TIBCO Spotfire and OSIsoft PI System Interactive Analytics

WHY SPOTFIRE?

TIBCO Spotfire is an analytics software platform for smart data discovery and collaboration. It has been ranked highest in ease-of-use, advanced analytics, cross-product integration, text mining, and upgrade evaluation criteria in the Forrester Wave: Enterprise BI Platforms With Majority On-Premises Deployments, Q3 2017. Spotfire lets you discover and share critical insights across real-time and static data to drive real business value.

Data analysts and information workers in manufacturing, energy, and utilities increasingly turn to TIBCO Spotfire® to analyze diverse data sources in a highly graphical and intuitive fashion. Spotfire connects to a vast array of structured and unstructured data sources, and you can combine its capabilities with OSIsoft PI System data to bring new, rich insights into product quality, operations, distributed assets, and the Internet of Things. What are the true root causes behind machine failures and product quality issues? How should you optimize maintenance to hold down cost and maintain efficiency and output in a safe operating regime? How can you use this new insight to build predictive models that let you intervene early and optimize operations across large fleets of assets?

The power of OSIsoft — the leader in operational intelligence — and Spotfire together allow you to answer these pressing questions.

TIBCO STATISTICA

The TIBCO Statistica® advanced analytics and data science platform provides validated enterprise analytics, predictive modeling, and advanced process monitoring for process and discrete manufacturing. TIBCO Statistica Enterprise can integrate OSI PI process data with external structured and unstructured data sources, supports big data and text mining capabilities, model-based virtual sensors, SPC, experimental design, and process monitoring. The Statistica Enterprise system delivers role-based validated GMP/GxP analytics for regulated industries, 21 CFR Part 11 compliance, approval processes, version control, and comprehensive model management and governance.

Spotfire allows for exploratory analysis. Above, stopped pumps and the sensor readings of each.

SOLVING PROBLEMS TOGETHER

Organizations have a wealth of sensor-based data available in their PI System. Spotfire allows them to analyze events either as they occur, using the context of past data for reference, or as part of a data discovery phase, combined with other data, to find root causes, trends, and outliers. OSIsoft and TIBCO have worked collaboratively to build and test these solutions in the field.

TIBCO brings a range of assets, many developed with the assistance of OSIsoft, to provide field-proven solutions to many of the most challenging asset-based analysis issues.
By combining PI System data “at-rest”—either directly from the PI Data Archive or via Asset Framework (AF)—with data from ERP systems such as SAP, relational databases, Apache Hadoop®, and unstructured sources, you can obtain a more holistic view of the business, allowing users to extract more meaningful insights and make educated business decisions. You gain the ability to mitigate risks of plant failure, measure regulatory compliance, reduce maintenance costs, and improve safety and security.

By connecting directly with real-time streaming PI System data “in-motion” via TIBCO StreamBase® streaming analytics, organizations can compare actual readings with sophisticated statistical models that will help predict performance, downtime, and running costs, such as energy efficiency. Moreover, real-time adjustments, alerts, and instructions can be generated to avoid failures and risks or to improve operational efficiency.

By being able to look at both at-rest and in-motion data sources, and therefore understand machine-operating characteristics in varying environments and points in time, you can produce continuous improvement.

**TIBCO CONNECTED INTELLIGENCE**

TIBCO® Connected Intelligence generates an Understand – Anticipate – Act analytical cycle, allowing users to analyze real-time events across all their enterprise functions and data sources for complete visibility into business operations. TIBCO Connected Intelligence enables you to:

- Use historical sensor-based data from the PI System to model patterns of good or bad behavior in Spotfire. For example, factors that may lead to component failures, excessive consumption of inputs, or poor quality product.
- Identify event anomalies during a business process with the help of event aggregation and real-time predictive models.
- Create an automated trigger to prepare and deliver a Spotfire analysis that provides contextual reference: “Something went wrong. Show me the data in a way I can understand.”
- Alert decision-makers of an urgent need to analyze the business process in question.
- Prompt the decision-maker to take action as appropriate.
- Review the models on a regular basis for adjustment, providing closed-loop continuous improvement.

