Automated Compliance – delivering standards data in a more usable fashion to the point of use

GLOBAL PRODUCT DATA
INTEROPERABILITY
SUMMIT 2025

Simon Powell - SAE Industry Technology Consortia, **Digital Standards Alliance**
Jan de Nijs – Fellow – Technical Fellow, **Lockheed Martin**
Terra Mullin – Senior Aerospace Consultant, **Auros IQ**

Presenters Bio

Jan de Nijs is a **Lockheed Martin** (LM) Technical Fellow responsible for developing strategies related to Enterprise Digital Production.

Joined LM in in 2004 with focus on advanced manufacturing technologies on the production floor and capital acquisition.

Since 2016 he has been part of the F35 program in Fort Worth, working on digital transformation.

Simon Powell is Senior Operations Program Manager of the **Digital Standards Alliance**, operated by SAE Industry Technology Consortia.

His career has focused delivering digital services that increase the value of content at the point of use.

He has worked in digital publishing and standards for over 25 years, primarily in product and technology roles with BSI, ISO & Wolters Kluwer

Terra Mullis is the Senior Aerospace Consultant at **AurosIQ**, bringing 15 years of experience in compliance and standards in aerospace and energy distribution.

At Boeing, she supported 787 Quality Engineering through compliance data managememt and AOG operations, she worked safety compliance at Puget Sound Energy and served on the Common Ground Alliance Data Committee on safety and pipeline standards.

Learning Objectives

1. The unique challenges faced by standards organizations in achieving true digitalization

2. How diverse use cases from a user perspective impact the approach to a solution

3. How analysis and a true collaborative effort can accelerate the solutions to these challenges

1. The key challenge for SDOs*

explored in this recent DSA whitepaper:

Complex Ecosystem

Legacy Formats

Market Confusion

Dependence on Voluntary Expert Community

Low Corporate Visibility

Different solutions for different “types” of standards in different use cases are required

2) Diverse use cases impact the approach to a solution

Every user of standards is in a unique situation, solving a unique problem in a unique environment.

This means that a “digital standard” must be:

a) Precise enough to accurately convey the required knowledge as intended by the expert committee
b) Flexible enough to be interpreted and implemented in endless scenarios using multiple processes and toolsets.

An example of a demanding use case follows…

LM use case: automatic operational planning.

At Customer:
Coming from Engineering

All requirements

At Supplier: Interpreted by Process and Operational Engineers

+

interpret

+

Manufacturing Plan

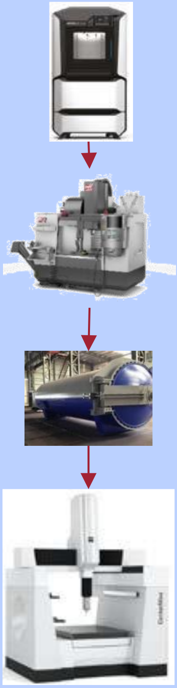
Test Plan

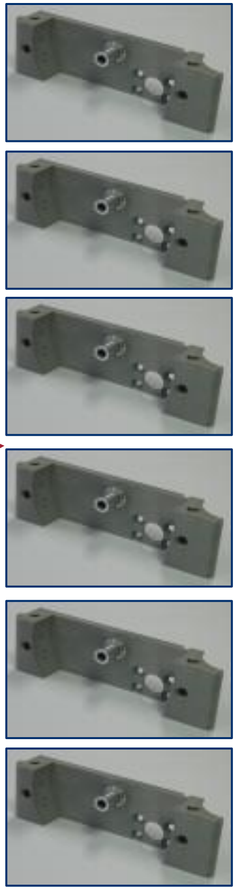
- Manufacturing and Test Rules and Resources
- Manufacturing and Test Specifications and Standards

Interpretation process current state:

- **100% done by humans (Manufacturing and QA Engineers)**
- **Time Consuming**
- **No automation because hard to get all requirements**

Instantiation:
Making multiple parts





Need for faster, machine assisted, operational planning

LM use case: how are the requirements conveyed?

At Customer: Coming from Engineering

All requirements

Information and Format	Status	Machine Interpretability
Contract: How Many? When? T&Cs (OAGIS)		**Pretty Good** • OAGIS
The Model: Geometry/Topology/PMI (Digital Frameworks emerging)		**Challenging** • Worked on in PDES • ISO 10303 STEP AP242 and others
Specifications and Standards (PDFs or Word files)		**Major Improvement Required** • only focused on human consumption • unclear as to what is are requirements • Circular logic • Texts do not follow semantic dictionaries • **this is the focus of the DSA**

