COTS Software for Real-Time Situational Awareness of Industrial Operations

by Paul Hagan
OSIsoft
• Intellectual Property – Real Time Operations and Performance
• Real-Time/Historical operational and performance data.
• Validate/Cleanse/Reconcile into Information
• Role Based Decision Support into ERP Strategy.
• Organizations that empower their employees with this information significantly increase productivity, performance, reduce cost and improve Return On Investment.

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During this Presentation we will:

- See examples of how Industrial companies have implemented and benefited from COTS deployments.
- How does this impact network performance and application availability?
- Discuss integration with Enterprise Resource Planning (ERP) system – SAP
  – Industrial Case Studies
- Entertain questions
• Late 1970s and 1980s – Automation
• Late 1980s - Manufacturing Resource Planning Systems - MRP and MRP II.
• Mid 1990s - present, Enterprise Resource Planning - ERP systems to understand and optimize asset performance and costing.
Real-Time Situational Awareness for Industrial Operations

Data – Knowledge – Dissemination – Action Infrastructure

- Data
- Information
- Knowledge
- Accessible
- Understandable
- Actionable

Increasing Value to Enterprise

Gather
Assign Context
Analyze
Distribute
Visualize
Act

Industrial Operations

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Real-Time Situational Awareness for Industrial Operations
The objective of the last 25 years has been to put the Right Information into the hands of the Right People to make the Right Decision, or … Role Based Decision Support.

The most successful companies have implemented software systems with both a real time and historical data availability.
Real Time information can be used to optimize decision making routines.

- Acquire
- Verify
- Process
- Disseminate

The Process of acquiring, verifying, processing and disseminating asset performance information in near real time provides instantaneous feedback to the decision making teams and engineers that are continually optimizing and maximizing net portfolio positions. Although current optimization tools require static curves, near real time bias of the curves can more closely approximate real unit operations.
There are Operational Risks with Assets

Generation Unit

• Availability
• Reliability
• Performance

The operational risks associated with generation assets include availability, reliability and performance.

Availability and reliability are typically trends that can be predictably quantified using recent historical information. Performance is a moving target influenced by a variety of issues, some controllable and some not.
Performance information is the cornerstone for the decision making process

- 80 – 90% of the cost basis is directly affected by performance
- Heat Rate is the Performance Metric for Utilities

Performance information is utilized in budgeting, strategic planning, unit commitment, fuel acquisition, risk valuation, benchmarking, emissions management and unit dispatching, among others. The issue of concern is that performance measuring information is usually acquired under the best possible conditions, at infrequent intervals, and does not necessarily project current operations. The ability to accurately track and predict performance characteristics increases the accuracy of, and reduces the risk of, all facets of the planning, analysis and delivery process.
Decision Support

Unit Boyd #4 Calculated Vs Actual

PI Heat Input is 3.9% Lower than Calculated Heat Input Curve

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Decision Support

Unit "Just Right" Calculate vs Actual Heat Input

PI Heat Input is 0.05% greater than Calculated Heat Input Curve

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AEP Global View

**North America**
- AEP Wholesale
- 75 plants in Fleet
- Plus
- IPP Cogen
- Brush II
- Fort Lupton
- Mulberry
- Orange
- Eastex
- Frontera
- Newgulf
- Sweeney

**Latin America**
1. Region Office: Washington, D.C.
2. Investment: Bajio (50% ownership) Mexico
3. Investment: Vale (44% ownership) Brazil

**Europe**
4. Region Office: London
5. Investment: Yorkshire Electricity Group (50% ownership)
6. Investment: SEEBOARD (100% ownership)
7. Investment: Medway Power Plant (37.5% ownership)
8. Investment: South Coast Power Plant (50% ownership)

**Asia/Pacific**
9. Region Office: Sydney
10. Country Office: Beijing
11. Investment: CitiPower (100% ownership)
12. Investment: Nanyang General Light Electric Co., Ltd (70% ownership)
13. Investment: Pacific Hydro, Ltd. (20% ownership)
### MR5 Controllable Cost Display

