A Framework for Data Standard Readiness

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Bio?

- Brandon Sapp, MIS, BSIT
- 18 years @ Boeing Commercial Airplanes
- 3 years @ PLM Consultant
- US TAG Designated Expert to ISO TC184/SC4 and SC5
- A&D PAG MBD Leader
- PDES MBx User Group Co-Leader
- ASME MBE

Presentation Overview

Problem Statement
Causes/Effects
Solution – Framework for Assessing Readiness

Problem Statement

Many organizations fail to realize the full and complete benefits of using industry data standards because they have not or inappropriately implemented them.

Causes/Effects

Cause 1: Knowledge of data standard's intended use
Cause 2: Poorly implemented in business processes
Cause 2: Inadequate tools to create/consume the data in a standard
Cause 3: Supply chain ability to consume

Effect: Wasted Resources [Rework, Common tools, etc.]

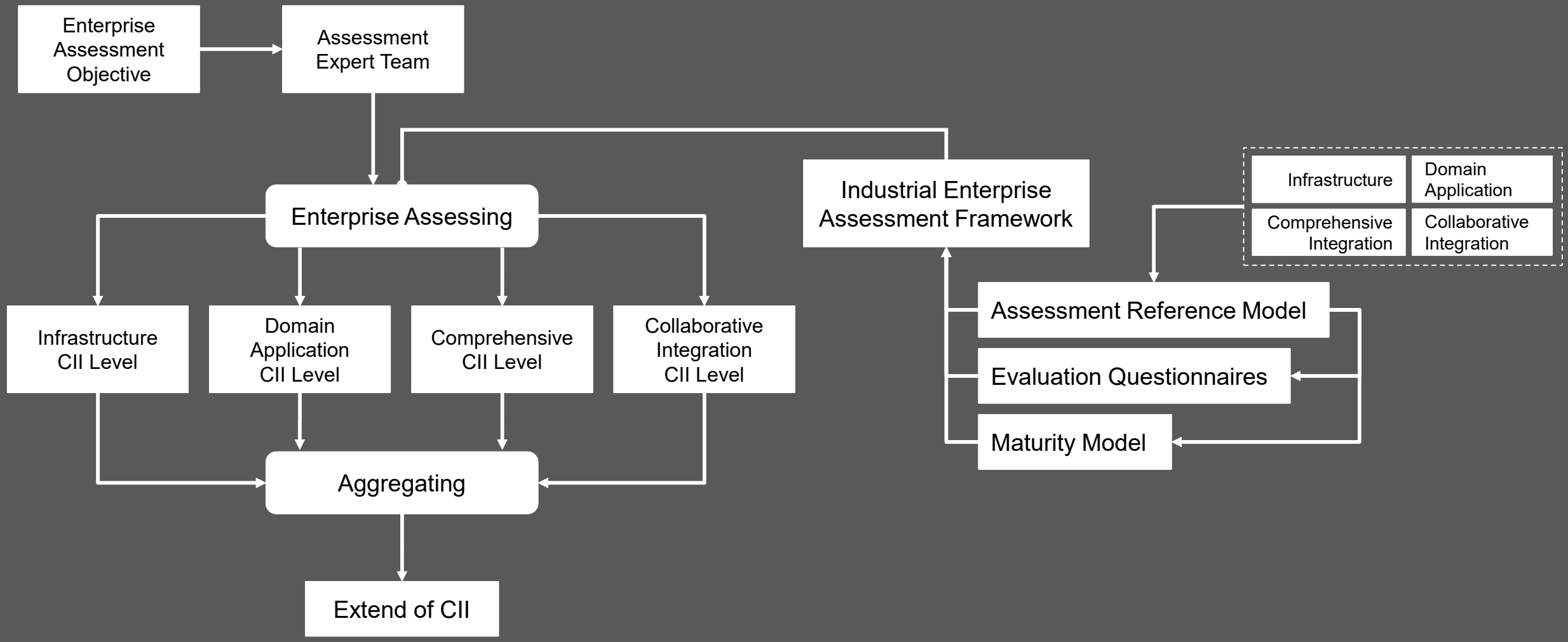
Industry Framework

ISO TC 184 : Automation Systems and Integration
SC 5 : Interoperability, integration, and architectures for enterprise systems and automation applications

ISO/DIS 22549-1 : Assessment on convergence of informatization and industrialization for industrial enterprises
Part 1: Framework and reference model

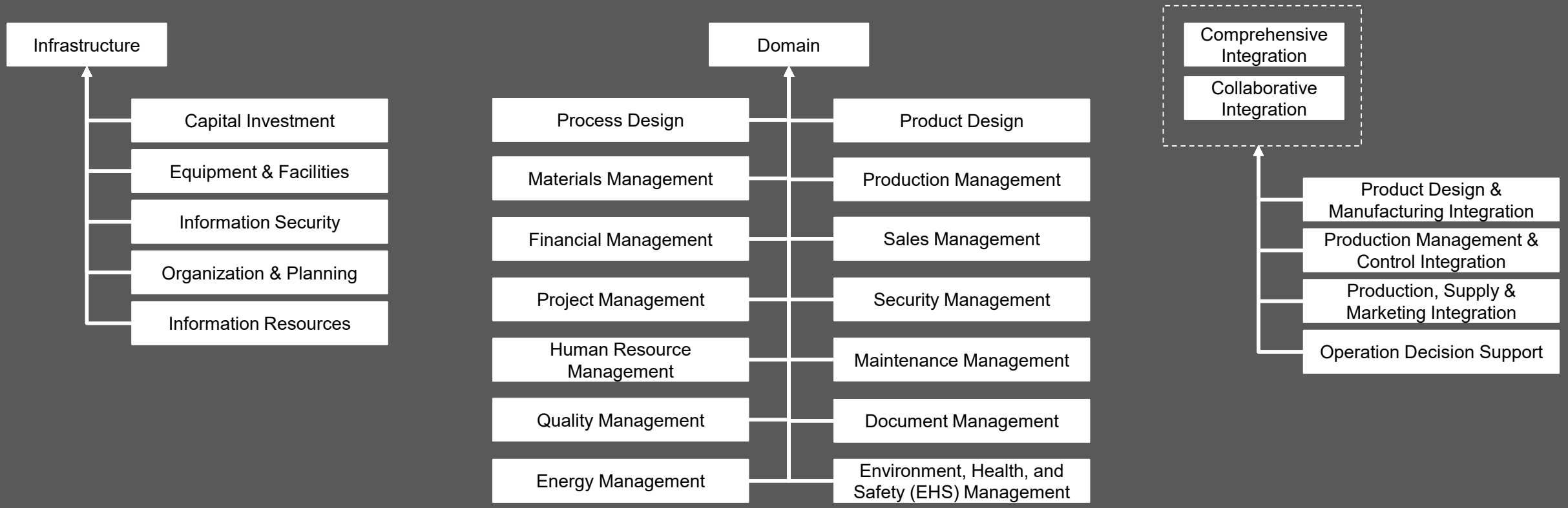
ISO/CD 22549-2.2 : Assessment on convergence of informatization and industrialization for industrial enterprises
Part 2: Maturity model and evaluation methodology

