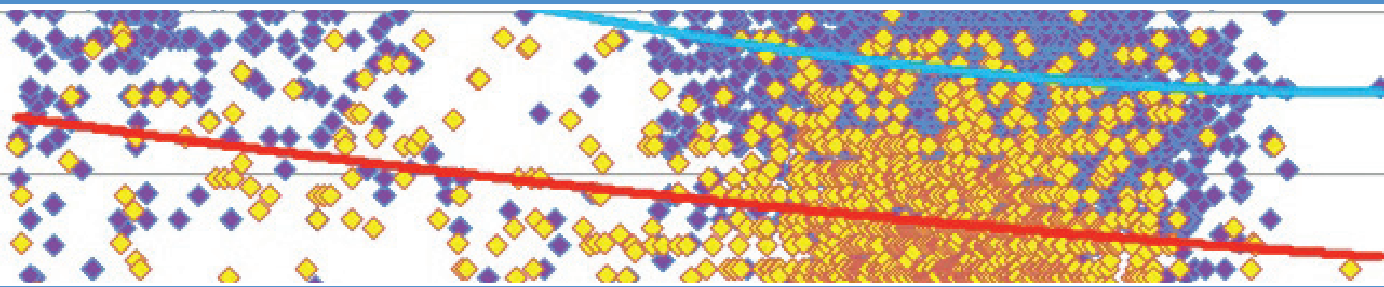

Effective Integration, Operational Consistency and Optimization Strategies Using Multi-Model Tool Kits

Process system operators face many challenges with operating units at their peak efficiency. Because mechanical means have mostly been exhausted, the opportunity to gain efficiency is increasingly found through operational consistency and the implementation of sustainable optimization strategies. A big component of this approach relies on systems integration.

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Systems integration means different things to different people. To some, it could simply mean getting systems to share data, while to others, it could mean implementing holistic approaches to optimization of control processes and other functions. An increasingly common method of helping us with the latter is the application of expert systems that employ strategies such as MPC, n-net and fuzzy logic. However, these expert systems often create a new set of challenges because their implementation unfortunately coincides with the all too common loss of experiential knowledge and highly variable operational demands that are plaguing the industry.

While some systems integration success has certainly been achieved, more opportunities exist. Yet operators are often constrained by tight budgets, loss of knowledge, operational variability and multiple process control/optimization systems that are not well integrated. Experience has shown that technology alone cannot get us there, and therefore a core principle of this paper is a holistic approach that advocates the combination of people with technology to achieve the ultimate results of operational consistency and maximum optimization with quicker and with better results.

Part 1 - Start with People

To reach the next level of efficiency in our organizations, it is imperative that processes and systems are made more effective by finding the right balance of people and technology utilization. Both need each other to be successful, thus they are not mutually exclusive resources.

People have the experiential "tribal knowledge" that is an integral part of process effectiveness. However multiple people have different pieces of this knowledge and this makes it hard to have consistent and holistic input across all processes. If it were possible to successfully and consistently combine all of these sources of tribal knowledge, exponential benefits could be realized.

The process starts and ends with people, who have many tools (i.e., expert systems) to interact with, but frequently these tools are complicated and the people don't have the time or training to be an expert on all of them. If it were possible to provide employees with tools that were simple, holistic and could help them leverage the full power of the systems they already have, the results would likely be more dramatic and sustainable over time.

Technology should not be considered as a replacement for people, but rather as an augmentation of the human capital investment made by organizations. With the right approach, technology can be used to capture the tribal knowledge that exists within organizations and make it more readily available to the whole organization, not just to individual parts of it.

People and technology should create a symbiotic relationship. They should simultaneously learn, evolve, implement and learn again. The process of continuous improvement should never be stagnant, otherwise, is it really continuous?

Part 2 - Technology

Today, there are so many choices for process optimization technology and these choices continue to evolve. Technology can be proprietary and non-proprietary. N-Nets, Optimizers, MPC, nMPC, Fuzzy Logic and Expert Logic all can play a role in the solution, but they can also be intimidating and misunderstood.

