Roadmapping Workshop on
Measurement Science for
Prognostics and Health Management of
Smart Manufacturing Systems

PANEL 3 -
PHM AND THE HUMAN ELEMENT

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SOAR Engineering LLC

- SOAR Engineering LLC
  - **S**upportable **O**perations
  - **A**viation
  - **R**esilience

- Our Mission
  - Help clients specify, develop and improve the PHM capability of their products and systems
  - We believe that the greater value of PHM systems lies in the operational and business intelligence unleashed when PHM is integrated into business operational systems
  - More supportable operations and more resilient products

Today's Environment

- Traditional PHM systems are too often isolated stand-alone systems based on simple cause-and-effect models
- Often ignore events caused by constraint violations and system (including human) interactions
  - Often assume equipment, usage, environment and operations are 'fixed'
  - Often ignore 'non-relevant' issues such as design, quality, supply chain and manufacturing problems
- Plenty of sensors and data but insufficient information for actionable intelligence
- People, organizations, training and leadership are often neglected in the PHM process

PHM is a Socio-technical System

Prognostic and Health Management Systems are socio-technical systems - this includes:

- Equipment, machines, shops, hardware and software
- Users/Operators
- All tiers of management
- Maintenance and support
- All other business systems
  - Engineering, marketing, sales, customers, supply chain, etc.

Systems should be centered on creating value for all participants in the value chain

Provide Actionable Information to People At All Levels To Enable Evidence-based Decision Making

Measurement and Reporting Results

- Measurement and reporting results at each level enabled by the PHM system is critical to system value
  - Every item of equipment
  - Every service provider
  - Every process
  - Every shop
- Knowing the actual capability of each element enables optimal use of resources and encourage resources to migrate to the best performers
- Report all the results

Examples:
-Visibility into the health status of the equipment and shop
-Ability to project future health status for various operational scenarios
-Information needed for operations and maintenance
-Ability to identify new and emerging issues
-Ability to respond to changes in usage, environment, etc.
-Making it possible for all users to participate in decisions affecting health
-Integration of PHM results into existing business systems

Value based PHM System Must Be Organic

- Elements of value based PHM systems
  - Learn
    - Improve usability with usage
  - Adapt
    - Stay current and meaningful in a dynamic environment
  - Influence
    - Support the decision makers – at all levels
    - Work with the social/human element - a helpful tool
    - Allow human intervention when needed
  - Communicate
    - Provide actionable intelligence to support evidence based decisions