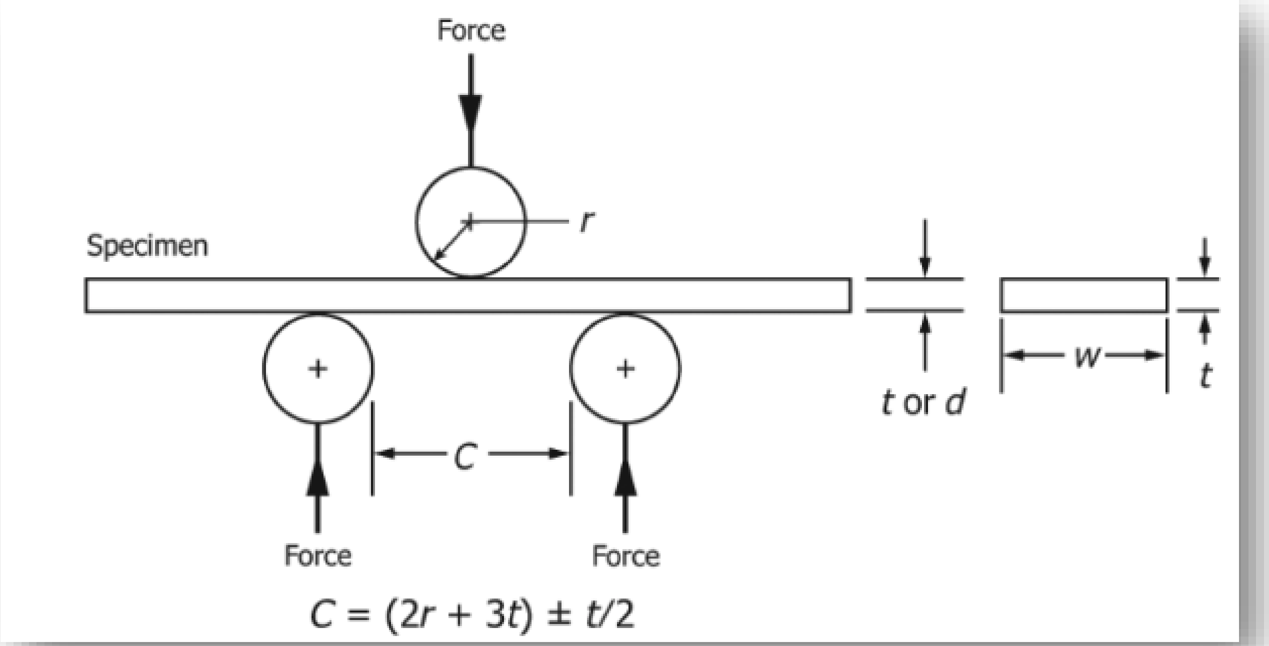
Biggest issue: Specifications and Standards

Requirements need to be provided in a consistent, machine interpretable format

3) How collaborative effort can accelerate the solution

Digital Standards Alliance: Automated Compliance

Modeling a practical bend test using data from multiple standards



Project Hypothesis and Requirements

Hypothesis

- Information from **multiple standards** from **different SDOs** can be viably normalized and modelled to create **useful digital outputs**
- These outputs can be implemented in **multiple user scenarios** by different role holders in the manufacturing supply chain.

Model-Based Requirements

- Create and test, with customers and committee representatives, a set of data models of a pair of connected standards.
- Make observations and quantified estimates about the **customer utility & value**, **viability** and **feasibility** of the deliverables from the modeling exercise

Tool Agnostic

- A data format, API, or integration protocol that works across systems without needing proprietary adapters or tools.
- Content or services that can be consumed across any channel or platform without requiring a specific medium or vendor lock-in.

AurosIQ

- No-code parameter-based model frameworks encapsulated in modular units "Knowledge-Packets" with classification meta-data.

- JSON, XML
- OmniBridge (API)
- AurosIQ Assessment Control

Automated Compliance: Project Approach

User Research
- Use cases
- Different roles

Discussed with multiple role holders along the manufacturing supply chain how they engage with, and use standards today to create draft personas

Example Modeling
- Different SDOs
- Agnostic outputs

Worked with third party modelling specialist (AurosIQ) to create platform agnostic models from multiple standards (to support a single process)

Identify Errors and Gaps
- Classify
- Quantify

Explicitly capture the level of effort alongside the issues and challenges of executing the modeling process during the work

Measure Utility
- Meet needs?
- What else?

Test the usefulness and the usability of the modeling outputs using multiple approaches with multiple role holders in the chain

About AurosIQ

An enterprise software platform delivering **Model-Based Cognition™** for complex adaptive enterprises in engineering, manufacturing & energy.

- Enables domain expert authorship of **no-code, symbolic models** (requirements, rules, processes, knowledge).
- **Executes models in real time** to drive data collection, compliance, and work instructions in the flow of work.
- **Coordinates parameters, models, evaluated values and qualitative response** across tools/teams; connectors include **Smart CAD, OmniBridge** and traditional API.
- **Adopted across aerospace, automotive, and defense**, with deployments spanning OEMs, tier-1 suppliers, research institutions and production environments (e.g. MIT Lincoln Laboratory, Spirit AeroSystems, BorgWarner, GE and more).

Scope of Standards Modeled

Specification	In Scope	Out of Scope
AEROSPACE MATERIAL SPECIFICATION — AMS5528™ REV. J; Issued 1953-12; Revised 2019-04; Superseding AMS5528H; Steel, Corrosion-Resistant, Sheet, Strip, and Plate 17Cr - 7.1Ni - 1.1Al Solution Heat Treated, Precipitation Hardenable (Composition similar to UNS S17700)	3.4.1.3 Bending *(1 paragraph)*	Remaining Sections
Designation: E290 – 22 — **Standard Test Methods for Bend Testing of Material for Ductility**[1] This standard is issued under the fixed designation E290; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval. *This standard has been approved for use by agencies of the U.S. Department of Defense.*	Free Bend Test Type 1 Free Bend Test Type 2 *(12 pages)*	Bend-and-flatten Test Guided-bend Test Guided-Bend Test, No-Die Semi-guided Bend Test Arrangement A Semi-guided Bend Test Arrangement B Semi-guided Bend Test Arrangement C U-bend Test V-bend Test V-bend test for cold-rolled sheet

Approach: Transform *Analog Documents* → *Digital Models*

Modularize: Logically chunk into discrete reusable units assuming re-use/translocation

Modularize

SAE AMS5528:
1 K-PAC

ASTM E290-22:
204 K-PAC

Designation: E290 – 22

Standard Test Methods for Bend Testing of Material for Ductility[1]

This standard is issued under the fixed designation E290; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

8. Test Specimens

8.1 Specimens shall be selected from the material to be tested using one of the following procedures:

8.1.1 *Full-cross-section Specimens*—If the smallest dimension of the cross-section is equal to or less than 38 mm (1½ in.), the specimen can be of the full thickness provided there is sufficient specimen length to permit bending to the specified angle of bend.

SUMMARY OF CHANGES

Committee E28 has identified the location of selected changes to this standard since the last issue (E290–14) that may impact the use of this standard.

