Power Plant Hierarchy

1: Corporate Offices

2: Plant Manager

3: Operations Manager

4: Maintenance Manager

5: Engineering Manager

6: Projects Manager

7: Shift Supervisors

8: Maintenance Supervisors

9: Preventative Maintenance Specialist

10: Unit Engineers/Specialists

11: Construction Manager

12: Operators

13: Maintenance Workers (Skilled Labor)

14: Outage Planners

A: Work Orders

B: Maintenance Meetings

C: Outage Planning

D: Real-Time Work Order List

E: Analysis Techniques

F: Preventative Control System (DCS) Sensor Data

G: PI System (Data Collection and Logging)

H: PMAX (Systems Modeling)

I: Unofficial Work Orders ("Laundry Tags")

All Plant Employees

Other Items

A: Documentation of a particular equipment issue within the plant.
B: Weekly or bi-weekly meetings to review all outstanding work orders and assign or reassign a priority to each one (fix immediately, fix at next schedule outage, or fix when we can get around to it).
C: Starts 3-12 months before the outage. Meet monthly and then more and more frequently to review all outstanding work orders, determining whether each one should be included in the list for this outage. Also ensure that parts and labor are lined up for the outage.
D: The list of all open work orders which is updated after every maintenance meeting.
E: Various automated and manually performed analysis techniques used on raw data to spot trends and upcoming problems. SmartSignal's services are a prime example of this.
F: Huge amounts of temperature, vibration, voltage, amperage, wattage, and other data constantly collected by the tens of thousands of sensors built into the DCS.
G: Logs all DCS data and anything else given to it. Allows everyone easy access to all previous data from any piece of equipment.
H: Allows modeling of various systems within the plant, especially the boiler and turbine, for more detailed analysis.
I: Unofficial work orders, placed on the offending equipment by anyone who notices a problem.

Decision Map

Information Map

D-1: The corporate offices set budget constraints and coordinate outages among plants within the fleet.
D-2: The plant manager, operations manager, maintenance manager, engineering manager, shift supervisor, preventative maintenance specialist, unit specialists, construction manager, and outage planner all take part in the outage planning process. The plant manager and operations manager generally have the final say, although it rarely comes to that.
D-3: The plant manager, operations manager, maintenance manager, shift supervisor, preventative maintenance specialist, and unit specialists all take part in the maintenance meetings. The plant manager and operations manager generally have the final say, although it rarely comes to that.
D-4: The operations manager, shift supervisors, and operators can all write work orders based on problems they discovered themselves, or problems reported by others.
D-5: Anyone can place a "laundry tag" to indicate to the operators that something is wrong with a piece of equipment.

Typical Employee Hierarchy

1: Most power plants belong to a "fleet" of several plants owned by a single company.
2: Oversees the entire plant. Deals with corporate and the market to determine when to sell power and how much to sell.
3: Oversees the operation of the plant. In charge of ensuring the plant delivers the required amount of power.
4: Oversees the maintenance of plant equipment.
5: Oversees the engineering department and compiles the analysis of the data from the DCS sensors.
6: Oversees and organizes major projects within the plant, such as replacing or upgrading major equipment.
7: Runs the plant. Responsible for keeping the plant running smoothly during an 8-12 hour shift.
8: Oversees and organizes maintenance during an 8-12 hour shift. Mainly handles immediate problems.
9: Monitors equipment sensors and uses the data to predict upcoming problems and failures. Takes a closer look at any equipment if asked to.
10: Runs a particular unit, such as the boiler, turbine, feed water heaters, etc. Responsible for keeping his or her unit running efficiently.
11: Oversees and organizes planned outages, especially during the outage itself.
12: Runs the plant from the central control room for an 8-12 hour shift. Periodically walks through the plant and visually inspects equipment.
13: Repairs equipment as needed.
14: Plans, organizes, and coordinates planned outages, especially before the outage itself.
The Life Cycle of a Planned Outage

**Legend**

- Process or Event
- Decision
- Document

**Typical Power Plant**

1. **Something breaks**
2. **A work order is written**
3. **Maintenance Meeting** (every 1-2 weeks)
4. **Do we have to shut the plant down?**
   - Yes, Forced outage
   - Yes, Now?
   - No, Set priority and label as "Scheduled Outage"
5. **Set priority and label as "Scheduled Outage"**
6. **Updated real-time work order list**
7. **Outage planning meeting**
8. **More frequently as the outage approaches**
   - Prioritize work orders using risk vs. reward
   - Planned outage begins

**Analysis Examples**

**SmartSignal**

- **SmartSignal Corporation** is a privately held software solutions company that uses Similarity-Based Modeling™ (SBM) technology to enable comprehensive, real-time analytics on any instrumented industrial equipment.

- **SmartSignal’s Predictive Analytics Software provides**:
  - Early, actionable warnings of impending equipment failure
  - Preliminary diagnosis and priority rating of emerging issues
  - Validation of sensor data to detect malfunctions
  - Adaptation to plants’ ever-changing conditions
  - The ability to fix a small problem before it grows into a large one

- **SmartSignal-Enhanced Power Plants**

- **Optimum**
  - Data Collection
  - Analysis
  - Decision
  - Action
  - Maintenance Costs
  - Availability

- **SmartSignal Analyzes Multiple Sensor Inputs, Giving Earlier Warning of Failure**

- **Analysis Examples**

- **Questions**
  - **Question 1**
    - "How often does your plant perform a system and plant examination?"
    - Options: 1 time/year, 2 times/year, 3 times/year, 4 times/year

  - **Question 2**
    - "What information would you consider critical to an upcoming outage?"
      - Options: Historical performance, Machine learning, Equipment condition, Environmental factors, Other

  - **Question 3**
    - "If a system fails, how often is it maintained during a planned outage?"
      - Options: As needed, Daily, Weekly, Monthly, Annually

  - **Question 4**
    - "What downtime do you consider to be critical during an outage?"
      - Options: Power generation, Water supply, Manufacturing, HVAC, Safety systems

  - **Question 5**
    - "What factors contribute to the success of an outage plan?"
      - Options: Communication, Planning, Equipment availability, Personnel training, Budget allocation