

PHME Panel

Standards and Regulations- Affecting PHM Development and Application

HOW STANDARDS PROLIFERATE: (SEE: A/C CHARGERS, CHARACTER ENCODINGS, INSTANT MESSAGING, ETC.)

500N: 14?! Ridiculous! WE NEED TO DEVELOP SITUATION: SITUATION: THAT COVERS EVERYONE'S THERE ARE THERE ARE USE CASES. 15 COMPETING 14 COMPETING STANDARDS. STANDARDS.

xkcd, 2013

Welcome- Jeff Bird (PHM Society)

Provocative remarks by panelists

Dr. Rune Prytz, Stratio

Dr. Huigi (Yvonne) Lu, University of Oxford Engineering Science

Computational Health Informatics Lab

Rhonda Walthall, Collins Aerospace

Invited inputs: Lee Glazier, Head of Service Integrity at Rolls-Royce

Lots of Open Discussion

- 1. Boost innovation, sustainability, business cases and trust?
- 2. More accessible, trusted and responsive to the value chain?
- 3. Other priority issues?

PHM Society Standards Committee

Brian Weiss, Jeff Bird, John Madsen, Ravi Rajamani

Participate in the standards discussion group on the PHME22 smart phone app



PHM Society Role?

Society Objectives

- 1. Free access to PHM knowledge,
- 2. Interdisciplinary and international collaboration
- 3. Advance the engineering discipline

Observations

- 1. Diverse body of PHM knowledge out there: Standards, lessons learned, information, few case studies
- 2. Multi-disciplinary awareness and engagement is lacking: Many entrants come from single specialities
- 3. Wide continuing standards participation is difficult: Small companies, long time frame for development
- 4. To mature knowledge from theory to practice is challenging: Knowing about relevant standards across disciplines, Developing Body Of Knowledge to complement academic training
- 5. Data and information sharing protocols are essential but problematic: Proprietary and sector specific information



PHM Society Activities

Traditional

- 1. Panels
- 2. Special issues of journal and tutorials- subjects?
- 3. Program updates and on-line forum
- 4. Connections among current PHMers

New initiatives

- 1. Standards Users Group
- 2. PHM Standards Portal: One stop for docs, resources, forum
- 3. Interactions with SAE, ASME, IEEE, ISA, NIST
- 4. Standards Review Portal: PHM- ISO Connect
- 5. Domain specific like Machine Learning??



Rolls Royce Aletheia Project

"The Aletheia Framework – a toolkit that we believe creates a new global standard for practical applications of ethical AI. Follow the checks and balances within it and organizations can be sure that their AI project is fair, trustworthy and ethical. We are applying it to accelerate our progress to industry 5.0" - Warren East, Chief Executive – Rolls Royce

Focii: Social Impact, Accuracy/Trust, Governance
With benefits, ethics and realization principles

Aletheia Framework™

the Rolls-Royce response to ensuring the development and use of Artificial Intelligence is undertaken in an ethical way



accessible, comprehensive, trustworthy, proceduralised





Observations to provoke thoughts:-

- Principle references for AI ethics guidance, standards, regulations and legislation are all generally 75 – 125 pages long.
- A very recent Standard published on Al Bias had 23 pages of references.



Mapping ethical challenges

Social Impact

- Benefits
 - Human impact
 - Communications
 - Potentially irreplaceable loss of skills

Accuracy/Trust



- Human safety/zero harm
- Transparency/traceability
 - Bias
 - Validity/explainability/ reliability
 - Sparse data interpolation

AF

Governance

- Data protection
 - Export control
 - Confidential information
 - Cyber secure
 - Accountability
 - Responsibility for decisions
 - Risks from re-use/ transfer across processes

Principle references

Good Corporation - Developing an Ethical Future for Al

EU Ethics Guidelines

European Parliament Committee on Industry, Research and Energy – Draft Report on a comprehensive European industrial policy on artificial intelligence and robotics

Validation and Control of Artificial Intelligence (AI) in Critical Manufacturing Processes

