

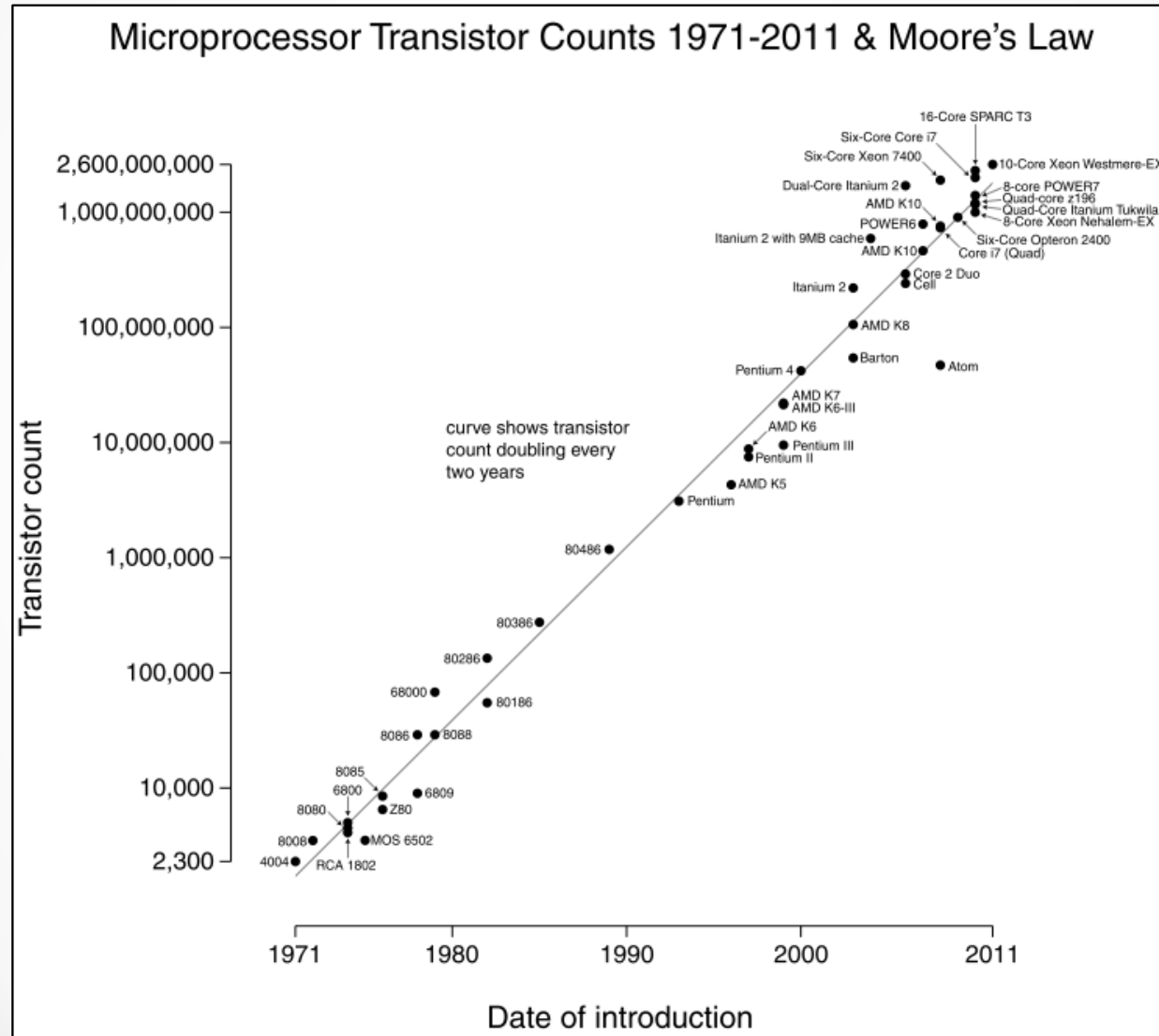


# Smart Generation – Integrated Advanced Pattern Recognition and Performance Modeling

2013 Symposium: Managing Plant Assets and Performance  
Clearwater Beach, Florida  
August 6-9, 2013  
July, 2013

Jim Herzau, Scientech  
Bob Holzworth, Scientech

# Moore's Law



# From Analog to Digital



**Advances in microprocessors first changed the way in which we collected and stored process data and controlled plant equipment**