Overview of Assessment System



Reference: ISO/DIS 22549-1:2019
CII: Convergence of Information and Industrialization

Breakdown of the Assessment Reference Model

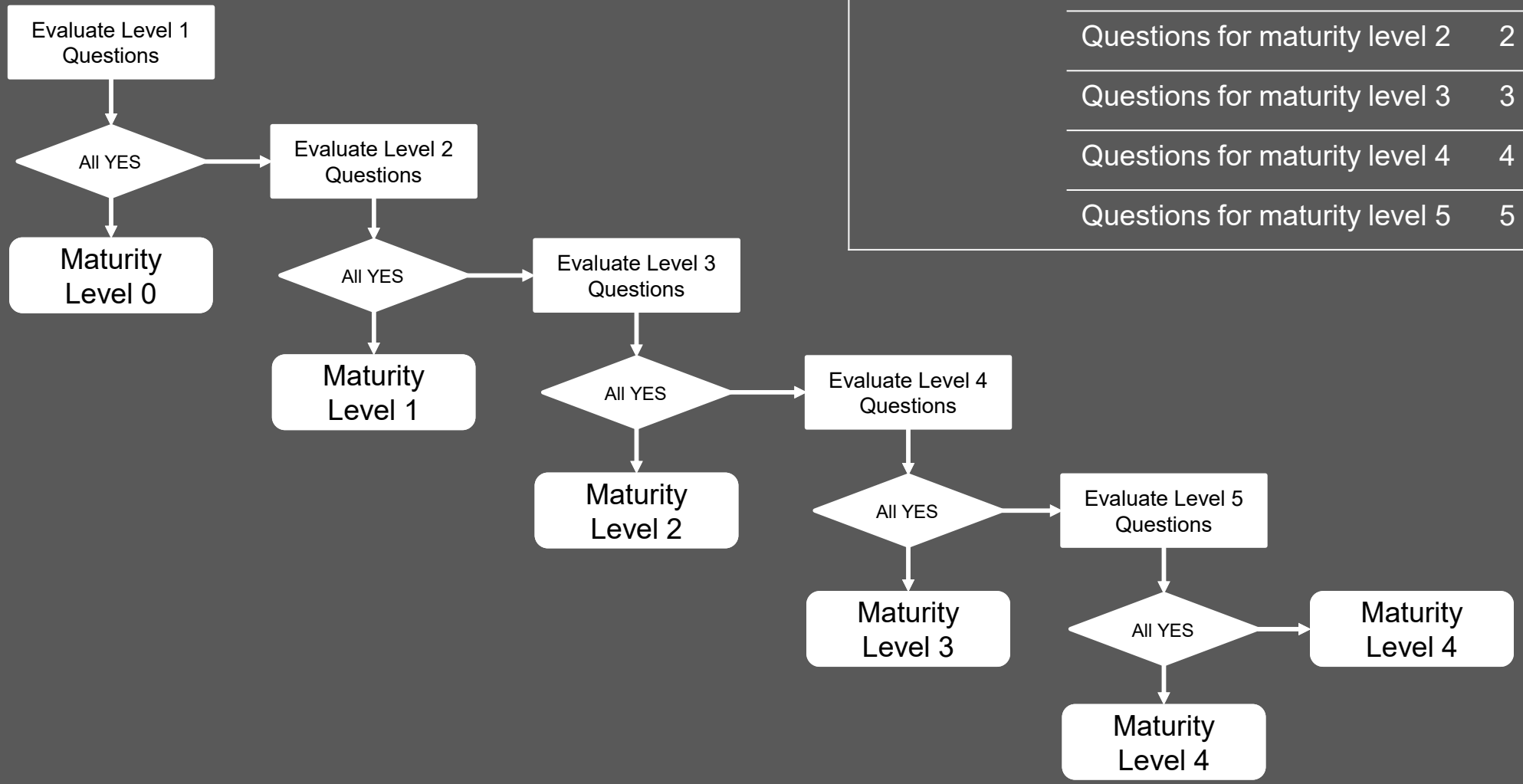


Maturity Model Definitions

Maturity Level Indicator	Descriptive Name	Characteristics
Level 0	Unidentified	Little or no systematic documentation available
Level 1	Identified	Tracking and traceability of materials, data and etc. Registration and management of data using information collection devices and systems.
Level 2	Measured	Real time data acquisition of materials, machinery, process and human roles, and data integration. Measurement, aggregation, classification and management of data using information collection devices and systems. Synchronous history of data for the same time, same lot and same product.
Level 3	Analyzed	Data analysis and optimized decision making using aggregated data.
Level 4	Optimized	Automation of processes according to optimized decision making throughout the intra-enterprise and/or the inter-enterprises.
Level 5	Customized	Self-diagnosis and self-healing through cyber-physical system [CPS], Internet of Things [IoT], artificial intelligence [AI], etc. Flexible production of customized products through autonomous control.

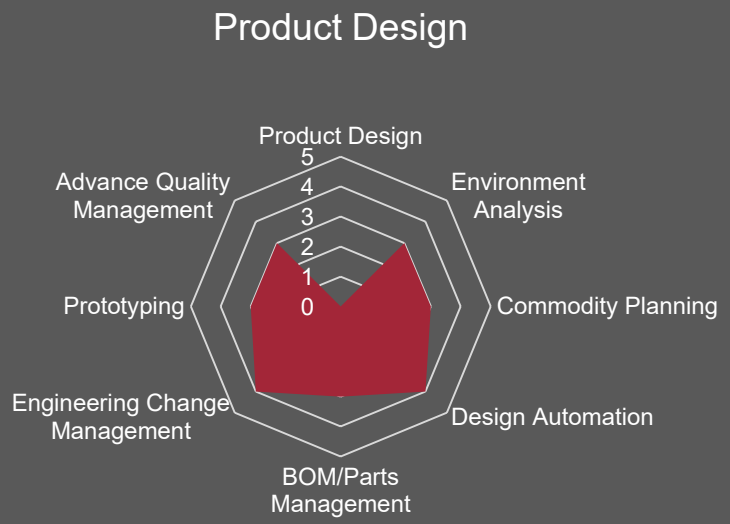
Assessment Method

Activity	Question	Maturity Level Indicator
Activity Name	Questions for maturity level 1	1
	Questions for maturity level 2	2
	Questions for maturity level 3	3
	Questions for maturity level 4	4
	Questions for maturity level 5	5