Community of Practice: American Society for Testing and Materials (ASTM)

ASTM-127 08.01.01 Sampling [Requirement]

DETAILS RELATIONS TEAMS DISCUSSIONS

v1

Description	Full-cross-section Specimens —If the smallest dimension of the cross-section is equal to or less than 38 mm (11/2 in.), the specimen can be of the full thickness provided there is sufficient specimen length to permit bending to the specified angle of bend.
Document Section	Test Specimens
Document Structure	08.01.01
Process Step	
Specification ID	E290-22
Specification Name	Standard Test Methods for Bend Testing of Material for Ductility
Superseding ID	E290-14

Approach: Transform ***Analog Documents → Digital Models***

Classify: What "type" (e.g. definition, requirement) and associated metadata (owner, scope, conditionality, etc)

Modularize

SAE AMS5528:
1 K-PAC

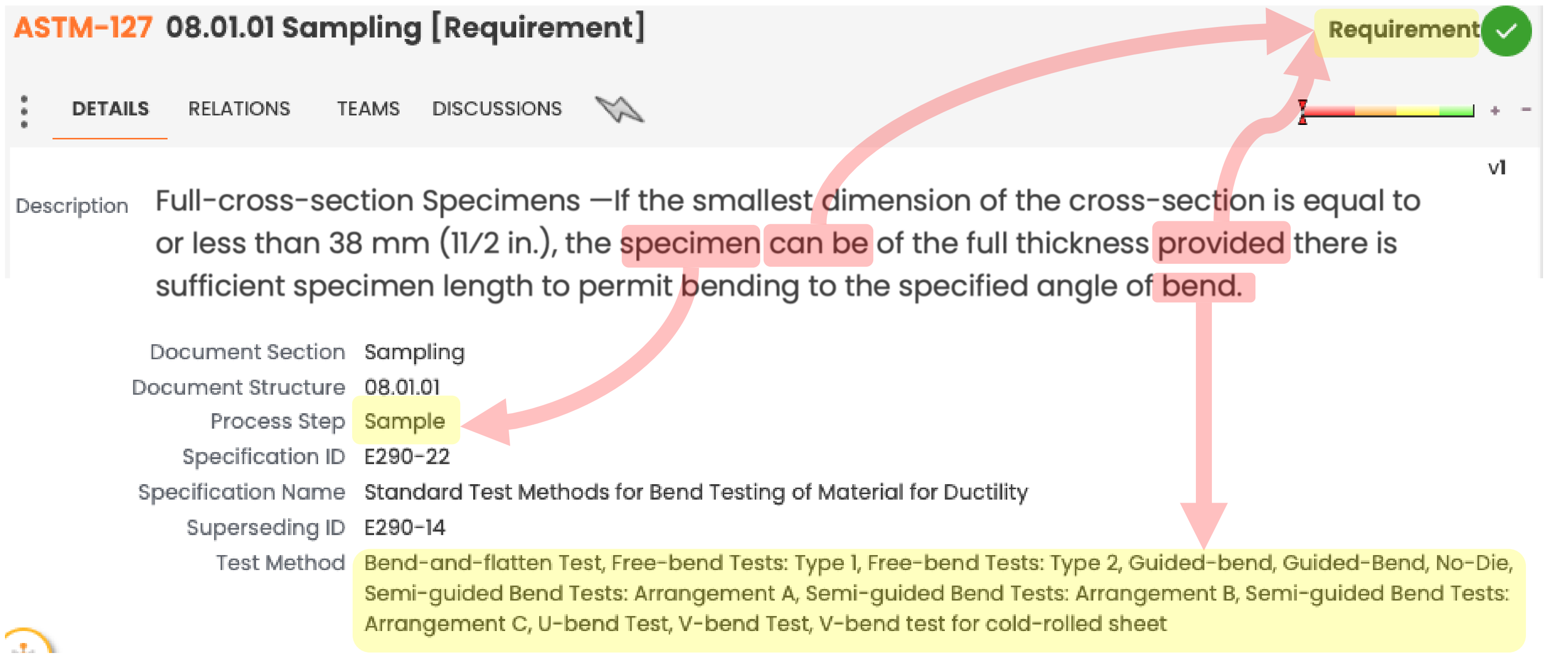
ASTM E290-22:
204 K-PAC

Classify

Test
Free-Bend: ***109***
Other: ***172***

Type
Requirement: ***122***
Allowable: ***5***
Classification: ***14***
Definition: ***30***
Information: ***30***
References: ***5***

Process Step
Sample: ***29***
Test: ***144***
Evaluate: ***18***
Report: ***7***



Approach: Transform *Analog Documents* → *Digital Models*

Parameterize – Identify unique name, definition and "kind" (length, temp, etc) for variables requiring evaluation during reuse