# Transforming Data into Business Value

Further advances made it possible to replace manual review of data with computer based tools to aid in the important effort of interpreting the data being collected

**Monitoring  
&  
Diagnostics  
Value**

**Interpretation - 70%**

- **Plant Engineering Expertise**
- **Specific Process Knowledge**
- **Analysis Tools**

**Information - 30%**

- **Data Acquisition**
- **Data Validation**

# The Smart Grid

## What does a Smart Grid do?

The Smart Grid represents an unprecedented opportunity to move our nation to a new level of electricity availability, and efficiency that will contribute to our economic growth. During the next period, it will be supported by existing, technology improvements, consumer education, development of standards and regulations, information sharing between projects to ensure that the benefits we envision from the Smart Grid become a reality. The benefits associated with the Smart Grid include:

- More efficient transmission of electricity
- Quicker restoration of electricity after power disturbances
- Reduced operations and management costs for utilities, and ultimately lower power costs for consumers
- Reduced peak demand, which will also help lower electricity rates
- Increased integration of large-scale renewable energy systems
- Better integration of customer-owner power generation systems, including renewable energy systems
- Improved security

Efficiency

Environmental

Reliability

# Smart Generation

## What Should Smart Generation Do?

- Optimize Thermal Efficiency
- Minimize Environmental Impact
- Maximize Equipment Reliability
- Reduce Operating and Maintenance Costs
- Provide Decision Support for Risk Informed Asset Management

