SAE INTERNATIONAL

WCX™ APRIL 9-11 2019 DETROIT

sae.org/wcx

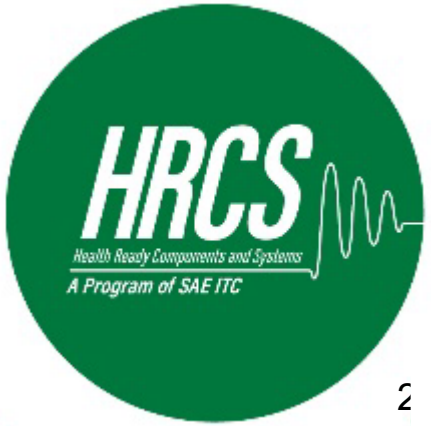
Health-Ready Components Going Mainstream

Session AE203: System Diagnostics/Prognostics and Predictive Maintenance

Steven W. Holland, PHM Consultant, Ref: 19AE-0336

SAE Health-Ready Components & JA6268™

- **Data is increasingly becoming *"the"* critical asset**
  - But even with big data, it can be difficult to use
  - We must rise from **Data ➔Information ➔Insight ➔Action**
- **VHM (or IVHM) encompasses both the traditional paradigm of diagnostics and the new paradigm of prognostics**
- **SAE JA6268™ lays out a future vision of how suppliers and OEMs can collaborate to mutual advantage to speed VHM implementation**
- **Today I will describe a unique opportunity for IVHM that has the potential to improve your company's products:**



What is a "Health-Ready Component"?

- **Health-ready components are supplier-provided components or subsystems which have been augmented to monitor and report their own health or…**
- **Alternatively, those where the supplier provides the integrator sufficient information to accurately assess the component's health via a higher-level system on the vehicle (or combination of both)**
- **Information sharing should be machine-readable or math-based**
- ***This is key to unlocking the potential of VHM!***

Unlocking the Potential of VHM Technology

Positive Feedback from Key Industry Leaders on JA6268™:

Aerospace

"Health-Ready Components on the 787 are enhancing Fleet performance and enabling customer support efficiencies today. This initiative has great potential." -Keith Sellers, 787 Fleet Chief, Boeing

"We really need better mechanisms like JA6268 to engage our supply base to bring IVHM into the mainstream" - Frank Kramer, Technical Specialist, Airbus

"We believe having this standard will accelerate the implementation of Health Monitoring for the civil aviation industry. This platform helps to decrease the costs for all involved and is a must-have for vendors when they move forward with widespread implementation." David Piotrowski – Sr. Principal Engineer – Delta TechOps

...

Automotive

"We believe that the most effective path to full implementation of IVHM/PHM technology must include robust best practices for exchanging design and performance information with our supplier partners" - Barbara Leising, Director of Global Aftersales Diagnostics & Electrical Engineering, General Motors

"As a supplier of automotive electronics, I believe that IVHM technology will be critical to the ultimate success of autonomous vehicles and we look forward to further collaboration with the OEMs to advance that goal." -Andre Kleyner, Global Reliability Engineering Leader, APTIV

...

Why is JA6268™ important to Industry?

- Motivation is to facilitate & speed the integration of the IVHM functionality for supplier-provided components to meet the needs of
  - OEMs,
  - end users/fleets and
  - government regulators
- Market forces will ultimately drive industry-wide application of IVHM and new health-ready requirements that suppliers must ultimately meet

New SAE Standards Document Published April 2018

Supplier Role Crucial for Cost-effective VHM

SAE INTERNATIONAL

SURFACE VEHICLE/AEROSPACE RECOMMENDED PRACTICE	JA6268™	APR2018
	Issued 2018-04	
Design & Run-Time Information Exchange for Health-Ready Components		

RATIONALE

This Surface Vehicle & Aerospace Recommended Practice was created to help reduce existing barriers to the successful implementation of Integrated Vehicle Health Management (IVHM) technology into the aerospace and automotive sectors by introducing health-ready components. Health-ready components are augmented either to monitor and report their own health or, alternatively, ones where the supplier provides the integrator sufficient information to accurately assess the component's health via a higher-level system on the vehicle. The principal motivation for health-ready components is to facilitate enhanced IVHM functionality in supplier-provided components that better meet the needs of end users and government regulators in a cost-effective manner. Underlying this motivation is the assumption that market forces will drive the need to achieve IVHM's benefits, which will in turn drive new requirements that suppliers must ultimately meet. This recommended practice has two primary objectives: (1) to encourage the introduction of a much greater degree of IVHM functionality in future vehicles at a much lower cost, and (2) to address legitimate intellectual property concerns by providing recommended IVHM design-time and run-time data specification and information exchange alternatives in an effort to help unlock the potential of IVHM.

https://www.sae.org/standards/content/ja6268_201804/ $78 or less

Selected SAE HM-1 IVHM Standards Issued or In-Progress

CURRENT ISSUED 2016-03-16

IVHM Concepts, Technology and Implementation Overview ARP6803

This SAE Aerosp
Integrated Vehic

CURRENT ISSUED 2014-07-07

Determination of Cost Benefits from Implementing an Integrated Vehicle Health Management System ARP6275

This ARP
return on
(HM) syst

WIP 2012-01-17

Data Interoperability for IVHM AIR6904

In ord
aeros
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WIP 2012-01-17

Integrated Vehicle Health Management Design Guidelines ARP6407

This SAE Aeros
Integrated Vehi

WIP 2012-01-17

Verification & Validation of Integrated Vehicle Health Management Systems and Software ARP6887

The ARP
required

WIP 2012-01-17

Guidelines for the Development of Architectures fo Integrated Vehicle Health Management Systems AR

This SAE Aerospace Recommended Practice (ARP) provides best practices and gu
creating an architecture for integrated vehicle health management systems. Whe