Breakdown of Activities and Sample Questions

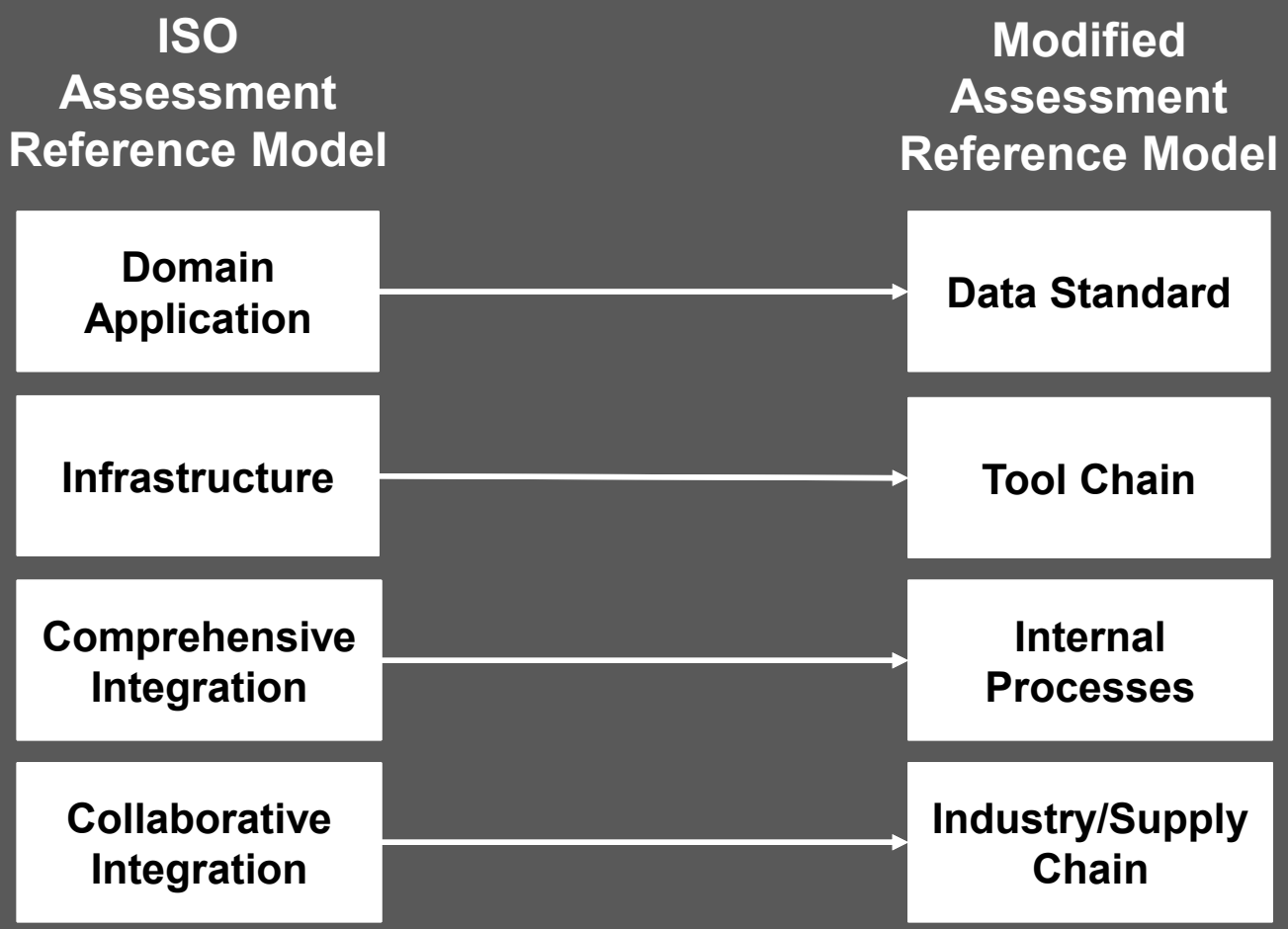
Activity	Description
Environment Analysis	Use of IT systems and applications for environment analysis
Commodity Planning	Use of IT systems and applications supporting commodity planning
Design Automation	Use of designing software systems and smart connected technology for design
BOM/Parts Management	Use of BOM/Part management system
Engineering Change Management	Use of engineering change management systems
Prototyping	Use of IT systems and applications for prototyping and its validation
Advance Quality Management	Use of IT systems and applications for advance quality management



Activity	Description	Level
Design Automation	Do you design with 2D CAD?	1
	Do you design with 3D CAD?	2
	Do you analyze and validate with CAE?	3
	Do you design automatically with optimization solutions as one of the following? • Model-Based Parametric Design • Engineering-based Parametric design • Integrated parametrical design	4
	Do you design a product by using smart connected technology such as IoT, AR/VR	5

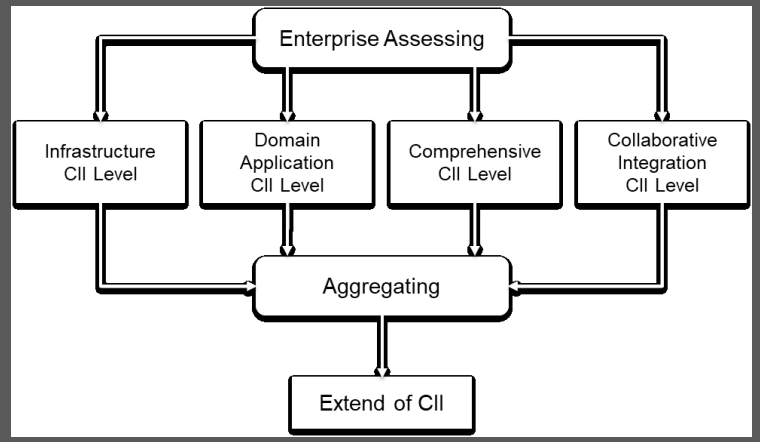
Activity	Description	Level
BOM/Parts Management	Do you upload the engineering BOM [E-BOM] to the system	1
	Do you integrate the E-BOM with 3D CAD? Do you generate the E-BOM automatically	2
	Do you generate the manufacturing BOM [M-BOM] automatically in PLM? Do you manage the software configuration in PLM?	3
	Do you configure the BOM according to the purpose of use such as procurement, process cost, production, and customer service for warranty, etc?	4
	Do you improve business through preliminary simulation using the BOM data according to the purpose of use?	5

