Almost all HMI and SCADA software packages feature a suite of independent applications or modules for graphics, trending and data logging, alarm management, I/O scanning, control logic, and more. The following are several features we perceive to be necessary and that represent a good choice for any application and are worthwhile requirements for any HMI system.

OPC Connectivity. Choose a software system that supports OPC. This standard will ensure a designer of endless OPC servers to connect plant-wide equipment. This is probably the single most important feature of any enterprise SCADA software system designer to consider.

Modularity. Choose a modular system, constructed of fully independent client and server applications. The client is the device using the data and the server the device making the data accessible.

VBA Compatible Scripting. There are times when the chosen software package does not contain standard functionality or formulas for a required operation or task. A simple example is calculating alkalinity by inputting A and B titrations. Visual Basic Scripting makes it easy. Many HMI software packages come with Visual Basic scripting capabilities. Based on the world's most popular macro language, Microsoft

Visual Basic for Applications, the script language is both powerful and easy to learn. Some applications have more than 600 commands available to perform almost any function imaginable. Use scripts to perform calculations, read and write files, and much more. For non-programmers, there are applications with script wizards that make programming easy.

Alarming. Choose a package that supports a variety of ways to present alarm data and information. Most systems provide real-time alarm analysis to empower the operators to analyze system performance and make informed decisions based on alarm data. Software alarm systems allow detailed analysis such as alarm frequency, alarm acknowledgement analysis, remote alarm annunciation via cell phones, and many other features to analyze alarms.

Graphics. One of single most important decisions in choosing SCADA system software is its ability to display a meaningful graphical interface. The ability to drop Active-x containers, standard AutoCAD symbology, real-time video and audio, JPEGs are to be considered. The graphical interface is the starting point and most visual of any system.

Trending. Historical data collection is meaningless unless you have a good way of presenting the collected data. Trending, whether real-time or historical, obviously has its place in process control and tuning the manufacturing process.

Reporting. Generating reports based on a historical database ties many of these systems together. The ability to automate the reporting process by generating reports and automatically disseminating the information using e-mail is common and practical. The ability to generate reports takes the collected data and puts it in a format personnel and managers can use as an analysis tool. Most reporting programs use report formats such as Excel or Crystal Reports. A template can be generated, reports are run automatically, and distribution is seamless

RATIONALE FOR IMPLEMENTATION AND MAXIMIZING YOUR RETURN ON INVESTMENT

One area of focus toward achieving Operational Excellence is resource optimization. As operations continue to improve, they must place an emphasis on reducing downtime, increasing asset utilization, better deploying personnel and ultimately delivering ever-better quality. While considering any capital purchase, one must contemplate several points. What is the payback and how soon does it occur? What are the immediate benefits to installing such a system?

Sharing data across an enterprise solution creates the opportunity to disseminate information to people at all levels. The payback is informed decisions based on quality objectives through enterprise information systems. There are countless instances of problems being solved before they manifest themselves. The immediate benefit of any system is its ability to *watchdog* the process. Of course there is operator intervention. But if applied correctly, it could potentially free up operators to perform other tasks related to their job.

TOTAL PROCESS MANAGEMENT

The term *total process management* (TPM) applies to the plant-wide implementation of the HMI system. We have taken the TPM approach to include not only the extrusion washer processes, but other elements of the industrial process affected by pretreatment chemicals and their application. Bake ovens, dry-off ovens, manual data entry, wastewater treatment, boilers and cooling towers are just a few. The ability to effectively manage interconnected processes is the goal, thus providing instantaneous data at the user's fingertips. A system flexible enough that allows expansion in any direction should be considered.

SUMMARY AND CONCLUSIONS

Plant-wide operational excellence in many ways is far fetched. But, when planning equipment systems capital expenditures it is important to know the engineering requirements for connectivity to ultimately

combine systems across enterprise networks. We have applied this strategy as a value added service to our customer base. It merits noting that systems are not intended to take anyone's place, but rather it should be used as a tool whose purpose is to improve the quality of the process by providing the data to do so. Using and interpreting the data becomes paramount. Diligence and training will pay dividends.

Exposing manufacturing information through connectivity and software systems is essential in performing lean manufacturing. We believe manufacturers also recognize that connectivity of each and every process is essential for meeting these goals. Fact-based analysis drives consensus and improvement, which is difficult without the real-time connectivity of systems at the plant floor.