Modularize

SAE AMS5528:
1 K-PAC

ASTM E290-22:
204 K-PAC

Classify

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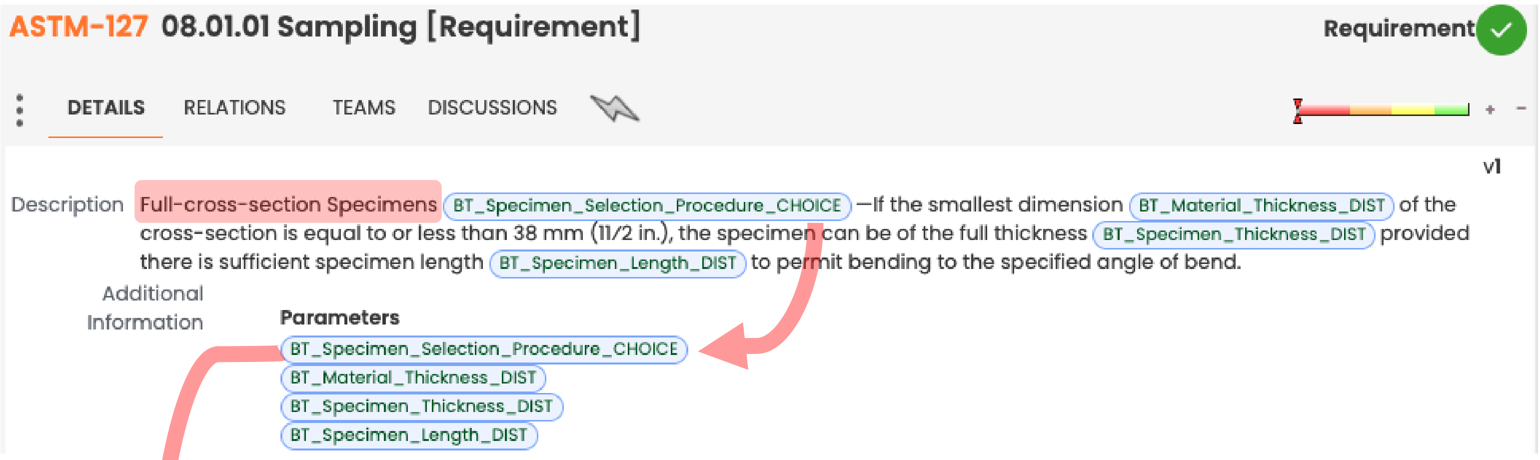
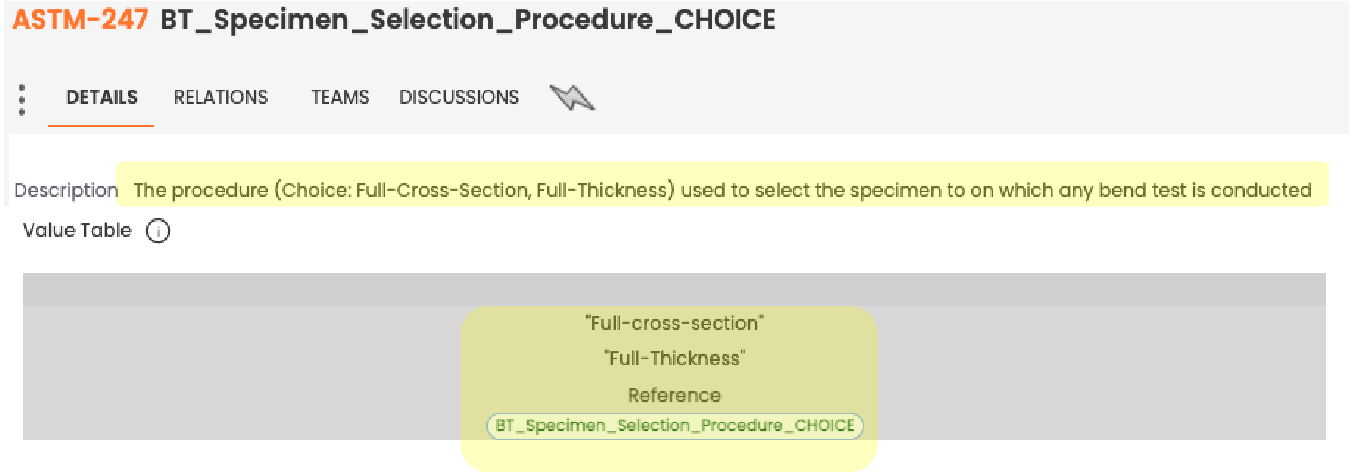
Parameterize