Modified Assessment Model

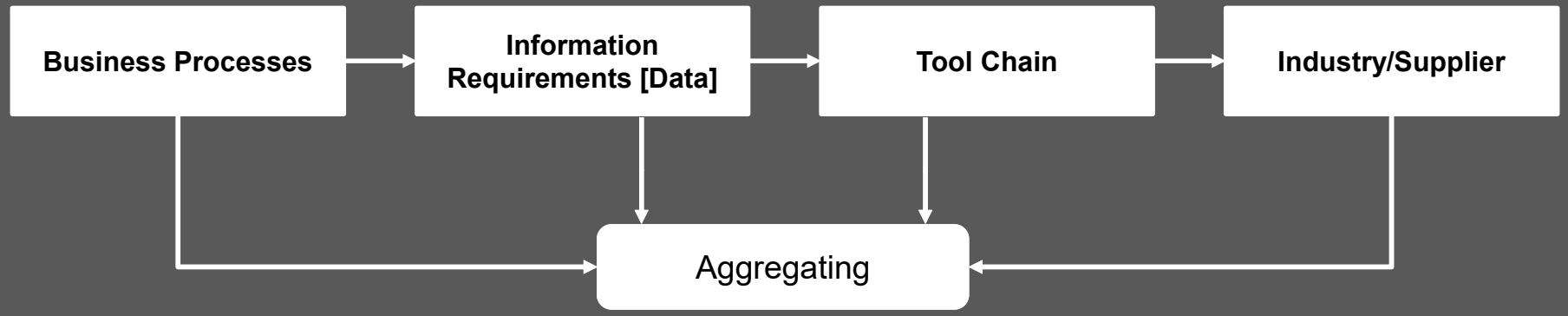


Modified Assessment System

ISO Assessment System

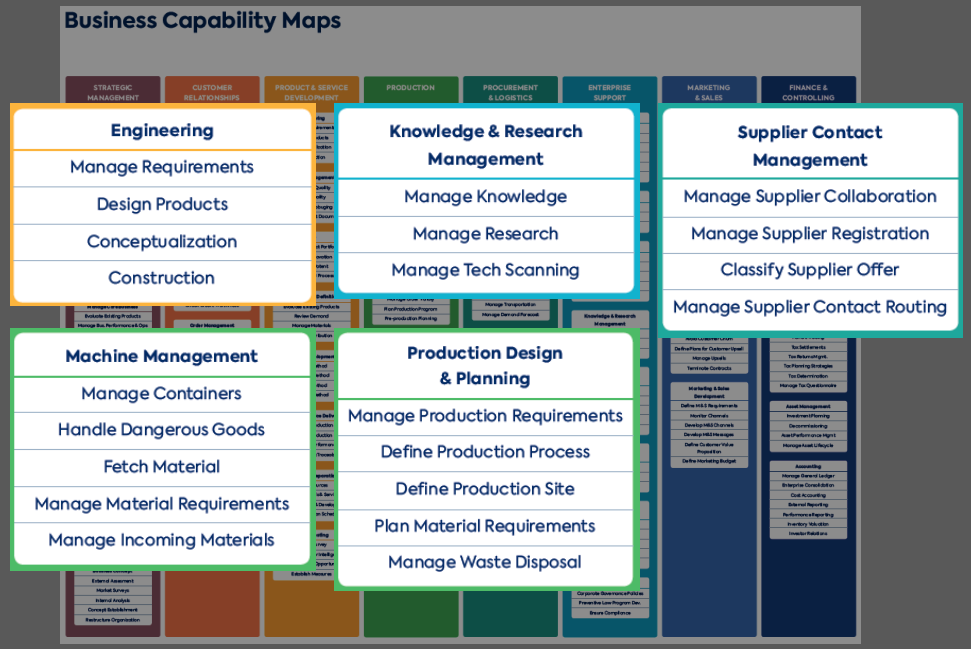


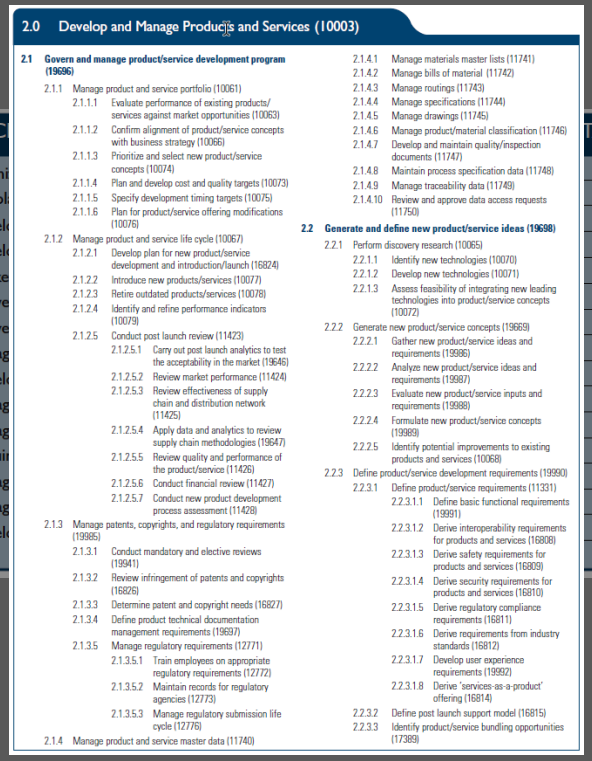
Modified Assessment System



Identify Business Processes

Start with Business Capabilities
Breakdown to the Business Processes





Reference:
http://www.leanix.com
https://www.apqc.org

Identify Business Processes and related Deliverables

Cross Industry Process Framework v721				
	Pe	Pr	Da	To
Total Requirements				
Develop and Manage Products and Services				
Generate and define new product/service ideas				
Generate new product/service concepts				
Formulate new product/service concepts				
Develop products and services				
Design and prototype products and services				
Conduct mandatory and elective external reviews				
Design products/services				
Design and manage product data, design, and bill of materials				

PEOPLE: Training, Certification, Skills, etc.

EX: 2 Classes [1 needing updates]

PROCESS: Business Instruction, User Guides, Modeling Requirements, etc.

