PATTERN DISCOVERY
TECHNOLOGIES INC

Production Intelligence

measure...monitor...manage plant performance™

The more information there is, the more time you must spend converting it into knowledge. We've made it easy to produce, collect and transmit information. We haven't made it easy to consume information.

MIT scholar Geoffrey Brooke summing up the relationship between people and information

Introduction

In the world of complex industrial processes, such as oil sands plants or petroleum upgrading facilities, organizations make significant investments in technology and infrastructure to automate processes and provide better control of plant operations. Distributed Control Systems, Process Information Systems, Dispatch Systems, Maintenance Systems and Quality Control Systems produce gigabytes of new data daily. Like a series of islands, data is often stored in separate repositories and in different formats, making it difficult to establish connections between the countless measurements taken. Even if data resides in one repository, the sheer volume makes it humanly impossible to discern meaningful patterns that contribute to poor plant performance.

Process engineers are forced to use subsets of information, often leading to incorrect or conflicting resolutions due to biases introduced or improper assumptions. Each automation and control subsystem, in its unique way, accurately describes ***what*** has happened in the plant but not ***why*** it is happening.

Organizations today demand improved productivity from their existing facilities. Plant operators, process engineers, plant superintendents and managers are looking for ways to leverage the wealth of data available from their production systems to improve plant performance and business profitability.

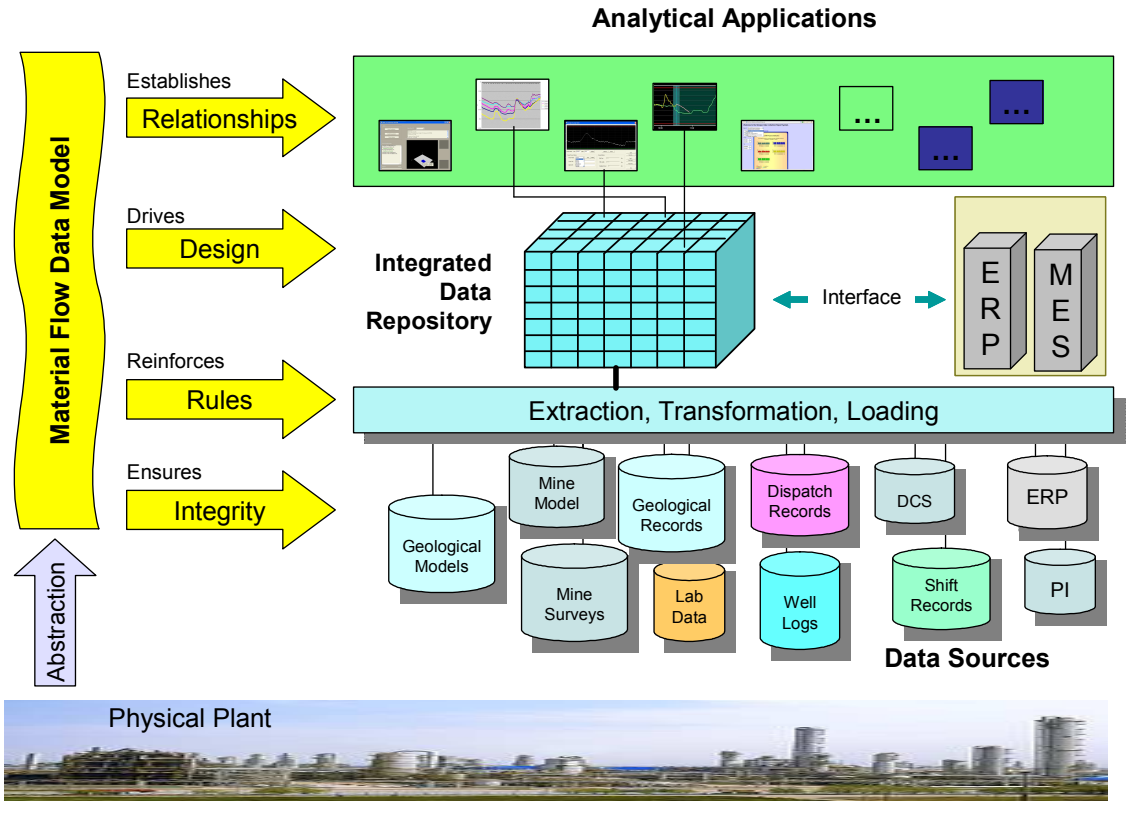
Pattern Discovery Technologies ***Production Intelligence*** solutions are designed to do just that!

