



May 2011

Early Detection of Abnormal Operation
using a real-time data mining tool
geoff.artley@gb.abb.com

Agenda



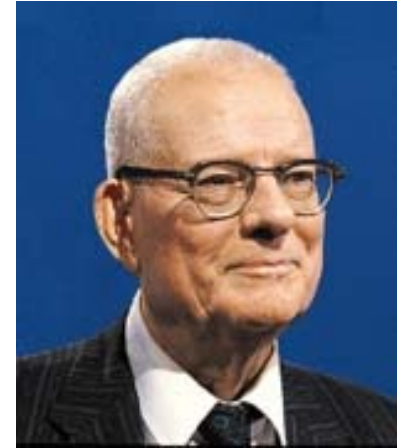
Short Introductory Presentation

- What is it and why is it important?
- How it works and typical execution
- How does the alert work?
- Scores Plots
- Benefits
- Summary
- Future

Understanding Variability

“If you are responsible for the management or improvement of a process then you need to understand process variability.”

Dr W. Edwards Deming



All processes exhibit variability

- Expensive and unwelcome
- Causes are hidden in data complexity

Control systems hold massive quantities of data

- Potentially valuable asset
- Mainly wasted

Process diagnostics enables organisational profit from data

- Process Investigation & Improvement
- Six Sigma & Lean Manufacturing

EDAO - WHAT is it and WHY is it important?

- Data Mining Application
 - Modern DCS generate terebytes of data that is generally unanalysed
 - What is done with that data
 - Kept for Regulatory requirements
 - Stored away on DVDs
- Data contains a goldmine of information
- Unlocks the hidden potential of a system's data
- Transforms data into Information
- Increases Profit
- Reduces waste
- Reduces unplanned shutdowns
- Aids the User to understand Process Variability
- The application is applicable to all processing units (including rotating equipment)

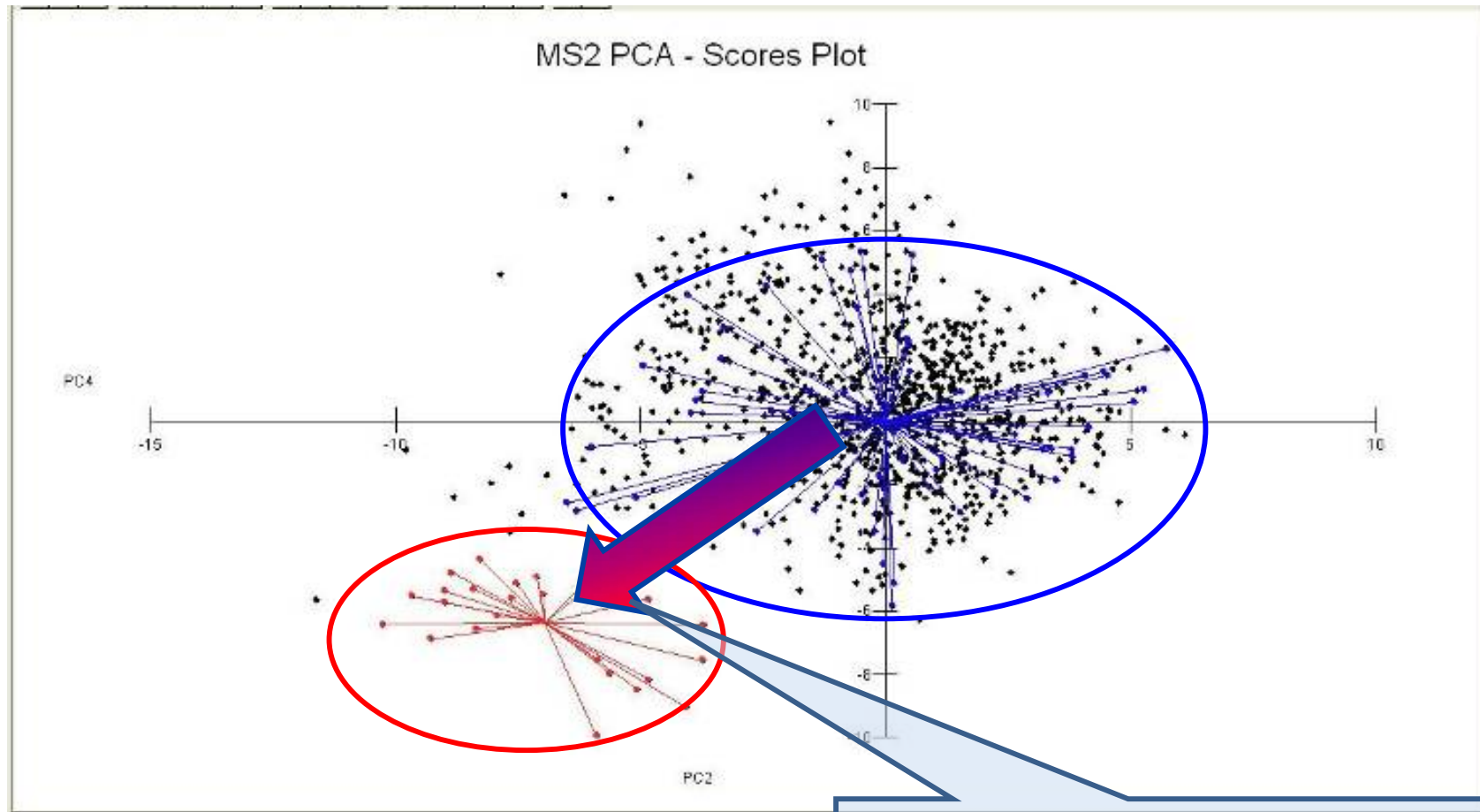
How it Works & Typical Project Execution

