# Revamping automation systems

**To achieve a safe and profitable upgrade, the many factors affecting revamp project scope must be taken into account. The authors focus on the automation components that maximise performance of process equipment**

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In recent years, refiners have worked to respond to trends in the industry that call for cleaner fuels, a more efficient use of energy, greater reliability, and growing incremental production capacity. In North America and Western Europe, a relatively large installed base of equipment already exists, but most of the units were conceived, designed and built long before today's stricter product quality, emissions and product demand needs were known. In an effort to comply with these stricter operational standards and environmental regulations, refiners are looking for ways to modify their equipment with minimal disruption to operations.

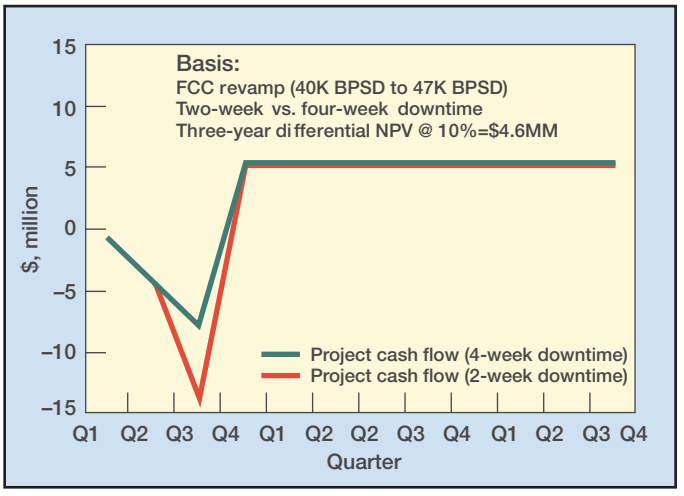


***Figure 1*** *Impact of downtime*

While this task is challenging, refiners are not shying away from revamp projects. They are driven by the benefits resulting from revamps, including accelerated production, higher yield and quality, increased operational flexibility, and improved reliability and safety.

Accelerated production is usually the primary reason for adding or modifying a process unit. A debottlenecking study will determine the scope of the revamp, including equipment, advanced process control (APC) software and systems, instrumentation upgrades and automation system upgrades. Improved production yield and quality can often be accomplished through equipment change-out or upgrades, or the addition of APC and process control optimisation to existing units.

Operational flexibility can be increased through a better use of equipment, piping and tankage, and through process automation. The key to success in this area is having the right process information available in the right context at the right time. These real-time tools help workers make critical business decisions to maximise production. New technology offers numerous benefits to refiners, including:

— Unprecedented access to process data
— Historical tracking of key data
— The ability to review process data leading up to incidents
— Trending capabilities
— Highly effective alarm management capabilities
— Graphical displays that present information to operators in concise, actionable form.

With access to relevant information in proper context, operators can act quickly, effectively and safely to ensure that plant availability and production are optimised. The broad range of process optimisation and production management software extends the operation of the plant to its limits safely and ensures the equipment and systems will operate for longer periods of time between maintenance and repair.

Safety is a predominant concern throughout the industry. Protecting people and the environment is a critical mission. In project execution, a single incident can completely negate the project ROI. But these costs are insignificant compared to the long-term liabilities incurred if someone gets hurt on the job site. Liabilities include increased workman's compensation costs, increased insurance costs and, for suppliers, reduced or terminated services.

## No revamp is alike

The automation component of revamps can be especially challenging for a number of reasons. In some cases, the process automation systems that operate the plant may be obsolete. In other cases, existing systems may not offer access to critical data in real-time. This significantly reduces workers' abilities to make informed decisions to optimise operations. Newer automation systems should focus on closing this "control room-to-boardroom" loop, effectively integrating actual plant performance with the business-planning and decision-making process, for a more efficient and flexible operation overall. Based on the outcome of the migration activities, the economic justification is clearly evident.

Finding ways to determine the real versus design limit of existing equipment and then pushing to that limit can deliver substantial improvement. Process automation systems have the potential to safely push the plant to or above its rated design limits, optimising maintenance and allowing repair or change-out before a major failure occurs. The value of the increased production and decreased maintenance costs will quickly pay for the system upgrade.

## Hot or not?

With refining and related facilities generally running at their operational limits, there are few, if any, opportunities to withdraw the plant from operations for anything other than very short periods of time. Furthermore, extended downtime can significantly impact the project economics and plant profitability (Figure 1). Often, the project's viability

hinges on short downtime and an efficient, flawless restart. Automation revamp projects that require plant shutdown, or "cold" cutover, need a tight turnaround schedule. They may limit the scope of revamp activities and increase the risk of an incident if not flawlessly planned and executed. Ideally, changes to a plant automation system are performed without disrupting operations. This situation is called a "hot" cutover.

