The Top-Down Approach to Successful Process Control Projects
By David Christie

The typical control modernization project is conducted via the ‘bottom-up’ approach. That is, hardware requirements are specified in great detail, and the overall system benefits are expected to somehow become obvious when the project has been completed. However, to gain maximum economic return from the process control equipment, a ‘top-down’ approach should be used.

Instead of preparing a hardware specification for a system, a performance specification should first be provided, based on improved operating objectives for the plant. This approach insures that the installed control system will result in tangible economic benefits, instead of just being the latest technology.

Bottom-up approach: the wrong way
A hypothetical bottom-up approach might start with an aging chemical plant, which has been limping along with 20-year old instruments and panel board controllers in the control room. Recently, its product market has improved and the oft-delayed project to renovate the control room finally passes muster at the corporate level.

The project begins. An equipment selection team is formed; a slate of potential vendors is chosen and system evaluations begin. Vendor’s plants are visited. Installed systems sites are visited. Countless color slide presentations. Chalk talks, laser shows and videotapes are endured, because the team believes it needs to know the latest about each candidate system so the most modern control hardware specification can be produced.

With the initial chase over, the specification writing begins. The team is careful to completely specify every detail of the system. A major milestone is realized when the team finally issues hardware specifications, which by now incorporate the most stringent design details for each facet of the system.

When the vendors’ proposals arrive, the team is faced with an enormous evaluation job. A spreadsheet is produced. Weighting factors for importance are negotiated, and each vendor’s proposed system is subjected to a scaling process. Although very straightforward, in reality this becomes a very frustrating exercise, commonly leading to the conclusion that the system will be chosen primarily on price.

For mere replacement of panel board instruments and controllers, a purchase decision based on the lowest priced response to a generic hardware specification can work. Most systems available today can handle panel board instrument replacement, and equipment configurations are available which are optimized for lowest price per loop.

A visit to the plant a year later reveals the system shipped and was installed; operators have been trained; loops have been tuned. The operators point out that the process visibility is better; a discernible operations improvement is noted because the old broken down hardware has been retired. The team’s expectations have been fulfilled.

The plant manager has arrived in the control room, escorting the division vice president from the corporate headquarters. The team spokesperson proudly shows off the specified 256 colored graphics display, the beautiful 600x800 pixel CRT dutifully updating variables at its specified twice per second rate, the alarm summaries with their three-color priority system, and the process variable trends which scroll vertically next to the window wing faceplate display. Everything is as specified.

The vice president nods at this display of electronic wizardry, then asks; “What is the system doing for our quality and productivity?” and “What has been the return on our investment?” entusiastically, the team spokesperson responds: “We should have installed one of these years ago. The operators say the plant runs better. Why, in process visibility alone, the system has paid for itself.”
The vice president nods, thanks the team spokesperson for the demonstration, and leaves for the plant manager’s office. There, he proceeds to hold forth for an hour on why another sizeable investment in the plant has failed to make the company significantly more competitive. It seems that success, like beauty, is in the eye of the beholder. In a corporation, some beholders are more important than others.

**Top-down approach: the right way**

Across town the company’s competition has also just completed a control room renovation. They used an entirely different approach.

The fundamental difference between the top-down and bottom-up approach is in the expectations for the results of the project. In the bottom-up example previously cited, the results did meet the team’s expectations; the new system did an excellent job of replacing the old instruments. The vice president, however, had different expectations—improved quality and productivity.

The top-down approach views the system as a tool to help the plant meet improved performance objectives rather than as an end in itself. Now, the mission of the team is to meet these economic objectives; installing a new digital system is only a means to that end. Specification of the control system becomes more a matter of identifying operational expectations, instead of system internal design.

Even before the system is specified the team must find answers to related questions.

- *Is the plant capable of meeting the improved performance objectives?* The team first must validate the performance objectives. Often, this may involve a feasibility study of the plant’s physical equipment.
- *Will existing instrumentation be adequate at the new operating conditions?* If improved product quality is an objective, on-line analytical equipment may be needed where a laboratory measurement was previously adequate. A thorough instrumentation review must be made with the new economic objectives in mind.
- *How will performance against the new economic objectives be measured and enforced?* This issue requires in-depth thinking about the role of each person in the manufacturing operation, especially his or her influence on the day to day economic performance of the plant.
- *How should real-time data be reconciled with the existing management information systems and PC networks?* Should there be a link to the MIS (management information system) department, with the daily production/quality/efficiency report sent to it? Should PC users be permitted as nodes on the control system network, or should there be an intervening ‘server’ with password control for data security?

