

Collaborative Production Management in the Process Industries: A Stepwise Approach from KPIs to Workflow Processes

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THE CALL TO ACTION

“We need to make better use of data”, “We need easier access to the data”, “We need to get the right data into the hands of the right people, so they can make the right decisions”, “We need one version of the truth”, “Don’t just give me more data, give me more knowledge”.

Any discussion about the use of plant operating data with plant management, operational staff or suppliers of Plant Information Management Systems will quickly spawn one of the above clichés. The clichés are right. We do need to improve our ability to make efficient use of our automation and plant information data system investments. But the questions are how and where is the value truly being delivered to the organization?

This call to action is being driven by reductions in resources, increased desire to maximize capacity utilization, the need to optimize operational performance, and the need to ensure that we are in compliance with company goals, targets and corporate responsibilities. To put the challenge in perspective, Figure 1 below shows the number of refineries in North America and their crude processing capacity. Clearly, we are being asked to do more with less. Data management is an essential element of the solution to this challenge.

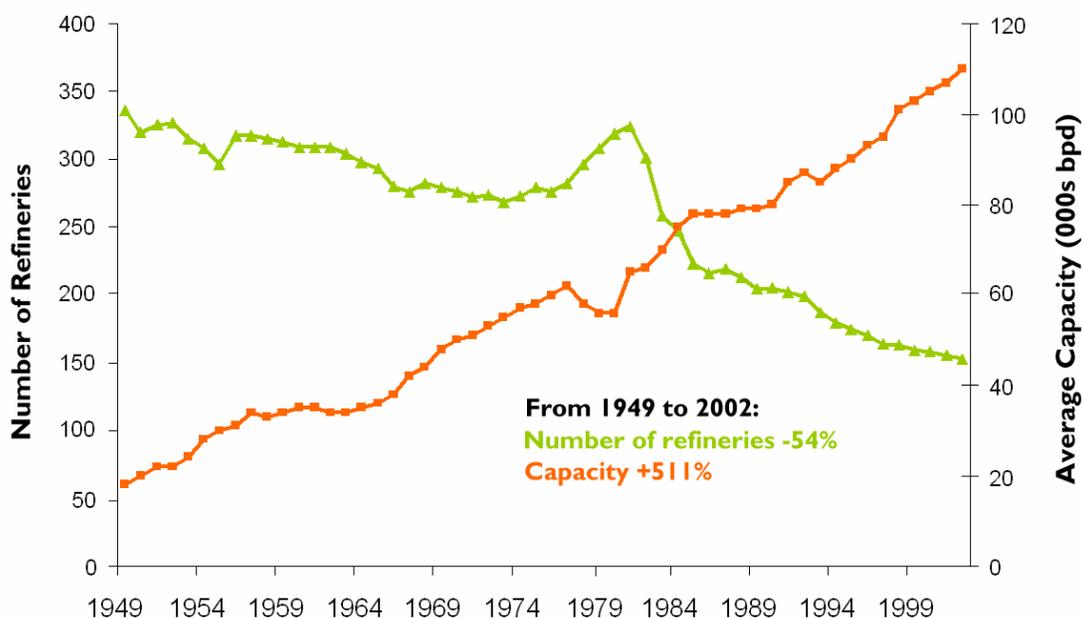


Figure 1: Number of refineries and their capacity from 1949 to 2002

“DATA TO KNOWLEDGE”

Over the last 20 years, the processing industries have invested heavily in automation and plant information systems such that the data is now accessible. As a result, we should now be able to put it to productive use. Or can we? The challenge with raw data, no matter how accessible, is that it is just data, and data still requires a lot of work before it can be turned into knowledge. In most cases, the data needs to be validated, analyzed and converted into a level of knowledge that is actionable. And this can still require a significant investment of time and resources.

The Key Performance Index (KPI) has been the first step in putting data into a context that is more aligned with organizational goals. Every plant functional group has high-level objectives and targets, and if the raw operational data can be converted in real-time or near real-time into these KPIs, then non-compliance to operational targets can be quickly identified and decisions can be made. But while converting this data into

contextualized KPIs is a necessary first step, this alone does not guarantee the desired operational improvements. If the KPIs themselves are not managed effectively, companies often simply transform the problem of “data overload” into the problem of “KPI overload”.