This means moving one loop at a time from the existing system to the new system while the unit operates, eliminating production losses. In some cases, a hot cutover is actually required. For example, in process control system upgrades, systems and field device changes often must be made while the plant is operational.

But how can a hot cutover be performed safely? Honeywell has identified several keys to success that mitigate the risks inherent to a hot cutover: minimising unplanned incidents and negative impacts on the production unit, and delivering the benefits of the revamp with minimal production losses. By adhering to the following guidelines, the project team can safely perform a hot cutover.

## Safety

Additional safety concerns always exist during hot cutovers. Therefore, defining and implementing safe procedures and work practices becomes one of the most important parts of managing the project. A formal hot cutover safety meeting must be scheduled very early in the project, well in advance of any device cutovers. The project team and all personnel involved in the project should be properly trained and formally acknowledge their understanding of the training lessons. The sign-off procedures are intended to instill the notion that no-one will work on a device without first receiving proper training on personal protective equipment (PPE). Naturally, if personnel roles or responsibilities change during the project, retraining is essential for new team members.

To sustain safe work practices and a healthy environment, it is a good idea to schedule a daily safety meeting throughout the cutover period. The meeting should cover topics such as: safety training; chemical exposure hazards; job safety analysis; MSDS; HAZCOM; hot cutover procedures; PPE requirements; lock out/tag out; and fall protection/heat stress.

Defining safe work practices, training all project personnel on those practices, and implementing efforts aimed at sustaining the practices throughout the life of the project are critical to the success of a hot cutover.

## Planning

Planning is not just a first step to beginning a revamp project; it is an ongoing activity. It is necessary to continually adjust project timelines and activities as event requirements change, especially during hot cutovers. In the front-end engineering phase of a revamp project, which begins with the field survey, the team must determine if the device may be safely cutover hot.

During the detailed design phase, the project team should begin to address any critical equipment failures that may impact progress with determination of a hot standby/spare requirement. It is also in this phase that the team should begin to categorise loops by type, such as emergency shutdown and control with or without steam tracing. These steps will help support the team as they finalise the broader hot cutover plan, bearing in mind that a single plan applying to all situations is not practical. Finally, prior to the completion of the detailed design phase, the team should perform extensive testing and validation of the hot cutover plan using a duplication of the system configuration prior to cutover.

With the start of the construction phase, qualified inspectors should be brought on prior to the receipt of any equipment for installation. The distribution of craft labour by geographical area must be considered in relation to the overall cutover sequence to ensure those early turnover items are completed on schedule. Using the installed control system, always perform a 100% loop check, with sign-off along the way to identify and resolve any design problems.

Prior to commissioning or hot cutover, unit operations should determine the sequential cutover list to facilitate their operator interface. The cutover team should then review the schedule one week ahead to determine any unforeseen problems. Upon review and approval, the list can be divided into daily work lists. The team's operations representative will share the list in the morning meeting and brief the unit operations supervisor on the activities required by the project. This allows the plant operations group to accommodate any time required to resolve issues. The typical workday during a cutover project is ten hours.

## Training

In any revamp, there may be significant changes to the way plant operators manage and operate the facility. Poorly trained operations and maintenance personnel can significantly impact overall ROI. During a hot cutover, operators will have to manage two systems, which makes proper training for the event critical.

Facilities that revamp their automation systems must decide how to train their employees in the safe and proper use of new systems while at the same time minimising training-related costs and disruptions to daily operations. In those plants where operations certification is required, the training also must be extended to include recertification when appropriate.

The growing scarcity of qualified personnel competent in process control poses additional challenges. A lack of internal resources capable of delivering high-quality training means that the supplier must be able to provide a tailored training program that meets safety and project requirements and considers site-specific strategy and work environment constraints. Conducting onsite courses can minimise employee travel expense and time away from the job. Operator training simulators may be an invaluable asset in the preparation of plant personnel to optimally operate the plant. E-learning via the Internet also provides comprehensive training. Both save time and money and allow a larger number of employees to participate than would have been possible with site-specific training.

The revamp project must address all critical issues in implementation and provide operations and maintenance personnel with the requisite training to optimally operate the plant and respond appropriately to process upsets and other incidents.

In Honeywell's experience, all successful hot cutover projects have an operations training plan with the appropriate budget allocation established very early in the front-end engineering phase. This plan is integrated as a subtask of the overall schedule to be tracked and discussed as part of the monthly project meetings. If not performed in this manner, it is always noted as one of the biggest customer regrets captured during the project's "look back and lessons learned" meeting. Some specific regrets around training pertain to a "should have taken a train-the-trainer" approach (one per shift). For whatever reason, delays in hot cutover have created a gap in the just-in-time training plan, allowing skills to become stale. Investing in additional stations via rental or procurement will keep skills fresh. These stations can then be used to support loop check or hot cutover activities. Another regret pertains to a realisation that time should have been appropriated to include more

personnel from each shift in the training. Procuring an operator training simulator staged adjacent to the control room would provide the flexibility to allow operators to invest more time in their training.

