

The Value of Process Automation

Some of us can remember a time when measurements were few, even in the petrochemical/refining sector. Automatic controls were used for certain functions, but setpoints were adjusted manually and each operator had a favorite setting to keep everything “under control” during his shift (women operators, if any existed, were precious few).

Historically, process control relied on experience and instinct as much as on engineering analysis to maintain stable, consistent operations. Control rooms had walls diagramming the process and appropriately interspersed with strip-chart recorders, gages and dials. Process data recording was done in pencil (much of it unreadable) and periodically bundled and warehoused. The process industries were, nevertheless, the most productive in the U.S. in terms of output per man-hour.

Process stability and product consistency were highly prized and plant management incremented process throughput until instabilities and/or inconsistencies surfaced — then reverse increment and seize the opportunity to wring profitable production from the process.

Fast-forward to the 21st century. Process control rooms appear to be designed by NASA. Measurements permeate every aspect of the process. Measurements per operator now far exceed the ability of a human to absorb, let alone comprehend, the volume of process data that is available. How did we get from there to here, at what cost, and is it worth it?

Let's tackle these questions one at a time.

Instruments have been getting better (more reliable, accurate, responsive etc.) since the beginning (starting with James Watt's flyball governor for regulating the early steam engines). Mechanical gave way to pneumatic and electronic by the 1950s. The major breakthrough for process control, however, was the application of stored-program digital computers with live, real-time input starting in the late 1950s and accelerating through the 1960s.

In the mid 1970s, large-scale integration (LSI) microprocessors became available that enabled the distributed control system (DCS) to be developed. The DCS allowed thousands of measurements in large process plants to be incorporated into the coordinated control of the facility. Complex control strategies that a decade earlier would have been impossible to implement economically became packaged for routine usage. Early process control computers were I/O- and memory-limited, which restricted their scope and complexity; DCS technology dramatically loosened those boundaries. The vast increase in available memory opened the door to packaged process control software that previously was a principal obstacle to the

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expanded usage of computerized process automation.

That, sounds good, but what's the cost? In 2006, total expenditures on process automation in the U.S. were approximately \$25 billion. U.S. process control revenues of the 50 leading suppliers were about \$8.5 billion. Extrapolating this figure to encompass all suppliers makes the total about \$12.5 billion.

Doubling this total brings in dedicated process-automation services provided by end-users and engineering contractors. End-user maintenance and support services for high-maintenance items like process analyzers would require a higher multiple but across the broad range of process instruments and controls a factor of two should be adequate.

The resulting total, \$25 billion, represents about one-third of a percent of our \$7 trillion economy.

This is an engineer's view of the subject, uncorrupted by discounted cash flows, capital vs. operating expense categorization, and other economic subterfuge designed to hide the obvious. The \$25 billion total includes expenditures on new equipment (measuring instruments, control actuators, controllers and control systems), software, supplies and services to implement the new systems, as well as upgrade and maintain the existing infrastructure.

But, is it worth it? This is the easiest question. In 2006, nondurables manufacturing was a \$1.1 trillion activity (\$1,097.5 billion according to the Federal Reserve Board). The chemical and petroleum sectors accounted for 43% of the nondurables total, or \$472 billion. The chemical and petroleum sectors also account for about half of the process automation expenditures (\$12.5 billion).

Modern processes could not operate without a significant investment in process automation for maintaining safe operating parameters, adhering to environmental constraints, ensuring product quality, attaining maximum efficiency in the use of energy and raw materials, to name the most obvious. The actual cost, using the chemical and petroleum sectors as a model, is 2.6% of the value of the product. A dollar invested in process automation yields \$4 and more in plant output.

This being the case, why not pump funds into process automation and realize the \$4+ in benefits per \$1 invested? In many instances, process understanding is the bottleneck, and further investment will yield little until chemical engineers elucidate the controlling parameters, their interactions and performance measures. With deeper insights and modeling techniques, process automation specialists can then work their magic in driving the process to ever-higher levels of economic performance.



Photo courtesy of Emerson Process Management.