SAE IVHM Book Series edited by Ian Jennions

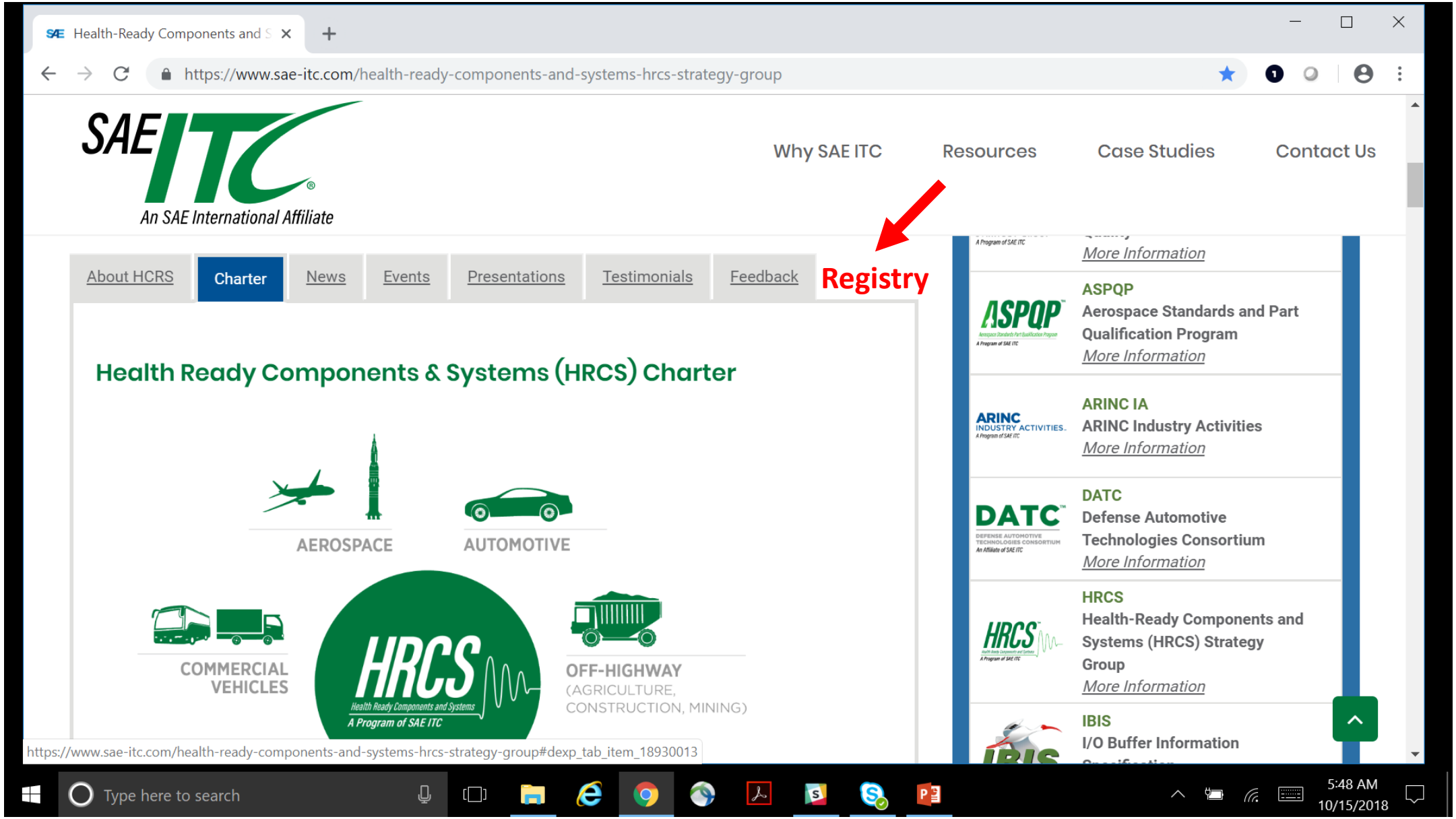
NTF OFFERS INSIGHT INTO IVHM COMPLEXITIES

- Auto industry uses **NTF** for “No Trouble Found”
- Aero industry uses similar **NFF** for “No Fault Found”
- Rates often exceed 50% (sometimes >90%) leading me to **NMF** as a better name since real reason could be:
  1) Testing machine/procedure in service bay or at supplier doesn’t capture all field failure modes
  2) Testing environment doesn’t reflect actual operating environment (temp, pressure, humidity, vibration, etc.)
  3) Wiring/connection problems in vehicle such as communication or power/ground issues
  4) Cooperating module(s) not performing as expected
  5) Purchasing Buyer negotiated a spec waiver for a lower price which allows supplier to limit warranty exposure
  6) …or component actually has no problems!

SAE ITC is launching the HRCS Consortium

- Unlike **SAE International** which is a 501(c)(3), **SAE ITC** is a 501(c)(6)
- It has the potential to amplify the impact of JA6268™ in unique ways beyond what a standards document could do
- HRCS website provides a wealth of info, with tabs for:
    - About HRCS
    - Charter (updated draft)
    - News
    - Events
    - Presentations
    - Testimonials
    - Feedback
    - Future tabs for HRCS database and HRCS membership

https://www.sae-itc.com/health-ready-components-and-systems-hrcs-strategy-group



WHY CREATE HEALTH-READY REGISTRIES/DATABASES?

- Provide assurance that a consistent process was followed and information is correct.
- Enable participants to find information they are seeking in a cost effective manner.
- Ensure a neutral, unbiased approach.
- Provide contacts for more information or issue resolution.
- Share costs.
- Leverage shared knowledge and technology

HRCS DATABASE

SAE JA6268™ REGISTRATION PROCESS

IVHM CAPABILITY *(VEHICLE LEVEL)* (SOURCE: SAE JA6268™)

Illustrating industry evolution in use of diagnosis & prognosis for vehicle maintenance

