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Has the advanced process control industry completely collapsed?

I stopped writing editorials for a while because people were uncomfortable reading them. But I have finally decided against burying my head in sand. We—control engineers—should discuss frankly how advanced process control (APC), being one of the most lucrative refinery projects when done correctly, has lost so much operating companies' faith (and funding). Only on understanding what has gone wrong will we learn how to fix it. In '97 I wrote an editorial[1] pointing to mistakes in implementing APC and suggesting that operating companies manage the efforts better and dedicate more engineers for the design stage as well as maintenance.

That has not happened, and now the APC industry is in a state of collapse. I would venture a guess that the number of experienced APC experts in the world has shrunk to one-third of what it was a decade ago. I know of only two (none public) companies that deliver APC projects profitably and to client satisfaction. Their business model is to work to long-term customer satisfaction, even at the cost of incurring a loss on a project. As a result, they have much repeat business, low marketing costs and low man-hour rates.

What has gone wrong over the past decade? My '97 editorial can be summarized as follows:

• Cutting corners to increase revenues. Under competitive pressures, APC vendors have reduced their services to cover only the dynamic control core of APC applications. That is not enough. In a live unit, there are many incidents when the normal dynamic control logic should be overridden by different logic. This could happen due to erroneous measurements, equipment failures or unusual disturbances. An application that covers only the basic dynamic core would at best lose service factor, and at worst cause a major disturbance and loss of money.

To a considerable degree, such corner cutting was encouraged by the clients, who did not appreciate the difference between a well-designed versus mediocre application. The more diligent vendor that wanted to supply a better service at higher price ended up losing the contract altogether.

• Weak inferential models that limit usefulness of applications. Perhaps the biggest failure of the industry is in the area of inferential models. APC, which makes money by pushing the unit against constraints, moves the throughput (or other key handles) continuously, and the unit is never at steady state. Under such conditions, the operator is in the dark whether product qualities are at targets.

Typically, lab samples are taken at 6 a.m., results come back at 10 a.m., and by that time the sun has come up and unit conditions have changed. The operator, not knowing how to correct unit conditions, is forced to limit the APC envelope. Thus, good inferential models are the prerequisite that must happen for APC to make money. When operators trust the inferential models, they keep manipulated variable ranges wide open, let the APC application maximize the profit to real constraints and do not mind the absence of steady state.

By and large, the industry has adopted a methodology of creating inferential models by regression. There are many reasons why regression models are weak;[2] suffice to say that regression, or neural network, which is also a form of regression, cannot replace chemical engineering principles.

My colleague, Myke King, has written a recent paper[9] giving general advice on how to manage inferential models. I do agree with much of the advice but take issue with Myke's statement about first-principles models not being necessarily better than regression models. I intend to address that issue in my next editorial.

• "Pie in the sky" optimizers. APC of a major unit would typically be implemented for $250,000 to $400,000, but online optimizers could be sold for five times that. Why? It is anybody's guess because the optimization technology has failed to demonstrate any value. Online optimization involves use of rigorous simulations to optimize the unit, and on paper they look good. I have written one article[3] and that was followed by a public discussion[4, 5, 6, 7, 8] about the problems of this technology. In a nutshell, it is hindered by:

► Lack of procedures for estimating refinery intermediate product prices. Without these, optimization of a process unit in isolation is meaningless.

► Inability to forecast the quality of feed to a process unit. Incorrect assumption of feed properties yields erroneous results.

► Difficulty of applying steady-state models to a dynamic problem.

• Alliances between APC vendors and operating companies. Not mentioned in the '97 editorial, a new clever business model was promoted in the late '90s. Following project failures, certain operating companies came up with the idea that if they choose one APC vendor to handle all of their APC needs, they would achieve better quality projects at reduced costs.

It baffled me how the alliance idea ignored the glaring conflict of interests. But it did, and in the late '90s several alliances blossomed. The inevitable result was a further deterioration of quality. Under a noncompetitive arrangement, APC vendors had an incentive to neither provide high-quality manpower nor efficient project management, and the failure rate became astronomical.

That state of irresponsibility has gone on for quite a while, much to my surprise. I thought that a failure rate of 60% would get people's attention quickly, but it took a decade before the

Editor's note: We're pleased to announce that Zak Friedman has joined our staff as a contributing editor. Zak, a well-known expert on advanced process control, will be responsible for providing the quarterly "In Control" column (sometimes more often). Zak is known to speak his mind without fear of being controversial, so we're sure you'll find his columns interesting and welcome your feedback. Zak has also agreed to answer your APC questions. E-mail them to him at: zak@petrocontrol.com.

chicken came home to roost. When you speak to vendor company executives, the party line is that the industry is crumbling because environmental regulations have taken all the funds and for years nothing was available for APC projects. I believe this is only part of the story. APC projects used to get funded even when refinery funds were very limited—when people believed that they delivered value—and they stopped being funded when people stopped believing their value.

What shall we do now to recover? I suggest that the traditional APC vendors would be better off limiting themselves to software rather then applications. In fact, with or without my advice, this process is already in motion. The traditional vendor ability to supply high-quality APC applications has been adversely affected by the loss of APC engineers and high overhead costs. APC engineers who left those traditional vendors have very successfully set themselves up to compete against their prior employers; now this situation is irreversible. The traditional companies that typically own the APC software tools should give their new competitors support and training in the hope to sell more software. That is where alliances should be formed: between software supplier and software implementer.

Further, I would suggest a major effort be made to develop first-principles inferential models. Given the existence of reliable simulations, we should be able to develop such models. After all—inferential models resemble "simulation turned on its side." In simulation, the feed and control handles are known. From that information, the simulation computes product qualities and other dependent unit conditions, whereas an inferential model reads control handles and unit conditions to come up with feed and product qualities. Once such models become available, APC profitability would not only improve but also become measurable.

This last point about measurability is important. A decade ago, people thought that there was no point wasting time on quantifying APC benefits. Today, a clear demonstration of value is a necessary step to obtain funding. **HP**

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