As an example, consider the application of “Control Asset Performance Management” (CAPM). In the chemical, oil and gas industries, 75% of a plant’s physical assets are under some form of automation or process control. Companies are now focused on the fact that optimizing control performance can improve plant performance by 3% to 5% in equivalent throughput capacity, with little or no additional capital investment. Thus, the objective of the CAPM program is to automatically collect the raw data from the DCS control systems and then convert this raw data into higher level KPIs like utilization and performance. As shown in Figure 2, below, most CAPM programs, will convert real-time measurements of controller operating mode, present value, set point, and output into daily KPIs such as variance index, oscillation index, valve stiction index, utilization index, economic performance index, etc.. As a result, it is now much easier to understand whether the control system is performing optimally, i.e. according to the plant’s operational and business goals, by monitoring these high level utilization and performance-based KPIs.

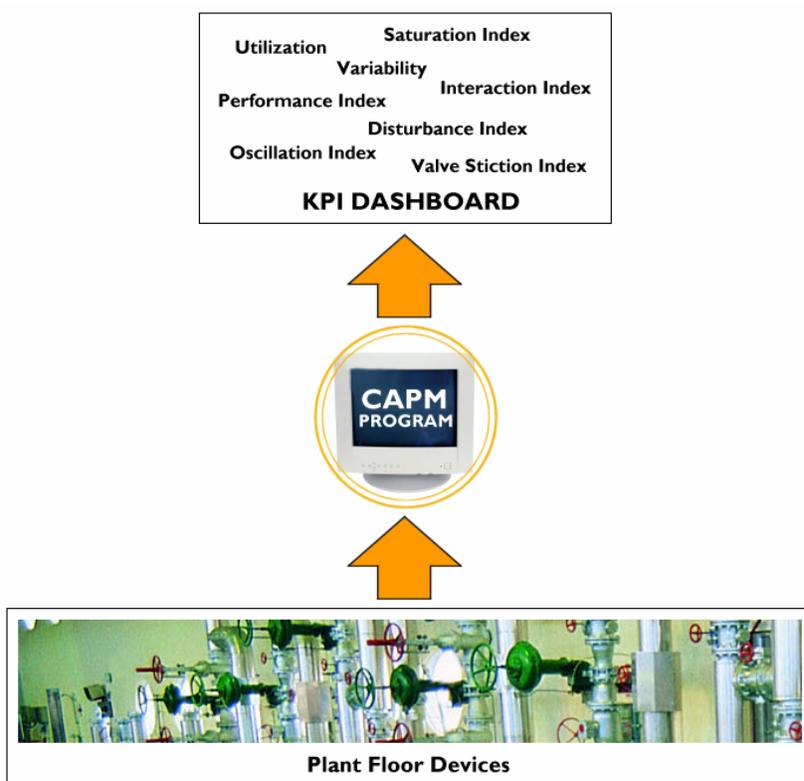


Figure 2: CAPM applications capture plant floor data to create KPIs

The consolidation of raw data into KPIs or performance metrics is a necessary step, but if not managed carefully, it will simply change the nature of the problem. If we consider the CAPM example above, a plant faced with the challenge of monitoring and sustaining the performance of 1000 control loops may find it every bit as difficult to act on the results of a CAPM program that computes several KPIs per control loop (and hence thousands of KPIs per day). Unfortunately, the transformation of data into KPIs alone seldom delivers the true improvements we’re looking for.

THE NEED FOR VISUALIZATION

The visualization layer is an essential element to getting the value from any KPI-based monitoring system. We have all seen the promises of the “digital dashboard” and speedometer-like displays of plant efficiency delivered in real-time through a web based environment. But the true power of the visualization layer is its interactive ability to quickly sort and display the consolidated performance metrics in order to highlight the high priority requirements and provide guidance on the actions required. This is performed through a combination of filtering, sorting and drill-down type analysis techniques. More sophisticated visualization techniques, such as Treemap Technology, which can allow users to visualize hundreds of assets in a single view and rapidly identify the key focus areas, are now delivering a step change in our ability to rapidly act on the information presented within a KPI-based environment.

Studies in the area of CAPM have shown that well-designed KPIs combined with powerful visualization techniques can allow plant personnel to improve the identification of high priority automation problems by 100%. More importantly, they can complete the task in less than 10% of the time required when using traditional analysis techniques. Figure 3, below, shows examples of both the sorting/filtering and Treemap visualization layers applied to CAPM.

