

Smart Manufacturing using existing standards

Kenneth Swope

Chair, ISO/TC 184/SC 4: Industrial Data

PDT Europe

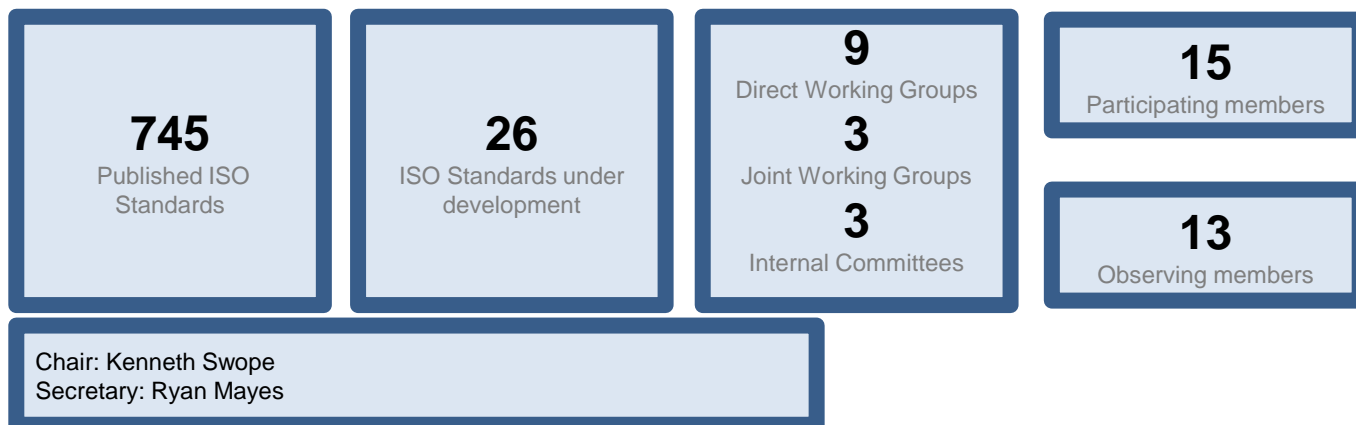
25 October 2018

ISO/TC 184/SC 4: Industrial Data

SCOPE:

Standardization of the content, meaning, structure, representation and quality management of the information required to define an engineered product and its characteristics at any required level of detail at any part of its lifecycle from conception through disposal, together with the interfaces required to deliver and collect the information necessary to support any business or technical process or service related to that engineered product during its lifecycle.

Note: Lifecycle includes recursive recycling to a terminal state.



What is Smart Manufacturing?

JWG21-TR-SMRM-N05-v14_2018-09-19

Technical Report: Smart Manufacturing Reference Model(s)

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3.1	Definition of smart manufacturing	
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3.4	Abbreviations and acronyms	

"Manufacturing that improves its performance aspects with integrated and intelligent use of processes and resources in cyber, physical and human spheres to create and deliver products and services, which also collaborates with other domains within an enterprise's' value chains.

Note 1: Performance aspects include agility, efficiency, safety, security, sustainability or any other performance indicators identified by the enterprise.

Note 2: In addition to manufacturing, other enterprise domains can include engineering, logistics, marketing, procurement, sales or any other domains identified by the enterprise."

"Smart manufacturing is extending manufacturing. It is characterized by independent actors sharing standardized information. The actors can pro-actively and re-actively act upon the information. The actors collaborate dynamically in network structures. This collaboration occurs among and within lifecycles, on both strategic and operational levels, providing added value for organizations. The scope is to develop a reference architecture for smart manufacturing.