SAE Level	Vehicle Health Capability	Narrative Description	Participation in Repair Actions	Key Data Resources	Availability of Logged &/or Real-Time Data	Use of Supporting Models	IVHM System Characteristics
Manual Diagnosis & Repair Process performed by Technician							
0	Limited On-Vehicle Warning Indicators	Service actions for scheduled maintenance or when Operator notices problems or is alerted by indicator lights or simple gages.	**Operator/Driver & Service Tech**	On-Vehicle Measurements & Observation	N/A	Paper-based Manuals	Only Manual Diagnostic Tools & No Condition-Based Services
1	Enhanced Diagnostics Using Scan Tools	Service techs gain added diagnostic insight using automated scanners to extract vehicle operating parameters & diagnostic codes.	Operator/Driver & Service Tech	**On-Vehicle & Service Bay/ Depot Tools**	Logged Diagnostic Codes & Parameters available to Service Tech	Paper-based Manuals	On-Board Diagnostics Available
2	Telematics Providing Real-Time Data	Service techs gain real-time vehicle data via remote monitoring of vehicle to more completely capture issues.	Operator/Driver, Service Tech & Remote Support Center Advisor	On-Vehicle, Service Bay / Depot & Cloud Data	**Telematic Data Available to Service Tech with Diagnostics Info**	Paper-based Manuals	On-Board & Remote Data Available
Diagnosis & Repair Augmented by Prognosis & Predictive Analytics							
3	Component Level Proactive Alerts	Operator and service techs are provided with component health status (R/Y/G) before problem occurs . Limited condition-based maintenance.	Operator/Driver, Service Tech & Cloud-Based Services	On-Vehicle, Service Bay & Cloud Data	Telematic Data Available to Service Tech with Diagnostics Info	**Addition of Component-Level Health Models**	Component-Level Health Predictions
4	Integrated Vehicle Health Mgmt.	Operator and service techs are provided with system or vehicle level health indicators before problems occur with remaining useful life estimated. Condition-based maintenance.	Operator/Driver, Service Tech & Cloud-Based Services	On-Vehicle, Service Bay & Cloud Data	Telematic Data Available to Service Tech with Diagnostics Info	Addition of Vehicle-Level Health Models	**Vehicle-Level Health Management**
5	Self-Adaptive Health Mgmt.	Self-adaptive control and optimization to extend vehicle operation and enhance safety in presence of potential or actual failures.	Operator/Driver, Service Tech & Cloud-Based Services	On-Vehicle, Service Bay & Cloud Data	Telematic Data Available to Service Tech with Diagnostics Info	Addition of Vehicle-Level Health Models	**IVHM Capability Integrated into Vehicle Controls**

SAE JA6268™ THREE REGISTRATION STAGES (NOTE: NOW AT COMPONENT/SUBSYSTEM LEVEL)

Stage 1: *Functional Self Assessment*

Stage 2: *Failure Modes Assessment*

Stage 3: *Detailed Design Assessment*

Note:

- *Stage 1 is intended to provide a provisional registration with a low barrier to entry. All Stage 1 information will be recorded in online HRCS Registry.*
- *Stages 2 & 3 are enhanced by seeking an OEM/ integrator to validate the more detailed supplier-provided assessments. Stage 2 & 3 submissions should be accompanied by Stage 1 info as well to populate registry. Stage 2 & 3 completion will be noted in HRCS Registry but the additional data will not be loaded since it contains potentially proprietary info.*

SAE HRCS HEALTH-READY COMPONENTS REGISTRY (CORE INFO) STAGE 1, 2, & 3

(SAE JA6268™ Chapter 9)

- Component Name (and known aliases)
- Supplier's catalog reference number (or numbers)
- Suppliers contact information and DUNS number, CAGE Code or other industry standard supplier identifier (if applicable)
- Validation approach can be based upon (a) design-time information, (b) run time information or (c) both design-time and run-time information
- Format of Health Ready info which provides a mathematical model (or mathematical relationships) in a machine-readable format to allow for a proper interpretation and use of specific component parameters
- Integrator/OEM name providing the validation along with their contact information and DUNS number (if applicable)
- Dates validation was completed and date which the validation expires (if applicable)

\+ *Other items to be determined by HRCS SG (all non-proprietary)*

SAE HRCS HEALTH-READY COMPONENTS REGISTRY

Stage 1

*All examples and associated numbers in this presentation are for illustrative purposes only.

ISO FUNCTIONAL REFERENCE MODEL *(INDIVIDUAL COMPONENT LEVEL)**

*(adapted for use) ISO13374-1 (2002). Condition Monitoring and Diagnostics of Machines, Geneva, Switzerland

IVHM Functional Block	Description	IVHM Process Stage
Data Acquisition (DA)	This function collects the sensor data and health state information from the equipment internal monitors, the system data bus or data recorder.	Sense / Acquire
Data Manipulation (DM)	This function processes and transforms the sensor data and health state information collected by the DA.	Transfer
State Detection (SD)	This function evaluates equipment state conditions against normal operating profiles and generates normal or abnormal condition indicators.	Transfer
Health Assessment (HA)	This function provides information to determine the current state of health of equipment.	Transfer
Prognostics Assessment (PA)	This function provides future state of health, performance life remaining, or remaining useful life (usage) indicators.	Analyze
Advisory Generation (AG)	This function provides actionable information to operational and maintenance personnel or external systems.	Act

STAGE 1: FUNCTIONAL SELF-ASSESSMENT, PART A

Part A only requires 6 entries (0-100%) to estimate Health-Readiness for each of the ISO categories

IVHM Functional	Common IVHM Function or Process	General Description
Data Acquisition (DA)	Data Management	System function and process to control, protect, manage, deliver and enhance the value of health state data and information for the user community.
	Data Transfer Interface	System function or system to download or communicate raw data, health state indicators and information for consumption by downstream systems.
	Data Capture	System function may be a specialized data acquisition module that has analog feeds from sensors, collects processed data from a data bus or provides the software interface to a smart sensor.
Data Manipulation (DM)	Feature Extraction	System function to manipulate data and compute certain statistical indicators from degradation (predictor) parameters.
	Data Normalization	System function to manipulate data and compute a limited range of values within a norm.
	Data Processing	System function to manipulate data to compute health state indicator(s) or extract information for down stream systems.
State Detection (SD)	Parametric Data Analysis	System function to process degradation parameter data streams captured in a predefined event, anomaly condition or using external equipment.
	Onboard Diagnostics	A dedicated system function for self-diagnostics and reporting of system failures.
	Built-in-test (BIT)	The integrated system function that monitors and controls system self-tests to detect and report system failures to downstream systems.
Health Assessment (HA)	BIT Filtering & Correlation	System function and process to manage false alarms, fault persistence and correlate primary and secondary diagnostic trouble (BIT) codes to operational capabilities.
	Fault Isolation Analysis	System function and process to resolve reported failure ambiguities using model-based diagnostics or multiple data observations.
Prognostics Assessment (PA)	Time-to-fail Assessment	System function to monitor, record, assess and report equipment degradation parameter data and produce predicted performance life remaining estimates.
	Usage Monitoring & Assessment	System function to monitor, record, assess and report equipment life usage parameter data and produce predicted remaining useful life estimates.
Advisory	Decision Support Analysis	System function and process for the transformation and analysis of health state data and information to produce prescriptive actions for the user community.