Asilomar Al Principles





Deployment of Allian orbotics that be stoom to improve the well-being of employees and/or the general public, such as improved order, working conditions, job substaction. Aland robotics shall be seen as delivering good being good is one of the Leo key orthical principles of the Additions, to I for instead off, deployment of All and robotics shall be supported by a business case that demonstrates it improves competitiveness and a not just Wilfer the sake of All. BU guidelines for ethical ALGCCC Includes commercial prosperity For any deployments, it shall be about whose the human boundow interfaced innerestion is with the Albenty loss Robertos system, and any neighbor positive impact on numeral factors and/or human between its fully understood and misgated where recognity. banky analysis, in companions with human resources and employees for their impresentatives, shall be undertaken to identify potential job role changes or potential human resource impacts and the opportunities for retraining Potential for upstilling apportunities or redeplayment shall be explored with farmer resources and amplayed for their representatives of when any impact on affected in players it, enabling to conspire that the organization has the key capabilities needed to secure energing apportunities in All and rehoritor. Allowers should be used to enhance positive social change and enhance social ratiolity Analysis shall be undertaken to assess the impact of the deployment on the supply chain - particularly assessing the Bellihood for the technology to have a ringel will report or the sealmantality of my character of the supply chain. The same resolution of the order of the depth of the customers is appropriate. Where there is potential for negative impact on the sustainability of the supply chain. Use shall be discussed with the supply chain partner as sport as possible to give their national opportunity to adapt to recoil nationals bid. This came appropriately should be a fibrated to existence as appropriate. Snowledge of the numer interactions with All disself terprivided by key stakeholders. Program communication and discussion should be had with all key strainhold his – in particular employees and employee represed his strongly a variety of channels.

REALISATION PRINCIPLES

EVIDENCE

The Aletheia Framework

What

Evidence

Al systems must be free from bias or prejudice.

It shall be clearly stated how any training data sets have been assured to have no unintentional or unethical biases, noting that, for example, if an Al sub-system is being used to detect anomalies, the training set may need a deliberate bias to ensure sufficient amounts of anomalies occur at different rates.

A practical tool for ethical and trustworthy AI

			carract man by a human.	
			4 process comprehensiveness check shall be deployed in the system. have the right number of estationards when place?	?
			20 A hubbas transmission of distributible displayed in the system - use of Cyclic Redundancy Checks (or equivalent) where appropriate	?
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	Delayproxection	For A to account I you'd by the leaded	$\underline{\infty}$. Rahall be stated whether there is, or will be any Powenial data or not	?
			The legit mate purpose for using the Personal data shall be declared and 25 confirmal or provided that the been agreed with the person or employed or person for which is defined on managing at	?
			The ench facture of the system shall protect the data from unwarred access 24. A thesi permission - complying a fit the principle of tartwice by design and by default.	?
Ф			The architecture of any data storage system should have the facility to, on 26. Dimand, carriffy an individually personal area and accurate, areand or necessions of the processor and and advantage plan.	?
			28 No Personal data shall be sent outside of the relevant legal zone for p. European Economic Area, (65)	?
	Export central	for N to succeed it must be trusted.	The data flow (including access/mading of data) shall be described to 27 obcounce with and approved by an Exper. Control manager to status complement with beginning applicants.	?
OVer	Confidential Information	For Alita succeed it must be trusted.	38. All confidential information shall be declared to, discussed with and the architectural protections approved by an IT security expert	?
6	Dyburswounty	For All to accound it yest by trusted.	29 All confidential information shall be declared to, discussed with and the architectural protections approved by an IT security expert.	?
D	Accountability	Mechanisms should be put in place to entire responsibility and accountability for All systems and their paragraphs.	Ultrade accounts by for the calconnes of the Arrays van needs to be clearly street with a business owner clearly identified.	?
	Require billy for decisions	Median cross distribilities put in discello oncuro recomo bility and accountability for Alleystens and their outcomes.	Against exceed this in the lightly on the developer and retter, or 31. The DevOps four. They shall also be take they they have assured confidence in the performance of their make dual expects of the Alleystem.	?
	Risks from re-use/transfer across processes	for N to succeed it must be this led	Thereforing incolledge between All options about the risk arranged using a \$2. formal both motivation determine where and how the system might fall. Any schools worsh and their courses must be identified using with the motivation before such enems. And shall be formally instead of other proceeding.	?