#### Muskingum River Unit 5 Operator Controllable Costs

<table>
<thead>
<tr>
<th>Controllable Cost</th>
<th>Units</th>
<th>Actual</th>
<th>Target</th>
<th>Design</th>
<th>Deviation from Target (Btu/Kwh)</th>
<th>Cost ($/Shift)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Steam Pressure</td>
<td>PSIG</td>
<td>3,615</td>
<td>3,600</td>
<td>3,500</td>
<td>-12</td>
<td>-12.34</td>
</tr>
<tr>
<td>Main Steam Temperature</td>
<td>F</td>
<td>999</td>
<td>1,000</td>
<td>1,000</td>
<td>-9</td>
<td>10.82</td>
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<tr>
<td>1st RH Steam Temperature</td>
<td>F</td>
<td>1,028</td>
<td>1,024</td>
<td>1,025</td>
<td>-1</td>
<td>-19.60</td>
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<tr>
<td>2nd RH Steam Temperature</td>
<td>F</td>
<td>1,049</td>
<td>1,034</td>
<td>1,050</td>
<td>-1</td>
<td>-69.35</td>
</tr>
<tr>
<td>1st RH Attemperation</td>
<td>klb/hr</td>
<td>107</td>
<td>100</td>
<td>3</td>
<td>-1</td>
<td>10.85</td>
</tr>
<tr>
<td>2nd RH Attemperation</td>
<td>klb/hr</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>-1</td>
<td>0.03</td>
</tr>
<tr>
<td>Excess A</td>
<td>%</td>
<td>19.2</td>
<td>18.8</td>
<td>18.8</td>
<td>-1</td>
<td>15.03</td>
</tr>
<tr>
<td>Exit Gas Temperature</td>
<td>F</td>
<td>294</td>
<td>294</td>
<td>290</td>
<td>-1</td>
<td>3.50</td>
</tr>
<tr>
<td>Steam Coil Air Heaters</td>
<td>klb/hr</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>-1</td>
<td>30.87</td>
</tr>
<tr>
<td>Condenser</td>
<td>in. of HG</td>
<td>1.91</td>
<td>1.98</td>
<td>1.84</td>
<td>-1</td>
<td>60.19</td>
</tr>
<tr>
<td>HP Feedwater Heaters</td>
<td>Btu/Kwh</td>
<td>-6</td>
<td>0</td>
<td>0</td>
<td>-1</td>
<td>28.54</td>
</tr>
<tr>
<td>LP Feedwater Heaters</td>
<td>Btu/Kwh</td>
<td>-13</td>
<td>0</td>
<td>0</td>
<td>-1</td>
<td>77.39</td>
</tr>
<tr>
<td>Auxiliary Power</td>
<td>Mw</td>
<td>23.5</td>
<td>22.3</td>
<td>22.7</td>
<td>-1</td>
<td>124.65</td>
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<tr>
<td><strong>Total Operator Controllable</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-1</td>
<td>140.29</td>
</tr>
</tbody>
</table>

**Instant Gross Load**: 598 Mw  **Feedwater Flow**: 3.45  **Fuel Flow**: 431.97  **Calculated Heat Rate**: 9062 Btu/Kwh

**Instant Net Load**: 577 Mw  **Air Flow**: 4.57  **Heat Rate Deviation**: 192 Btu/Kwh

**Load Control (AGC)**: ON  **Target Deviation**: 497 Btu/Kwh

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For more information, explore the following sections:

- Unit Summa
- Guidance
- Boiler Schema
- Turb/Cond Schema
- FW Heaters Schema
- Air Heater Schema
- Sootblower Trends
Canal Electric Case Study

• Business Objectives:
  – Improve Performance
  – Reduce Emissions
Combustion - Normal Operation

- **REDUCING ENVIRONMENT**
  - CO
  - NOx
  - Efficiency

- **OXYGEN RICH ENVIRONMENT**
  - Low CO

Excess Fuel  | Excess Air
------------|------------
NDIA 2003   | Aggregate Excess Air

Real-Time Situational Awareness for Industrial Operations
Optimized Combustion - With Reduced O2

Real-Time Situational Awareness for Industrial Operations

Excess Fuel
Excess Air

18% 20%

Efficiency
Eff Increase

NOx Reduction

CO

Low CO

Same SAFETY Margin

Aggregate Excess Air

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Proven, Measurable Results

Before

After

Boiler Efficiency
Stack Flue Gas NOx

Boiler Efficiency
Stack Flue Gas NOx
Canal Electric Results

- Lower NOx (10% to more than 45%)
- Improve Heat Rate (0.5% to more than 2%)
- Substantially Reduce Cost Of Emissions Retrofits
- 240 BTU/kwh Heat Rate improvement, 2% annual Heat Rate gain @ $20/ton of coal on a 1150 MW Station …

over $2 million annual savings
Exposing the Criticality of Networks

• What about my networks?
• Getting the right data into the hands of the right person highlights network performance, and application availability.
• Availability and Performance
Identifying, Solving and Preventing IT Problems

- Identifying a network or application problem is the first step. This seemingly simple fact highlights the need for the history of network operation especially for intermittent problems.

- We need to know if the problem is:
  - **Hardware**
    Server, Router, Firewall, Switch, etc
  - **Software**
    Operating System, Application, etc.
  - **Networks**
    Local Area Network, Wide Area Network, Remote Locations

- Understanding the history of operation can improve Network Performance, Bandwidth Utilization, and Capacity Planning.