STAGE 1: FUNCTIONAL SELF-ASSESSMENT, PART B

Part B asks 7 Supplemental Questions for Covered Failure Modes Identified in Part A to quantify sophistication

- **For Data Acquisition and Manipulation**
  - Machine readable description of input parameters
  - Machine readable procedure to convert raw parameter inputs into engineering units
- **For State Detection & Health Assessment**
  - Size of ambiguity group (can you identify single root cause or a list of “n” possible root causes)
  - Can you identify key parameters to assess onset of failure modes (machine readable)
  - Can you identify key relationships (or models) to interpret when those parameters indicate onset of a given failure mode (machine readable)
- **For Prognostics Assessment & Advisory Generation**
  - Average advance notice (RUL—Remaining Useful Life expressed in days)
  - Accuracy of forecasted failures (% false positives; % false negatives)

STAGE 1: *FUNCTIONAL SELF ASSESSMENT*

Part Name	Supplier	Sector	Supplier Part #	Supplier Contact	DUNS #	Validation: Design-Time Run-Time Both	Model: Machine Readable Format?	Validating OEM or Integrator	Date of Validation	Stage	Data Acquisition & Manipulation (DA & DM) % Coverage for Given Failure Mode	State Detection & Health Assessment (SD & HA) % Coverage for Given Failure Mode	Prognostics Assessment & Advisory Generation (PA & AG) % Coverage for Given Failure Mode
P/S													
AID													
T/C													
Starter													

SAE HRCS HEALTH-READY COMPONENTS REGISTRY

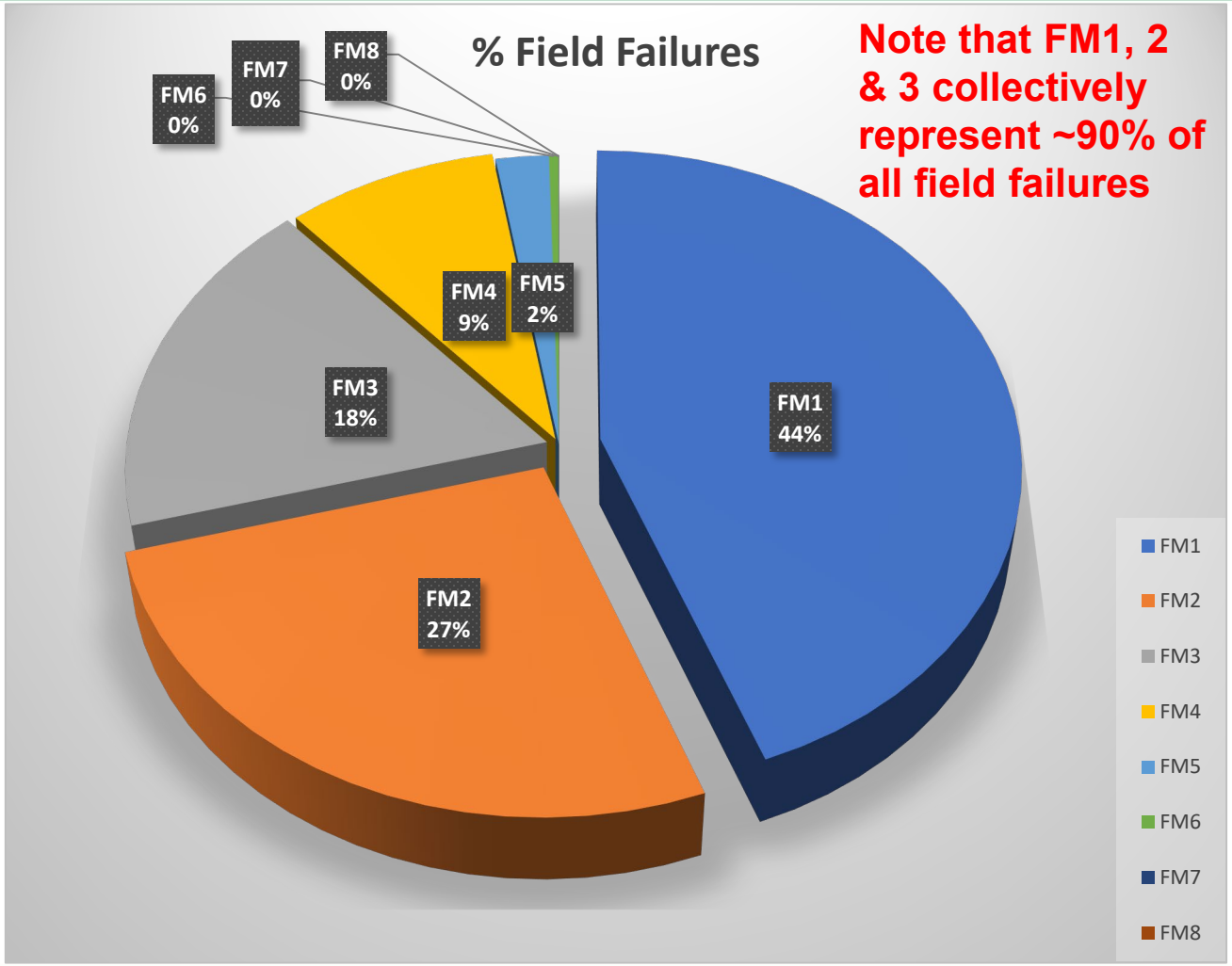
Stage 2

*All examples and associated numbers in this presentation are for illustrative purposes only.