54

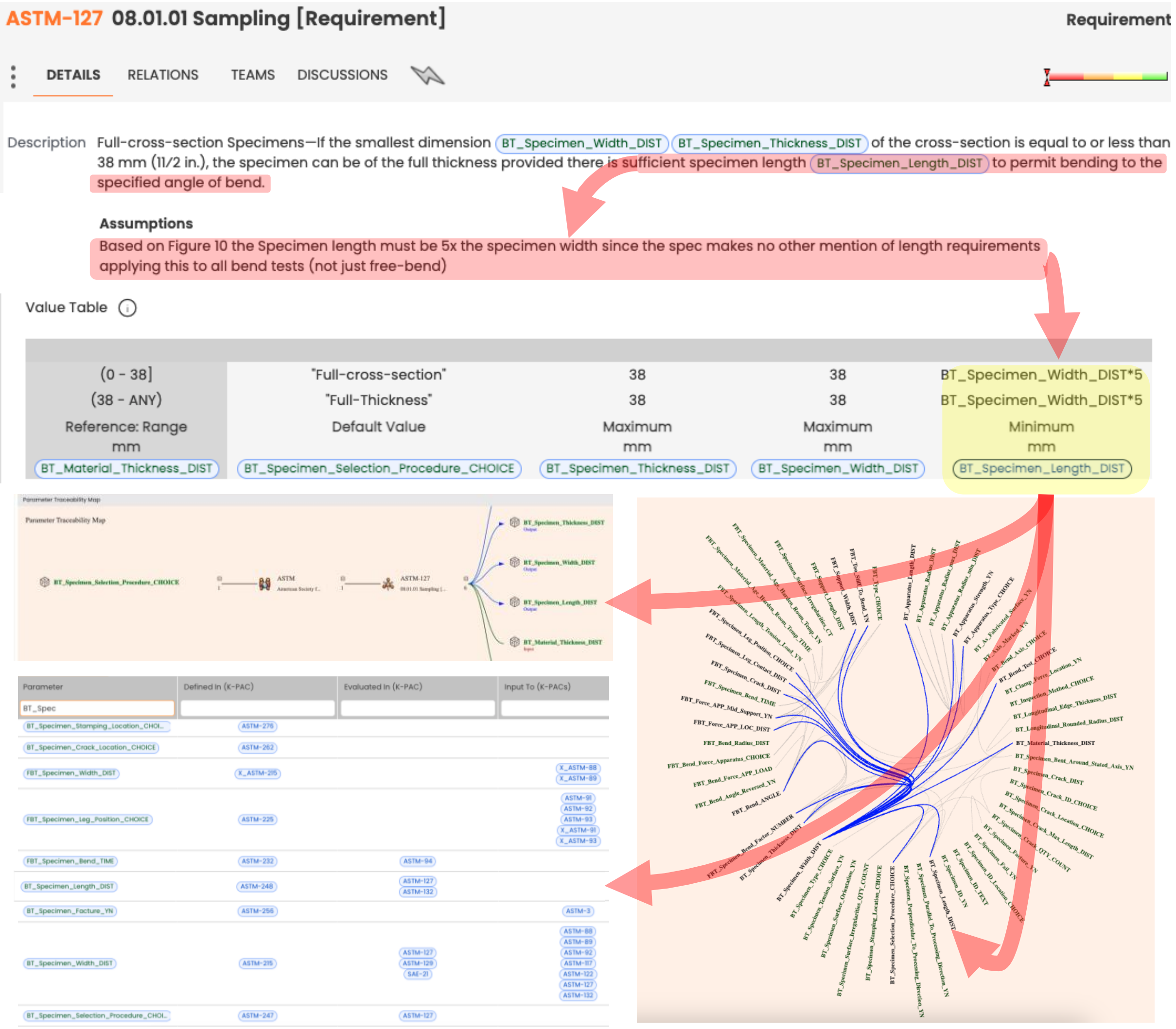




Approach: Transform *Analog Documents* → *Digital Models*

Model (components) - abstraction based on defined *parameters*, structured by neutral representation capable of being processed by any tool. Encodes logic, rules, relationships and decision criteria.

Modularize	**Classify**	**Parameterize**	**Model** *Components*
SAE AMS5528: **1 K-PAC** *ASTM E290-22:* **204 K-PAC**	***Test*** *Free-Bend:* ***109*** *Other:* ***172*** ***Type*** *Requirement:* ***122*** *Allowable:* ***5*** *Classification:* ***14*** *Definition:* ***30*** *Information:* ***30*** *References:* ***5*** ***Process Step*** *Sample:* ***29*** *Test:* ***144*** *Evaluate:* ***18*** *Report:* ***7***	***54***	***33***



Approach: Transform *Analog Documents* → *Digital Models*

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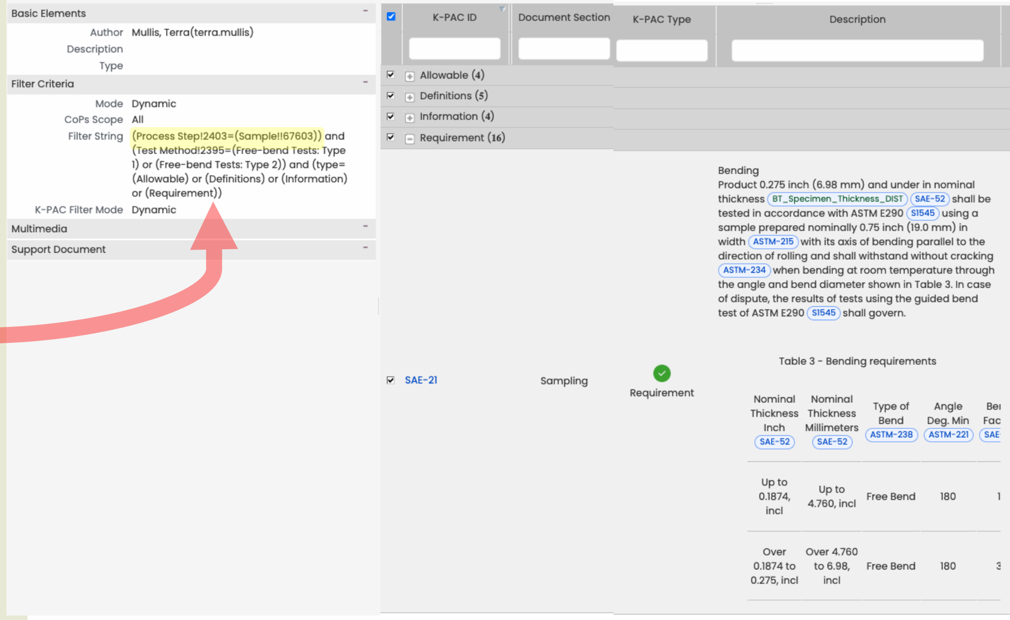
Model (groups) - Identify and model (through grouping) the modularized units & models which must be instantiated together

Modularize	**Classify**	**Parameterize**	**Model** *Components*	**Model** *Groups*
SAE AMS5528: **1 K-PAC** *ASTM E290-22:* **204 K-PAC**	***Test*** *Free-Bend: **109*** *Other: **172*** ***Type*** *Requirement: **122*** *Allowable: **5*** *Classification: **14*** *Definition: **30*** *Information: **30*** *References: **5*** ***Process Step*** *Sample: **29*** *Test: **144*** *Evaluate: **18*** *Report: **7***	***54***	***33***	***4*** ***Process Step*** *Sample: **29*** *Test: **144*** *Evaluate: **18*** *Report: **7***



Approach: Transform *Analog Documents* → *Digital Models*

Model (orchestration) - Identify and model the order (precedence) and conditionality of the model groups

Modularize

SAE AMS5528:
1 K-PAC

ASTM E290-22:
204 K-PAC

Classify

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Free-Bend: ***109***
Other: ***172***

Type
Requirement: ***122***
Allowable: ***5***
Classification: ***14***
Definition: ***30***
Information: ***30***
References: ***5***