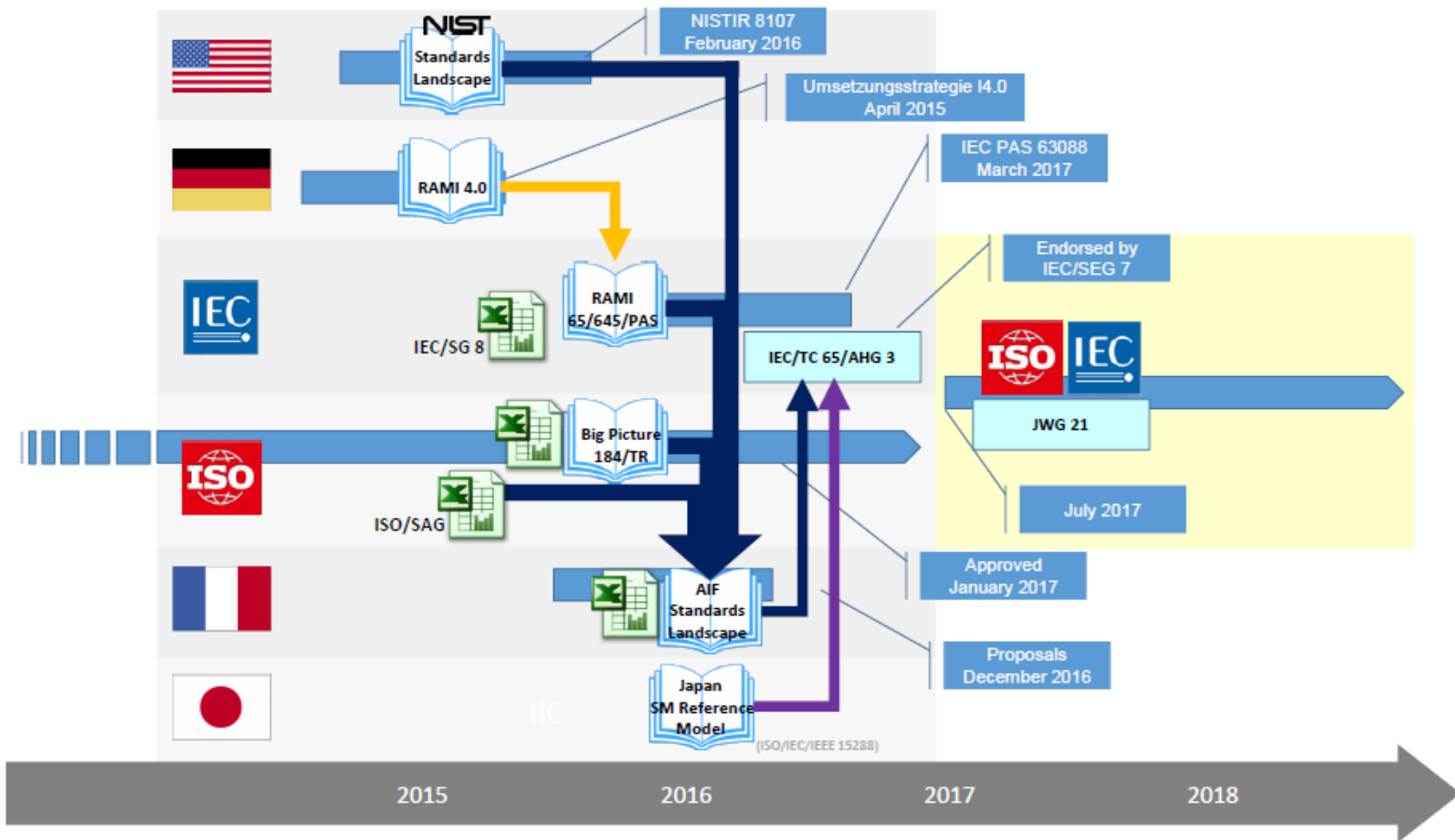
Note: examples of actors are companies, products, assets, processes and parts."

"Set of methodologies and technologies for making goods and providing services with manufacturing systems that are designed with learning capability and operated based on product/service requirements so that it can respond in real time to meet changing demands and conditions in the factory, in the supply network and in customer needs, and can improve itself continuously.