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Performance
Monitor Subsystems, Windows, Hardware

IT Monitor

PI System Status

% Processor Time

Archive Subsystem
- Out-of-Order Events/Sec: 0
- Events Cascade/Sec: 0
- Archived Events/Sec: 6
- Time to Archive Shift: 0.86 days

Snapshot Subsystem
- Out-of-Order Snapshots/Sec: 0
- Event Queue Record Count: 0
- Snapshot Events/Sec: 11

Update Manager
- Pending Events: 18

Base Subsystem
- Point Count: 3249

Network Manager
- Total Connections: 23
- Total Messages Sent/Sec: 6

Corporate WAN
Performance
Monitor Disk Storage & Memory Capacity

Low System Storage
Prove a Memory Leak
Performance
Predict Server Failure - Virus Attack In Progress

Impact on Server from Virus
Performance
Plan Capacity by Bandwidth Usage with SNMP

JONV-329-C1-1
IP: 10.5.55.192

JONVH1ROPC1

JONVH1RPI1

Vers le 321B
**Monitoring:** Global Networks

- US, Europe & Asia

**Benefits of Monitoring Networks**

- **Intelligently Eliminated Over Utilization of Networks, Servers & Applications**
  - Now Can Anticipate & Help Prevent Network Outages
  - Reduce Troubleshooting & Downtime

- **Reduced costs for network bandwidth and line speed**
  - Monitored Service Level Agreement
  - Established baseline to prove usage needs
• DOD has decided to standardize on SAP for ERP. Currently there is a major effort in deploying SAP within the Navy and the ARMY is doing infrastructure planning. This will ultimately impact all installations and intelligent weapon systems.
Gartner Group

"Manufacturing businesses that make investments in ERP-directed manufacturing applications that fail to provide for accurate real-time information from the process will achieve at least 50% lower ROI on those investments..."
Why Link Plants to SAP

- Reduce cost, increase utilization
  - Perform maintenance on usage, not fixed-duration (calendar)

- Maintenance Problem Diagnosis
  - Timestamp comparison of PM notifications to other production events
    - Why recurring problems?
    - Equipment condition affect production/quality?
Asset Management Strategy

- **Condition Based Maintenance**
  - Run hours
  - Service factor excursion
  - Start up/shut down effect and recording
  - Efficiency driven maintenance identification

- **Maintenance Problem Diagnosis**
  - Timestamp comparison of notifications to other production events
  - Why do we have recurring problems?
  - How does equipment condition affect performance?
  - Track asset performance to ensure acceptable operation

- **Budgeting**
  - RLINK delivers validated actual readings into R/3
    - Trust the information
    - Reduce maintenance costs
    - Risk assessment

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Consistent view of plants for ERP

Architecture

ERP
- Production
- Quality
- Maintenance

Client PCs
- Graphics
- Analysis
- ERP portal showing plant KPIs

Corporate LAN/WAN

Typical architecture per plant

Plant LAN

Plant/ERP Gateway

Process Control Secure LAN

PIMS has interfaces to DCS/PLC, LIMS, OPC, SCADA, etc

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Real-Time Situational Awareness for Industrial Operations
Case Studies

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Power Generation (USA)

- Overhaul coal pulverizers
  - Costs US$150,000 every 18 months
  - Coal ground into fineness of talcum powder
    - Blown into furnace, mixed with air, burns 2500 degrees F

- Overhaul based on total coal flow
  - PM has measurement point for coal flow total
    - Calculated in historian
  - Still operate safely, under warranty
Power Transmission/Distribution

- **Power T&D (USA)**
  - $1B invested in 30,000 assets, spend $40M/yr on maintenance
    - Abnormal conditions found during substation inspections
  - Condition-based maintenance
    - Transformer tap changes every 10,000 operations
    - Circuit breakers (calculations)
      - Quantity: if gas added > 5 lbs and < 10 lbs per month on avg. over 6 month rolling period, schedule outage & repair seals
  - Transformers, circuit breakers, relays OK?
    - Reduce transformer & breaker maintenance costs

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Real-Time Situational Awareness for Industrial Operations
• **Plant Profits**
• Estimated greater than $5,000,000 USD saved per annum:
  – At line recovery of batches
  – Automatic Data Entry
  – Fewer data errors and corrections
  – Predictive Maintenance fewer unplanned shutdowns
  – Assignable causes determined more quickly
• Showed quantified savings to the plants of $5 million per year.
• Overall, the operators gain more visibility, avoid spills, monitor plant emissions and environmental conditions more easily, and do a far better job of trouble-shooting problems.
Monitoring real time hearth temperatures set several production records.

Using this real time process information, plant increased the life of their blast furnace shells by over 2 years, which now stands at 12 years. Their cost to reline the furnace is over $150 million.

In their Utilities area, having access to real time data increased their boiler efficiency by 2.5%, which translates into $100,000 savings per year.
• Industrial companies synchronize decisions using ERP systems with real-time information … directly impact on business goals.