Panelists and Discussion Leaders

Dr. Rune Prytz, Stratio

Dr. Huiqi (Yvonne) Lu, University of Oxford Engineering Science Computational Health Informatics Lab Rhonda Walthall, Collins Aerospace

- 1. How can innovation, sustainability, business case rationalization and trustworthiness be boosted by standards and best practices?
- 2. How can best practices and standards be more accessible, trusted and responsive to all parts of the research, development, commercialization and asset management value chain?
- 3. Panelists challenge questions
 - 1. What are the main issues with ethics and bias ... and the solutions?
 - 2. How should ethics and bias apply to standards etc. generally?
 - 3. Are tools and decision support accurate, true and fair?
 - 4. Operating well for good outcomes for all stakeholders?
 - 5. Ethically sound as standards for human experts?

stratio

Privacy and Regulations

Developing and deploying PHM systems for machines used by humans

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Background

Predicting vehicle failures ahead of time to optimize vehicle fleet operations

- Not safety critical
- Add on solution to existing vehicles

Add on solution to existing vehicles

stratio Not safety critical

Background

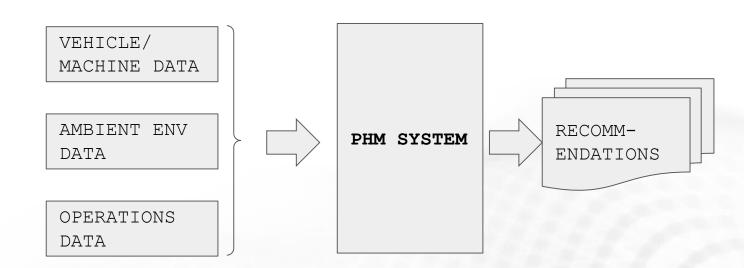
Predicting vehicle failures ahead of time to optimize vehicle fleet operations

Not safety critical

Add on solution to existing vehicles

Add on solution to existing vehicles

Not safety critical



Problem formulation

The better we describe the machines historic use the more precise we can predict its future

its future

nistoric use the more precise we can predict

More detailed data will inevitably reveil patterns and information not only related to the primary goal. I.e. PHM.

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Problem formulation

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its future

historic use the more precise we can predict

the better we describe the machines

The longer historic data records improve generalization and faults covered.

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More detailed data will inevitably reveal patterns and information not only related to the primary goal. I.e. PHM.

patterns and information not only related to the primary goal. I.e. PHM.

Longer history may also reveal which patterns that are not related to PHM.

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Maintenance personnel in the workshop uses a fleet management tool with PHM support in order to plan their upcoming work

Maintenance personnel in the workshop uses a fleet management tool with PHM support in order to plan their upcoming work

They discover a pattern

They discover a pattern

- There is always one bus indicating significantly higher wear rate
 it is not always the same bus
- It is not always the same bus
- significantly higher wear rate
- There is always one bus indicating

Example

Example

assigned to said bus.

assigned to said bus.

stratio

uses a fleet management tool with PHM support in order to plan their upcoming work

support in order to plan their upcoming work

uses a fleet management tool with PHM The increased wear pattern is found to be

correlated with the same driver being

correlated with the same driver being

The increased wear pattern is found to be

Maintenance personnel in the workshop

identified and linked to undesired behavior. since he has indirectly been monitored, The privacy of the driver has been violated

Lue being always one bus indicating since he has indirectly been monitored, identified and linked to undesired behavior.

t is not always the same bus significantly higher wear rate

It is not always the same bus

significantly higher wear rate

There is always one bus indicating

They discover a pattern

Questions of the audience

- What technical or non-technical best practices have you developed to ensure privacy in real world data?
- Have you used any standard to ensure the necessary privacy is met?