EX: 9 Internal Process Docs [4 needing updates]

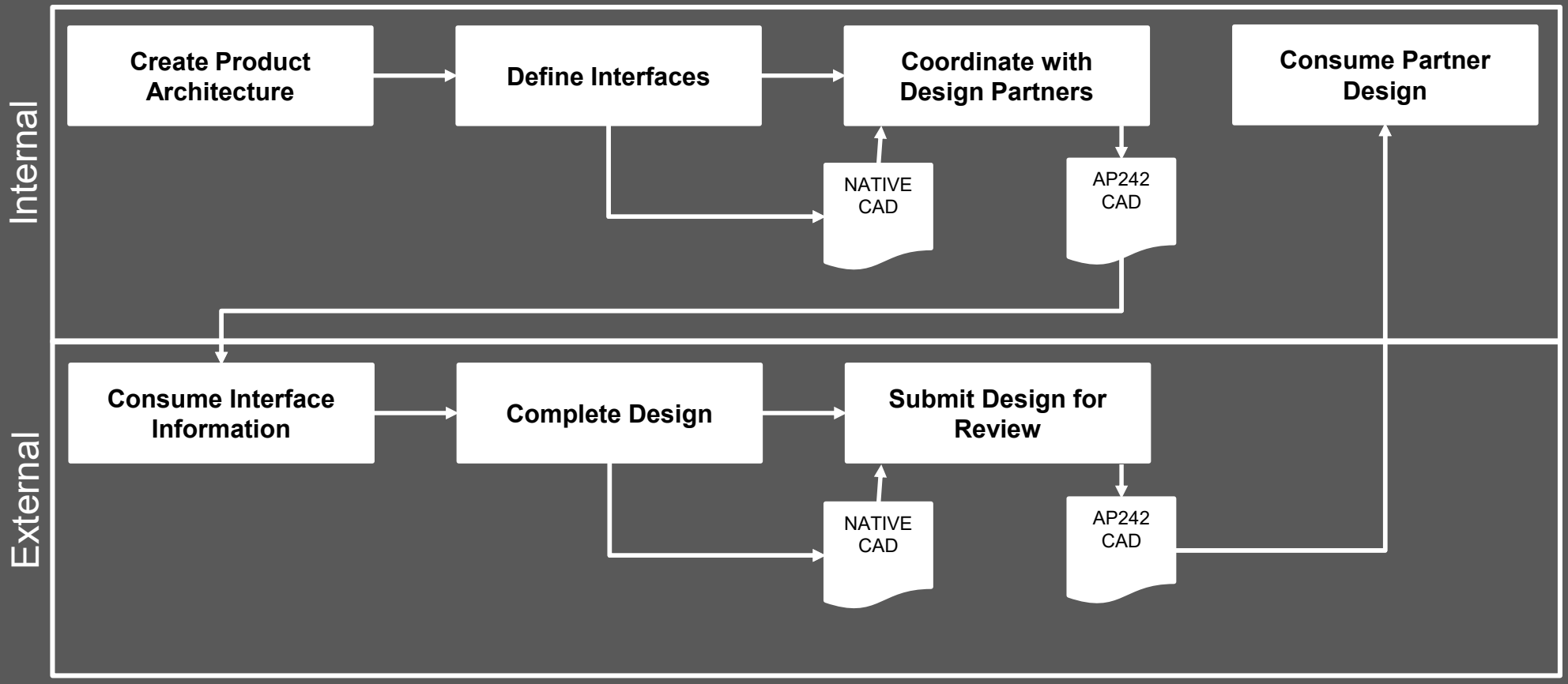
EX Summary: 11 Total Reqs [5 needing updates] = Score 54

DATA: [Used in STEP 2]
Modeling Requirements that define the format of the information artifacts in the applications that comply with the industry standard

TOOLS: [Used in STEP 3]
Software Applications used to create, manage or consume the information in the form of the data standard format

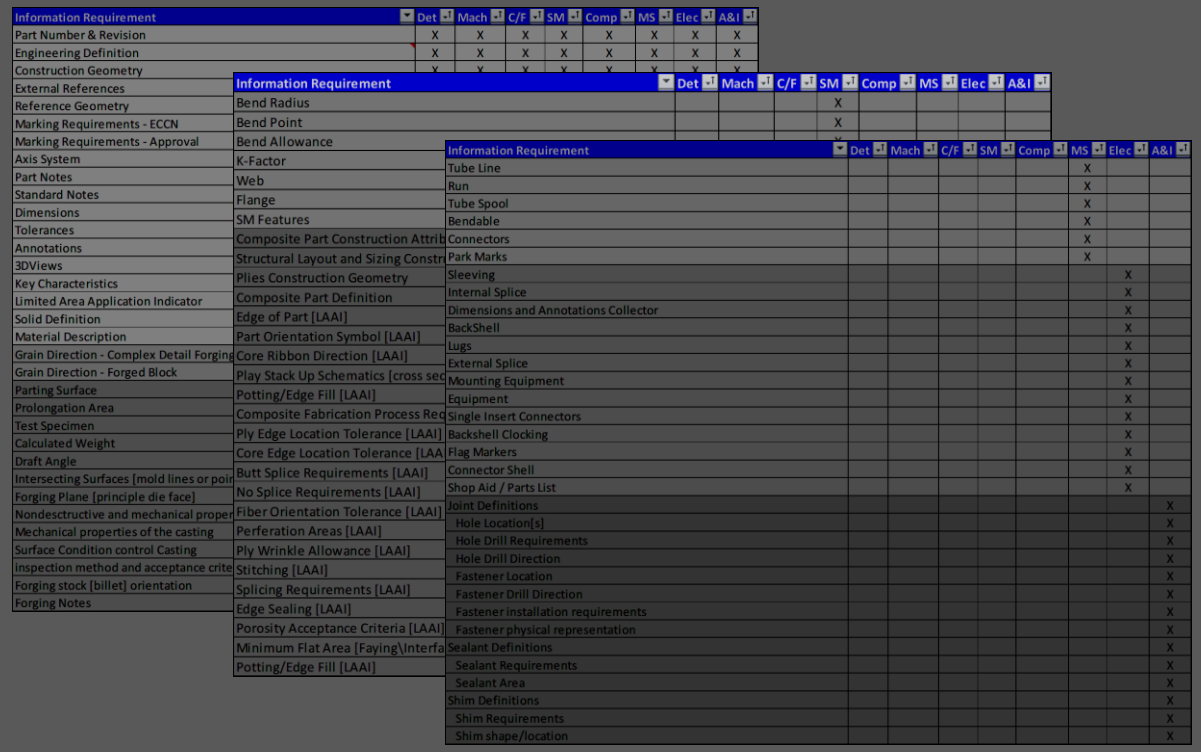
Identify Information Requirements

Identify the data used by the processes



Identify Information Requirements

Aggregate all the Information Requirements from Business Processes
Use ASME/ISO Authoring Standards or A&D Minimum Digital Thread Position Papers to provide additional perspectives.