These questions are fully answered before the purchase specification is prepared. The team realizes the importance of resolving these issues, which by their very nature involve nearly all areas of the plant organization. Often it is necessary to seek additional expertise in advanced control and optimization methods, or to provide knowledge in analytical instrumentation, project management or systems integration.

Some typical purchase specification requirements that come from the top-down approach might include:

- A three-level password access shall be employed, with the first level for plant operators, second level for shift supervisors and maintenance personnel, and third level for process control engineers.
- Capacity shall be available for compiling and running a 350-line FORTRAN material balance program. Run frequency shall be every ten minutes.
- The system shall provide capability for configuration of adaptive gain PID controllers, with tuning constants periodically recalculated on line from live process measurements.
- Files of operating data shall be made available to one network node for access by plant PCs. Update frequency shall be every six seconds, with up to 200 instrument tags in each file.
• Connectivity to the plant MIS computer shall be by Ethernet; hourly files of up to 100 parameters each shall be transmitted to that company.
• Trend displays shall have the capability of displaying results of calculated variables, such as economic indicators.

To be sure, the system specification must list the I/O requirements, number of desired operator interfaces, and other parameters that will allow the plant to meet its improved economic objectives. This is often the area in which different systems do begin to differ enough that a best choice is possible. In the top-down approach, control system selection choice is based upon how the system should perform in its intended role.

**Reviewing the results**

Let’s now turn the clock ahead on the installation of the team that used the top-down approach. As before, controls are controlling, trends are trending, logs are logging and the vice president’s visit is underway. When the inevitable questions are asked regarding quality, productivity and return on investment, the team spokesperson calls up the appropriate display and demonstrates: “This trend shows we’re producing at 32,350 pounds per hour, which is an eight percent increase over a year ago. The plant is currently operating against a cooling tower constraint, which eases overnight. The optimizer says that during the night we should gain another 1,500 pounds per hour. Based on year-to-date figures, this system pays for itself every 63 days.”

The top-down approach is a lot more work, and considering it involves more than the purchase of a minimum performance system at the lowest bid, it may require a larger investment. However, when the objectives are met, the plant becomes much more competitive than its counterpart across town or across the ocean.

**Control project organization**

How do you organize for a top-down approach to process control projects?

1. *Begin by defining the economic objectives.* These must be large enough to be measurably significant, yet within the operating limits of the plant. Be realistic, but do not be afraid to set sights high.
2. *Keep ownership of the project local.* Team selection is critical; meaningful operating objectives require plant wide ‘ownership’. Even if temporarily employing a corporate specialist, the project’s direction should be set largely by the plant. A successful project should not deteriorate when the corporate specialist goes on to the next project.
3. *Do not hesitate to employ assistance when needed.* Consultation can provide not only specialized technical expertise, but also fresh insight to old problems. Seek expertise from system vendors; most full-service firms should be able to provide help.
4. *Specify “what” instead of “how”.* Firmly resist the day to day temptation to specify how the system will achieve its results. A successful specification should tell the vendor what final results are wanted. Be specific concerning what the system us to achieve; this will be difficult if the performance improvements were properly defined up front in the project.
5. *Do not ignore project staffing, as well as staffing for continued operation.* Major process control projects of this nature are not done in people’s spare time. They require dedicated effort even after the system is commissioned and initial results are achieved. In contrast, a bottom-up project can be walked away from after installation because that much to the well-being of the plant.
6. *Never lose sight of the objective of economic performance.* Today’s latest hardware will be out of date tomorrow. Performance improvements always remain in style. A properly executed top-down project will continue year after year, even after the glitz is gone and the new hardware matures.

Top-down projects are significantly different than bottom-up projects. They require more involvement, more thought, more up front work and often more money. Mainly they require a different frame of mind—but then so does competing in a global marketplace.