PRIORITIZE FAILURE MODES BY FREQUENCY OF OCCURRENCE

Failure Mode	IPTV Expected in 1st 5 * Years	% Field Failures
FM1	10.0000	44.2605
FM2	6.0000	26.5563
FM3	4.0000	17.7042
FM4	2.0000	8.8521
FM5	0.5000	2.2130
FM6	0.0900	0.3983
FM7	0.0030	0.0133
FM8	0.0005	0.0022
Total	22.5935	100.0000

* or other reference period
IPTV=Incidents Per Thousand Vehicles



OTHER CONSIDERATIONS

- Frequency of failures (expressed as IPTV) as shown prior slide is clearly important. It is unlikely different modes will have uniform likelihood of occurrence in the field but, there are also other important factors to consider:
  - **Cost Per Vehicle** (CPV) – This measure tells us how costly on average it is to repair a vehicle once a given failure mode has happened
  - **Severity** (Type) – This measure tells us how important this failure mode is in terms of loss of functionality or its impact on vehicle safety
    - 5. ***Most Severe***: Non-operational Vehicle or Safety Issue
    - 4. Urgent Vehicle Repair
    - 3. Important Repair or Customer Inconvenience
    - 2. Minor Vehicle Repairs
    - 1. ***Least Severe:*** Routine Vehicle Maintenance

AIR7999 - DIAGNOSTIC AND PROGNOSTIC METRICS FOR ENGINE HEALTH MANAGEMENT SYSTEMS (DRAFT)

Metric Name	Definition	Description
Accuracy Based Metrics		
True Positive Rate (TPR)	$TPR = \frac{TP}{TP + FN} = P(D1\|F1)$	The proportion of fault conditions correctly detected. Also known as "sensitivity."
True Negative Rate (TNR)	$TNR = \frac{TN}{FP + TN} = P(D0\|F0)$	The proportion of no fault conditions correctly rejected as a fault. Also known as "specificity."
False Positive Rate (FPR)	$FPR = \frac{FP}{FP + TN} = P(D1\|F0)$	The proportion of no fault conditions incorrectly detected as a fault. Also known as "false alarm rate".
False Negative Rate (FNR)	$FNR = \frac{FN}{TP + FN} = P(D0\|F1)$	The proportion of fault conditions incorrectly rejected as a fault.
Positive Predictive Value (PPV)	$PPV = \frac{TP}{TP + FP} = P(F1\|D1)$	The proportion of positive fault prediction cases actually having a fault.
Negative Predictive Value (NPV)	$NPV = \frac{TN}{TN + FN} = P(F0\|D0)$	The proportion of negative fault prediction cases that are fault free.
False Discovery Rate (FDR)	$FDR = \frac{FP}{TP + FP} = P(F0\|D1)$	The proportion of positive fault prediction cases that are fault free.
False Omission Rate (FOR)	$FOR = \frac{FN}{TN + FN} = P(F1\|D0)$	The proportion of negative fault prediction cases actually having a fault.
Fault Detection Coverage	$C_D = \frac{N_{DF}}{N_{TF}} * 100\%$	The percentage of fault modes that can be detected.

True State \ Predicted State	Fault	No Fault
Fault	*TP (true positives)*	*FN (false negatives)*
No Fault	*FP (false positives)*	*TN (true negatives)*

A 2×2 matrix that reflects an algorithm's ability to discriminate between fault and no-fault cases. Its main diagonal reflects the number of correct predictions (true positives and true negatives) and its off-diagonal elements reflect the number of incorrect predictions (false negatives and false positives)

STAGE 2: FAILURE MODES ASSESSMENT

Similar to Stage 1 but based on each individual failure mode instead of aggregate performance

Failure Mode Descrip-tion	% Field Failures	Avg Cost of Repairs (CPV) $	Severity of Failure (5-1)	Health Indicators ID'd (text)	Relation-ships / Models ID'd (text)	Size of Diagnostic Ambiguity Group (n)	Machine Readable Informa-tion Exchange	Typical RUL Notice (stated units)	% False Posi-tives	% False Nega-tives	Data Acquisition & Manipulation (DA & DM) % Coverage for Given Failure Mode	State Detection & Health Assesment (SD & HA) % Coverage for Given Failure Mode	Prognostics Assessment & Advisory Generation (PA & AG) % Coverage for Given Failure Mode	•••
1														
2														
3														
4														
"n"														
Sums <=100%	**0**													

Stated RUL Units:

- ○ Hours
- ● Days
- ○ Weeks
- ○ Months
- ○ Cycles (flights/trips/starts)
- ○ Engine Hrs
- ○ Operation Hrs
- ○ Other: _____

SAE HRCS HEALTH-READY COMPONENTS REGISTRY

Stage 3

*All examples and associated numbers in this presentation are for illustrative purposes only.

STAGE 3: DETAILED DESIGN ASSESSMENT (~16 TABLES)

Stage 3 is the most complete, providing design data. Stage 3 still under development.

ISO 13374 (OSA-CBM) Implementation Level / SAE JA6268™ Interface Name			Data Acquisition (DA)	Data Manipulation (DM)	State Detection (SD)	Health Assessment (HA)	Prognostic Assessment (PA)	Advisory Generation (AG)
Design-Time Interfaces	1	Table of Corrective Actions	X	X	X	X	X	X
	2	Table of Interfaces	X	X	X	X		
	3	Table of Parameters	X					
	4	Table of Failure Modes	X	X	X			
	5	Table of Condition Indicators		X	X			
	6	Table of Health Indicators			X	X	X	
	7	Table of Predictive Indicators				X	X	
	8	Table of Reported State/Mode Indicators	X	X	X	X	X	
	9	Table of Loadable Software and Data Files	X	X	X	X	X	X
	10	Table of Automatically Reported Configuration Indicators			X	X	X	X
	11	Table of Internally Managed Data Recordings			X	X	X	X
	12	Table of Suggested, Externally Managed, Data Recordings	X	X				
	13	Table of Suggested, Externally Executed Algorithms	X	X				
	14	Table of Corrective Actions to Health Indicator Relationships	X	X	X	X	X	
	15	Table of Corrective Actions to Interface Anomaly Relationships	X	X	X			
	16	Table of Indicator to State/Mode Validity Relationships	X	X	X			

*All examples and associated numbers in this presentation are for illustrative purposes only.