Information Requirement	Det	Mach	C/F	SM	Comp	MS	Elec	A&I
Part Number & Revision	X	X	X	X	X	X	X	X
Engineering Definition	X	X	X	X	X	X	X	X
Construction Geometry	X	X	X	X	X	X	X	X
External References								
Reference Geometry								
Marking Requirements - ECCN								
Marking Requirements - Approval								
Axis System								
Part Notes								
Standard Notes								
Dimensions								
Tolerances								
Annotations								
3DViews								
Key Characteristics								
Limited Area Application Indicator								
Solid Definition								
Material Description								
Grain Direction - Complex Detail Forging								
Grain Direction - Forged Block								
Parting Surface								
Prolongation Area								
Test Specimen								
Calculated Weight								
Draft Angle								
Intersecting Surfaces [mold lines or poi								
Forging Plane [principle die face]								
Nondesctructive and mechanical proper								
Mechanical properties of the casting								
Surface Condition control Casting								
Inspection method and acceptance crite								
Forging stock [billet] orientation								
Forging Notes								

Information Requirement	Det	Mach	C/F	SM	Comp	MS	Elec	A&I
Bend Radius				X				
Bend Point				X				
Bend Allowance								
K-Factor								
Web								
Flange								
SM Features								
Composite Part Construction Attrib								
Structural Layout and Sizing Constr								
Plies Construction Geometry								
Composite Part Definition								
Edge of Part [LAAI]								
Part Orientation Symbol [LAAI]								
Core Ribbon Direction [LAAI]								
Play Stack Up Schematics [cross sec								
Potting/Edge Fill [LAAI]								
Composite Fabrication Process Rec								
Ply Edge Location Tolerance [LAAI]								
Core Edge Location Tolerance [LAA								
Butt Splice Requirements [LAAI]								
No Splice Requirements [LAAI]								
Fiber Orientation Tolerance [LAAI]								
Perferation Areas [LAAI]								
Ply Wrinkle Allowance [LAAI]								
Stitching [LAAI]								
Splicing Requirements [LAAI]								
Edge Sealing [LAAI]								
Porosity Acceptance Criteria [LAAI]								
Minimum Flat Area [Faying\Interfa								
Potting/Edge Fill [LAAI]								

Information Requirement	Det	Mach	C/F	SM	Comp	MS	Elec	A&I
Tube Line						X		
Run						X		
Tube Spool						X		
Bendable						X		
Connectors						X		
Park Marks						X		
Sleeving							X	
Internal Splice							X	
Dimensions and Annotations Collector							X	
BackShell							X	
Lugs							X	
External Splice							X	
Mounting Equipment							X	
Equipment							X	
Single Insert Connectors							X	
Backshell Clocking							X	
Flag Markers							X	
Connector Shell							X	
Shop Aid / Parts List							X	
Joint Definitions								X
Hole Location[s]								X
Hole Drill Requirements								X
Hole Drill Direction								X
Fastener Location								X
Fastener Drill Direction								X
Fastener installation requirements								X
Fastener physical representation								X
Sealant Definitions								X
Sealant Requirements								X
Sealant Area								X
Shim Definitions								X
Shim Requirements								X
Shim shape/location								X

Total Requirements	398
Detail MBD	19
Assembly&Instl MBD	93
PMI	189
Additive Manufacturing	43
Casting/Forging	5
Machined	2
Sheetmetal	5
Composites	23
Mechanical Systems	6
Electrical Wire Harness	13

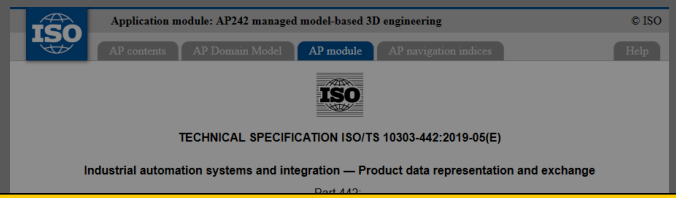
Identify Information Requirements

Map the Information Requirements to AP242 and Aggregate

EX: 520 unique information requirements, AP242 supports 450 = Score 86

Business Object [Function]	CATIA V5 Object BCA	Part Types: Gen	Mc	C/F	SM	BC	MS	E
Part Number & Revision	Part Number, Revision	X	X	X	X	X	X	X
Solid Definition	Part Body	X	X	X	X	X	X	X
Material Description	Parameters	X	X	X	X	X	X	X

PMI Entity			
Tolerances	PMI symbol	Name	Description
Geometric tolerance			
Form	—	Straightness	Form Tolerance
	▱	Flatness	Form Tolerance
	○	Roundness (ISO) Circularity (ASME)	Form Tolerance
	⌭	Cylindricity	Form Tolerance
	⌒	Profile any line (ISO 1101:2012) Line Profile (ISO 1101:2017)	Form Tolerance
	⌓	Profile any surface (ISO 1101:2012) Surface Profile (ISO 1101:2017)	Form Tolerance



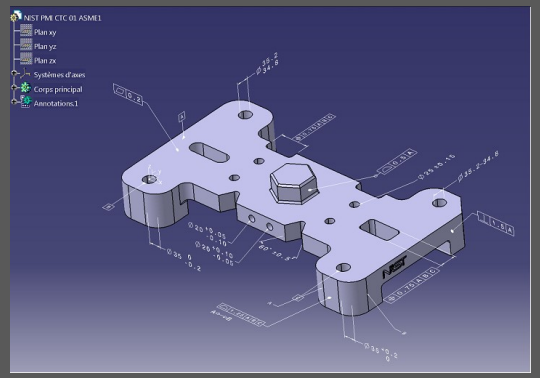
Interop standard						
STEP AP242 ed 1	STEP AP242 ed 2	Bugzilla numbe	Module	ARM entity	AIM entity	Rec Practice CAX-I
YES	YES		ISO/TS 10303-1051:2013-01 Geometric tolerance	Straightness_tolerance	straightness_tolerance	YES
YES	YES		ISO/TS 10303-1051:2013-01 Geometric tolerance	Flatness_tolerance	flatness_tolerance	YES
YES	YES		ISO/TS 10303-1051:2013-01 Geometric tolerance	Roundness_tolerance	roundness_tolerance	YES
YES	YES		ISO/TS 10303-1051:2013-01 Geometric tolerance	Cylindricity_tolerance	cylindricity_tolerance	YES
YES	YES		ISO/TS 10303-1051:2013-01 Geometric tolerance	Line_profile_tolerance	line_profile_tolerance	YES
YES	YES		ISO/TS 10303-1051:2013-01 Geometric tolerance	Surface_profile_tolerance	surface_profile_tolerance	YES