- The Early Detection of Abnormal Operation Application is real-time, on-line.
- An off-line version (MS2) is used to assess the potential and determine normal operation – We can do this through a PILOT PROJECT (you only pay for our time)
- The measurement of interest is determined (quality or other high-level measurement)
- History data is used to model the process and determine the “normal”, “good”, “required” operation.
- The off-line analysis determines the variables that affect the measurement of interest
- It is multi-variable and uses Principal Components Analysis
- OPC is used to connect the application to the system data
- When on-line, the current values of the variables are compared to those that make up the “normal” operation. If they are found to be outside the normal operation envelope then the operator/engineer is alerted – BEFORE A PROCESS ALARM IS INVOKED.

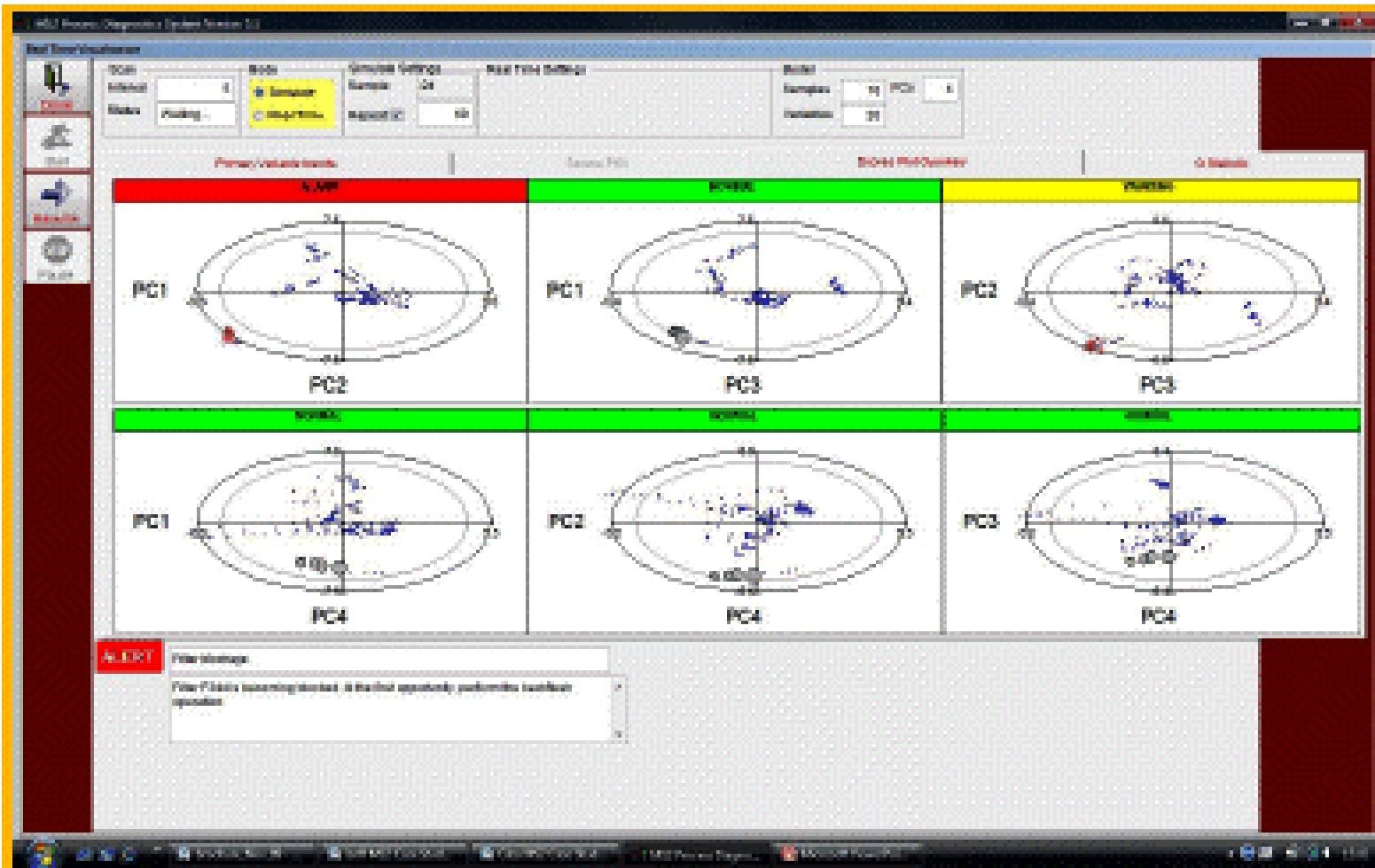
How does the alert work?