SAE HRCS HEALTH-READY COMPONENTS REGISTRY

Registry WILL NOT contain any proprietary information (only Stage 1 info will be included regardless of the Stage completed.)

HRCS DATABASE- SHOWING MULTIPLE LISTINGS

SAE ITC HRCS Health-Ready Components Registry

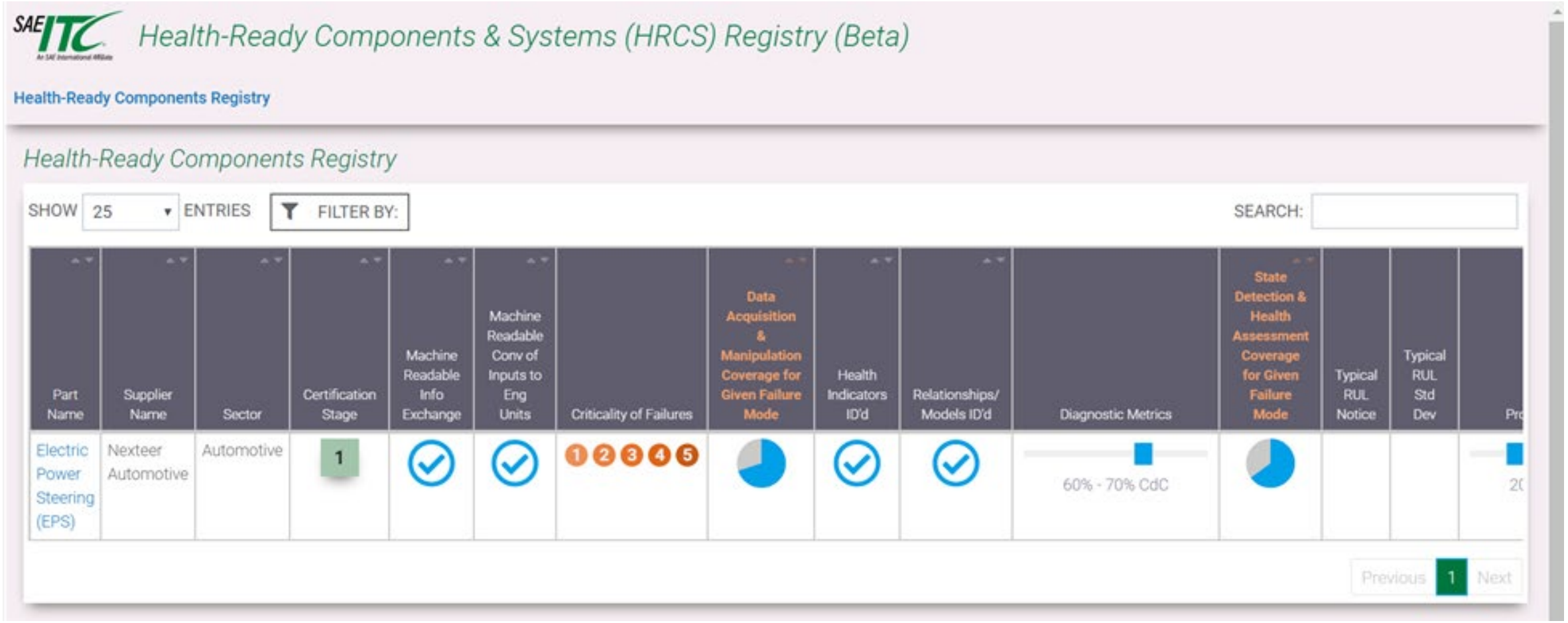
Search registry

Home > Health-Ready Components Registry

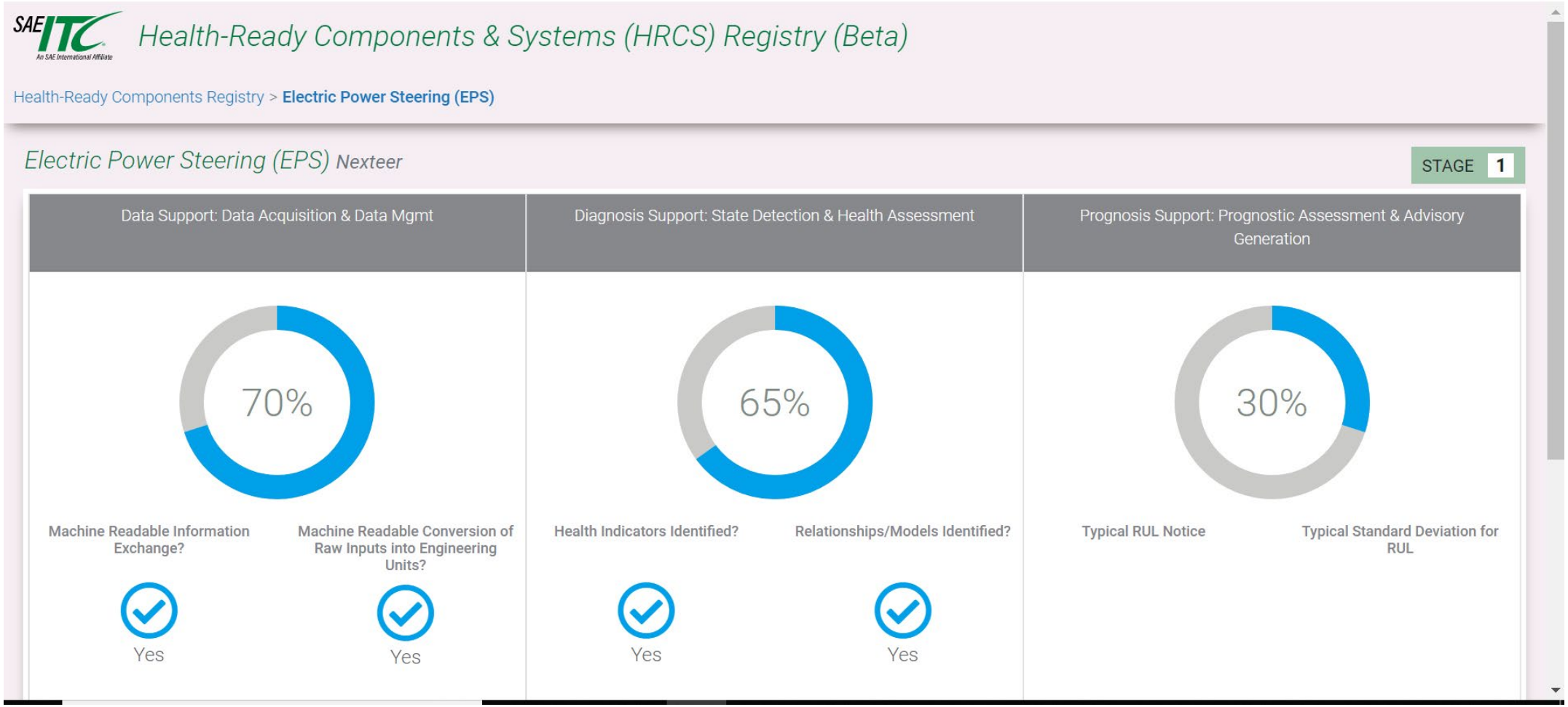
Health-Ready Components Registry

Part Name	Supplier Name	Sector	Certification Stage	Machine Readable Info Exchange	Machine Readabe Conv of Inputs to Eng Units	Criticality of Failures	Data Acquisition & Manipulation Coverage for Given Failure Mode	Health Indicators ID'd	Relation-ships/ Models ID'd	Diagnostic Metrics	State Detection & Health Assessment Coverage for Given Failure Mode	Typical RUL Notice	Typical RUL Std Dev	Prognostic Metrics		Prognostics Assessment & Advisory Generation Coverage for Given Failure Mode
Antilock Brake Module	XYZ Co	Automotive	1	✓	✓			✓	✓	80% - 82% NTF						
Turbocharger	GA Co	Automotive	3	✓	✓			✓	✓	85% NTF		10 OPERATION HRS	4 OPERATION HRS	80% TNR	20% FNR	
Electric Power Steering	NE Co	Automotive	2	✓	✓		100 %	✓	✓	65% - 70% NTF		2 WEEKS	0.5 WEEKS	90% PPV	85% NPV	
Flight Control	Up Co	Aerospace	1	✓	✓			✓	✓	80% NTF						
Antilock Brake Module	Stop Co	Aerospace	1	✓	✓			?	✗	80% NTF						
Infortainment	Entertain Co	Aerospace	1	✓	✓			✓	✓	80% NTF						
Auxilliary Power System	Power Co	Aerospace	1	✓	✓			✓	✓	80% NTF						
Landing Gear	Land Co	Aerospace	1	✓	✓			✓	✓	80% NTF						