Process Step
Sample: ***29***
Test: ***144***
Evaluate: ***18***
Report: ***7***

Parameterize

54

Model *Components*

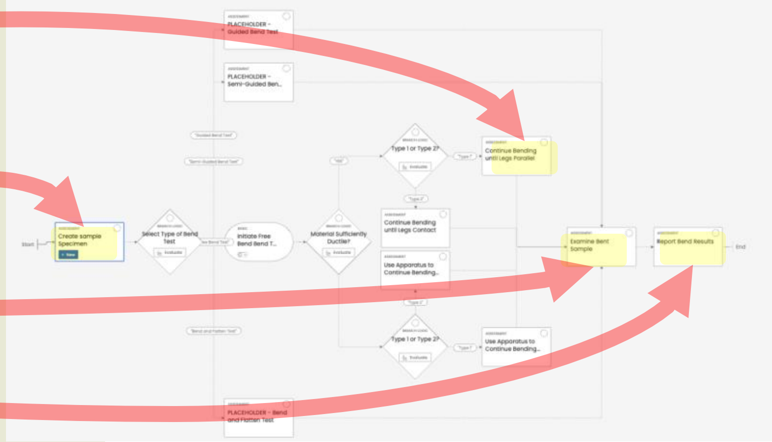
33

Model *Groups*

4
Process Step
Sample: ***29***
Test: ***144***
Evaluate: ***18***
Report: ***7***

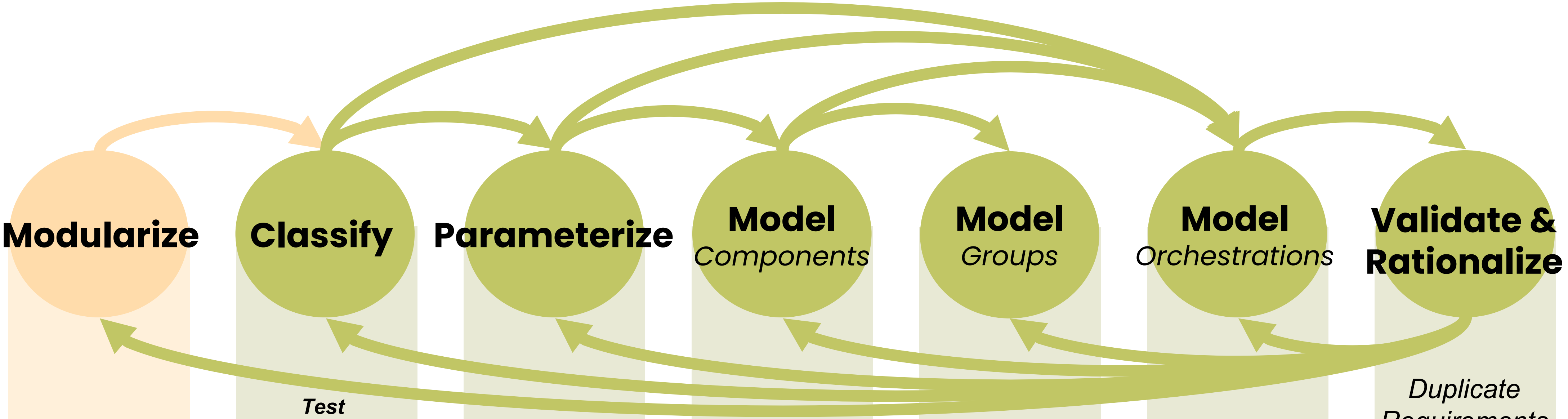
Model *Orchestrations*

1



Approach: Transform *Analog Documents* → *Digital Models*

Validate & Renationalize - refine and reduce duplications, optimize for reuse, enforce consistency, validate with authoritative SME and make corrections



Modularize

SAE AMS5528: **1 K-PAC**

ASTM E290-22: **204 K-PAC**

Classify

Test
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Report: ***7***

Parameterize

54

Model Components

33

Model Groups

4

Process Step
Sample: ***29***
Test: ***144***
Evaluate: ***18***
Report: ***7***

Model Orchestrations

1

Validate & Rationalize

Duplicate Requirements

Ambiguous Requirements

Missing Requirements

Approach: Transform ***Analog Documents*** → ***Digital Models***

Validate & Renationalize - refine and reduce duplications, optimize for reuse, enforce consistency, validate with authoritative SME and make corrections

Model *Components*

33

Model *Groups*

4
Process Step
Sample: ***29***
Test: ***144***
Evaluate: ***18***
Report: ***7***

Model *Orchestrations*

1

Validate & Rationalize

Duplicate Requirements

Ambiguous Requirements

Missing Requirements

Issues

Duplicate Requirement: ASTM-88 "no external force is applied to the specimen in the immediate area of the bend" and ASTM-89 "force ... shall be applied at, or within one width distance from, the ends of the specimen" and ASTM-117 "no bending force is applied directly to the bend area in a free-bend test during th final bending"

Duplicate Requirement: ASTM-89 "if the material is too stiff to respond to such force it shall be supported at the mid-length" and ASTM-118 "A support may be necessary to initiate the bend"

Assumptions

Referencing FIGURE 10 which shows a 5:1 ratio of length to width

Assumptions

Based on Figure 10 the Specimen length must be 5x the specimen width since the spec makes no other mention of length requirements applying this to all bend tests (not just free-bend)