Artificial Intelligence and Machine Learning Regulatory Frameworks and Standards

Dr. Huiqi (Yvonne) Lu, Engineering Science, University of Oxford







Governance





- Regulatory Frameworks and Standards: Regulate Al technologies to be developed responsibly, work as advertised, and are safe for industry users and customers.
- Evaluation and Validation: Evaluation based on regulations and standards; validation externally and locally.
- **Guidelines**: Procurement, development and use of Al.
- Liability and Accountability



EU AI Regulation – what it means for industries







Unacceptable-risk Al systems

- Subliminal, manipulative, or exploitative techniques causing harm
- Real-time, remote biometric identification systems used in public spaces for law enforcement
- All forms of social scoring

High-risk Al systems

- Systems that evaluate consumer creditworthiness
- Recruiting or employee-management systems
- Systems utilizing biometric identification in nonpublic spaces
- Safety-critical systems (eg, systems that would put the health of citizens at risk due to failure)
- Any systems used in the administration of justice

Limited- and minimal-risk Al systems

- Al chatbots
- Al-enabled video and computer games
- Spam filters
- Inventory-management systems
- Customer- and market-segmentation systems
- · Most other AI sy

EU Regulation into Effect – Preparations

- **EU and Non-EU Products**: developed in the EU use worldwide; developed outside of the EU but used within the EU.
- Risk-specific Requirements for AI Systems: develop risk-management infrastructure, data governance and management, technical preparations (accuracy, robustness, ethical, human oversight, and cybersecurity), and post-market monitoring pipelines.
- Timeline





ISO Standards in Al



- ✓ ISO/IEC 38507:2022: Information technology Governance of IT Governance implications of the use of artificial intelligence by organizations
- ✓ ISO/IEC 23053:2022: Framework for Artificial Intelligence (AI) Systems Using Machine Learning (ML)
- ✓ ISO/IEC TR 24372:2021: Information technology
 Artificial intelligence (AI) Overview of computational approaches for AI systems
- ✓ ISO/IEC TR 24030:2021: Information technology
 Artificial intelligence (AI) Use cases
- ✓ ISO/IEC TR 24029-1:2021: Artificial Intelligence (AI) — Assessment of the robustness of neural networks

- ✓ ISO/IEC TR 24027:2021: Information technology Artificial intelligence (AI) Bias in AI systems and AI aided decision making
- ✓ ISO/IEC TR 24028:2020: Information technology Artificial intelligence Overview of trustworthiness in artificial intelligence
- ✓ ISO/IEC TR 20547-5: Information technology
 Big data reference architecture
- ✓ ISO/IEC 20546:2019: Information technology
 - Big data Overview and vocabulary



IEEE Standards in AI + Industry



- ✓ IEEE 2801-2022: Approved Draft Recommended Practice for the Quality Management of Datasets for Medical Artificial Intelligence
- ✓ IEEE 2671-2022: Approved Draft Standard for General Requirements of Online Detection Based on Machine Vision in Intelligent Manufacturing
- ✓ IEEE 2941-2021: Standard for Artificial
 Intelligence (AI) Model Representation,
 Compression, Distribution, and Management
- ✓ *IEEE 7010-2020*: Recommended Practice for Assessing the **Impact of Autonomous and Intelligent Systems on Human Well-Being**
- ✓ IEEE 3527.1-2020: Standard for Digital Intelligence (DQ) —Framework for Digital Literacy, Skills, and Readiness