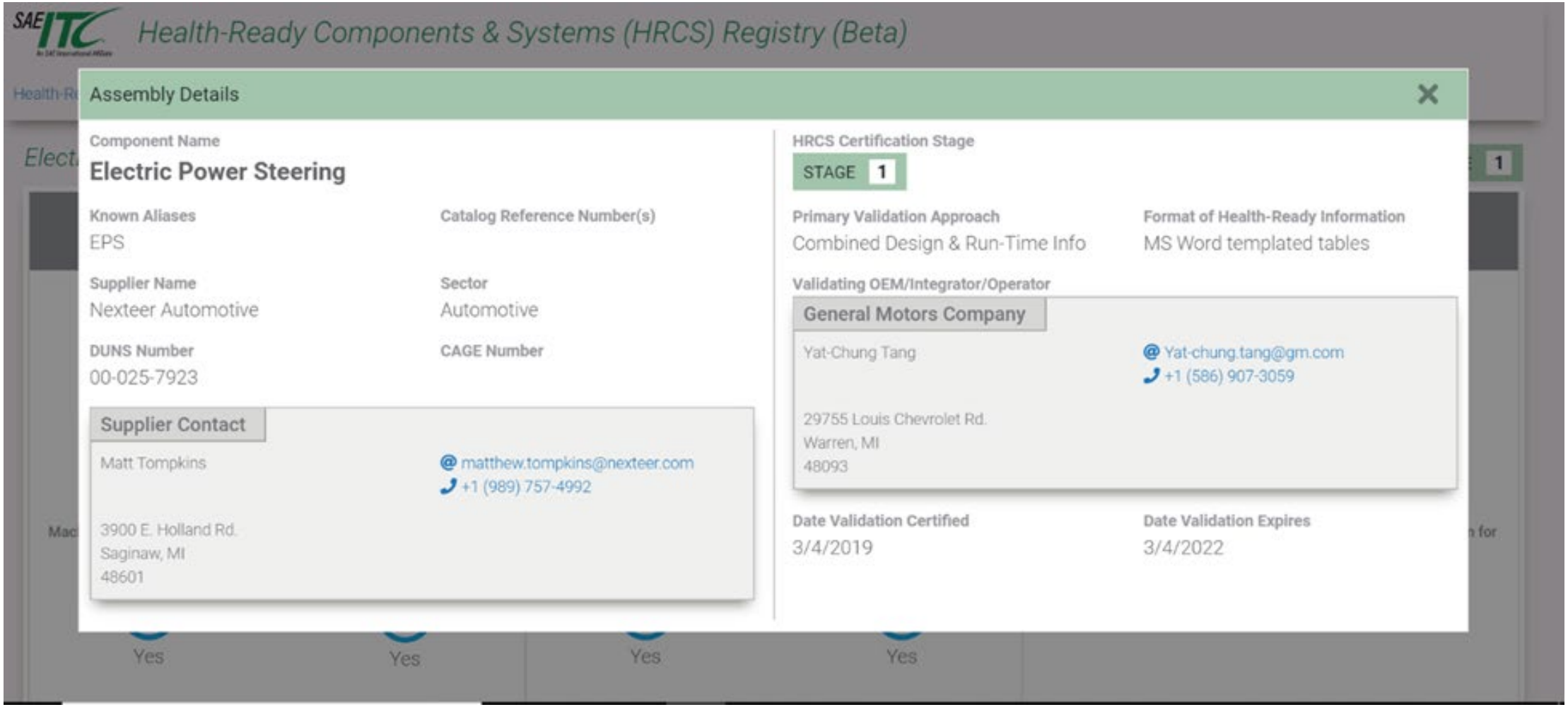
HRCS DATABASE- ACTUAL STAGE 1 LISTING



HRCS DATABASE- STAGE 1 LISTING DETAIL



HRCS DATABASE- STAGE 1 LISTING CORE INFORMATION



HRCS DATABASE AND OTHER ACTIVITIES

- Listings:
  - All new listings during calendar 2019 free of charge for one year from listing date
  - Discounted listing fees commensurate with membership level
  - SAE certification badge by Stage (registration level) for improved product branding
- Conference with HRCS track and exhibition later in 2019

HRCS DATABASE REGISTRATION BADGES

CONSORTIUM DEVELOPMENT

Mission

SAE Industry Technologies Consortia (ITC) enables organizations to connect, collaborate and positively impact global industries by empowering implementation of precompetitive solutions and innovative technologies.

Vision

We are a trusted global leader in consortia-based collaborative tools and services for highly technical industries' operations and supply chain, especially automotive and aerospace.

Collaborative Innovation. Trusted Implementation.

HRCS STRATEGY GROUP LETTER OF INTENT & CHARTER

- **Purpose of Letter of Intent (LOI)**
  - Outline of anticipated responsibilities, benefits, and scope
  - Identify champions within prospective member companies
  - No financial commitment
  - Interested parties who sign up will have primary input on consortium development


HRCS

- **Purpose of Membership Agreement**
  - Defines membership levels and associated privileges
  - Forms a structure to manage new initiatives
  - Three membership levels, pricing to include commensurate benefits
  - Timing- response by May 15th

HRCS MEMBERSHIP BENEFITS AND PRICING

Membership Category	Leadership Voting	Corporate Member Voting	Complimentary Parts Listing	Webpage/ Promotion	Program Documents	Online/ WebExTraining	Event Promotion/ Recognition	Registry Electronic Access	HRCS Events	Sponsorship rates	Annual Fee
Bronze	No	Yes	3	Listing	10% discount	10% discount	Yes	10% discount	10% discount	10% discount	$3K
Silver	No	Yes	6	Listing +Link	25% discount	25% discount	Yes	25% discount	25% discount	25% discount	$6K
Gold	Yes	Yes	9	Logo + Listing +2 links	50% discount	50% discount	Yes	50% disocunt	50% discount	50% discount	$9K

Membership term will be a calendar year but initial year will be prorated for partial year

HRCS DATABASE COMPONENT PRICING

Membership Category	Initial Setup Fee	2019 Listing	3yr Listing Fee	3yr Listing Bundle (of 10)
Non-member	$200	Complimentary	$300	$2,500
Bronze	$100	Complimentary	$270	$2,250
Silver	$50	Complimentary	$225	$1,875
Gold	Complimentary	Complimentary	$150	$1,250

HRCS STRATEGY GROUP POTENTIAL ACTIVITIES

HRCS Activities and Objectives Roadmap

1. Strategy (Communications, Prioritization, Deployment, Standards, Trial Use Pilot Projects, etc.)