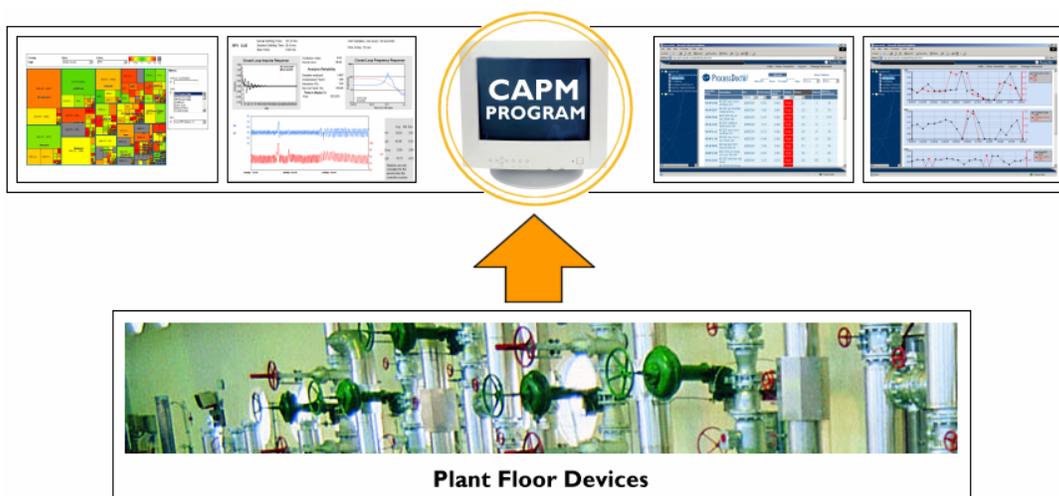


Figure 3: CAPM application with data visualization tools

WHAT ABOUT WORKFLOW?

By today's standards in the chemical and oil & gas industries, any company with a real-time, web-based KPI environment for operational views and decision-making is considered a pacesetter in their effective use of data. So has the “real-time web-based enterprise” delivered on the promises? And what's the next step for these pacesetters?

To deliver the full value that these systems promise, the meaningful knowledge they generate must be acted upon. This requires integration with the plant's workflow processes. The consolidation of data to KPIs and its visualization is often still deployed in a data-centric view that still places it in a functional silo. If we consider CAPM again, many systems that compute the automation layer performance metrics and present these through a set of visualization tools are designed only for process control engineers. In effect, all the information is channeled through a human funnel before it is dispatched to the wider group of resources who have to act on it. This model, as shown in Figure 4, does not empower the organization nor facilitate work processes. In order to ensure that action is taken to correct problems, we must move from a data-centric view to a functional “process-centric” view, where the system can directly support the higher-impact business processes.