- ✓ IEEE C37.237-2018: Standard for Requirements for Time Tags Created by Intelligent Electronic Devices—COMTAG
- ✓ IEEE 1232.3-2014: Guide for the Use of Artificial Intelligence Exchange and Service Tie to All Test Environments (AI-ESTATE)
- ✓ *IEEE 1445-2016*: Standard for **Digital Test**Interchange Format (DTIF)
- ✓ IEEE 1686-2007: IEEE Standard for Substation Intelligent Electronic Devices (IEDs) Cyber Security Capabilities
- ✓ IEEE 1636.2-2010: Standard for Software Interface for Maintenance Inform and Analysis (SIMICA): Exchangin Action Information via the Exten Language (XML)

Case Study: Assessing factors that impact confidence in Alderived information during clinical decision making

Clinician Attitudes

- Experience with AI and innovations.
- Clinical evidence

Clinical Context

 Levels of clinical risk, degree of human oversight in AI decisionmaking flow

Al Model Design

 Format of AI (diagnosis, risk score, or recommendation) and clinical characteristics that involved

Cognitive biases

 Automation bias, aversion bias, alert fatigue, confirmation bias and rejection bias





Recommendations for Healthcare Industries



- > A robust and flexible legal framework
- > Future-proof in its fundamental regulatory choices
- ➤ Risk-based regulatory approach









Questions for the audience

- 1. What AI-related standards would you like PHM to develop?
- 2. Which standards are most relevant for your area of interest and why?











STANDARDS AND REGULATIONS AFFECTING PHM DEVELOPMENT AND APPLICATION

Rhonda Walthall

PHM Fellow, Collins
Aerospace
SAE Fellow
PHM Society Fellow

July 9, 2022

IMPLEMENTATION OF AHM INTO THE MSG-3 ANALYSIS

- ▶ On June 20, 2022, the IMRBPB voted to accept the implementation of IP-180 into the MSG-3 analysis
- ► TC holders may now use AHM as an alternative means of compliance to scheduled maintenance for non-safety critical items



SAE PHM STANDARDS COMMITTEES

IVHM STEERING GROUP

Development of a single definition and taxonomy of IVHM

Identification of how and where IVHM could be implemented

Development of a roadmap for IVHM standards

Identification of future IVHM technology and regulatory needs

Recommendation of technical standards requirements

- Coordinates IVHM and health management standards developed by current and future SAE committees
- Provides leadership for the aerospace and IVHM communities

Sep 29 – Austin, Texas, USA Spring 2023 - TBD

HM-1 COMMITTEE STANDARDS

18 Documents Published:

- ARP6803 IVHM Concepts, Technology, and Implementation Overview
- ARP6407 IVHM Design Guidelines
- ARP6883 Guidelines for Writing IVHM Requirements for Aerospace Systems
- AS4831A Software Interfaces for Ground-Based System Monitoring
- JA6268 Design & Runtime Information Exchange for Health-Ready Components
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- AIR8012 PHM Guidelines for Electro-Mechanical Actuators
- AIR6275A Determination of Cost Benefits from Implementing IVHM

6 Documents in WIP:

- ARP6290 Guidelines for the Development of Architectures for IVHM Systems
- ARP7122 Utilizing Aircraft Integrated Health Management for Airworthiness Credits
- AIR6970 Environmental Spectra and Corrosivity Monitoring Using Electrochemical and Electrical Resistance sensors
- ARP6887 V&V of IVHM Systems
- **JA1013** CBM Recommended Practices
- JA7214 Special Considerations for the Application of IVHM to Autonomous Aircraft and Vehicles

Oct 11-13, 2022 – Lisbon, Portugal Feb 28 – Mar 2, 2023 – Orlando, FL USA HM-1R COMMITTEE STANDARDS

6 Published Documents to be Transferred from HM-1:

- ARP5783 HUMS Metrics, Monitoring the Monitor
- AS5391A Helicopter HUMS Accelerometer Interface Specification
- AS5392A HUMS Rotational System Indexing Sensor Specification
- AS5393A HUMS Blade Tracker Interface Specification
- AS5394A HUMS Advanced Multipoint Interface Specification
- A\$5395 HUMS Data Interchange Specification