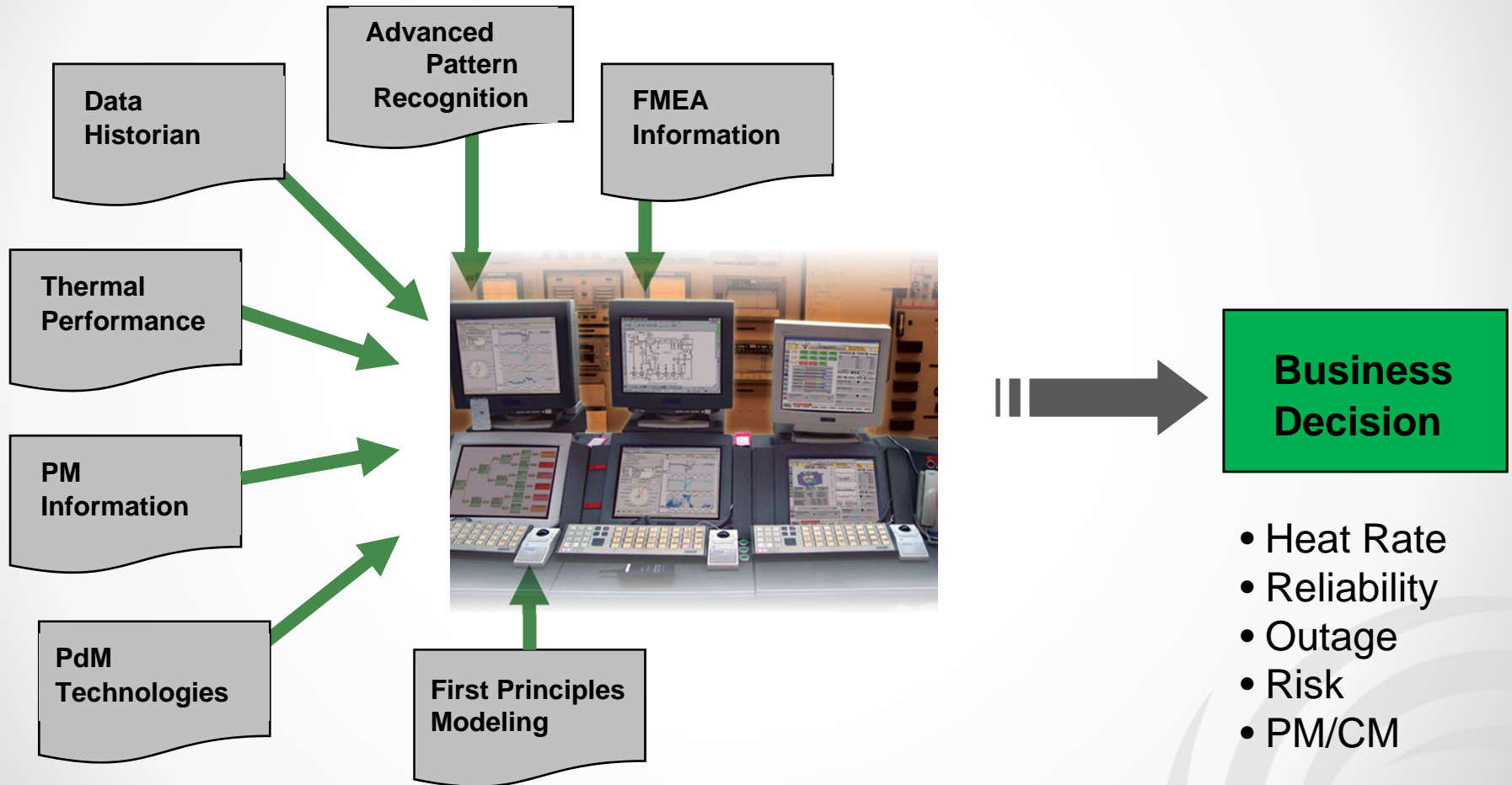
Efficiency

Environmental

Reliability

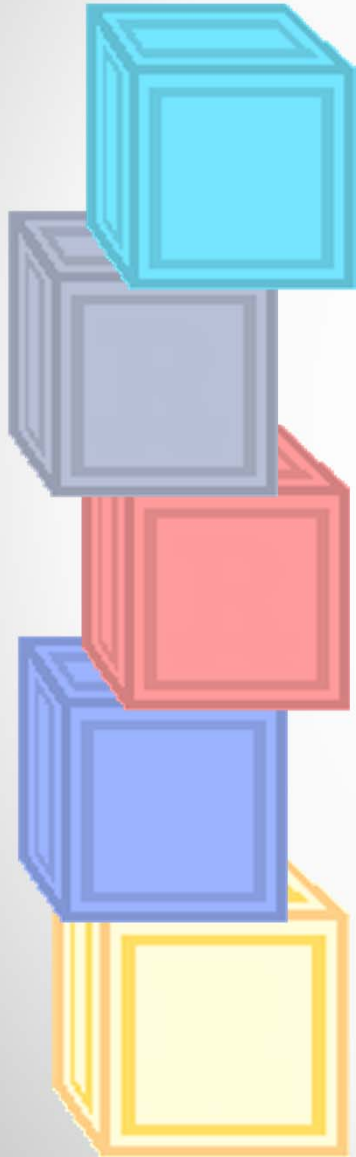
Risk Assessment

# What Information Do We Want to Transform into Knowledge?



# Building Blocks for Smart Generation

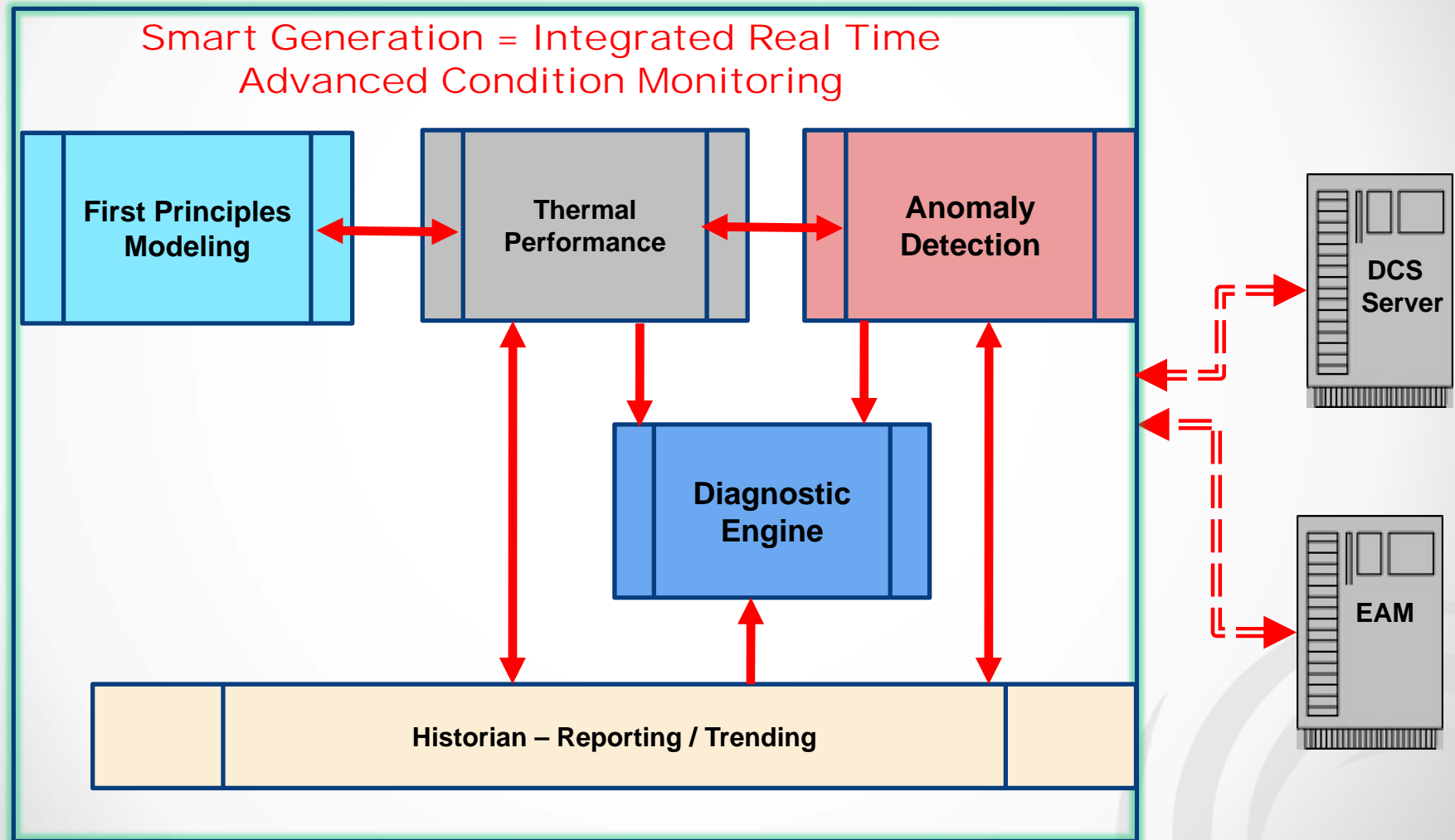
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- ✓ ***First-Principles Energy Balance Modeling*** - to evaluate system efficiencies and perform modification and “what-if” analyses
- ✓ ***Real Time Thermal Performance Monitoring*** - and Process Optimization
- ✓ ***Anomaly Detection*** - typically using Advanced Pattern Recognition (APR)
- ✓ ***Automated Diagnostics and decision support***
- ✓ ***Historian*** - High speed data acquisition, including presentation & reporting



