Abstract
It’s no good just looking at a problem—you need to be able to act on it. An effective collaborative production management environment brings together data from many sources and makes it available in a format for rapid business level decision making. For this to work, many components need to be in place. Data needs to be managed and accessible. Information needs to be filtered down to the essential with the facts displayed effectively in context for analysis. Options related to best practice methods and procedures need to be presented. Actions or inactions need to precipitate a predefined workflow thread. The benefits of such a program are seen in organizational agility and predictability. This translates into profitability as decisions are based on a single credible set of information using true business drivers.
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Collaborative Production Management, for the purpose of this paper, is defined as a method to unify disparate systems in order to achieve Operational Excellence. Operational Excellence occurs when key decision makers from different disciplines are able to act on the unified information to effectively drive the business. Production Intelligence is Powered by Matrikon, which represents vendor neutrality. This product works with third-party control systems and applications.

The ultimate goal is seamless access to accurate, filtered, validated and meaningful information customized for each user. Also, appropriate recommended action paths are followed up with auditable business processes. The environment must also facilitate continuous improvement by empowering each individual to adapt to new opportunities. The steps to achieving this can be built up, making use of some fundamental building blocks.

**Manageable and Accessible Data**

“Process Data” come from a wide variety of data sources: instrumentation values collected by plant control systems, lab analyses, manual inputs, stand-alone instrumentation, automated equipment and more. Taking raw values from the multiple sources and presenting them on a single display can be useful, but leaves the user with information overload and is subject to interpretation of context and meaning. Any changes in configuration require an expert to collect the appropriate tag references and update the displays. At many sites, the proliferation of displays is a management and quality control headache.

![Process Historian View vs Object Model View](image)

Assessments of data quality accompany every data point explicitly or implicitly. Instrumentation values have an inherent accuracy dependent on the type of measurement device and service. Laboratory values have an accuracy based on the test performed. However, all of the accuracy determinations can be completely overpowered by operational and configuration management problems. Business controls for measurement and analysis systems ensure appropriate management of change and calibration processes are followed. These controls are becoming mandated in many industries as part of regulatory reporting traceability.

Real-time data sources tend to be tag-based systems where knowledge of location and tag attributes are required in order to use it effectively. Operations staff can become quite familiar with the tag identifiers and often build their own spreadsheets using data access facilities for analysis and reporting, assuming responsibility that they are using the tag correctly.

- Are the units of measure correct?
- Is the value volume corrected to standard conditions or is still at observed conditions?
- Is this analysis for the total stream or just the hydrocarbon phase?

When tag configuration changes, for any reason, the risk is that propagation of that change to all custom spreadsheets essentially never happens.
Quality information requires basic characteristic knowledge about every value, which defines the property being measured, the method of measurement, the stream reference conditions, the unit of measure, and the interval and scale of measurement. The rules of engagement for all values are defined with characterization. For example, a laboratory measurement of Naphtha density is characterized as Liquid Density, ASTM D4052, 15 deg C reference conditions, measured in g/ml and is a daily average.

The next step beyond characterization is context, defining an access path to the information based on an object understood by the general user community. Each value is referenced to a plant object, so FI-1201 becomes the instantaneous Naphtha feed liquid flow rate to the Naphtha Hydrotreater Unit 12, volume corrected to 15 deg C measured in m$^3$/hour.

![Figure 2 – Operational Facilities](image)

**The Plant Model**

Plant objects positioned in a simple plant or business hierarchy allow users the ability to drill down to successive levels along with roll-up of information. Summary reports collect information from all child nodes and aggregate to any level.

A plant model takes the hierarchy one stage further to add relationships between objects. These relationships are used to model specific behaviours, thereby adding to the information base from which reports and calculations are used to customize their operation. For example, a balance calculation can derive the feed streams and product streams for a unit from the model to generate a unit imbalance. Volume correction calculations can determine appropriate lab densities from sample points associated to the process stream with the flow instrumentation. Equipment efficiency calculations can access appropriate instrumentation and analysis values to derive the efficiency numbers.

The benefits of a plant model extend beyond a single application, providing a reference point for federating information from different applications. The model ensures that everyone has the same information and maintains references on how to access object based information in each system. Requests are routed appropriately, as it also understands which information is available from each system.

Data validation cannot be done in isolation. The plant model enables bringing of data from multiple sources and time periods together in a consistent format, allowing automated comparison checks and validation processes to be executed. Validation processes include range checks, consistency checks, balancing, statistical reconciliation and simulations.

Validation means identification of errors and therefore, a need to make adjustments. For example, the raw version gets its data from a plant historian on a 5-second scan, the design version was manually entered in 2006, the planned version comes from a scheduling system that is providing weekly averages and the regulatory version is computed monthly and is saved in a secure storage location. Different versions of data will have different sources and different aggregation levels. Adjustments cannot affect the raw data, so multiple versions of information must be supported in any production management data system.
Auditable Business Processes

Current regulations require that values presented to shareholders have passed scrutiny, that their source and quality are known, and that there is an audit trail providing documentation of their source and change history.