1 Document soon to be in WIP:

 Data Interchange Specification for HUMS

Inaugural Meeting in August: Huntsville AL USA

E-32 STANDARDS

8 Documents In WIP:

- ARP5987A A Process for Utilizing Aerospace
 Propulsion Health Management for Maintenance
 Credit
- ARP6835 Propulsion System Monitoring for Continued Airworthiness
- ARP1587C Aircraft Gas Turbine Engine Health Management System Guide
- ARP5120A Aircraft Gas Turbine Engine Health Management Development and Integration Guide
- AIR1871D Lessons Learned from Developing, Implementing and Operating a Health Management System for Propulsion and Drive Train Systems
- AIR1900B Guide to Temperature Monitoring in Gas Turbine Engines
- AIR4176B Cost Versus Benefits of Engine Monitoring Systems
- AIR46C The Preparation and Use of Chromel-Alumel Thermocouples for Aircraft Gas Turbine Engines

14 Documents Published:

- AIR1828C Guide to Engine Lubrication System Monitoring
- AIR5317A A Guide to APU Health Management
- AIR5871A Prognostics for Aerospace propulsion Systems
- AIR7999 Diagnostic and Prognostic Metrics for Aerospace Propulsion Health Management Systems
- ARP1839 A Guide to Aircraft Turbine Engine Vibration Monitoring Systems
- 4 thermocouple documents

Mar 29-31, 2022 – Madrid, Spain Fall 2022 – San Diego, CA Spring 23 – Long Island, NY – Meeting #100!

AISC-SHM STANDARDS

3 Documents Published:

- AIR6245 Perspectives on Integrating Structural Health Monitoring Systems into Fixed-Wing Military Aircraft
- AIR6892 Structural Health Monitoring Considerations and Guidance Specific to Rotorcraft
- ARP6461A Guidelines for Implementation of Structural Health Monitoring on Fixed Wing Aircraft

1 Document in WIP:

 ARP6821 – Guidance for Assessing the Damage Detection capability of Structural Health Monitoring Systems

SHM Summit with Regulators planned for 2022 Meets in conjunction with IWSHM at Stanford

G-11M STANDARDS

5 Documents Published:

- AIR4276A Survey Results: Computerization of Reliability, Maintainability, and Supportability in Design
- JA1010/1-202205 Maintainability Program Standard Implementation Guide
- JA1010-201108 Maintainability Program Standard
- JA1011-200908 Evaluation Criteria for Reliability-Centered Maintenance Processes
- JA1012-201108 A Guide to the Reliability-Centered Maintenance Standard

No meetings planned

Contact SAE Committee Manager, Kevin Bires: <u>kevin.bires@sae.org</u>

HOW TO GET INVOLVED

Questions for the audience

- 1. What PHM standards would you like to see developed?
- 2. Which standards development organizations do feel produces the most relevant standards and best practices for your area of interest?
- 3. What is your primary source for PHM standards and recommended practices?





STANDARDS AND REGULATIONS AFFECTING PHM DEVELOPMENT AND APPLICATION

Rhonda Walthall

PHM Fellow, Collins
Aerospace
SAE Fellow
PHM Society Fellow

July 9, 2022



- On June 20, 2022, the IMRBPB voted to accept the implementation of IP-180 into the MSG-3 analysis
- Introduces Level 3 decision logic to determine if AHM can be used in conjunction with existing scheduled maintenance tasks (hybrid) or as an alternative to these tasks
- Applicable only to non-safety critical fault effects
- Allows TC holders to use AHM as an alternative means of compliance for initial and continued airworthiness determinations

IMPLEMENTATION OF AHM INTO THE MSG-3 ANALYSIS

Existing Maintenance Tasks

Level 1

Each Functional Failure is evaluated to determine the Failure Effect Category

- Catastrophic, Critical, Major, etc.
- Safety, operational, economic, hidden safety, hidden non-safety
- ► ETOPS, RVSM, Cat III

Level 2

The Failure Causes for each Functional Failure is used to select the specific type of maintenance task(s) required