Delivering Production Intelligence ~ An Overview

Production Intelligence is an analytical framework developed by Pattern Discovery Technologies to measure, monitor and manage plant performance. ***Production Intelligence*** leverages existing investments in technology and infrastructure and provides a unified platform to unlock knowledge hidden in plant operating data. It consists of:

- Material Flow Data Model (MFDM)
- Extraction, Transformation and Loading (ETL) Tools
- Integrated Data Repository (IDR)
- Modular Analytical Applications

The applications, driven by end-user requirements, are sophisticated analytical tools and predictive models that create actionable views of plant performance. By connecting, transforming and presenting plant data in a unified fashion, ***Production Intelligence*** reveals new and exciting opportunities for process improvement. The following figure illustrates the components of a ***Production Intelligence*** framework.

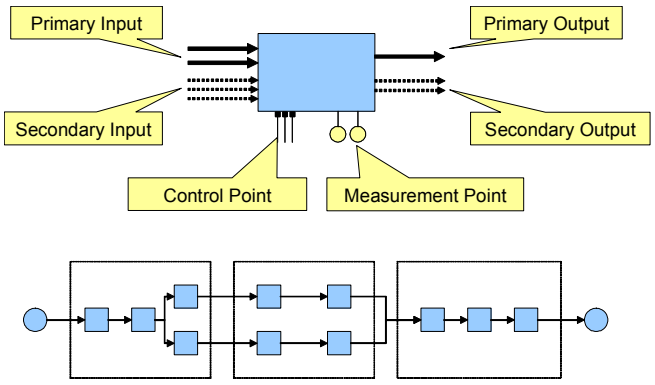


Production Intelligence Framework

Establishing Context ~ The Material Flow Data Model

Complex industrial processes pose a unique data analysis challenge for process engineers and data mining experts. Sophisticated systems that manage and control the production process serve unique purposes and are seldom linked to provide an "overall view" of the operation. Data is often stored in separate databases and in different formats, making it extremely difficult to link events in an informative way.

Data integrity issues such as volume, errors and omissions compound the problem and must be rationalized before any meaningful analysis can be done. Pre-processing data, including working with subject matter experts to establish "context" for each data element, rationalizing data integrity issues and developing data models suitable for analysis, consume much of an analyst's time. To streamline this prerequisite, Pattern Discovery Technologies has developed the Material Flow Data Model (MFDM) which is designed to capture context knowledge and ensure data can be used readily and efficiently in downstream analysis applications.



The Material Flow Data Model is the foundation of the ***Production Intelligence*** framework. It is a representation or schema of the operational flow of data throughout the entire process and mirrors the readily understood material flow through the plant. Building on generic elements of material inputs, outputs and transformations, the MFDM establishes "data relationships" across the entire production process. Regardless of how the data is generated or where the data is stored, it can now be linked to other data elements in the operation, providing a clear picture of circumstances and situations that occurred at point of capture.

The MFDM also ensures that data conforms to specific standards, capturing errors, omissions and data gaps that may exist with each data source. As new sources of data become available, it is simply a matter of "plug and play" to incorporate this new information.

In addition to establishing context for the data within the industrial process, the MFDM also provides the computational logic necessary to drive analysis applications.

