

Proceedings for Panel: Standards for the Digital Age

Aim: To summarize for the broad PHM community the issues identified by the panelists and the audience; and determine collective priorities and recommendations for a path forward to guide the PHM Society in their contributions to the standards community

Panel Summary

Nearly every industry associated with the discipline of PHM is undergoing a digital transformation. The automotive sector is a prime example while other disciplines, such as manufacturing, are not far behind. Most standards development organizations (SDOs) have recognized this shift and are responding to it with new documents, including roadmaps, outlining their approach to dealing with this technological evolution. In the automotive and aerospace sectors, SAE International is forming multiple technical committees to address digital transformation and to develop standards, accordingly. Digital communications and interoperability, Blockchain, Model-based design and testing, Artificial intelligence in safety critical systems, etc., are some of the topics being considered. Other organizations such as the ASME, A4A, IATA, IEEE, and ASTM are also developing standards in one or more of these topic areas. This panel brought together industry experts to discuss the latest progress in these fields, with goals:

- Discuss what existing standards are working well?
- Identify standards that need to be updated/improved?
- Identify challenges that are ripe for standards development?
- Illuminate panelist perspectives on their specific focus areas, approaches, and expected impacts
- Build the PHM Society's standards community through increased awareness

Speakers/Presentations

1. Brian Weiss (Chair): Introduction – agenda, benefits of standards, specific focus, panel goals, panel format
2. Steve Holland (VHM Innovations, retired from General Motors Research): SAE JA6268 on health ready components, evolution of VHM capabilities in automotive and aerospace, new SAE ITC HRCS consortium, lessons learned

3. Ginger Shao (Honeywell Aerospace): Industry challenges – data management, product certification and security
4. Logen Johnson (SAE International): Ends, keeping pace with innovation, role of the Digital and Data Steering Group, advancing technology adoption, case example – block chain, case example – JA6268, case example – cyber, case example – AI, challenges and solutions
5. Brian Weiss (National Institute of Standards and Technology (NIST)): Motivations for standards in manufacturing, ASME standards subcommittee, guidelines flow, priority topic areas, Issues

Summary of Key Issues

What are the most critical contributions for people who get involved and measures of success?

Holland: We have to be aware that standards are being developed by groups of volunteers. It's critical to gather the right Subject Matter Experts with the right experience and who can ultimately agree on common goals that they would like to achieve. When you have different people with different subject areas and technology areas it leads to really stimulating results. The process is pretty good but there are always ways to improve.

Shao: Standards are really a community thing – standards development is a service to the community so the community interest is the most important part. We cannot forget that it is a volunteer community. Often, it is inefficient for an individual organization to solve problems on their own so we need to come up with agreement so everyone can benefit from it. This process requires a needs assessment of the target domain and a passion to assess the pain points of the community. Arguably, it may be difficult to agree on the range of scenarios and situations within a standards community – the participants need to be willing to compromise and negotiate.

Johnson: The most useful people to get involved are the ones most impacted by the standard. This is not always as easy as one may think. The standards development community might not always want consultants, only, to participate. It can be critical to get the expected users of the standard involved. A lot of times our standards are used by other domains.

Weiss: We need everyone to take a leap of faith; volunteers will contribute a lot in the beginning but need to be willing to let it grow and let the standards give back. People need to be willing to jump in with both feet. Similarly, we need the community to be open and honest about what are their pain points.

How do you balance prescription and flexibility in developing a robust standard?

Holland: There are a lot of different types of standards. It is important to be specific for some elements (such as interfaces) but in other cases, standards can/should be written at a higher level. There are a lot of PHM standards in different communities. Sometimes standards needed to be written at a high level

because they are not ready for the precise detail. In this scenario, writing the standard at a higher level maintains forward progress as opposed to stifling it [progress].

Shao: The key point to start is at a top-level system performance requirement. From there, you drive down to the individual needs; e.g., how accurate does your sensor need to be? Or how does your algorithm need to perform? The standards should define methodologies, not requirements; e.g., standards should describe what to do and data formats, whereas they should not describe what data to communicate.

Johnson: Performance-based standards, especially minimum performance-based standards, are important in aerospace. Users have a lot of different tolerances for cost – users need to meet minimum performance in different ways. Balancing safety and quality is always a concern.

Weiss: It is community driven - it really depends on what the community wants and needs.

What is the Need for Reference Implementations?