# Smart Generation = Integrated Analytics

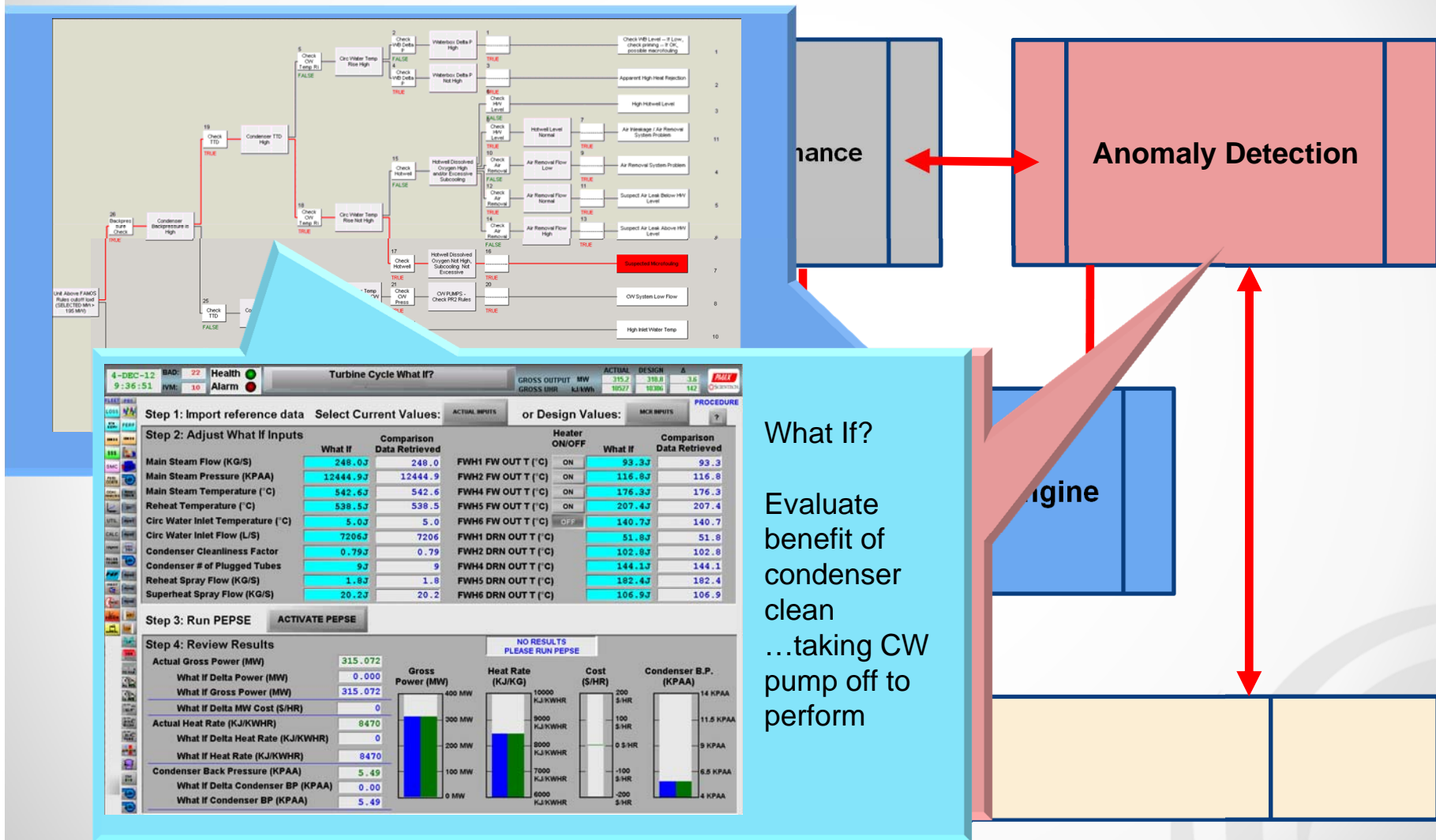


# Features of Integrated Real Time Analytics

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- Input Validation – mitigate garbage in / garbage out
  - Use APR to identify suspect inputs
  - Use APR to provide robust substitutes for bad inputs
- Thermal performance indicators and pattern recognition anomaly detection provide early indication of equipment / performance degradation
- Synchronized results feed rules based diagnostic engine providing real time assessment of developing faults or cause of operational issues
- First Principle Models automatically seeded with real time data allows evaluation of potential actions to mitigate performance or reliability concerns

# Smart Generation – Illustrative Example



What If?

