A Digital Plant Vision for Increasing Value using a Real Time Data Infrastructure

Summary

The process industries are facing many pressures: increased environmental and safety governmental regulation, increased energy, water and air usage to process natural resources that are more complicated.

The alignment to resolve business processes is the key for continuous improvement, innovation and increased profitability. This strategy describes a digital transformation.

Whatever the issue, the answer is in the abundant and growing quantity of real time data and events collected from plant process operations. A strategy is needed to quickly and efficiently transform the data and extract the necessary insights that will enable operations/maintenance/management to investigate issues and opportunities to improve bottom line results.

The proposed strategy accelerates the configuration of production and consumables data. In addition, it makes it easy to maintain the PI system. The alignment to a business process between Production Planning and Operations Reports reduces production variance while reducing operating costs. Consumables are aggregated based on critical operational modes (Running, Trouble, Idle, Down and Maintenance).

The Information is presented in real time using dashboards in PI Vision and published in the MS Azure into Power BI in dashboard for personal consumption. The dashboards can be self-tailored for an overall Production Effectiveness or by specific disciplines such as Management, Operations, Maintenance and Planning. Benchmarking by unit, mode, and losses. The created dataset can be used to find insights and for predictive analytics using machine learning tools. This strategy lowers the bar for integrating the planning and execution goals. The access of real time insights in the CLOUD cannot be over emphasized. This is a true digital transformation.

Proposed Strategy

One Process Unit Template is used to digitize a process plant.

The business objective is to track the Production Variance for every process unit while tracking the consumption of energy, water, and other consumables. The analytics is abstracted for all units using an object that is configured to represent each physical asset.

One Process Event Template is used to aggregate the production and consumable variable for enterprise tracking for every plant and process unit. The results are presented in PI Vision and PowerBI.

A Master Algorithm for Gross Operational Mode detection generates the Mode of Operation (“Running OK” meaning on target, “Trouble” Meaning off target, “Idle” Meaning No Material Available, and other such as “Maintenance”.

The Plant operational data can be visualized in Power BI as shown in this example or using PI Coresight. The Algorithm is called Follow the Money by some customers.
One Process Unit Template with Analytics and Event Frame Generation is used to put the data into one Process Unit Event Template. All units are filtered by the same algorithm providing a simple way to understand the data and for detecting insights. The data sets are reused for machine learning or for online predictive calculations.

The following diagrams show a typical refinery process block diagram. Each unit is scheduled to process a certain process flow rate on a daily basis based on the planning and scheduling plans. This value is the target entered into the process unit template via a PI AF table lookup. Each unit element is configured for the specific factors to tailor the process unit template and to process the PI Analytics and PI Event Frame generator automatically. At every time cycle the Process Unit Template processes the targets, process flow feed rate, electricity consumption, and water consumption values based on the operational mode calculated in PI Analytics.
A Process Unit Template is used to generate the insights reported in self-service power BI dashboards and additional analysis can be performed.

Power BI example showing the consumption variables for every unit based on operational mode.

PowerBI Desktop is published to the Cloud to share the information by the functional teams at the plant or enterprise. They can use their phones, tablets, or traditional laptop depending on the needs. The generate real time events can generate Notifications to accelerate the resolution of abnormal situations and active resolution workflows by the teams. Details are presented in Chapter 3 and Chapter 4 of the A Journey towards a Digital Transformation Manuscript (work in progress, see PI Square).
Fish Bone strategy to link data and events to teach Cortana with PI Data.

This figure shows the published PowerBI in the Cloud and enables the use of Cortana to share the information.

The next figure shows how to use Cortana in your devices to ask questions about your plant. PowerBI absorbs the PI Event Frame Template and then Cortana assists in generating answers and visualization reports for the data set.
asset electricity consumption total mode

asset, electricity consumption total, and mode
Source: Steel Industry Complex OpInt April 2

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<thead>
<tr>
<th>Mode</th>
<th>Down</th>
<th>Idle</th>
<th>Maintenance</th>
<th>Running</th>
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<tr>
<td>01 - Stockpile</td>
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<td>03 - Coke Pl...</td>
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Example of Event Frame results Generated Dataset for analysis, visualization, and collaboration by the different functions in a typical production environment. The following graphic shows the Business Process Workflows in a typical industrial environment. (Kennedy, Bascur, Hydrocarbon Processing). The event frame data set aggregates the real time data into information based on the operational modes (Running, Trouble, Idle, Down or Maintenance).

Business Workflows in a typical plant. This example features the Planning versus Operation and Maintenance workflow. From Kennedy and Bascur published in Hydrocarbon Processing.
One of derived value of using a Generalized Data Hierarchy as shown in this figure is that a data set can be made available to build predictive analytics models. Simple models can be used in PI Analytics to generate softsensors by correlating quality or yield data versus key process variables. (Bascur, A control framework with distributed intelligence, ISA-88-1556)

Basic business strategy to transform data and events into desired information. Data + Events = Information. Today, Operation Events are the new transactions in the Digital Age. This is the true Digital Transformation.
The IDEA is Infrastructure, Data, Engineering and Analysis (Kennedy & Bascur, AIChE www.nt.ntnu.no/users/skoge/prost/proceedings/cpc6-jan2002/cpc6-all.pdf).

The Asset Framework becomes your new knowledge coordinator. (Bascur & Kennedy, Measuring, Maximizing and Managing Refinery Performance, Hydrocarbon Processing, page 111).

The IDEA is to track the variance in Real Time and not wait for the end of day or week to make important decisions in the digital age.

Extracted from:

A Journey towards a Digital Transformation in the Process Industries available in PI Square.

https://pisquare.osisoft.com/docs/DOC-2935-journeydigitaltransformation-draft-c1-4-binder1pdf