- There is a statistical value “Q Value” (which is the square of the errors between current and “normal”). When this value goes high (say greater than 40) the current data is outside of the “normal” and the operator/engineer is alerted.
- The alert can be in the form of an alarm (not always recommended), or a SMS text message to the engineer, or a screen message to the process operator that flashes, and so on....
- For 800xA we can create a text message on the process graphic that could suggest what action the operator should take.
- The text message is generated from an intelligent database where the same abnormal occurrence has already been seen and analysed and configured into a message. (e.g. heat exchanger xxx fouling, filter yyy blocking and so on).
- The alert can be configured to meet the client needs

Example – abnormal operation indication through the scores plot



If the scores plot moves as shown here, bad quality will result **BUT** no single point is in alarm



MS2's PCA score plots provide a fault signature

Benefits

- Increased understanding of the process variability leading to
 - Improve productivity while maintaining quality
 - Reduce operating costs
 - Lower environmental impact and reduced energy & CO2 emissions
 - Improve health and safety
 - Increase operational efficiency
 - Reduce downtime
- Payback can be in days
- Companies are losing knowledge
 - Retirees with experience
 - Downsizing through manpower reductions
 - Reliance more on 3rd party services and consultancies

Summary

- Traditional, single variable statistical techniques are inadequate to understand interactive process problems.
- A cost-effective solution designed for ease of use, flexibility and applicability to real issues was needed.
- Applicability of process analytics technologies to a wide variety of process plants has been achieved with a uniquely integrated system:
 - Need for integrated data pre-processing.
 - Need to address both univariate and multivariate problems.
 - Flexible, powerful visualisation is critical to success.
- Users are experiencing real business benefits through using these applications.
- Demand exists for online detection and identification of process faults.
 - EDAO will meet that demand.

Future

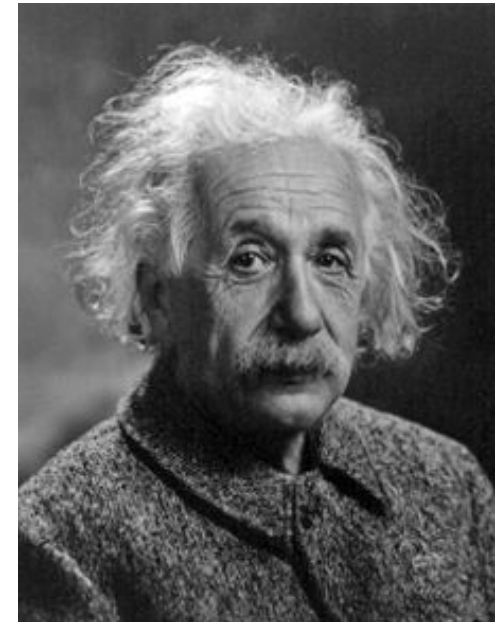
These are my thoughts and considerations

- More powerful computers
- Reduction in alarms
- Less people
 - BUT
 - More OTS
 - What to do if automatic actions fail

A final thought...

**“We cannot solve today’s problems
with the same technology we had
when we created them”**

Albert Einstein



Power and productivity
for a better world™