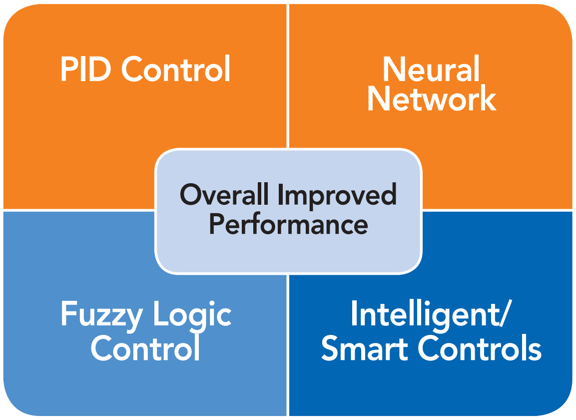
Organizations may lean heavily on technology to be THE solution for all of the problems they wish to address. At one time, technology gave us large gains in process efficiency that resulted in lower emissions, increased capacity and operational flexibility. But these technology solutions–once applied–no longer continue to evolve, nor are they working together to determine the ultimate optimization solution. This standalone, black box approach makes the next level of gains more difficult, but if used in a different way, technology once again can be an important part of the solution.

Solutions need to be flexible and focusing on standalone technologies can be limiting. Approaching the problem with the mindset of "I need a Neural Net or Expert System" misses the bigger picture of using smart people and sophisticated tools TOGETHER to make our systems work better.

How the people and the tools (technology) are combined is the missing link that will provide the additional optimization that most organizations desire. Too much reliance on an inexperienced knowledge base (people) may result in less than satisfactory results, while too much reliance on sophisticated expert systems without someone knowledgeable in the "wheelhouse" could lead to unfair perceptions of what the technology brings to the table.

The challenge is how to achieve the right balance.

Part 3 - Open Architecture; Putting the Parts Together



Using intuitive and sophisticated tools that complement people's abilities to improve process effectiveness and create sustainable operations will generate the efficiency. Each technology tool, independent of the others, offers a specific focused benefit. While together, these individual tools have the potential to offer much more. A hybrid technology is available that can help achieve this cohesion. It is an open architecture multi-model software tool that combines the proprietary with the non-proprietary and helps make existing controls technologies better.

Griffin Open Systems is a platform for building rule- and model-based systems that can be used to fine-tune and optimize business and/or plant processes. This platform is used to deploy offline big data applications, with real-time monitoring and closed loop control applications. A key differentiator is that this software does not replace existing control or expert systems. Instead, it integrates them and makes them better.

The power of this tool lies is its ability to deploy multiple modeling and control strategies in parallel, while processing large numbers of inputs, to allow the user to engineer solutions through a graphical user interface in real time. No programming language knowledge is required. The software continually analyzes incoming patterns of data and uses optimizers to interrogate models and find improved combinations of bias to optimize the targeted process. There are also sophisticated neural network training algorithms that regularly retrain the models as new data is collected, so the system is always learning. Models can be used in any combination for single or multiple process improvement goals.

The software analyzes incoming patterns of data to find improved combinations and fine-tune control curves and response. Because the existing control system technologies remain the primary control and constraints remain in place, including hard limits, calculated limits, data limits and ramp rates, the result is fewer burdens for operators and engineers to learn a new system.

Def: Open Architecture
A type of software architecture intended to make adding, upgrading and swapping components easy. It allows users to create add-on capabilities that increase a system's flexibility, functionality, interoperability, potential use and useful life.

Knowledge Base Builder

Capturing the existing knowledge base and supplementing knowledge transfer is critical to sustaining operations, and this should not be independent of optimizing operations. Knowledge capture and transfer should be achieved holistically, and the software's wide range of tools, logic, models and optimizers supports this goal. Because the software provides access to the built-in tools through a graphical user interface, does not require programming language knowledge and can apply solutions in real time, users are able to readily capture individual operator knowledge and implement strategies that have proven to be successful according to experience. This allows operators to leverage each other's strengths while collectively achieving a broader system optimization goal.[1]

An ancillary benefit of this approach is increased buy-in from individuals. Because operators are involved with the creation and implementation of solutions, they begin to increasingly trust the various technologies that they are required to interact with. This leads to a higher level of effectiveness and sustainability of results over a wider range of process variability.

