Valuable information is hidden in the vast amounts of data being collected at today’s process industry facilities. Finding that information and presenting it to the right people is a significant challenge facing industry today. Finding the right data and analyzing it with the right tools within the correct context transforms plant data into actionable information. Actionable information enables corporations to more quickly make business and operational decisions, respond to changes in the market and deal with upset conditions.

Getting plant data to the user community is the goal of many industrial information projects. A more effective goal is to get the right information to the right people at the right time. Having the right people spend more time with the right information enables them to find areas for improvement and cost savings instead of wasting their time looking for relevant data.
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Before a system can truly provide value to the organization, you must consider and overcome several problems. This paper will discuss the best practices I have discovered implementing user-centric decision-support systems for small, large, and global companies. I will discuss issues surrounding proper architecture, appropriate data consolidation, the use of KPIs and metrics, advantageous visualization techniques, and decision-support strategies. Figure 1 illustrates the concepts in a hierarchical diagram.

Figure 1 - Data visualization framework

Architecture

The architecture of the solution is the foundation of the system. This can make or break any information project. The first issue to consider is ensuring a secure and reliable connection to your data facilities such as historians, maintenance databases, lab systems, and financial information. No matter how much time and effort is spent on the later steps nothing will affect the acceptance and usability of the system more than consistent and fast access to the raw data and information users are after.

A consistent issue at many facilities is the proprietary nature of control systems and the barriers between systems as seen in Figure 2. Each system requires its own analysis and management tools, leading to training and maintenance problems. Having a thick-client application installed on all users’ computers requires a license fee and annual maintenance for every install, as well as support personnel to ensure smooth handling of upgrades and troubleshooting.
Implementing Decision-Support Portals based on Data Visualization Best Practices

Introducing tools that bring the disparate systems together at the lowest possible level alleviates the need for proprietary interfaces. OPC has become the published industry standard for integrating the control layer with the information/application layer. This approach addresses the first part of the data consolidation problem. Having your plant data consolidated allows you to begin correlating your business data such as LIMS, alarms, maintenance and financial.

Figure 2 - Different DCS, different historians, proprietary clients

![Figure 2 - Different DCS, different historians, proprietary clients](image)

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Figure 3 - Different DCS, common historian, common web client

![Figure 3 - Different DCS, common historian, common web client](image)
Another issue to consider at this time is ensuring a secure control network while providing easy access to the appropriate data. This can be addressed with a three-tier network strategy that isolates the control network from external disturbances and issues such as denial of service attacks or excessive network traffic generated by worms and viruses. A three-tier network, similar to the one represented in Figure 3, restricts network access to a one up/one down style of communication. This restricts anyone from the business network from connecting directly to a DCS and having unrestricted access. DCS data is available to the business network through an historian and web visualization application.

End users require easy access to the system and to the information they need. Balancing this with the need for a secure environment is the function of the three-tier architecture. Using network security allows for easy access and seamless connectivity to the new decision-support system. Reducing the number of passwords and logins a user has to use to do their job is important in that it makes the adoption of a new system easier.

**Data Consolidation**

The number of data repositories in a plant is continually growing. With each new data source users must learn a new tool to access the data and analyze it. Each silo of data has its own method of data access and it is very difficult to correlate the information from these disparate sources. Collecting operational data and compiling it into production and operations reports takes significant amounts of time and effort. Often these reports are out of date by the time they make it to the key decision makers. Making business decisions on old information prevents an organization from being agile and responsive in changing market conditions.

Consider that Maintenance history + current operating conditions + financial implications = ability to intelligently schedule maintenance. Does it make sense to run this component to failure or does it require scheduled downtime for repair? Consolidating disparate data into one tool allows this type of analysis to be accomplished quickly and effectively.

Reducing the number of tools needed and enabling users to analyze data from multiple sources allows decisions to be made quickly and more accurately. Having access to accurate and timely reports allows facilities and organizations to respond faster to external market forces. Companies that consolidate their information systems into a single environment also reduce administration costs and license fees.
Implementing Decision-Support Portals based on Data Visualization Best Practices

Figure 5 - Data consolidation

Figure 5 illustrates how consolidating plant data into a web visualization application allows multiple thin-client applications from many groups to access the data in a consistent and controlled manner.

Have your experts analyzing data and making decisions on timely information, not searching for data and relying on rules of thumb or fudge factors to come up with mission-critical decisions.

Using existing infrastructure reduces the cost of implementation and allows for easier integration into existing business practices. Products like Operational Insight are good examples of software solutions that help organizations overcome their data disparity and take advantage of the information hidden within their facilities.

Operational Insight is Powered by Matrikon, which represents vendor neutrality. This product works with third-party control systems and applications.

**KPI and Metrics**

All organizations use metrics and key performance indicators (KPIs) to do business and remain competitive. A decision-support portal presents this key information to the right audience. Translating business objectives into measurable statistics requires industry specialists and domain experts. Producing the results takes instrumentation, business processes and software.

