

How to lose money with advanced controls

Companies have applied rules to ensure reduced profits

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Advanced control is a well established technology in the oil and petrochemical industries, and it is tempting to believe that a large portion of its users have captured the greatest share of the available benefits. However, despite massive investments in hardware, few companies have fully exploited the opportunities made available by this investment. In the Western world probably about 85% of the total investment justified on existing plants has already been committed. The benefits captured, however, are probably less than 50% of those readily available. Assuming this investment was justified on a three year payback, the incremental cost to finish the job should pay back in about six months. So why isn't everyone doing it? The following gives guidance on how to maintain, or even worsen, the status quo. Known as the "Whitehouse Rules," violation of most of them could cause a significant improvement in process profitability.

1. Choose the wrong operating objective. Advanced control will then help you achieve it better. This is by far the best way of losing money, hence, its pole position in the list of rules. Not only will installation of the control system and advanced control applications incur significant cost, but they will help the plant operate even further from optimum.

This can arise from a number of situations. One of the most common is choosing the wrong target variable in constraint control applications. For example, a fired heater is not necessarily firing at maximum when the design duty (in energy units) has been reached. Provided maximum skin temperatures are not being exceeded, the fuel control valve is still in its controlling range, minimum excess air ratio is not being violated, etc., it may be acceptable to continue to exceed the design. Commissioning a poorly conceived strategy under these conditions would reduce the duty and the profit.

Other examples can arise from a misunderstanding of the process economics. Obsession with energy minimization strategies may lose money on balance due to their negative effect on yields. Minimizing the heavy key component in distillation overheads is not the same as maximizing light key in the bottoms.

The use of linear programs (LPs) for planning purposes can often take some of the blame. Constraints within LPs

are a simplification of what exists in reality. LPs cannot be expected to model limits such as hydraulics, firing, cooling, etc. In practice the constraints in LPs are more global and will usually have a "comfort margin." Obeying them religiously in a control strategy will cause many opportunities to be missed.

2. Justify the investment in reinstrumentation solely as 'the cost of staying in business.' There may be perfectly valid reasons for an instrumentation upgrade simply to keep the plant operational. The existing instrumentation may be obsolete and unreliable, jeopardizing the security of the plant and incurring excessive maintenance costs. An expansion project may require more than the available panel space. There may be a safety requirement to relocate the control room to a safe area or simply to consolidate it with another plant to increase manpower flexibility.

If these are the only justifications considered then there will be a tendency to minimize the project cost rather than maximize profitability. For example, the cheapest, rather than the most beneficial, control system will be selected (see rule 7). No allowance will be made in a new process design for the additional instrumentation required by advanced control (see rule 10). Secondly there will be a tendency to delay the investment to improve cash flow or to concentrate on apparently more pressing priorities. This will result in a so-called "fast track" project (see rule 12).

3. Claim global rather than application specific benefits. For example, a 1% energy saving across the whole site is well within credibility limits and you may not get asked to explain in detail how this will be achieved. It is also well within measurement limits and you will never be able to prove it has been achieved. Such an approach will engender an attitude of "why bother?," reducing commitment to both the installed applications and future projects.

4. Understate the benefits. Valuable opportunities can be missed if only short term "tactical" benefits are considered. Longer term "strategic" benefits are difficult to quantify in advance but there are many examples of unpredicted benefits proving larger than the tactical benefits. An expensive, analyzer-based, quality control strategy may not be very attractive if only yield improvements or energy savings are quantified. But improved quality control of certain products will help increase the market share. Fully using plant capacity during unpredicted high market demands could justify the investment in a few days of operation.

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5. Overstate the benefits. This is likely to smooth the path for approval of the first project, but a significant overestimate will result in this being the wrong decision. If the claimed benefits are not achieved then it will certainly undermine the credibility of the technology when it is time to approve the next project.

6. Ignore the site computerization strategy—better still don't have one.

The process operator could end up with multiple interfaces to the plant operation: one for the basic controls, another for advanced controls and yet more for information applications such as process performance monitoring, laboratory information, etc. Providing a number of the interfaces within the same screen is no better if they each have a different "look and feel." Most consoles will contain several screens, so the effort should have been spent getting the interfaces comparable.

Without an overall strategy the "islands of automation" problem will almost certainly arise. Each application will be beneficial in its own right but there will not be the synergistic benefits of being able to readily merge data from different applications. There will be multiple entry of the "same" process data, some for the advanced controls. The process control system will get bogged down with reporting functions, leaving no capacity for advanced controls.