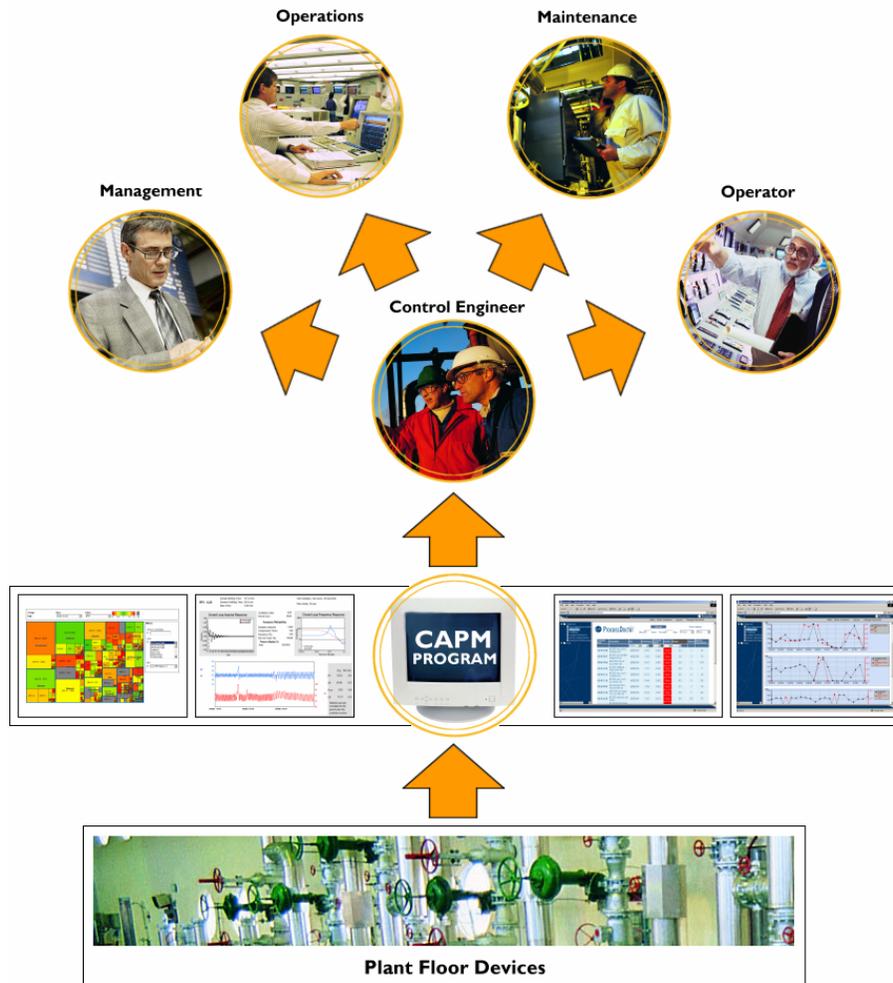


Figure 4: Non-integrated CAPM application

As an example, consider the case of a poorly performing slide valve on a refinery FCC unit. This poor performance, due to valve wear or mechanical complications, can cause serious process upsets and a possible unit trip. A traditional CAPM program would only consolidate the valve and control data into performance metrics for the process control engineer to review. But the impact of this poorly performing valve has significant economic impact on the refinery, with a scope well beyond that of the process control engineer alone.

Now let's look at this situation from a functional or business process perspective. The poorly operating slide valve has a significant impact on the operation of the refinery and should directly impact decisions made by the following functional roles:

1. **Maintenance:** Must have an understanding of the maintenance requirements and potential failure of the valve along with priority level to ensure action plan is in place in case of shutdown.
2. **Operations:** Must understand through both CAPM and alarming information the rate of degradation in performance and the risk of unit trip or required shutdown.
3. **Process Control:** Must understand the degradation in control performance and the root cause along with the economic impact associated with disabling of the advanced process control systems.

4. Process Engineering: Must understand the impact on overall unit performance and the overall cost associated with poor control.
5. Planning and Scheduling: Must understand the change in capabilities of the FCC unit and the potential for trip or shutdown on production.
6. Management: Must understand the current economic loss due to reduction in unit performance and potential future losses due to further trips or shutdowns.

This necessary distribution of knowledge requires an understanding of various relevant functional roles, but also requires integrating several data sources or knowledge bases. Both the data and workflow requirements for this to happen are shown in Figure 5, below.

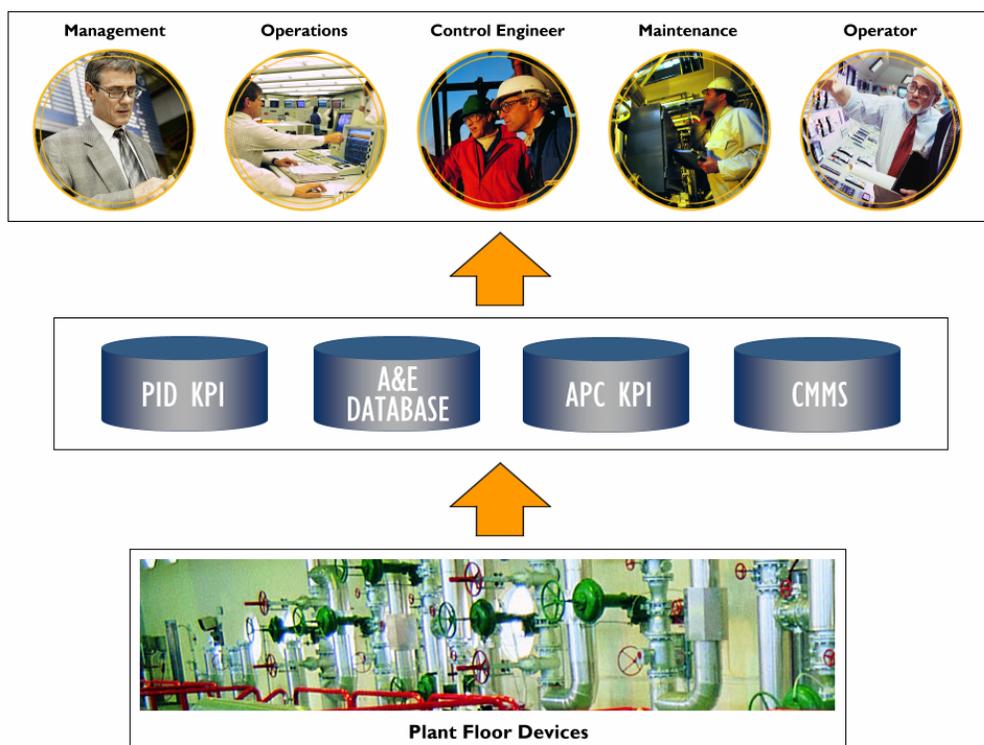


Figure 5: Plant floor data integrated with other data sources for presentation throughout the organization