• Companies significantly increase their Return On Investment leveraging real-time and historical production information to improve asset efficiency, reduce operating costs, and improve personnel productivity.

• Role Based Decision Support integrated through ERP.
Enterprise Role Based Decision Support

Engineers
- Heat rate improvement
- Reduce unscheduled outages
- Quicker reports

Operations
- Better decisions
- Identify drifting
- Track profitability
- Run at optimal rates

Business
- Optimize fleet per market conditions
- General dispatch
- Lower $/kwh
- SAP integration

Traders/Marketing
- Trade strategy
- Fuel reporting
- Scheduling
- Increase profits

LAN/WAN

Intranet/Internet
Management
Suppliers/Vendors
Partners
Customers
T&D Co-ops

OSIsoft SERVERS

Other Data Sources

DCS, PLC, Lab, Manual, CEM
The Best Companies Successfully Implement COTS

NDIA 2003 Real-Time Situational Awareness for Industrial Operations
THANK YOU

Paul Hagan
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Paul@OSIsoft.com
• Support Slides
Customer Satisfaction, Reliability and ROI

“We saved 50 million over the course of our 10 year relationship with OSIsoft. The PI System is one of the best investments we’ve made in our business with significant payback.”

Barry MacGregor
Dow Corning Corporation

“I don't know of any other software that can positively impact every important business driver - environmental, safety, quality, and ROI.”

Dwight Stoffel
ATOFINA Chemicals, Inc.

“We have a critical need for instant and accurate data. OSI offers the Real-Time and historical process condition information that we need in order to meet our deadlines.”

Bill Wight
Eastman Chemical Company
### Customer Satisfaction, Reliability and ROI

<table>
<thead>
<tr>
<th>Quote</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>“The pilot project was started in mid-March and went live at the end of June within budget. The success of this pilot allowed us to quickly move to converting our six automated plants over to OSIsoft’s RLINK as our SAP interface. This will eliminate our custom interfaces in advance of a corporate plan to upgrade to the latest version of SAP.”</td>
<td>Mr. Roger McKinney, PolyOne</td>
</tr>
<tr>
<td>“RLINK gave us the integration that resulted from the seamless flow of information from the process unit to business management.”</td>
<td>Carlo Volpones, Polimeri</td>
</tr>
<tr>
<td>“RIPI is an asset that very quickly demonstrates its value to a company’s bottom line.”</td>
<td>Alex Grguric, Dofasco, Inc.</td>
</tr>
<tr>
<td>“RLINK saved us over $650,000 in labor costs.”</td>
<td>Kris Zywicki, Dow Corning Corporation</td>
</tr>
</tbody>
</table>
“If you are going to buy software, buy it from a successful software company. That will ensure that you are buying the best. OSIsoft continues to grow financially and technologically, offering even more value to customers by reinvesting a large percentage of sales revenues back into product development and upgrades.”

Dr. J. Patrick Kennedy
President
Improve Operational Efficiencies

- **Increased Operational Efficiency**
  - Reduced fuel consumption (Users report 1 to 2% Fuel Savings)
  - Management of controllable losses (Losses expressed in financial terms)
  - NOx and SOx monitoring and reduction

- **Improved Availability**
  - Better operator information and advice
  - Improved maintenance strategy

- **Better Asset management**
  - Designers have access to plant technical information
  - Enhanced plant monitoring (Plant comparisons)
  - Predictive maintenance (Monitor run-times and Start/Stops)

- **On line emission monitoring**
  Real-time information allowing immediate operator intervention
  Direct feed from the Continuous Emissions Monitoring System (CEMS)

- **Avoid competitive disadvantage**
  - Many Power Utilities already use PI
COTS Results

- Expect a rapid direct payback that is 2 to 5 times your PI software investment in 12-18 months.
- PI users have reported a 10 to 30% reduction in controllable costs.
- The ability to monitor asset performance and production costs reported to have reduced raw material utilization from 1% to 5%.
- Expect the paradigm of "80% of the time spent collecting data / 20% of the time analyzing the problem" to change dramatically (5% / 95%)!
Time

• According to Webster's New World Dictionary
• Time – every moment there has ever been or ever will be.

• “If it can be measured, it can be controlled.” W. Edwards Deming

• "Knowledge is of two kinds: we know a subject ourselves, or we know where we can find information upon it." -Samuel Johnson, compiler of the first comprehensive English dictionary
“It is not enough to do your best; you must know what to do, and THEN do your best.” W. Edwards Deming
According to Webster's New World Dictionary, history is the branch of knowledge that deals systematically with the past.

Knowledge is defined as 1. The act or state of knowing; clear perception of fact, truth, or duty; certain apprehension; familiar cognizance; cognition. "Knowledge, which is the highest degree of the speculative faculties, consists in the perception of the truth of affirmative or negative propositions." - Locke.