![Trace data for three sensors visualized in TIBCO Spotfire and compared to total and average machine usage.](image-url)
The empowering capability streaming analytics steers organizations to identify new opportunities, minimize their business risks, reduce costs, and drive operational agility. And streaming analytics applications are useable by people in the field because they are simple to create, modify, learn, and share, with no coding involved.

WHERE STREAMING ANALYTICS IS USED TODAY
Streaming Analytics can be used in a wide range of applications where sensor data from PI System needs to be analyzed on its own against other PI System instances and other application data.

OPERATIONS
Root cause analysis is used to determine which sensor parameters and trace signatures have the greatest value for predicting machine failure, operational efficiency, or product quality. The original sensor trace data, real-time or historical, can be retrieved along with machine status data into compelling Spotfire visualizations that bring immediate insight.

For example, in upstream oil and gas exploration, users want to know why certain drill bits stick and slip in certain locations, in order to improve penetration rates. They need to know what to do right now to mitigate issues in the field, but also to reliably predict which conditions may cause issues in order to improve procedures going forward. Spotfire allows them to combine results across multiple wells and reservoirs to build a robust model for guiding the driller as he drills. In this scenario, you can replace “wells” with any type of machinery or vehicle to produce a model of operation in a given location. And Spotfire will also help resolve differences in tag names across machines so that comparisons can be made faster and more accurately.

A further example of operational improvement occurs in high-volume solar cell manufacturing. Here, real-time monitoring is needed at critical process steps to alert workers as soon as equipment sensor readings or in-line product measurements predict that bad product will be produced.

Diagnostic Spotfire analysis showing well location, sensor traces, and values.

MAINTENANCE AND FAILURE
Models that predict failures from sensor data are also used to trigger just-in-time machine maintenance, thus avoiding unexpected downtime, unnecessary maintenance, and sometimes, environmental and health risk. Models in Spotfire are built using out-of-the-box regression and classification capabilities or a wide variety of more advanced models deployed with TIBCO Statistica (and Python, Spark, spark.ml), R, S-plus, SAS, MATLAB, Teradata, or KNIME functions. Multiple models can be fitted and then evaluated to select the one with the best ability to predict for the particular plant item, whether a pressure vessel, pipeline, pump, drill bit, or even an airplane engine.
Comparison of classification, logistic regression, and random forest models to accurately predict machine failures.

Once selected, a model is deployed directly from the Spotfire analysis to the Spotfire Event Analytics engine. This engine monitors all real-time incoming sensor data, scoring it against the model. When the model predicts a machine failure is imminent, automatic alerts are triggered.

DEPLOYMENT
Spotfire, Statistica, and StreamBase connectivity to OSIsoft’s PI System is via custom built extensions. Along with working samples that enable users to build interactive visualizations on top of PI System data, these capabilities help our customers get up and running faster, able to see their PI System data in new ways and share it with colleagues whatever their technical abilities.

The following custom components are currently provided:

- A Spotfire custom data source that can read lists of PI System tags into memory along with metadata describing the tags
- A Spotfire custom data source that can read tag data from multiple tags across multiple PI System servers into memory
- A Spotfire custom data function that allows dynamic updating of tag data based on marking, document properties, or scripts
- A Spotfire custom data source that can read element and attribute metadata and attribute data from the PI Asset Framework into memory
- A set of Spotfire custom automation services tasks that allows use of the above components within TIBCO Spotfire® Automation Services for batch operations
- The PI Add-in for TIBCO Statistica integrates data from PI databases and the PI Asset Framework and provides it either in a Statistica spreadsheet for further processing, or as a data access template for repeatable or scheduled analytics or process monitoring. The PI Add-in creates a native Statistica querying tool for both online and offline processing by PI and Statistica suite users.