Although the Refinery FCC Unit slide valve example above may be an extreme case, this example demonstrates the need to understand the overall data and workflow requirements if these systems are expected to support business processes and deliver their full return on investment. Without workflow integration, the promises of the integrated operating environment will always exceed the reality delivered.

COLLABORATIVE PRODUCTION MANAGEMENT: ENABLING THE WORKFLOW PROCESSES

Collaborative Production Management (CPM) is often defined as a method to unify disparate systems in order to achieve Operational Excellence. This unification must be performed along two lines. We must combine both the data/information layer as well as the functional layer into a single workflow environment. This will allow plant resources, from operators to managers, to get away from complicated workflows where they must interface with multiple systems in order to assess situations and perform tasks. This unified workflow environment enables collaboration and helps the different functional roles work together with an understanding of their specific requirements in the context of a view of the bigger picture.

If we again consider the refinery FCC unit slide valve malfunction described above, the data/knowledge integration requirements and the functional user-level integration are shown in Figure 5. The sharing of the

data, knowledge and functional views ensures that each functional group in the plant understands the operational situation and their role in improving it. In essence, *this* is the integration needed to truly deliver on the promises of collaborative manufacturing.

Although the focus here is on the operational level, the challenge is even greater as one moves up into the refinery or plant planning logistics layer. The data requirements, disparate databases, financial impact of decision-making and abundance of custom calculations often produces a highly inefficient environment based largely on manually created spreadsheets (sometimes referred to as “Excel hell!”). The proper planning of CPM requirements follows the same principles as they do at the operational level and can yield even greater benefits.

Most companies that set out to achieve operational excellence through a “web-enabled real-time enterprise platform” are actually hoping that it delivers the collaborative production management environment described above. For companies that are successful, the benefits to the organization are significant and the implementation will change the way people work. Typical benefits include:

- Improve capacity utilization (3-5%)
- Increase equipment reliability (5-8%)
- Optimize production of higher value components through yield upgrades (8-12%)
- Improved compliance reporting (environmental & safety)
- Improved efficiency and productivity of staffing (10-50%)
- Improved energy efficiency (5-15%)

THE NEXT STEP: EXCEPTION-BASED MANAGEMENT

So what does the future hold for Collaborative Production Management? The push forward will not end with the real-time integrated environment providing seamless access to data and streamlined workflow. Rather, decision makers will push for even greater efficiency by minimizing the time people spend asking questions and monitoring KPIs. Rather, users will be alerted when things are going wrong (and when they are going very well). Thus, an information delivery system, based upon pre-determined business targets and logic, will alert users of non-compliance to goals and give them insight into the situation, as well as an action plan to resolve the problem. Finally the system tracks non-compliance through a resolution tracking environment and ensure the item is dealt with in a timely manner.

CONCLUSION

We have all heard the promises of how more data and more knowledge will deliver significant benefits to plant operations. But before we embark on building the “real-time enterprise” and providing seamless access to every piece of data, it is important to understand where and how the value is truly delivered. Data access, KPI generation, digital dashboards, web-based visualization and a collaborative workflow environment are all essential pieces of the puzzle. We also need to walk before we run. Understanding the stages and having a strong vision of where you need to go are essential first steps in adopting a staged approach to a successful Collaborative Production Management System.

ABOUT THE AUTHOR

Mike Brown, M.A.Sc., P.Eng., has served for the past 15 years as an advanced process control consultant providing implementation expertise and technology guidance for a large number of operating companies. Mike sits on the ISA-SP18, Instrument Signals and Alarm Standards committee, where new alarm management standards and practices are updated to reflect the changes in automation control systems and alarming functionality. Mike was recently presented with the Ray Molloy Award for co-authoring the best-selling ISA book in 2002, entitled “Advanced Control Unleashed: Plant Performance Management for Optimum Benefit”

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