AHM Alternative

Level 3

Each Failure Cause is evaluated to determine if: the IAHM system could

- detect the need for lubrication and servicing, detect degradation, or detect hidden failures
- detect the above conditions with enough lead time to schedule corrective action
- be effective
- satisfy a full or partial alternative to a classic task

MSG-3 2022 will include the Level 3 analysis



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ARP5987A

A PROCESS FOR UTILIZING AEROSPACE PROPULSION HEALTH MANAGEMENT SYSTEMS FOR AIRWORTHINESS CREDIT

- > First version published in 2018.
- New version incorporates major terminology change: "Airworthiness Credits" replacing "Maintenance Credits," to emphasize both initial airworthiness and continued airworthiness.
- Has input from major engine OEMs and regulators.
- ▶ Is the basis for ARP7122.
- Emphasizes the end-to-end nature of the HM function involving onboard and offboard elements.
- Presents guidelines for HM systems that are certified during initial type certification and for systems that are approved for retrofit.

Health Management & Airworthiness Credits

Retrofit design (modify existing ICA)

Examples

- Replace a manual task with automated one.
- Reduce/remove a scheduled task.
- Make tasks condition-based.
- Support in-service issue with monitoring instead of mandated inspections.
- AMOC for an airworthi-ness directive (AD).

New design (develop novel ICA)

Examples

- Reduce design conservatism with health management.
- Use data to drive new maintenance procedures.

HM-1 COMMITTEE STANDARDS

18 Documents Published:

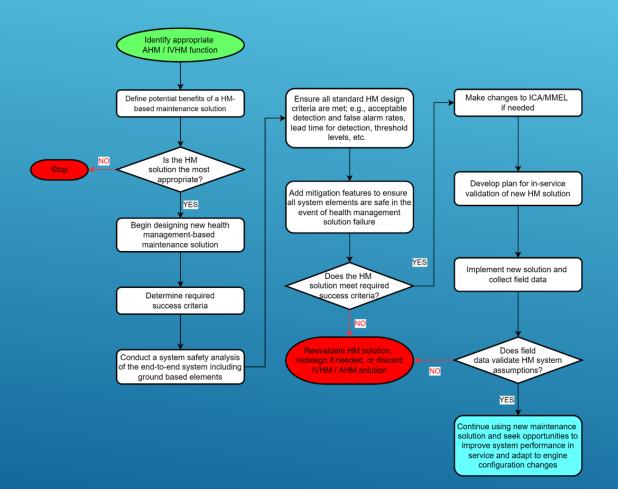
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ARP7122A UTILIZING AIRCRAFT IVHM SYSTEMS FOR AIRWORTHINESS CREDIT



1. Scope 2. REFERENCES. 2.1 Applicable Documents. 2.1.1 SAE Publications. 2.2 Related Publications 2.3 Definitions. 2.3.1 AIRWORTHINESS CREDIT. 2.3.2 HEALTH MANAGEMENT DEPENDENT DESIGN. 2.3.3 AIRWORTHY 2.3.4 CONTINUED AIRWORTHINESS. 2.3.5 INSTRUCTIONS FOR CONTINUED AIRWORTHINESS (ICA). 2.3.6 MITIGATING MEASURE 2.4 Glossary. 3. INTRODUCTION. 3.1 Consequence vs Probability Concept Applied to Fielded System. 3.2 Consequence vs Probability Concept Applied to New Design 4. AIRWORTHINESS CREDITS and HEALTH MANAGEMENT DEPENDENT DESIGNS 4.1 Introduction to Airworthiness credits. 4.2 Introduction to Health Management Dependent Designs. 4.3 Airworthiness credits Process Questions 5. Notes	222333334444567778880
5. Notes	
APPENDIX A - AIRWORTHINESS CREDIT CHECKLIST	11 13

Target Publication: EOY2022

ARP5987A AND ARP7122

- Considers EHM and Integrated Vehicle Health Management (IVHM) systems to be end-to-end processes with on- and off-board elements.
- Outlines a high-level process for obtaining approval for any EHM or IVHM system.
- Leaves the details of the guidance steps up to the applicants and their dialog with regulators.
- Extends the IP-180 Level 3 analysis from non-safety critical failure effects categories to all categories (FEC 5-9).
- Provides examples in the appendix to guide applicants on how to obtain approval for airworthiness credits for a system or component.