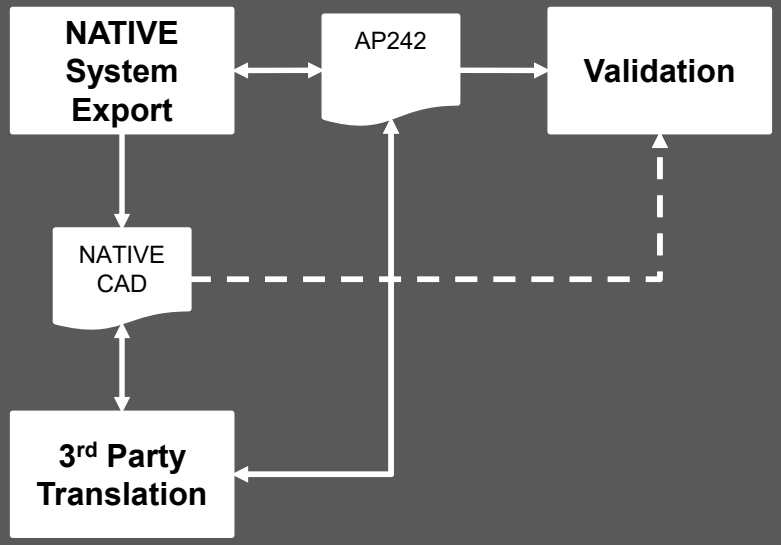
Identify Tool Chain Requirements

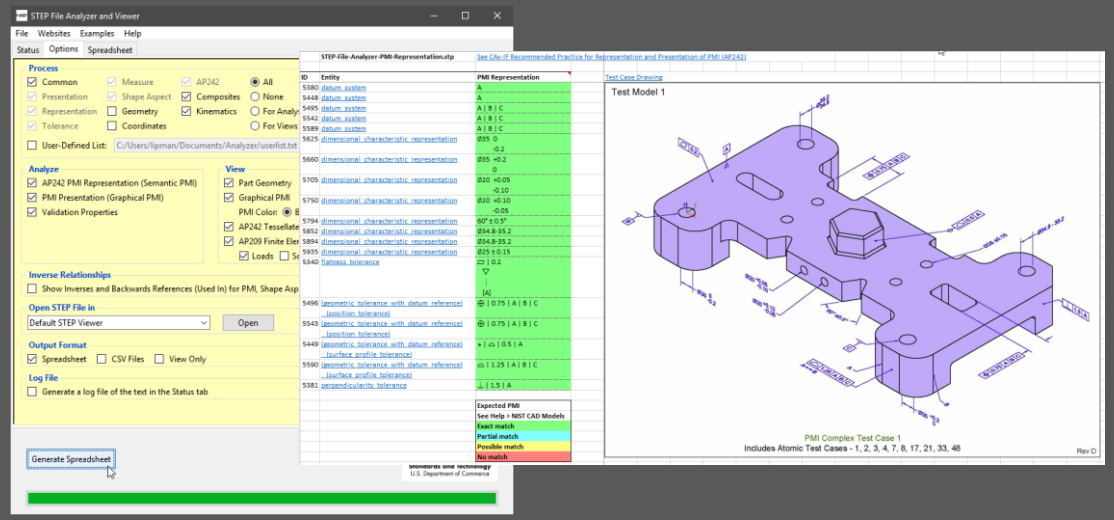
Align tool chain to business processes:

- Manual Creation of AP242 focusing on all information requirements
- Automated Creation via Service or Triggered Event
- Control exported content [control IP]
- Validate output
- Consume/Import back into native authoring system

EX: 5 Tool Chain Reqs [3 needing updates] = Score 40



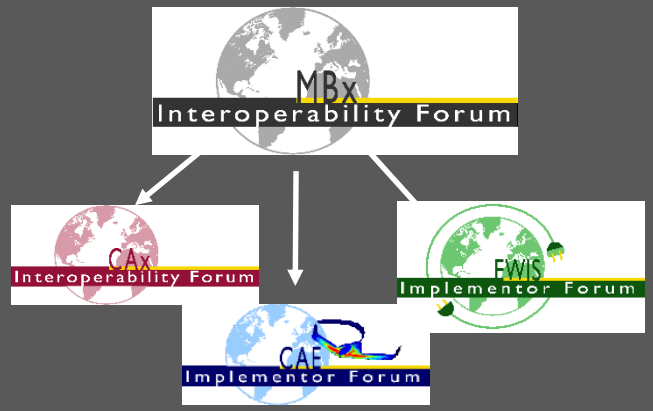


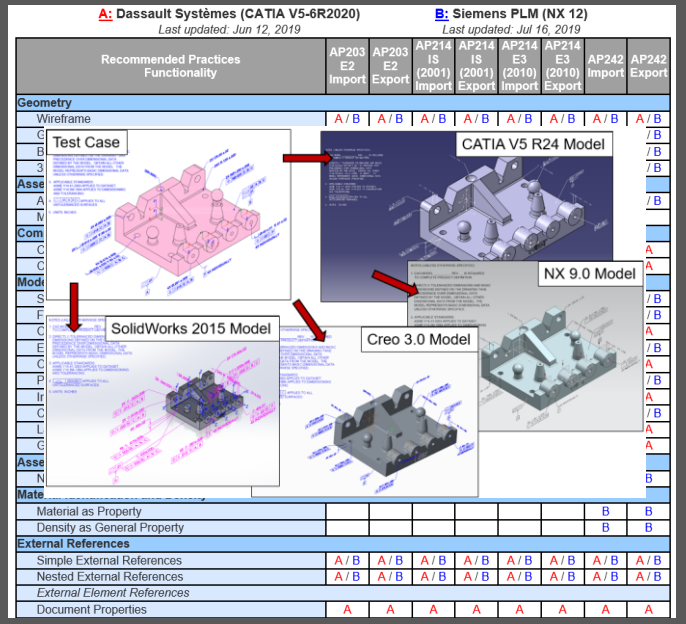


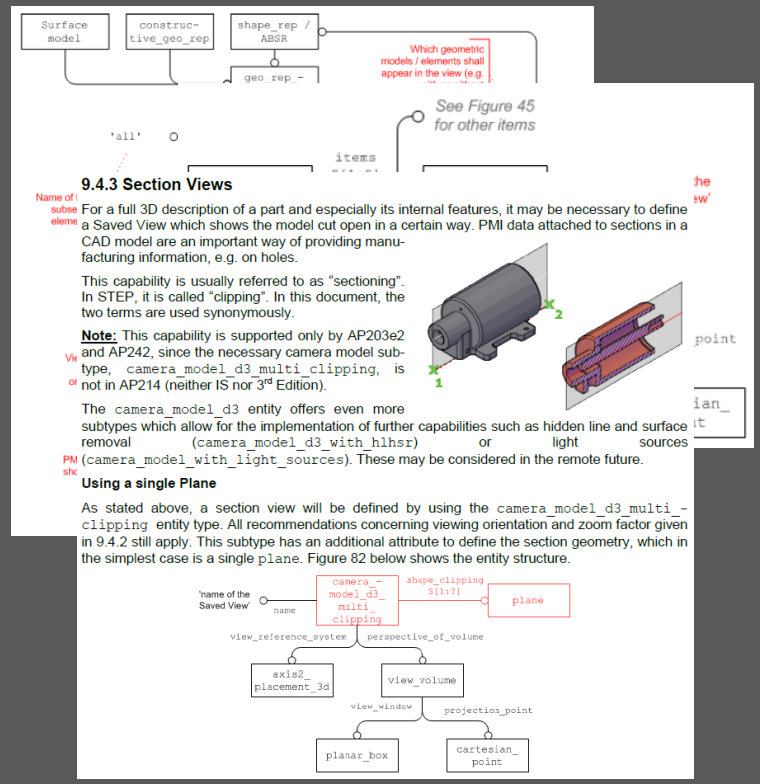
Identify/Supplier Requirements

Analyze needs of the industry [primary or potential suppliers] to support business identified business processes such as design collaboration, build to print or regulatory certification.