Insights Into Improved Performance ~ Analytical Applications

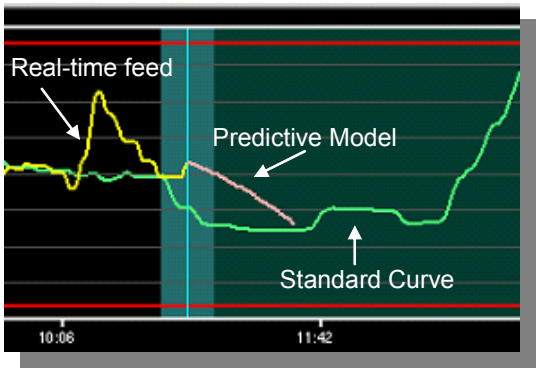
The real power of ***Production Intelligence*** lies in the analytical applications that extract meaningful insight from operational data. These applications, used by operators, engineers and managers alike, deliver actionable views of performance across the enterprise. Sophisticated analytics and predictive models, combined with monitoring and reporting tools, provide real-time decision support systems for plant operators. In-depth analysis capabilities unlock treasures hidden in production data that lead to performance improvement.

Analytical applications fall into four broad categories:

Feed Forward Process Control

Distributed control systems allow operators to monitor continuous processes and ***react*** to conditions. Feed Forward Process Control (FFPC) adds a new dimension by equipping operators with tools to anticipate change and ***proactively*** make adjustments prior to performance deterioration. It is a series of analytical applications that moves process control from a reactive to a proactive mode. FFPC provides:

- Advanced notice of changes in material
- Standard operating conditions for Key Performance Indicators (KPI's)
- Real-time monitoring of KPI's
- Models that predict deteriorating conditions



Root Cause Analysis

Fluctuations occur in any complex industrial process. They can be a result of unexpected feedstock changes, operator adjustments or even equipment failure. It is critical to quickly understand the cause of these deviations, rectify the problem, and implement standard practices to prevent a recurrence. Root Cause Analysis (RCA) modules provide the ability to trace critical conditions by time stamping events in the process. Rather than simply pointing fingers, cross-functional teams can now collaborate effectively on causes and cures.

Performance Learning

In order to optimize operations, it is important to systematically capture performance results and link them to specific operating conditions. We call this a Performance Learning System. By clearly understanding cause and effect relationships between results and contributing conditions, process engineers can develop operator guidelines that enable superior performance at each step of the process. ***Production Intelligence*** provides the framework to capture these relationships and create the guidelines. Process improvement engineers can validate simulation exercises and perform additional "what-if" scenarios to fine tune the process.

Real Time Visibility

Dashboards and scorecards have emerged as one of the most effective ways to monitor the performance of an organization. ***Production Intelligence*** brings this capability to key stakeholders in the production process by providing real-time feedback on performance issues. Rather than relying on outdated production records reporting on how things ***were***, production managers gain improved visibility into how things ***are***. They are now equipped to contribute to strategic and tactical decisions that will positively impact production throughput. ***Production Intelligence*** provides highly customizable, interactive dashboards, scorecards, graphs and reports for superior management of plant performance.

Summary

When it comes to large, complex, industrial processes, even small improvements in operating performance can yield significant returns to the bottom line. Without the right framework, finding areas for improvement is like searching for "a needle in a haystack". Pattern Discovery Technology's ***Production Intelligence*** solutions unlock valuable information hidden in process data, providing unprecedented opportunities for improved plant performance.

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Pattern Discovery Technologies Inc. (PDT) is the leading provider of ***Production Intelligence*** solutions to manufacturers who demand real-time measuring, monitoring and managing of plant performance.

Headquartered in Waterloo, Ontario, Canada, PDT is a spin-off from the world renowned Pattern Analysis and Machine Intelligence (PAMI) Lab at the University of Waterloo.

PDT has been performing analysis services and providing solutions based on its patented data mining and predictive analytic technologies since 1997. Its solutions and services have been utilized by leading oil and gas companies in North America and Asia.

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