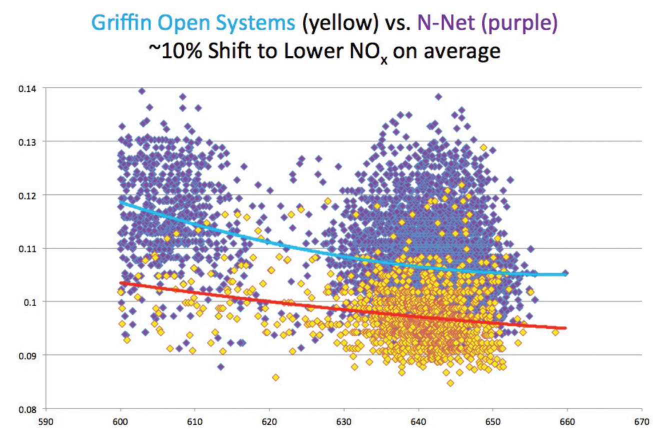
[1] *https://www.chieflearningofficer.com/2006/03/27/managing-the-learning-lifecycle-retaining-organizational-knowledge/*

Results

Real-life examples of the additional opportunity that was created by combining an experiential knowledge base with an intuitive tool to extract the synergies of existing systems are provided below.

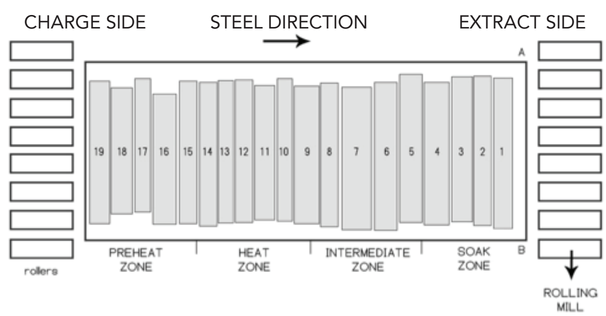
Example 1 - 10% Reduction in NO_X Emissions

A Midwestern 600MW coal-fired power plant was able to achieve an additional 10% reduction in NO_X (Avg) when they augmented their existing neural net expert system and DCS with a Griffin Open System toolkit. After installing the system and implementing supplemental optimization strategies to the existing control system, the plant's emissions were reduced to a level low enough that they no longer required their SNCR control system. This provided a significant savings in consumables and maintenance required to operate within their NO_X limits.



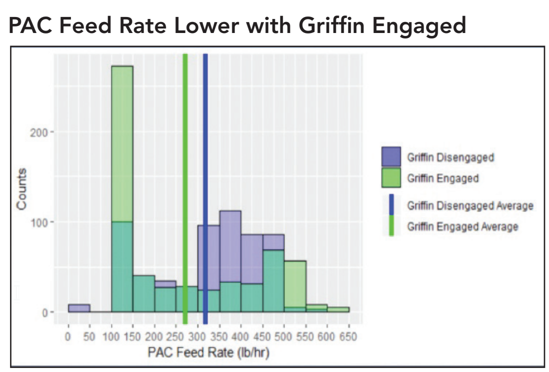
Example 2 - 10% Reduction in Fuel Consumption

In another example, a Midwestern integrated steel plant augmented their steel slab reheat furnace control system and reduced the consumption of natural gas by 10%, while simultaneously decreasing their slab reheat processing time. The result was reduced slab rejects and increased production rates.



Example 3 - 15% Reduction in Powdered Activated Carbon (PAC) Usage

Finally, a large Western coal-fired power plant implemented an optimization program through the Griffin Open Toolkit to improve Hg control and reduce PAC usage. Integrating the system with the existing DCS and Hg control system allowed the plant to achieve a reduction in PAC usage averaging 15%, with even more adaptive control of Hg under varying process conditions. The better control of Hg also reduced opacity events by 95%.



Conclusion

Achieving the next level of efficiency is going to come from an integration approach that creates more operational consistency and sustainable optimization strategies. By integration, we mean combining the people who have the experiential knowledge and skills with the technologies that offer tools to process large amounts of information effectively and efficiently. By combining people and technology in a holistic way, it is possible to improve profitability by reducing waste, increasing efficiency and improving process effectiveness. With this approach, we can solve these and many more problems.

1. Capture and transfer the knowledge base to make it consistent across our processes and people.
2. Identify the unseen possibilities to reduce waste and improve profitability that our existing processes, systems and people are not finding.
3. Create operational consistency without burdening our existing processes and people.
4. Identify and correct unnecessary constraints that limit production or use excessive energy.

Acknowledgement

Neundorfer, Inc. is an authorized integrator of Griffin Open Systems.

We thank our partners Griffin Open Systems and Taber International for their contribution to this document.

About the Author

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