

SentientCause

Rapid Root Cause Identification Technical Fact Sheet

SentientCause is Synengco's leading technology for managing abnormal process and equipment operation and to assist power generators to:

- Improve efficiency and reliability;
- Reduce emissions;
- Manage abnormal operations; and
- Monitor equipment and processes,

SentientCause finds the root cause of abnormal process and related equipment operation.

SentientCause Operation

When we developed SentientCause we understood that no single technology could provide the solution to all problems. SentientCause was, therefore, designed using a framework of hybrid technologies, combining fundamental (using the laws of physics) and statistical (using the laws of relationships) techniques.

To overcome challenges with existing analysis tools on the market, SentientCause uses a range of technologies such as standard instrument evaluation based on process knowledge,

process relationships and other instruments within the system to validate instrument data within seconds. To accelerate analyses, data and time sets are created that can be re-used during the analysis and shared with all users.

These data and time sets can then be selected and a total solution provided by a full range of analyses including (but not limited to) the following:

- Standard statistical analysis
- Statistical process control;
- Multi statistical process control (a powerful tool providing a unique signature for comparison to future faults to allow rapid identification of root causes);
- Partial least squared;
- Hotellings TA² score;
- Standard prediction error;
- Sentient event impact analysis;
- Neural networks;
- Mass and energy balance precision model;
- Patented Sentient process and financial analysis; and
- Business component analysis system. A financial analysis linked to the process operation that provides you with, the

commercial impact of the problem on efficiency, emissions, maintenance, quality and capacity.

Each analysis provides a different diagnostic view of the problem. The insights and information revealed allow the user to triangulate to identify and isolate the root cause of the problem.

To overcome the requirement for fleet wide specialists to have local knowledge of every plant, data sets are organised in a hierarchal manner reflecting the system. The user can then select all the data tags associated with a piece of equipment in two clicks. With common instrumentation (e.g. feedwater heater outlet is also feedwater heater inlet temperature) the data is presented for both pieces of equipment, so the user does not have to trace the process information diagram to find the data tags required for analysing a problem.

Notes can be added to the data and time sets throughout the process to assist others in reviewing the root cause analysis or as a reference in future fault and abnormal operations analysis.

The multi statistical process control analysis is particularly powerful and provides a unique signature that can be compared to future faults for rapid identification of a root cause.

SentientCause allows for:

- Rapid abnormal or fault identification;
- Data/instrument validity checking;
- Exclusion of invalid data from analysis;
- Identification of component contribution to fault;
- Identification of event contribution;
- Analysis of long term vs. short term contributions;

Table 1: SentientSystem Coverage

Equipment	Frequency of Fault	Fault Impact	Ability to take short term rectification	Sentient Cause Coverage
Generator	Low	High	Low	✓
Steam Turbine	Low	High	Low	✓
Condenser	High	Medium	Medium	✓
Condenser Cooling System	Medium	Medium	Medium	✓
Feedwater Heating	Low	Low	Medium	✓
Boiler Feed Pump	Low	Medium	Low	✓
Boiler Fans	Low	Medium	Low	✓
Air Heater	Medium	Medium	Medium	✓
Boiler	High	Medium	High	✓
Emissions Control	High	High	High	✓
Pulverisers	Medium	Medium	High	✓
Coal Handling	Medium	Medium	High	✓

- Comparison against previous operations and base case;
- Quantification of process impact;
- Quantification of financial impact; and
- The capture of knowledge for future use by all users.

The range of users who benefits from SentientCause

SentientCause was structured to allow both the experienced engineer and specialist to carry out rapid fire analysis and also for the new user to follow the SentientCause 10 step analysis process to ensure a thorough and complete analysis is undertaken.

The step by step process adopted by SentientCause allows for analysis by a new user to be completed in a timely effective manner and readily reviewed by colleagues and experts.

Integrated with SentientAlert (Earlier Warning System)

The information gained by using SentientCause can be transferred to the SentientAlert System and automatically presented to the appropriate personnel to increase the speed, consistency and suitability of the abnormal operation or fault response.