- Industry Agreement on data representation of AP242
- Generally Available tools to create/consume AP242
  EX: 4 RP [2 needing update] and 3 Imp [2 needing updates] = Score 42







Aggregate

Over All Readiness Summary

57

Ready: Manual creation of partially complete AP242e1, 1 Class and 5 Internal documents
Not Ready: 1 Class, 4 Internal documents and Automated Tool Chain to create complete Ap242
Major Next Steps to Close: Work with external organizations to close on industry capabilities

Data Standard

90

Ready: AP242e1
- Shape Representation, Some PMI/Composites

Almost Ready:
- AP242e2

Actions to Close:
- Incorporate needs [e.g. Mech Sys/Hyd] into AP242e3

Internal Processes

54

Ready:
- 1 Class, 5 Internal business documentation

Not Ready:
- 1 Class, 4 Internal business documentation

Actions to Close:
- Agreement with end users on methods
- Creation of content

Industry/Supplier

42

Ready:
- 2 Partial Commercial Implementations
- 4 Partial Free Implementations

Not Ready:
- 0 Fully Implemented solutions

Actions to Close:
- Provide requirements to implementers

Tool Chain

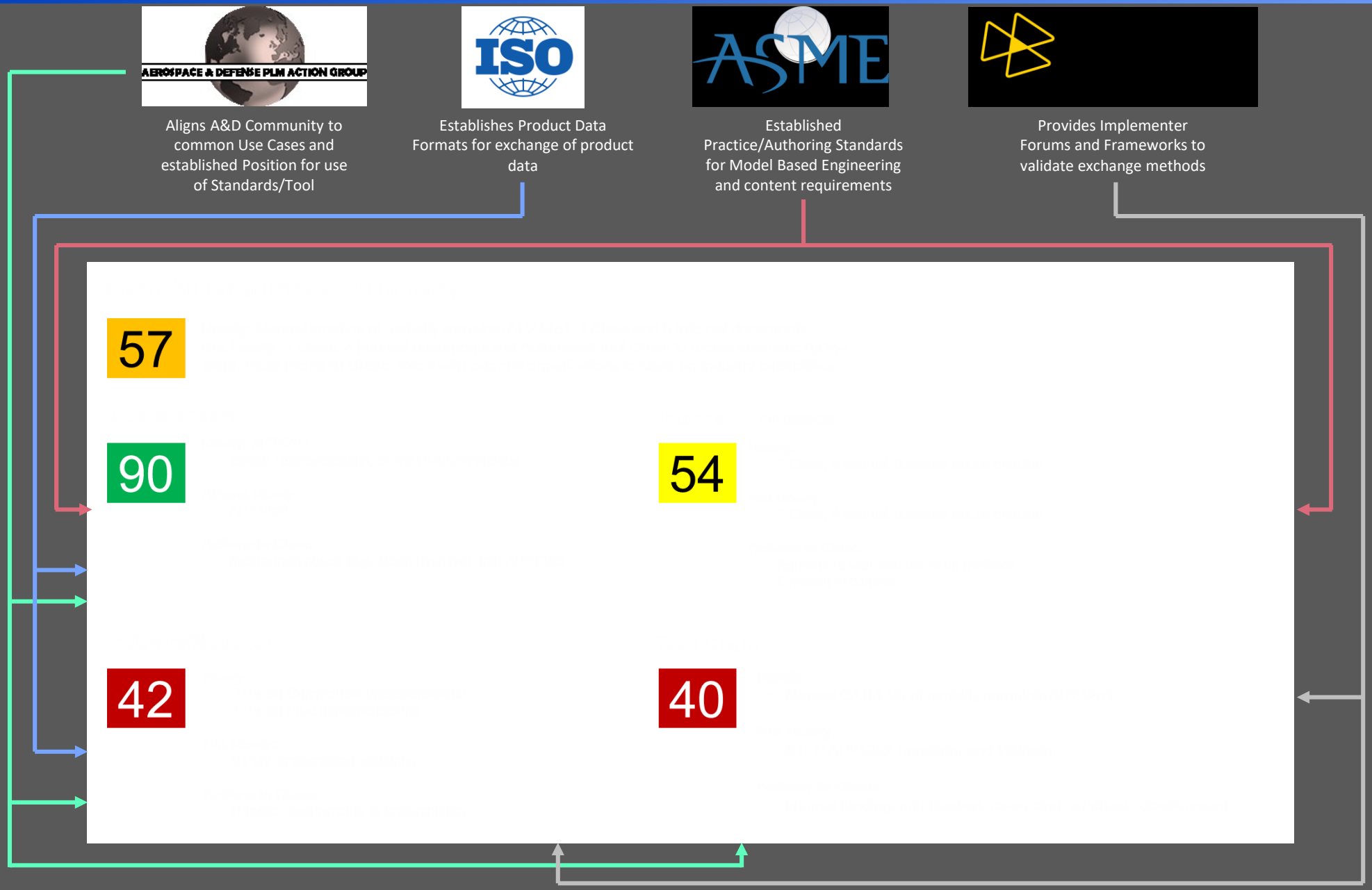
40

Ready:
- Manual CATIA V5 of partially complete AP242e1

Not Ready:
- STEP AP242e2 Translator and Validator

Actions to Close:
- Internal funding, prioritization, resourcing, purchase, development….

Make a Difference



Summary

The ISO Framework can be adapted to your organizations needs.

Join industry consortiums and standard bodies to ensure your needs are met.

References

ISO/DIS 22549-1:2019, Automation Systems and Integration – Assessment on Convergence of Information and Industrialization for Industrial Enterprises Part 1: Framework and Reference Model

ISO/CD 22549-2:2019, Automation Systems and Integration – Assessment on Convergence of Information and Industrialization for Industrial Enterprises Part 2: Maturity Model and Evaluation Methodology

ISO 15704, Industrial Automation Systems – Requirements for Enterprise-Reference Architectures and Methodologies