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Make the Most of automation UPGRADES

Avoid common mistakes that undermine projects

Many plants rely on outdated process control systems — ranging from panel-based pneumatic controllers to Distributed Control Systems (DCS) installed in the 1980s — and now need to consider updating them. However, new technology for its own sake can't justify capital spending — instead, it's important for you to find compelling economic reasons for modernization.

Using obsolescence for justification isn't easy. While maintenance costs probably are rising and spare parts may be getting scarce and expensive, true maintenance savings normally aren't large enough to justify the capital investment. Obsolescence is a viable approach only if you can show an increasing risk of control equipment failure shutting down a critical process. Establishing the risk factor becomes the challenge. It's difficult to convince management that a system is about to fail when it has no history of failures.

Predicting failure is a tough task. Mean Time Between Failure (MTBF) data for older, especially obsolete, equipment are hard to obtain. Plus, MTBF data normally are component-based, not system-based — making it hard to use these data to estimate control system life because a control system consists of multiple components.

Fortunately, modernization can provide considerable financial benefits and thus significant incentives for a project. Whether these benefits will suffice to justify an upgrade, of course, depends on the company's capital-spending payback policy. Some firms demand a one-year-or-less payback, others allow two-to-three-year paybacks, while a few factor in reduced risk of system failure in determining an acceptable period.

Past financial failures

Unfortunately, many control-system modernization proj-

ects haven't provided the economic benefits that were initially expected. While engineering is happy to have the newest technology to implement and operations personnel view the process as easier to run, management may see the new system as a financial failure.

Several factors can contribute to an automation upgrade project not bringing the expected economic value:

- *The process control system was chosen based on technology instead of how well the system allows operations to improve the manufacturing process.*

When DCSs first became available, the process control engineering department chose or at least strongly drove the choice of system. Selection was centered on the ability of the control system to meet certain technical standards and the initial sales price. Operations wasn't involved much if at all in specification and selection, and real analysis of operational improvements wasn't done.

Leaving operations out of the selection process usually led to a system that wasn't friendly to the operator. Related process information was scattered on numerous graphic pages, causing the operator to have to toggle among several graphics. While this may be tolerable during normal operation, it can become time consuming and frustrating when abnormal situations arise and the operator needs to manipulate the process and closely monitor measurement readings.

Modifying the system may be difficult and may need the assistance of a system engineer. So, operations management may resist changes in graphics suggested by the operator. Also, it's very likely that any complex control strategy will be abandoned if it's not easy to use and troubleshoot without the presence of a system engineer and the process run in a manual mode.

- *Process problems weren't fixed because the control system was expected to overcome them.*

Modern control systems, along with properly installed instruments and valves, can allow major improvements in operations. However, faults in process design or equipment may negate the advantages of automation. Performance after the implementation of a new system may be disappointing if a thorough review isn't done to identify the existence of process or mechanical issues — e.g., related to agitation, heat exchange, undersized units and shared equipment. A control scheme sometimes can overcome a process-related issue but generally the robustness of the control strategy will be low and circumstances will occur that will cause poor operating performance.

Be leery of promises made by sales people in competitive situations. The system vendor may oversell the features of the control system when a bid specification focuses on them and low cost.

- *The existing process control system was replaced in-kind.*

There are many excuses for why systems get replaced in-kind. Two stand out. First is the desire by management to keep the cost of the replacement as low as possible. This typically means system obsolescence was used to justify the replacement, which, as mentioned earlier, usually is a dubious approach. Driving down the cost of the new system becomes the primary goal of management. No process or operations reviews are conducted to assess areas of poor performance and to design in new control strategies or instrumentation to improve operations.

The second reason is operations management's desire to not alter the "look and feel" of the system so the operators aren't confused. This really is unfair to most operators. Sure, there'll always be the operator who doesn't want change. He's the one who goes through the local gauges and the single loop controllers and marks the normal operating point with a grease pencil. Such an operator tends to run the plant by rote rather than by really understanding the operation and the actual impact of his actions. However, most operators desire a better method to run their plants and already have experience with computer technology throughout their private lives.

Establishing the business goals

So, how is modernization of the automation system properly planned and implemented to achieve financial benefits?

First, it's important to correctly define "process automation modernization." It isn't replacing one control system with another. Instead think of it in a broad sense. Process automation's scope must include instrumentation, automated block valves, and final control elements such as control valves and adjustable speed drives. You also must consider integration of information between the process area and the plant's business. Finally, take advantage of the additional instrument-specific data available with HART and Foundation Fieldbus devices through digital communication, along with maintenance-based asset-management software, to improve operations — for instance, advances in centrifugal pump monitoring use Foundation Fieldbus as an infrastructure to communicate information on unit health to the maintenance shop.

Second, the design must consider the company's business direction. Questions to address early include: Does the business need additional production capacity, or does capacity suffice but manufacturing costs need reducing? How important is it to distinguish products from those of competitors? What's the competitive situation? Is the company the market leader? Is business volume in jeopardy of being lost? Is this facility the only maker of certain products within the corporation or do several sites make the same products? What is the marketing department opinion about a product's future? Are sales rising or declining? What values do the customers appreciate and what can be done to increase sales?