2. Communication, branding, and marketing actions (e.g., websites, press releases, social media, certification badges to use in ads, etc.)
3. Development of an HRCS database. The database will list components, their capabilities, and certification stage
4. Establishing a voting and membership policy, meeting cadence, and rules
5. Liaison with SAE committees (e.g., SAE HM-1, OBD-II, E-32, and ARINC Industry Activities, etc.) and other standards organizations
6. Liaison with government organizations and regulatory bodies to review requirements relating to the flow down of Health-Ready Component requirements to the supply chain
7. Development and coordination of HRCS characterization training, certification training, JA6268™ training, liaison/endorsement of providers
8. Guidance for applicable tool development to support implementation (e.g., registries, databases, data exchange tools, training, etc.)
9. Deployment actions (timing, execution)
10. Management of third-party service providers
11. Program Participant Agreement Appendix (HRCS Strategy Group contracted work)
12. Funding/finances - budget & invoicing and what it supports/limitations

WHY JOIN THESE EFFORTS IN THE HRCS SG?
(ADDITIONAL THOUGHTS)

- Creation of the **Health-Ready Component Registry** to give visibility to SAE JA6268™ health-ready components and to create a cross industry movement to take advantage of IVHM.
- Subcommittees to agree on **specific document interchange content and format descriptions** building on existing documents (like GM's ICD component description file and ARINC's standard documents) that could be augmented to include better support for health-ready components.
- Agreed upon **actions to put SAE JA6268™ into practice** by going down a level from the high-level content captured in JA6268™.
- Subcommittees to tackle **terminology/lexicon/vocabulary** in important industry domains
- **Shared training efforts** in support of JA6268™ application in standardized ways

ADDITIONAL BENEFITS OF MEMBERSHIP

- Protection of operating in a legally protected environment
- Establish key relationships and trusted networks
- Voting privileges for all Consortium activities
- Free access to Consortium specifications and publications
- Discounted listing fees for HRCs in the registry
- Complimentary event attendance
- Professional training courses and development
- Implement strategic business improvements and innovative technologies
- Co-develop, publish, and gain access to standards, tools, products, programs, and services

HOW CAN YOU GET INVOLVED NOW?

- **Have your company sign the LOI or Membership Agreement!**
- Submit components for listing in the database
- Volunteer to participate in consortium development
- Submit pilot program recommendations

Thank you!!!

- Steven W. Holland
- PHM Consultant
- St. Clair, Michigan, USA
- +1 (810) 432-2911
- swholland@gmail.com