Holland: We would like to think from a software development point of view – the worst way is to start with cumbersome and complex specifications and then try to build the implementation. The trick to make development go faster is to choose wisely what the customer actually needs first. Initial development efforts should focus on the relatively well-understood needs first. Later, you can better flesh out additional customer needs and further develop the standard to provide more complete coverage.

Shao: Need to think: are you forced to be fast or do you want to be fast? Will your standard already be outdated by the time it comes out? The traditional standard view is to output a complete document. Providing a minimum viable product concept is not necessarily the same thought process.

Johnson: SAE handles it by working with academia. We have started developing edge reports. SAE has large CEOs internally write white papers on how they use the standards/technology which then speeds up the standards process. In the case of drones, would you really want the standards process to go faster?

Weiss: The need for a reference implementation will vary based upon the technology in focus (e.g., robotics vs advanced manufacturing). Again, it is up to the community to decide what is needed.

Audience: The automated vehicle safety consortium is defining principles where you have an industry group that can move quickly and come to consensus and then can go to a Standards Development Organization to be implemented as a consensus standard that is recognized by regulatory agencies.

How will standards evolve to ingest and merge non-digital information with digital systems?

Holland: There are some quirks when an operation/organization/enterprise goes digital. Many suppliers are switching to digital control because it is cheaper. Once they have digital control, they can do other things such as putting in protection mechanisms so circuit boards won't be damaged. We need to think

at a systems level where a circuit board would start to protect the component instead of killing the engine – it's important to think of component interactions.

Shao: Digitized standards really provide a lot of value. For example, if things are digitized, you can automate a lot of your process of checking requirements.

Johnson: A lot of companies reference standards. A challenge is to digitize the actual documents and really understand the content in a machine-readable way. Hopefully, the SDOs can use this meta-information to better understand changes in the standards. This can help more people understand the standards. Also there are a lot of different maturity levels in the manufacturing world.

How will standards evolve to ingest and merge non-digital information with digital systems?

Does it help when you think more about best practices vs. standards and the notion of using data methods more than expert input?

Holland: SAE is starting to focus more on data specific standards.

Shao: Best practices are often well used.

Johnson: It can be confusing because so many types say standards - often it just means to some group it is an accepted conclusion and it has gone through a formal process; standard often means more than one person agrees on something.

Weiss: It is important to define the difference, and appropriate points of usage, for best practices vs. standards vs. guidelines.

Can Github (or something similar) be used for standards development?

Shao: There are practical difficulties.

Johnson: In SAE, it is very difficult to do this especially. It might be easy to do with some players. How do you handle only changing some parts of a standard?

Weiss: How do you consistently recertify different standards?

Audience:

International Transport Forum uses Request for Concepts as a place where people can suggest ideas for standards and then people start examining/addressing these requests. This allows things to grow organically - could a NIST role be to operate this? One question that was posed in the discussion is how are these organically-grown standards tested and verified? The audience respondent noted that the process is usually started with a few people getting together and then a charter is put together - then working groups are put together. The mantra is if you have two groups that use it, it is a standard.

Standards are important for data mapping and to do analysis in their software; it would be useful to have an industry-driven standard.

Other topics: Recertification of different standards, interoperability when protocols are up to vendors, autonomous operations in factory, evaluation of reliability of an algorithm's failure detection and reliability, fusion of data-driven and model-driven methods, and security risk mitigation for data analysis.

Prioritization of Issues Following open discussion and ranking

Specific products of interest (no ranking was available)

a) Guidelines on: cleaning data, semantics and sharing data, data ownership, system integration, data governance, data security, and Verification and Validation for PHM

b) Best practices for: autonomous vehicles, data archiving, model validation, data transmission and ingestion, and prediction of business

c) Standards for: data acquisition and storage, PHM processes, data analysis, and communications between OEMs and suppliers

Recommendations for Way Forward

1. Continue Society involvement in standards knowledge generation and sharing under the existing Standards Committee of the Society Board.
2. Activate a society standards interest group from the broad PHM community starting with the attendees and interested registrants from past PHM conferences who will give back:
 - a. Share their standards knowledge with the Standards Committee based upon any involvement with various PHM standards development organizations and/or efforts to integrate standards into their organization.
 - b. Participate in standards-oriented panels and workshops
 - c. Contribute lessons learned and case study documents
3. Continue standards-oriented panels or workshops at all PHM events
4. Implement a standards portal on the PHM website as an entry point for standards information and past activities in this domain.

Prepared by the panel with assistance from the PHM Standards Committee Chair, Jeff Bird.

Contribute at the standards forum at: <http://www.phmsociety.org/forum/592>