The automation design must focus on providing financial benefits in the process area. This infers an audit of the process unit must be done to identify areas for financial

improvement. It's important to define the problem before designing a solution.

A key preliminary

To properly establish a modernization plan, it's crucial to conduct a conceptual engineering study. While each study should be done on a custom basis, most consist at least in part of the following major activities:

- establishing the current process baseline;
- setting business and process operation goals;
- identifying potential financial benefits and appraising the financial impact;
- creating a process automation plan to achieve the benefits and goals;
- estimating an order-of-magnitude cost to implement the plan; and
- determining the feasibility to continue the engineering effort.

This study is the first real engineering effort for a modernization project. It begins after the initial internal discussions that identify that something needs to done and a basic viability check that an upgrade can actually improve operations. The output of the study should feed the decision process on whether to spend additional engineering funds for front-end engineering design.

The study begins with a high-level review session with, at a minimum, representatives from plant management, operations management, and process or manufacturing engineering. People from maintenance, quality control and operations planning also may be useful. A meaningful review, of course, requires the involvement of knowledgeable personnel.

Establish the Key Performance Indicators (KPI) for the process unit. These are the essential metrics that indicate how the unit is doing versus budget or goal. Some typical KPIs include production volumes, quality measurements, and variable manufacturing costs per unit produced.

Obtain historical values of these KPIs to establish a performance baseline. Are the historical trends of these indicators steady or showing improvement? Or do the historical data indicate variability or a consistently deteriorating performance? You must then set a desired or target value for each KPI that is achievable through modernization of the automation system.

Estimate or develop a means to calculate the financial benefit of moving from the current value to the target value. Benefits generally fall into two categories:

1. *Increased plant or unit production capacity.* This is a benefit if the extra product actually can be sold.
2. *Reduced cost of goods sold.* Higher raw material yields and lower energy costs are the type of benefits that fall into this category.

Some benefits are difficult to associate with a monetary value. These can include certain quality issues, increased plant safety, reduced emissions and integrating process information into the plant business system. Nevertheless, it's important to press to get some value associated with any benefits that are identified. As a matter of fact, these benefits may be the most valuable. So, for instance, it's a good idea to meet with the marketing and sales organization to get their input on the importance of meeting product specifications and delivery schedules.

Typically, not enough detailed information is available during the review session to develop a good estimate of the financial benefits. Therefore, the next step is an extensive review of the process unit. You should assess the operating procedures, equipment, process measurements, control strategies and historical performance records.

Identify the measurements that have the greatest effect (both positive and negative) on the KPIs. These generally are readings taken for closed loop control, but also may include lab-analysis-based ones for open loop control.

In some cases, especially for older facilities, a measurement may only be available through local instrumentation. Establish the status of the measurement device for performance. Note any instrumentation-specific problems that may limit controllability.

Determine any constraints and major disturbance variables that affect the crucial performance measurements and key control variables, and then evaluate their specific impacts.

Also identify manual operations that are part of the normal operating procedure. Note those that are capable of being automated and the benefit that automation would bring.

Enough information now should be available to attack the difficult task of developing the financial benefit esti-

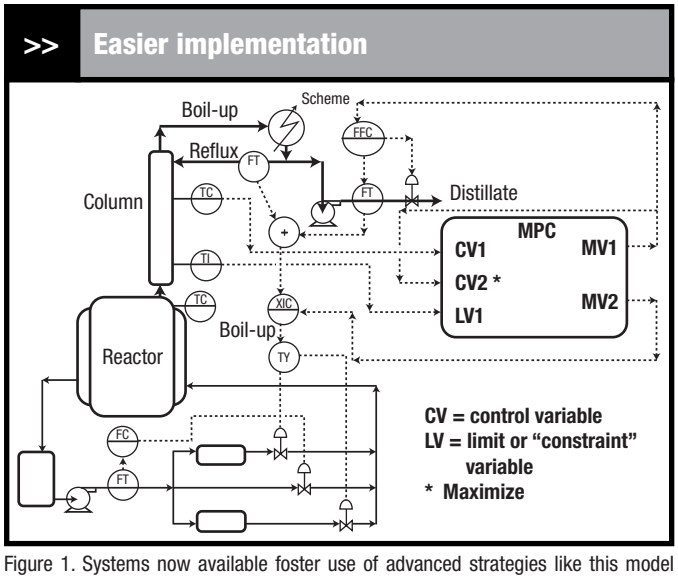

Figure 1. Systems now available foster use of advanced strategies like this model predictive control scheme.

mates. The financial benefits will come from raising the performance of KPIs. So, evaluate which ones the updating can improve. Establish the current baseline performance using recorded historical data. The more difficult exercise is estimating performance with automation. The prospective improvement hopefully will justify to management the value of investing capital in the modernization.

The right approach

Only after you've established where the plant may obtain potential benefits from updating should you begin developing the modernization plan. Again, it's important to take a very broad view of automation. Make sure to include new or more accurate instrumentation where it affects process performance. New control valves and automated sequences may add consistency and reduce process variability. Use new or more-complex control strategies when necessary — today's automation systems have made implementation of advanced control easier (Figure 1). And don't forget the ability to easily integrate and communicate process and equipment health information to other areas of the plant to assist the overall operation of the facility. **CP**

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