Finally, one solution that always proves very beneficial to the project's success is the procurement of a smaller version of the actual distributed control system (DCS.) This serves many purposes, including a training system for operations, development system for engineering and hot standby system for maintenance.

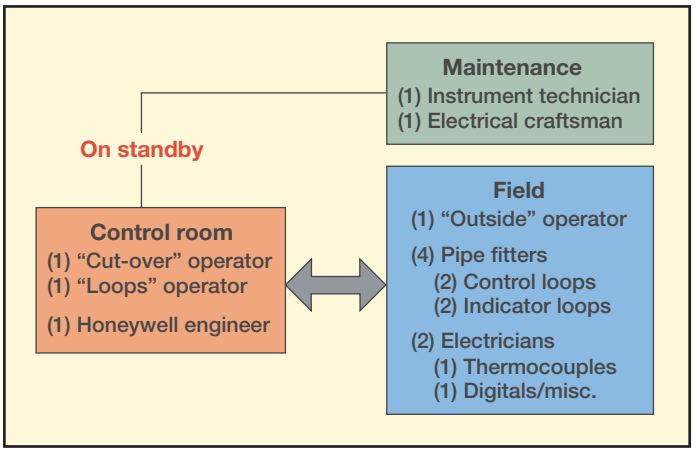


***Figure 2*** *Organisation of cutover team*

## Communication

Communication in a hot cutover project takes many forms: written, visual and verbal.

Written communication generally consists of drawings and documents. These must be recorded on the project's site document index and have an order of priority. For example, from highest to lowest order of priority: updated P&IDs; new loop/wiring diagrams; loop check forms with signatures; device specification sheets; old loop/wiring diagrams.

Visual communication consists of techniques to indicate a particular group. For instance, red stickers or dots placed on a folder containing loop data can indicate that the loop is part of an emergency shutdown system. Other colours could be used to indicate loops by their category, such as control with or without steam tracing. The posting of the daily cutover list in the control room allows everyone to easily identify which devices are planned for cutover on any given day.

Visual communication may also be used to indicate a particular status. Again, red stickers or dots placed on a control room panel device can indicate that a loop has been cutover to the DCS. Maintaining a master set of P&IDs highlighted in the control room can be used to indicate which devices are now controlled from the new DCS interface. Also, a loop acceptance log sheet located in the control room and kept up-to-date will advise operations of the daily progress.

Verbal communication is used to reinforce previous training and give clear and immediate instructions during the hot cutover. For example, no action should take place until advised by the unit operations supervisor in the control room to proceed with a loop. A "roles and responsibilities" matrix must also be created to determine who has control at every point during the hot cutover. Radio channels should be predetermined for both loop-check and cutover teams, including one spare for each.

## Organisation and teamwork

The cutover team is a combination of personnel from the plant, from the automation supplier and from the construction contractor for the project. To facilitate an effective cutover process, it is essential that these personnel be dedicated for the duration of the project. Of course, all personnel must be competent in their roles and capable of understanding all aspects of the cutover process. Also, team members should be trained and highly skilled in their area of responsibility during the cutover process. Experience indicates that the following resources are required from the plant (Figure 2):

— One "cutover" operator in the control room to interface between "outside" operator and "loops" operator

— One loops operator to control loops that have been turned back to operations. [Note: an additional operator may be required here to perform loop tuning]

— One outside operator to co-ordinate field devices (bypass valves, and so on) with cutover operator in control room

— One instrument technician and one electrical craftsman assigned on standby to assist the cutover effort if required.

The following resources are required from Honeywell and the construction contractor:

— One system engineer in the control room to manage and control the cutover process. [Note: this engineer can effectively manage two teams in the field reducing wait time]

— Four construction contractor pipe fitters in the field. Two for control loops and two for indicating loops

— Two construction contractor electricians in the field. One for thermocouples loops and one for digitals and miscellaneous loops.

What other factors are important to a successful revamp?

## Project engineering support

It is also important to determine how much support and assistance is required from the automation supplier. Many operating companies are focusing intensely on their core competencies, while reducing costs in other areas. That can mean fewer internal engineering resources. With engineering support critical to the success of a revamp project, the automation supplier must have a comprehensive organisation in place to provide engineering standards, tools and methods to efficiently deliver project engineering support. In today's open DCS environment, an experienced and knowledgeable supplier is invaluable when it comes to system network design, I/O layouts, graphics and interface design. Also, much of the more mundane work, such as database configuration and graphics implementation, can be handled externally in order to keep internal resources focused on project-critical tasks.