Coverage of Process and Systems

SentientSystem® covers the entire process and systems of power generation for both gas and coal fired power generators. While each plant has a unique set of equipment and challenges, Table 1 summarises the typical fault frequency and impact as well as the ability of the plant to take short-term corrective action (i.e., not major outage to investigate and repair) for each of the components within a coal fired power station. Many of these components are also common with gas-fired plants. As noted in Table 1, SentientAlert and SentientCause cover all equipment and processes. Importantly they cover both equipment with a high impact and also the equipment most likely to generate faults.

This comprehensive coverage allows plant operators to take short- term corrective actions.

This extensive coverage is unique to SentientSystem® and has the benefits of providing:

- A comprehensive solution for early warning of potential problems; and
- The root cause of a fault and identification of the required solution.

Benefits of SentientCause

SentientCause rapidly identifies problems that other systems are unable to find.

The SentientCause process also captures information in real time without reliance upon an expert to record his or her knowledge.

SentientCause provides earlier warning of impending failures, as it is able to:

- Detect smaller process changes;
- Analyse the impact individual sootblowers have on the boiler heat transfer;
- Detect 0.1% changes to turbine stage efficiency;

- Detect sub-optimal control of heater levels in feed water heating systems;
- Detect intermittent failure of electric static precipitators to clean (resulting in opacity breaches on effective operation);
- Detect pump efficiency losses;
- Isolate boiler slagging to an element; and
- Evaluate effectiveness of overhauls in maintaining or improving the process.

The platform provided by SentientCause automatically creates data and time sets, or re-uses them to allow the user to quickly carry out analysis. The knowledge capture function benefits both new and experienced users. It is our experience that a new user can carry out investigations after an 8-hour training session and is fully proficient within one week of use.

SentientCause has effectively and commercially diagnosed the root cause of problems from \$10,000 to \$15,000,000 per year.

Table 2: SentientCause Options

Option	Features	Hardware	
		Sentient Server	User
SentientCause Basic	<ul style="list-style-type: none"> • Low Cost • Uses plant instrumentation 	CPU: Intel® Pentium® IV 3.2GHz/800/1M RAM:2GB HDD: 250GB Monitor: 17" (1280x1024 res)	CPU: Intel® Pentium® IV 3.0Ghz/533/1M RAM: 1GB HDD: 160GB Monitor: 17" (1280x1024 res)
SentientCause Lite	<ul style="list-style-type: none"> • High precision total unit model including boiler • Virtual instruments of key parameters 	CPU: Intel® Pentium® IV 3.2GHz/800/1M RAM:2GB HDD: 250GB Monitor: 17" (1280x1024 res)	CPU: Intel® Pentium® IV 3.2GHz/800/1M RAM:2GB HDD: 250GB Monitor: 19" (1440x900 res)
SentientCause Quantum	<ul style="list-style-type: none"> • Trend profile analysis • BiCas Financial Analysis 	CPU: Intel® Xeon® 3.2GHz/800/2M (Dual Core) RAM:4GB HDD: 500GB Monitor: 17" (1280x1024 res)	CPU: Intel® Pentium® IV 3.2GHz/800/1M RAM:2GB HDD: 250GB Monitor: 21" (1440x900 res) Recommended 2nd Monitor: 17" (1280x1024 res)
Operating Systems	Microsoft Windows 2000 professional Microsoft Windows XP Professional Microsoft Windows Server 2003 Linux		

SentientCause Options

SentientCause is the most sophisticated analysis tool in the market today. As not everyone will require the full range of tools that comprise SentientCause, a range of smaller modules can be chosen to meet your specific needs (See table 2)

SentientCause can be expanded to include all or some of the remaining modules as required by you. The additional modules provide further diagnosis types that may be required to resolve more complex problems.

The Payback Period

SentientCause effectively pays for itself. Our clients experience payback periods ranging from 6 to 18 months.

To Contact Us

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