Evaluate benefit of condenser clean  
...taking CW pump off to perform

## Other Quick Examples

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Anomaly detection determines deviation from normal on FWH drain valve position, thermal performance monitoring indicates impact on heater/cycle performance (changes in DCA, TTD, temp rise) , diagnostic engine flags suspected condition (tube leak) , first principle model used to conduct assess the impact of taking the FWH out of service and conduct sensitivities around the best time to repair

## Other Quick Examples

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Boiler NOx emission running higher than predicted, thermal performance indicates reduced boiler efficiency, but O2 level are normal.... Anomaly detection uncovers a change in feedback signals from tilt and overfire air damper operation since the previous outage

## Other Quick Examples

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Thermal performance indicators indicate that one cooling tower in a bank of four is underperforming, anomaly detection points towards fouling of the fan blade, reinforced by diagnostic engine. First Principle model used to analyze impact of taking tower/fan OOS for cleaning

# Smart Generation in the Field



## Fleet Wide M&D Centers – In House or Contracted

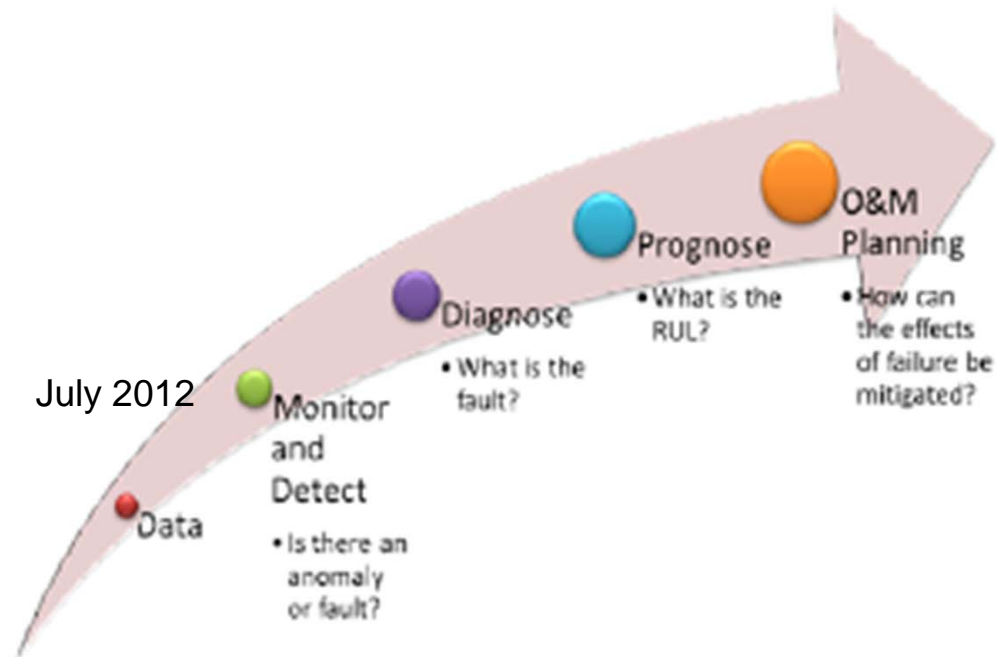
- ✓ Advanced Monitoring Technology
- ✓ Expert staff with power plant experience
- ✓ Comprehensive security and data acquisition
- ✓ Performance / reliability optimization

## Mobile Apps

- ✓ E-Mail Alerts
- ✓ Remote data access / diagnostics
- ✓ Real Time KPIs for management
- ✓ Performance / reliability optimization