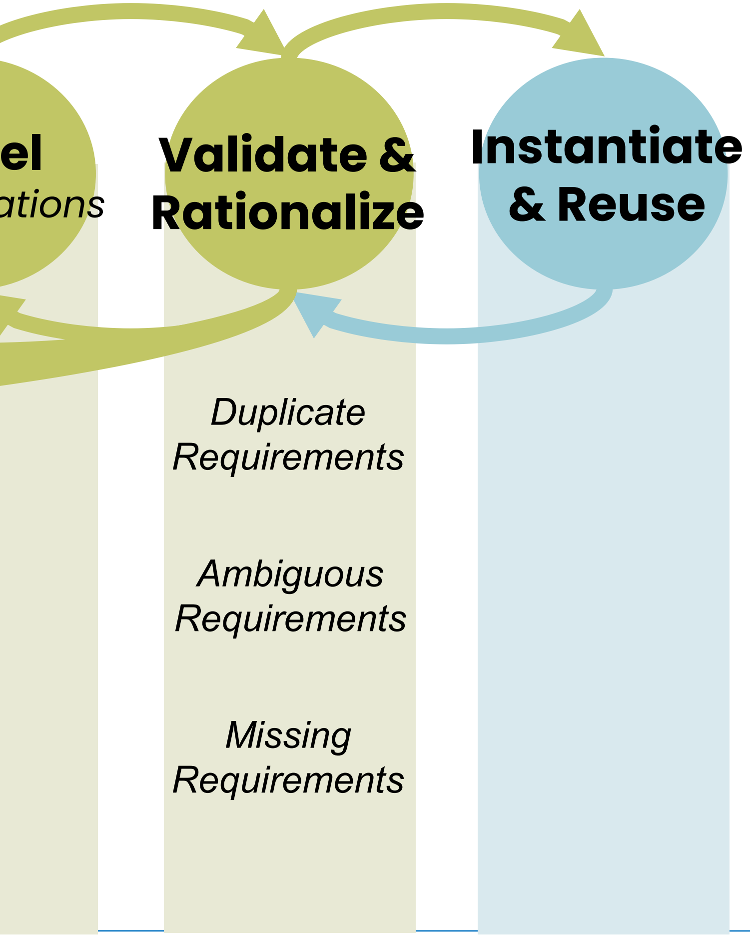
Issues

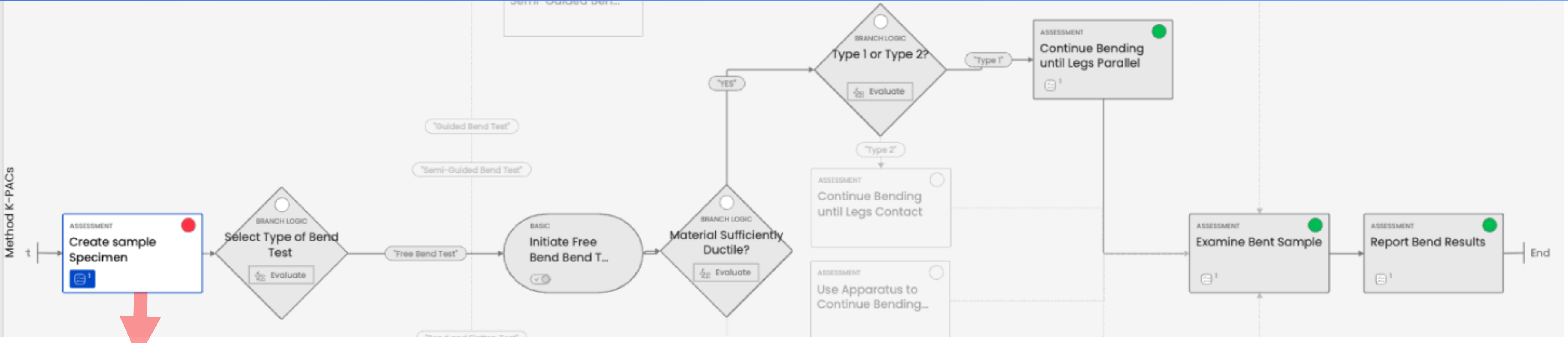
where is the requirement for the specified nominal value for the radius?

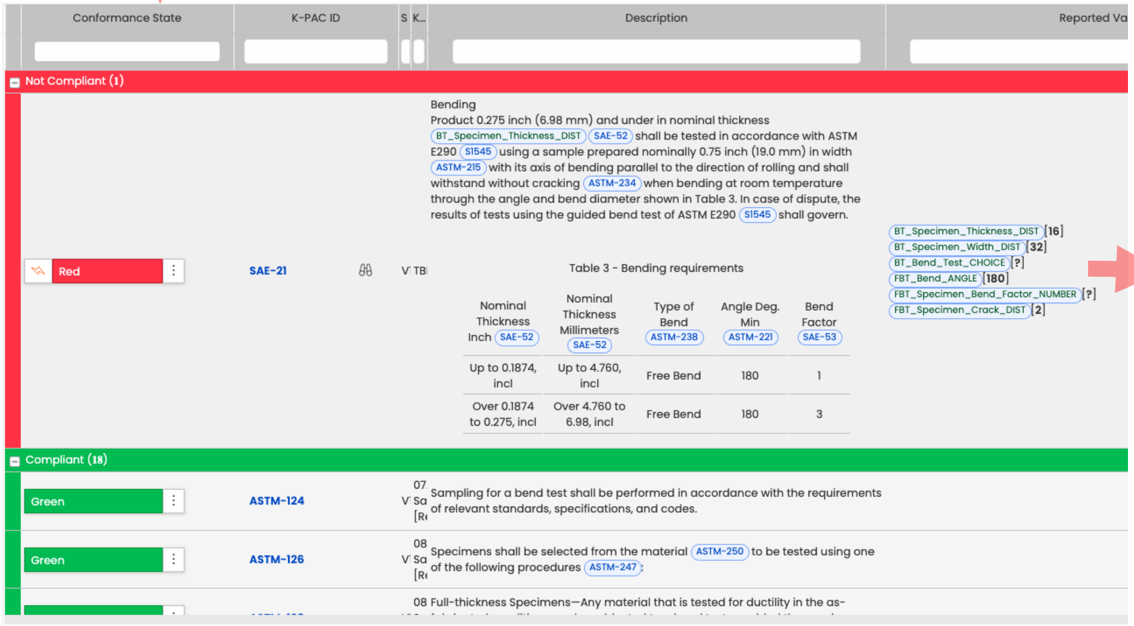
Note: These duplicates, ambiguities and gaps must be identified, quantified and resolved at source for accurate modeling and effective digital interoperability to be achieved.

Approach: Transform *Analog Documents* → *Digital Models*

Instantiate & Reuse - expose and/or publish the models and services to be instanatiated and reused.