It is important to be certain that the automation supplier can provide these services in an efficient and cost-effective manner. This type of automation contractor ensures a single source of responsibility and accountability for all aspects of the project deliverables. The elimination of additional contractor interfaces allows the automation supplier to engage across multiple customer discipline areas and work processes. He or she can help identify duplication of work, enforce consistency and reduce rework. This may also lead to the generation of fewer deliverables, which directly affects the project cost. The equipment ordering process is a good example of this. Equipment orders now become an internal communication versus a formal purchase requisition.

Project database optimisation is another benefit of having a single automation contractor. Since data entry occurs in one place, multiple work practices and processes may use one source for data. The single-point-of-entry concept ensures the validity of the data regardless of its use and reduces the change management burden significantly.

With a single automation contractor approach, the integration of the overall project schedule becomes much tighter. There are fewer groups involved in the

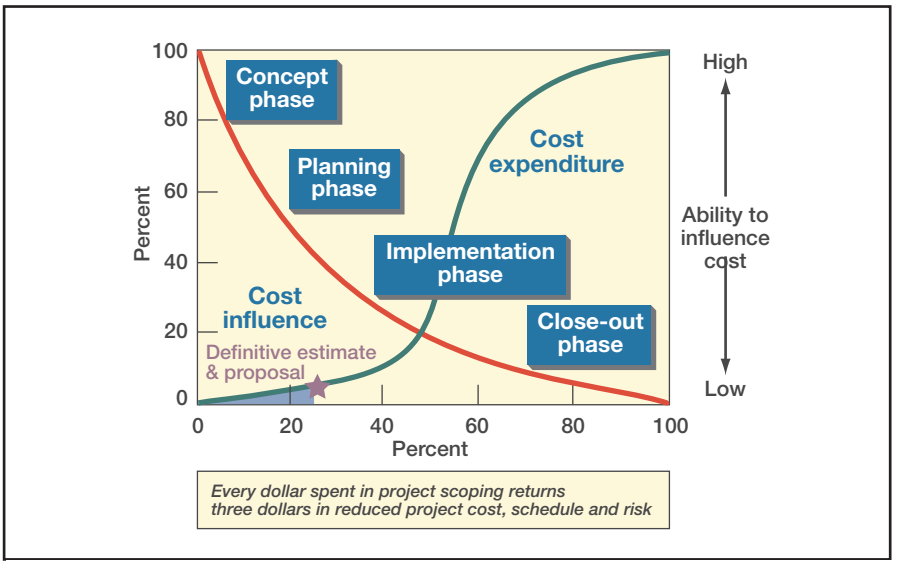


***Figure 3*** *Project cost influence curve*

process, leading to fewer disconnects between them, and the elimination of formal document distribution to multiple parties delivers further cost reduction. The revamp customer now has one point of contact to review and manage the status of all project deliverables, improving communication and co-ordination.

## Legacy applications

Automation revamp projects must also consider the question of legacy process automation applications. What should be done with these legacy applications, which, in some cases, were developed over many years to add operational yield, increase flexibility and produce custom reports? As a part of the revamp project, they should be carefully assessed. Will they continue to be functional in the revamped process? Does it make sense to rewrite or migrate the legacy applications to the new system?

Refiners have found that some solution providers tend to take a "replace in-kind" approach even though newer process automation systems feature inherent capability and flexibility. In some cases, the legacy applications will simply not execute in the new environment and must be rewritten or replaced with more up-to-date versions. For example, the open nature of the Honeywell DCS (Experion PKS) allows refiners to develop application toolkits using the latest .NET technologies in a development environment.

## Project management

Ultimately, superior project management is the most crucial contributor to the success of an automation revamp project (Figure 3). Without it, all other aspects of the project are at risk. In study after study, it has been proven that ensuring that process automation projects achieve their technical objectives while meeting cost and schedule milestones requires strict adherence to the principles and practices of professional project management. The complexity of industrial automation projects, greenfield, brownfield or revamp, is increasing at an unprecedented rate. Contributing to the complexity are open systems-based architectures and platforms, the integration of systems from multiple suppliers, the increasing use of advanced applications, evolving requirements for plant- and enterprise-wide solutions, diverse choices of products and services, and high software content in the delivered solution.

## Benefits

Refiners have too much at stake not to revamp their automation systems. They stand to gain a wealth of benefits in their operations as long as they follow a few carefully established guidelines. Refiners should expect their automation provider to have a defined plan or road map for control system upgrades. With guaranteed product support, multiyear service agreements and an overall plant modernisation strategy, this approach can be a win-win proposition for both the supplier and refiner.

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