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Motivations for Standards in Manufacturing

• Complex interactions/relationships within manufacturing systems make it challenging to determine the specific influences on the health and degradation of equipment and processes.

• Increasing interest and ability to leverage data and analysis to generate actionable intelligence about system interactions/relationships for control.

• No uniform process exists that guides sensing, monitoring, and control at all levels from the component to the system.

• Proprietary solutions exist, but they apply to specific systems from one vendor and are often expensive and inaccessible to many manufacturers.
Standards Subcommittee Meeting on Advanced Monitoring, Diagnostics, and Prognostics for Manufacturing Operations
Committee Charter

Develop standards and guidelines that advance the design and implementation of monitoring, diagnostic, and prognostic capabilities, along with ways of verifying and validating their performance, to enhance adaptive maintenance and operational control strategies within manufacturing.
### Guideline Action Plan for Topic 7 – Guideline Adoption

**Description:** The parameters that a data. The health of a process is also a critical factor in determining the health of data and to address the points, next steps are failure analysis. Process helps identify what health data and Syst. typically use in the data.

**Guideline Action Plan Steps:**
- Assess the pros and cons of local, edge, or cloud data processing for PHM, and ownership and governance of the data (e.g., who conducts analysis, has expertise, and data anonymity: who owns the data and governs it).
- Determine how to structure the data and whether data should be real time, historical, etc.
- Determine how much information is needed and how it should be structured (MTC and data strategy considerations).
- Examine and develop monitoring methods for data collection - "instantaneous, per-dedicated, etc."
- Determine how analysis needs to be conducted (real-time, after-the-fact, etc.).
- Determine differences for PHM between various process types (i.e., batch, discrete, continuous).

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### Priority Guideline Action Plan – Standardized Terminology for Availability and Maintenance of Manufacturing Operations

**Description:** This presents the action plan to develop a document outlining standardized terminology necessary to draft the corpus of guidelines to be developed within this PHM sub-committee. This document is expected to contain a list of defined terms relevant and important to monitoring, diagnostic, and prognostic capabilities and technologies within manufacturing. This guideline could contain a relational map to correlate relevant manufacturing and PHM terms so the entire manufacturing community can easily communicate with one another. The terminology can be in a hierarchical structure. Basic concepts could initially help to setup basic concepts. Wider and/or deeper terms separated into different categories and sub-categories would provide greater context.

**Guideline Action Plan Steps:**
- Create a skeleton outline of the terminology document.
- Identify monitoring, diagnostic, and prognostic terms that are expected to be used within the development of the suite of guidelines based upon input from the sub-committee.
- Review existing PHM and Manufacturing standards to identify additional terms that can complement the list created based upon the sub-committee's input.
- Define cluster terms based upon overlap (e.g., predictive maintenance – condition-based monitoring).
- Update the skeleton outline to add/amend the required sections based upon the work done to date.
- Review existing roadmap action plans and guidelines under development.

**Milestones/Key Deliverables:**
- Spreadsheet listing identified terms including any existing standards they are already defined, terms they are related to or synonymous, and their priority of expected usage.
- Draft/skeleton outline of what the terminology document is expected to look like.

**Performance Targets:**
- Standard terminology covering 80% (or more) of terms that are expected to be referenced in the suite of guidelines developed in the PHM sub-committee.
- Promotion of standard terms to enhance communication of PHM terms within the sub-committee and throughout the manufacturing community to promote greater adoption.

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### Stakeholders

**Industry:** Cloud service providers, hardware comparison scientists/engines, PHM analysts

**Association/Trade Groups:** V4I

**Academia:** Data scientists, AI experts

**Standards Dev. Organizations:** MIMOSA, OASIS, FRC

**Government:** NIST, DoD

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### Stakeholders & Potential Roles

**Industry:** Manufacturers – Small, medium, and large, operators, maintenance personnel, PHM system developers and technology developers, technology integrators, process engineers

**Association/Trade Groups:** IEEE, PHM Society

**Academia:** Those involved in industrial and process engineering R&D, and data collection

**Standards Development Organizations:** ASME, SAE, ASTM, ISO 108, OIML, IEC

**Government:** NIST
Guidelines Flow

A Standardized Terminology

B Expand MTConnect/Data Communications

C Determine Where and When PHM Capabilities should be added/integrated
   1. Identification of critical metrics (e.g., OEE)
   2. Relationship of metrics to processes and equipment

D What Data and Collection Strategies to Employ
   1. What metrics/data to capture
   2. Determine what sensors to deploy
   3. Determine where to deploy sensors
   D.4 Determine where to store and organize data

E Guidance for Data Analysis
   1. Analysis of single sensor
   2. Analysis of multiple sensors/data fusion
   3. Location of data analysis (e.g., local, edge, cloud)
   4. Additional data analysis considerations (e.g., home org, software analyst)

F Decision support including determination of optimal maintenance strategy based upon data analysis results

G Determination of appropriate visualization and/or communication to enable human consumption for decision-making

H Establish new baseline of health and performance; update ROI (pull from C)
Where are we today?
Priority Topic Areas

1. Standardized Terminology for PHM Guideline
2. Guideline to Determine Where and When PHM Capabilities should be added/integrated
3. Guideline to Determine What Health Data to Capture and Collection Strategies to Employ
5. Guideline for Implementing Sensor Data Fusion/Multi-Modal Data Fusion
6. Expand MTConnect/Data Communications
7. Guideline to Determine Where to Perform PHM Data Analyses
8. Natural Language Analysis for Maintenance Documents
9. YOUR IDEAS??
• Does the standards process need to evolve to address the speed of advancing digital technologies?
• What community contributions are most critical to realize standards for these emergent technologies?