7. Choose the cheapest control system. Lowest cost is not necessarily the same as maximum profit. It is easy to seek competitive bids for a system which provides the basic regulatory controls. The bidder basically needs only the I/O list and the console configuration. However, some systems are considerably more powerful and flexible than others. Asking the lowest bidder to revise the quote to take into account the longer term needs could result in a large price increase, whereas there may be little increase in the bid of the highest bidder.

A poorly chosen system will successfully inhibit implementation and support of advanced controls. Application commissioning will be delayed and service factors will be lower. It may not be practical to build in all the desirable checks into control strategies, undermining their reputation if they perform incorrectly because of an undetected problem. The operator interface may be clumsy, resulting in less willing operator use. Application maintenance can be more difficult because of reduced diagnostic capabilities.

8. Pick the latest technology. There are some excellent, and expensive, technologies available for both process measurements and control software. They may appear to be justifiable in terms of the overall benefits. However, the 80/20 rule may apply—80% of the benefits for 20% of the cost. Inferential quality controls may capture most of the benefits at a fraction of the cost of onstream analyzers. Basic constraint control strategies may similarly make on-line optimization uneconomic. Simpler, more established technologies may in the long

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run be more beneficial. What they lose in lack of sophistication, they make up for in increased service factor and ease of support.

9. Go to one company for the control system, instrument engineering and advanced controls. Increasingly control system vendors and engineering contractors are offering advanced control technology. There are also a number of links between vendors and contractors. Choosing one company which has the best to offer in all three areas is unlikely—resulting in a compromise in at least one.

10. Ignore advanced control and information systems when designing a new plant. During post-commissioning the control engineer is likely to be faced with a number of "control" problems which should have been more properly resolved by small process design changes, but which are now impractical to implement. Many opportunities to improve profitability, through advanced control or performance monitoring, will no longer be viable because of the now unavoidable cost of retrofitting the instrumentation. At best there will be a delay in exploiting the opportunities.

11. Flood the new process with additional instrumentation. In addition to increasing the project and long-term maintenance costs, this will help confuse the operator and generally give the control engineer a bad name. A systematic approach, agreed prior to the P&I review, will ensure that only instrumentation important to plant operation is considered.

12. Progress the project as 'fast track.' If this means that not enough time is allowed for proper scope definition, selection of suppliers, documentation, etc., then the project is likely to overrun on cost and, through schedule slippage, also delay capture of the benefits. This is particularly true of reinstrumentation projects where "as is" documentation is almost certainly "as was."

13. Forget about the basic regulatory controls and instrumentation. Advanced controls need the basic controls to be effective. Without them service factors will suffer and process operators will feel that the control engineers are on a "technology trip" ignoring the needs of the operation. Advanced controls will need to compensate for the limitations of the basic controls, making them more costly to engineer and support. It may be that a large portion of the benefits could be captured with lower level control applications, at a significantly lower cost—possibly even eliminating the justification for the more costly advanced controls. Worse, it may be that a higher level application worsens the performance of a lower level one. Operators won't thank you if your latest feed maximization strategy puts the product off-grade.

Examples can be as trivial as properly tuning a level controller on a feed surge drum (to minimize flow disturbances rather than to keep the level close to setpoint) or

simple measurement conditioning (to compensate for pressure, temperature or physical properties). It seems unnecessary to point out that the field instrumentation has to be fully functional, but there are countless examples of advanced controls based on instrumentation which doesn't work or is outside its operating range.

14. Design 'black boxes.' This approach makes the advanced controls difficult for operators to understand and will present support problems when the designer moves on and another engineer takes on the maintenance role. A more modular approach avoids the "all or nothing" problem. Parts of the overall strategy can be commissioned earlier, thus helping with the cash flow. Operators see a phased commissioning and, therefore, are more comfortable with the end product and will use it more fully. The overall strategy can degrade "gracefully" if a module cannot be used for some reason, capturing at least some of the available benefits. Modules can be cloned for use elsewhere on site.

15. Allow each control engineer freedom to design his own control strategies. This approach will result in as many different approaches as there are engineers. A similar result can be achieved if different advanced control suppliers are used for different processes. The advanced controls may work well but the support costs will be greater. Control engineers following others into plant areas will have to first understand the approach taken before they can usefully contribute to support. Operators moving from plant to plant will have a similar problem. Standards agreed to prior to design of the more generally applicable technology will avoid this. They will also encapsulate the best each engineer has to offer.

16. Never allow feed rate to be manipulated by an advanced control strategy. The setpoint of the feed flow controller is often treated as a value which can only be adjusted manually and then only reluctantly. Of course feed rate changes can be a significant source of process disturbances, but in any case these should be dealt with by feedforward techniques. If the plant has a measurable capacity constraint then continuous feed rate maximization might be the most profitable application on site. Similarly, there may be an economic trade-off between feed rate and severity.