What do you do if data are missing for key reports and calculations? Your production engineer knows but your general users may not. An ideal situation therefore involves defining a strategy for missing data and encoding that knowledge into the plant model. Each version has a best available value, ideally with corresponding quality estimation. For example, if there is no density available for the material being transferred, take the value from the source tank; if that value is not available, take the density from the specification of the material being transferred but downgrade the confidence in the value. If that value is not available, take the value from the design version for the same process stream but mark it as approximate. Unknown values can be approximated to fill in missing details but must be rightly labelled as such.

So what we have so far is the ability to access validated auditable data, in a consolidated format from multiple systems with multiple versions, through built-in model intelligence, adding value by converting data to information. This combination provides the one version of the truth that all users can view. What we are missing is personalization, collaboration, and action.

Figure 3 – Process Dashboard

Personalization

Up to this point, we have considered production data as being mostly values from measurements and analysis. Production data also includes events, annotations, comments, logs, inspections, documents and reports associated to plant objects but generated by people. Having one version of the process data visible to all is good, but collaboration occurs when communication and knowledge sharing builds on that shared view of the information.

The ability for individual users to build their own dashboards, configure their own performance indicators, set up their own alerts and subscribe to information of interest can all be made available when using an information web portal. The portal can also provide access to documentation libraries.

Unified communications providing messaging, e-mail, faxes, voice mail and calendar events all arrive in the one inbox. Wouldn’t it be nice to see plant events and tasks also in the same inbox? Knowledge sharing involves accessing both information and the people affected.

Users need to have the right tools to act on their analysis. Transactional forms and applications need to have immediate information accessibility passed from one to another. Retyping information is time consuming and tedious, so a report or form with the appropriate context is then easily passed to the selected application for immediate decision making and action.
Making use of a portal with integrated workflow provides a set of capabilities that facilitate user interactions with task lists and e-mails. Standard workflows can ensure company best practices and procedures are being followed along with reminders and escalation steps to ensure critical actions are not forgotten. For maximum integrated workflow value, the system requires the ability to activate the transactional forms at the level where user actions and data manipulations can be performed.

![Plant Model Simulation](image)

**Figure 4 – Plant Model Simulation**

The **Collaborative Environment**

Current technologies provide workflow enabled, portal activated applications and data manipulation from diverse data sources. Combined with communication and messaging tools, you are able to facilitate interaction and knowledge sharing through collaboration.

How do you keep all this running? The secret is to empower individuals to configure their own environment with tools to take advantage of opportunities. Users should be able to participate in workflows as well as make adjustments or create new ones.

The plant model is an information resource that everyone is working with. As a focal point, it remains up-to-date with many users continually reviewing the data. When changes are made in plant configuration or operating mode, the model reflects that and then operating reports and dashboards automatically adjust. A small number of reports can then service many operational areas, given that they receive their context from the model.

The use of templated graphics minimizes display maintenance enabling a few dashboards to service many operational areas. Updates to a single template can then roll out to benefit many users. The maintenance effort and resistance to change are minimized, allowing enhancements and improvements to be easily accommodated.

The use of intelligent interfaces can be configured to keep themselves synchronized. When a new piece of equipment is created, messages are sent to each system subscribing to that event so that they can keep their own databases in synchronization. Some of the latest interfacing technologies use semantic processing methods that do not need synchronization. Instead, they access objects in other systems and perform actions using them without any pre-configuration.
Auditing with Point in Time Reconstruction

Auditing of changes is important, extending beyond value changes to comments, configuration, applications, etc.

- Can you reconstruct what the configuration of the plant was six months ago when there was a flaring incident?
- What calculations were being used at that time to generate the flaring reports?
- Did we have the online analyzer active at that time?
- What was submitted to the government seven days after the incident?
- Who submitted the information?

To effectively audit, point in time data management is required where every piece of information has a validity period. This change management needs to be built into the fundamental data architecture along with auditing by user.

Summary and Benefits

The building blocks for a Collaborative Production Management environment, as outlined above, will provide for a maintainable, extensible system that is able to meet the strict data quality needs of current regulatory bodies. It allows each user to be involved in the continuous improvement process by customizing their environment and adding to the general knowledge base. It positions an organization to be able to embrace change and follow best practices. Above all, Collaborative Production Management environments enhance the credibility of information and allow business decisions to be made with confidence, ultimately enabling operational excellence.

For more information:
For more information about Production Intelligence, visit our website www.honeywell.com/ps or contact your Honeywell account manager.

www.matrikon.com
mpi@matrikon.com

Honeywell Process Solutions
1250 West Sam Houston Parkway South
Houston, TX 77042
Lovelace Road, Southern Industrial Estate
Bracknell, Berkshire, England RG12 8WD
Shanghai City Centre, 100 Junyi Road
Shanghai, China 20051

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