# Prognostics

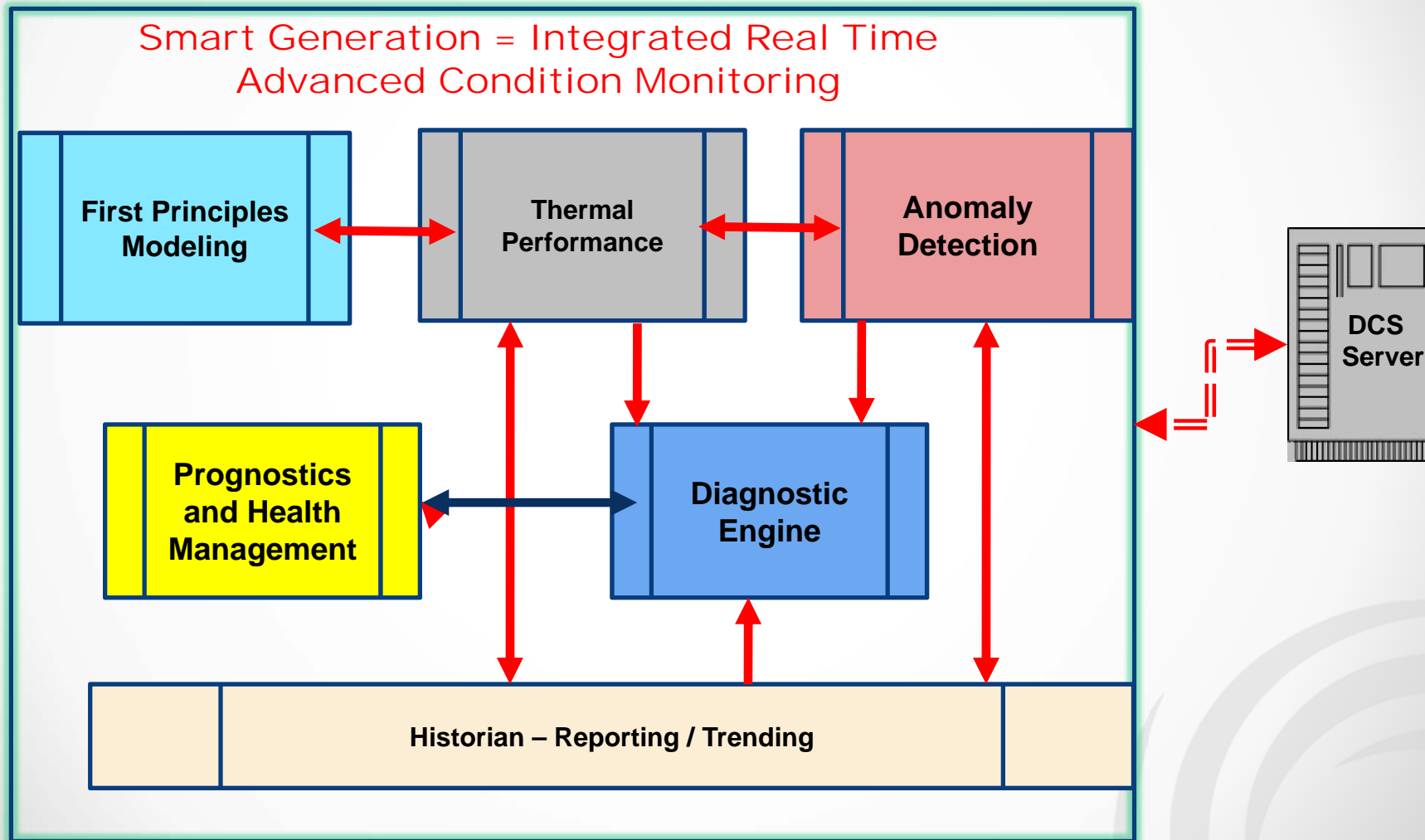


**Figure 4.1. Suite of Modules in a Health Monitoring System (Hines et al. 2008b)**

Prognostics and Health Management in Nuclear Power Plants: A Review of Technologies and Applications  
July 2012 , Pacific Northwest National Laboratory,  
PNNL-21515, under DOE Contract DE-AC05-76RL01830



# Smarter Generation



# Questions

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