17. Believe your staff when they tell you they don't need outside help. Unless they have had broad experience outside the company, they are not likely to be aware of exactly what is achievable. Unless very experienced they will follow "blind alleys," not only delaying capture of the benefits but creating a poor reputation for the technology in general. Another trap is the "not invented here" syndrome. There is no shortage of generally available generic process control technology. A number of companies make their money out of developing and marketing it. Process specific technology, depending on the process, may be less readily available, but there is usually a source somewhere. The key is the ability to *apply* the technology. Finally, however skilled your own staff, there may simply not be enough of them and they will become the bottleneck on the rate of benefits capture.

18. Don't believe your staff when they tell you they need outside help. Even the most competent engineers will work more effectively if there is a "guiding partner" to give them the confidence they need when moving into unfamiliar territory.

19. Implement the advanced controls only with outside resources. There is no substitute for the routine support provided by the plant's control engineer. He or she is best trained by being directly involved in the design and implementation of advanced controls. Without the control engineer's support, application service factors could fall from around 90% to about 30%. In other words, inadequate support can slash the benefits by a factor of three.

20. Ignore the process operator. Technical support for the advanced controls is usually only onsite for about 25% of the operating time. The process operator will be one of the major factors in determining service factors the remaining 75% of the time. If the operator's process control needs have not been satisfied, however trivial the process benefits, the operator will be less inclined to use truly valuable, but possibly troublesome, applications. If not fully trained, he or she could take actions which lose more money in a few hours than the control strategy achieves in a year.

21. Confuse the operator. This can be achieved by using all the alarm functions a modern DCS has to offer. If a controller has hi/lo, rate of change and deviation alarms, a trivial upset could generate half a dozen messages all requiring acknowledgment. A major disturbance could develop into something more serious as a result.

Advanced controls can be commissioned too quickly resulting in undertrained and generally unenthusiastic operators, which in turn impacts service factors. Alternatively, they can be made unnecessarily complex in either their operation or operator interface.

22. Ensure that there is no management attention. For advanced controls to be fully successful requires a number of different groups working toward a common goal. This includes planning/economics, process operations, instrument maintenance, technical services and the project team. Any one of these groups can undermine the benefits achieved if management support is not forthcoming. Senior managers may feel uncomfortable with the technology or may not be fully aware of the benefits. Technical staff may present the technology in a way that only they can understand and not effectively "sell" the benefits.

23. Give responsibility for application service factor to the technical department. High quality technical resources are limited and should be reserved for troubleshooting and ensuring practical improvements to process profitability. This should not include "chasing" operators to use proven advanced controls or maintenance staff to repair associated instrumentation failures. Advanced controls should be treated as any other addition to the process. Once proven they should be formerly accepted by the operations department which should feel accountable for their service factor. Of course, as with any

other part of the process, the technical department can be called back if the application fails to perform.

24. Rely on academic training for the control engineers. Few universities teach the practical application of process control. The engineer may arrive with a solid theoretical background and underestimate the importance of basic practical aspects of instrumentation and process control (see rule 13).

25. Encourage your best control engineers to ask for transfers or to quit the company. Control engineers need to work with, coordinate and get the commitment from a large number of groups within the organization. The skills they develop in doing this are much the same as those required of management. The engineer may well have aspirations in this direction. Staff otherwise happy to pursue primarily a technical career will be reluctant to do so if the culture of the organization is such that they feel this is an admission of being a "failed manager." Like all staff, control engineers want to feel "valued." If there is little management support for their work or if they are technically isolated they will become disillusioned. There is still a large market for experienced control engineers. If sufficiently frustrated they may vote with their feet.

26. Don't rotate control engineers into other roles. Some of the most effective advanced control installations are so because the plant or site is managed by someone who was formerly a control engineer (see rule 22). Some of the most successful control engineers are so because they

developed a pragmatic approach during their time as plant manager, or fully understand the operating and economic objectives from the time they spent in the planning/economics group.

27. Treat advanced controls as an optional extra. The failure of a key piece of process equipment will receive a great deal of attention to minimize its impact on process downtime. Repairing a day sooner (assuming one failure per year) increases process capacity by about 0.3%. A control strategy maximizing feed rate could gain an extra 5% over a year but can get nothing like the same level of attention to improve its service factor by 5%, which would give the same benefit.

There are a number of ways of indicating to the operators that advanced controls are optional, other than simply ignoring their disuse. Having a different operator interface for the advanced controls, installing them separately from the reinstrumentation project or loss of project management interest once the hardware is commissioned are all good ways of establishing the wrong psychology. ■



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