Conformance State	K-PAC ID	S	K...	Description	Reported Va
Not Compliant (1)					
Red	SAE-21		V TB	Bending Product 0.275 inch (6.98 mm) and under in nominal thickness BT_Specimen_Thickness_DIST SAE-52 shall be tested in accordance with ASTM E290 S1545 using a sample prepared nominally 0.75 inch (19.0 mm) in width ASTM-215 with its axis of bending parallel to the direction of rolling and shall withstand without cracking ASTM-234 when bending at room temperature through the angle and bend diameter shown in Table 3. In case of dispute, the results of tests using the guided bend test of ASTM E290 S1545 shall govern.	BT_Specimen_Thickness_DIST [16] BT_Specimen_Width_DIST [32] BT_Bend_Test_CHOICE [?] FBT_Bend_ANGLE [180] FBT_Specimen_Bend_Factor_NUMBER [?] FBT_Specimen_Crack_DIST [2]
Compliant (18)					
Green	ASTM-124	07	V Sa [R	Sampling for a bend test shall be performed in accordance with the requirements of relevant standards, specifications, and codes.	
Green	ASTM-126	08	V Sa [R	Specimens shall be selected from the material ASTM-250 to be tested using one of the following procedures ASTM-247:	
		08		Full-thickness Specimens—Any material that is tested for ductility in the as-	

Table 3 - Bending requirements

Nominal Thickness Inch SAE-52	Nominal Thickness Millimeters SAE-52	Type of Bend ASTM-238	Angle Deg. Min ASTM-221	Bend Factor SAE-53
Up to 0.1874, incl	Up to 4.760, incl	Free Bend	180	1
Over 0.1874 to 0.275, incl	Over 4.760 to 6.98, incl	Free Bend	180	3

Parameter List	Reported Value	Minimum	Nominal	Maximum
BT_As_Fabricated_Surface_YN	YES			
BT_Axis_Marked_YN	NO			
BT_Bend_Test_CHOICE				
BT_Longitudinal_Rounded_Radius_	1.5			1.5
BT_Material_Thickness_DIST	2			
BT_Specimen_ID_Location_CHOICI	"End"			
BT_Specimen_ID_YN	YES			
BT_Specimen_Length_DIST	190	160.0		
BT_Specimen_Parallel_To_Process	YES			
BT_Specimen_Perpendicular_To_P	YES			
BT_Specimen_Selection_Procedure	"Full-cross-section"			
BT_Specimen_Thickness_DIST	16			38.0
BT_Specimen_Width_DIST	32			
FBT_Bend_ANGLE	180			
FBT_Specimen_Bend_Factor_NUMI				
FBT_Specimen_Crack_DIST	2			

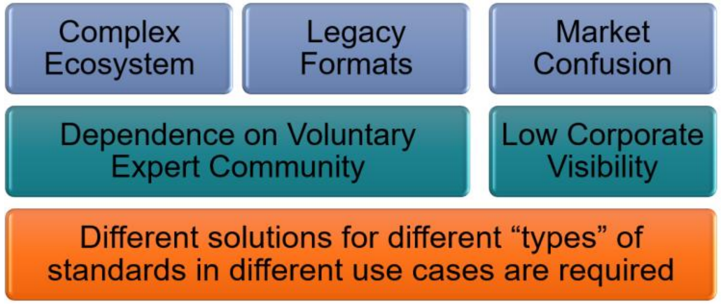
Quantification – what effort was involved?

Deliverables	*AVG* **Effort (Manual)**	*EST AVG* **Effort (LLM Assisted)**
Modular K-PAC + Classification (175)	5 min / K-PAC (14.5 HRS)	0.5 min / K-PAC (1.5 HRS)
Parameters (54)	5 min / Parameter (4.5 HRS)	0.5 min / Parameter (0.5 HRS)
Modular K-PAC + Classification + Model (34)	30 min / K-PAC (17 HRS)	15 min / K-PAC (8.5 HRS)
Orchestration Model (1)	60 min / Orchestration (1 HRS)	60 min / Orchestration (1 HRS)
Validation & Rationalization (206)	1 min / K-PAC (3.4 HRS)	0.5 min / K-PAC (1.7 HRS)
TOTAL:	**40.4 HRS**	**13.2 HRS**

*This is the effort and complexity of modelling **1 paragraph** of an SAE specification and **12 pages** of an ASTM specification*

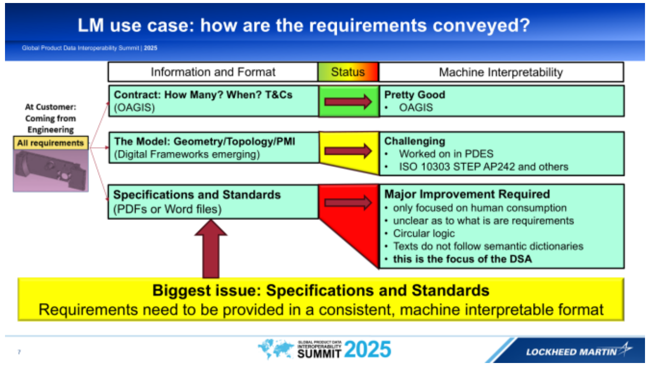
Recap

1) What are the key, unique challenges faced by standards organization in terms of digitalization?



SDOs need the support of industry to focus on solutions of **most value**

2) How diverse use cases from a user perspective impact the approach to a solution



Every role, every task, has a unique set of requirements that SDOs need their outputs to fulfil

3) How collaborative efforts can accelerate solutions to these challenges

DIGITAL STANDARDS ALLIANCE
A Consortium of SAE ITC

auros IQ

We can quantify:
- Approach
- Effort
- Customer priorities

and accelerate progress using the right technology.

What is the Digital Standards Alliance (DSA)?

The Digital Standards Alliance™ (DSA™) creates best practices for digital standards to suit the entire product development lifecycle, formed under the established legal framework of **SAE ITC** (Industry Technologies Consortia).

Major OEM
*1st October**

Leading SDOs have signed up to DSA to collaborate with industry.
It is critical that the aerospace industry participates.
There is a limited window of opportunity.
Talk to us about membership.

Simon Powell
Program Manager
Simon.Powell@sae-itc.org

M: +44 (0)7798 826443

*subject to contract