- 1. What improvement(s) will the health management solution provide?
- 2. What is the criticality of the failure condition associated with the improvement?
- 3. How is the impending failure detected, and is there sufficient time to mitigate it?
 - 4. What are the success criteria?
 - 5. Can any existing checks, constraints, and/or actions be removed?
- 6. Have all necessary mitigating measures (protections, redundancies, backups, etc) to support the heath management approach been evaluated?
 - 7. What frequency of automated checks and data delivery rate are needed to ensure the required success rate?
- 8. Has the health management system approach been included in the appropriate airworthiness documentation?
 - 9. Is there a plan to ensure that the process is improved and updated for technology and/or system configuration changes?

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- AS5391A Helicopter HUMS Accelerometer Interface Specification
- AS5392A HUMS Rotational System Indexing Sensor Specification
- AS5393A HUMS Blade Tracker Interface Specification
- AS5394A HUMS Advanced Multipoint Interface Specification
- A\$5395 HUMS Data Interchange Specification



1 Document soon to be in WIP:

 Data Interchange Specification for HUMS

Inaugural Meeting in August: Huntsville AL USA

AISC-SHM STANDARDS

3 Documents Published:

- AIR6245 Perspectives on Integrating Structural Health Monitoring Systems into Fixed-Wing Military Aircraft
- AIR6892 Structural Health Monitoring Considerations and Guidance Specific to Rotorcraft
- ARP6461A Guidelines for Implementation of Structural Health Monitoring on Fixed Wing Aircraft

1 Document in WIP:

 ARP6821 – Guidance for Assessing the Damage Detection capability of Structural Health Monitoring Systems

SHM Summit with Regulators planned for 2022 Meets in conjunction with IWSHM at Stanford

G-11M STANDARDS

5 Documents Published:

- AIR4276A Survey Results: Computerization of Reliability, Maintainability, and Supportability in Design
- JA1010/1-202205 Maintainability Program Standard Implementation Guide
- JA1010-201108 Maintainability Program Standard
- JA1011-200908 Evaluation Criteria for Reliability-Centered Maintenance Processes
- JA1012-201108 A Guide to the Reliability-Centered Maintenance Standard

No meetings planned

Contact SAE Committee Manager, Kevin Bires: <u>kevin.bires@sae.org</u>

HOW TO GET INVOLVED

Questions for the audience

- 1. What PHM standards would you like to see developed?
- 2. Which standards development organizations do feel produces the most relevant standards and best practices for your area of interest?
- 3. What is your primary source for PHM standards and recommended practices?



Open Discussion

- 1. How can innovation, sustainability, business case rationalization and trustworthiness be boosted by standards and best practices?
- 2. How can best practices and standards be more accessible, trusted and responsive to all parts of the research, development, commercialization and asset management value chain?
- 3. Which standards are most relevant for your area of interest and why?
- 4. What PHM and Al-related standards would you like PHM to develop?

Others?

At the end of the session, what are your priorities for PHM Standards:



Way Forward- Get Involved!

- IJPHM papers and communications
 Indexed in the Emerging Sources Citation Index
 - Submit an abstract
 - Submit an abstract for the Standards Special Issue
- Updates on standards in progress
 - PHM Standards Portal what else would be useful there?
 - Standards Users Group join
 - Forum discussions or Slack channel participate
- Standards Review Process
 - PHM-ISO connect: want to help?
 - Other Standards Development Organizations- want to help?
- What else would be useful?

Standards forum: https://www.phmsociety.org/forum/592

Please complete the evaluation of the session on the VERT app.

Thank you

Hope to see you contribute your ideas and time for PHME24