When implementing a decision-support system the equations behind the numbers must be validated and made transparent to all stakeholders. Standardizing the way performance is measured removes finger-pointing and shoulder-shrugging and brings accountability and traceability to the system.
Implementing Decision-Support Portals based on Data Visualization Best Practices

Automating data collection and analysis frees up your domain experts to act on the information instead of chasing the numbers down and verifying their validity. Ensure the system has processes in place to verify the raw data being used in the metrics. Decision makers need to have faith in the information being presented to them. A successful data visualization system provides user-specific information. Displaying the appropriate information in context to key decision makers will allow them to make timely decisions and monitor progress.

A history of metrics and KPIs is necessary to provide concrete evidence of improvement and can be used to quantify ROI on efficiency and productivity initiatives.

KPIs and metrics provide a consistent message and quantifiable goals. Having the entire organization on board and understanding their individual impact on the numbers aids in morale and accountability.

Visualization

The problem in today’s facilities is too many single-use tools. One tool is used to trend the raw process data, one tool to review lab results, one tool to look up maintenance details, and one tool to view alarm information. The bulk of a person’s day is spent finding the relevant data and manually correlating them into static reports that are already out of date. This non-value-added time would be better spent making decisions on actionable information.

Display the right information to the right people. Visualize information in context with user-centric displays. Having the most recent data correlated, aggregated and available at any time allows for better decisions that are more relevant to the current conditions. Figure 6 is an example of how to organize appropriate information for key decision makers. KPIs give insight into the operating status of a plant while the appropriate visualization tools provide the ability to further investigate the information behind the KPIs. This functionality in one common interface speeds up the analysis of issues affecting the operations of a facility.

![Figure 6 - KPI Dashboard](image-url)

Use advanced display techniques to highlight key issues. Sorting through record after record or displaying information in its raw form can make it difficult to isolate the largest issues at a facility. The design of the interface should bring attention to the most important assets or problems immediately. Identifying the assets that have the largest impact on profitability and weighting the data aggregation appropriately can allow users to focus on the key issues.
Figure 7 showcases the advantages of using a technology such as treemapping to visualize the Relative Performance Index and saturation of the control loops in a pulp and paper plant. Large red boxes immediately draw the attention of an engineer to a trouble area in the facility. Historically an engineer would need to analyze large amounts of operating data to find issues such as these.

![Figure 7 - Advanced visualization](image)

Having various tools has historically meant many ways of interacting and displaying data. This is a costly problem, as every user requires training on how to interact with the system and requires several sources of support. Having one consistent interface allows for lower support and training costs. Allow experts to create content and collaborate on key issues by providing an easy-to-use tool that consolidates all the data and information needed to improve productivity and profitability. When designing displays, ensure there is consistent layout and functionality to all tools regardless of where the information is coming from.

**Decision Support**

A decision-support portal facilitates getting the right information to the right people at the right time. Notifying maintenance of an imminent equipment failure can save immense amounts of money. For example, a large power company was able to identify an issue in their turbine four weeks before a bearing failure would have occurred. This one event saved the company over one million dollars in lost production, as they were able to schedule maintenance at the appropriate time. Identifying key underperforming areas in the facility can reap large returns. Focusing the right personnel on the right information at the right time is the goal of any decision-support portal.

Use roll-up metrics to focus on key areas. That is, consolidate information into a high-level indication of the general status of an asset. Group associated rolled-up metrics together to provide top-level displays that will highlight areas in the facility or enterprise that require attention. Figure 8 is an example of a corporate-wide, top-level display. It is showing the current health of key assets across the enterprise in real time.

![Figure 8 - Corporate monitoring](image)
Implementing Decision-Support Portals based on Data Visualization Best Practices

The ability to “drill in” to the area of concern will bring up a more detailed breakdown of the information creating the metric. Weight the data used to ensure mission critical information is not glossed over by other information used in the metric. This approach allows experts to monitor large areas and ensure they are focusing on the key issues affecting performance.

A decision-support portal encourages the sharing of domain knowledge and concepts allowing experts to create content that is shared among peers. This will capture their knowledge in a public space as opposed to Microsoft® Excel® sheets trapped away on hard drives.

To encourage adoption of a new system, ensure end users are involved early on in the design phase. The people who will use the system know what information they need to see and will have valuable input on the ways to present the information. Having “Champions” involved during the validation stages reinforces the user communities’ trust in the information. Exposing a test audience to the system allows for genuine feedback and reduces the risk of frustrating and alienating the final user group.

Conclusion

The proper implementation of a decision-support portal will reduce time spent looking for and manually manipulating data while increasing the time spent analyzing actionable information. The proper system will increase collaboration and knowledge capture while reducing total cost of ownership.

Increase the time your people are spending on higher priority issues. Get the right data to the right people, at the right time!

For more information:
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