This is obtained by the intensive use of digital technology (including IoT) to integrate products, production systems and business activities through their life cycles and value chains, and increasing decentralized decision making."

Industry Consensus continues to mature as Smart Manufacturing evolves

Journey to Smart Manufacturing



Joint Working Group 21

Teaming Model

ISO

TMB

Technical Management Board

SMCC

TC 184

Automation systems and integration

SC 1

SC 4

SC 5

AhG-STLA

Smart Through Life
Architecture

JWG 21

Smart Manufacturing Reference Models

TR, PAS, IS

IEC

SMB

Standardization Management Board

SEG7

TC 65

Industrial-process measurement,
control and automation

AhG 3

TC 65A

TC 65E

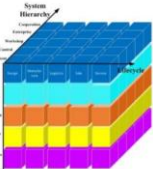
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Smart Manufacturing
Framework &
Architecture

Smart Manufacturing
Information Model

Smart Manufacturing Reference Models

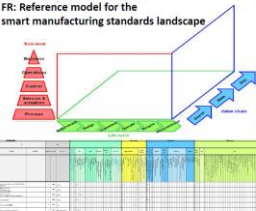
IEC TC65 & ISO TC184 JWG21
CN: Intelligent Manufacturing System Architecture



Ding Li 1 hour

China

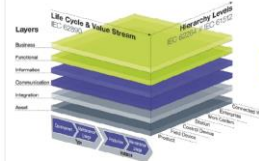
IEC TC65 & ISO TC184 JWG21
FR: Reference model for the smart manufacturing standards landscape



Hoffmeister 2 hours

France

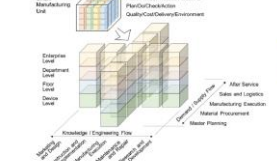
IEC TC65 & ISO TC184 JWG21
GE: IEC/PAS Reference Architecture Model Industry 4.0 (RAMI4.0)



Hoffmeister 2 hours

Germany

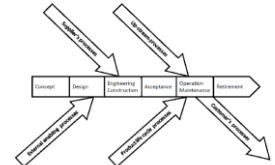
IEC TC65 & ISO TC184 JWG21
JP: Industrial value chain reference architecture (IVRA)



Opina 1 hour

Japan

IEC TC65 & ISO TC184 JWG21
JP: A proposal of Smart Manufacturing reference model



Tera 1 hour

Japan

IEC TC65 & ISO TC184 JWG21
US: NIST: Smart Manufacturing Systems: Standards Landscape & Reference Models



Yan Li 1 hour

USA

IEC TC65 & ISO TC184 JWG21
SE: Thomas Lundholm 2017-07-05

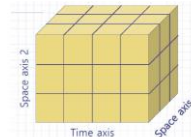
- I could briefly present some smart manufacturing results from and initiatives in Sweden regarding:
- LISA (line information system architecture)
 - tweeting machine
 - the Engineering innovation factory
 - model-driven process and quality planning
 - digital twins for efficient tool usage in manufacturing
 - digital manufacturing infrastructure
 - Swedish/German testbed for smart manufacturing.

Lundholm, Thomas 1 hour

Sweden

IEC TC65 & ISO TC184 JWG21
KR: Soonhung Han

- RAMI 4.0 + simplification proposal



Soonhung Han 1 hour

Korea

IEC TC65 & ISO TC184 JWG21
US: Dan Carnahan

- Enterprise Reference Architectures (ISO 15704 – Requirements for Enterprise reference architectures and methodologies)
- Enterprise Control Models (ECM) (ISO 62264 – Enterprise–Control System Integration)
- Key Performance Indicators (ISO 22400 Manufacturing Operations Management – Key Performance Indicators)
- Open Technical Dictionaries (ISO 22400 – Exchange of Characteristic Data)
- Data Quality (ISO 8000)
- Open Technical Dictionaries (ISO 22400 – Application to Exchange of Master data)
- Oil & Gas Industry Interoperability (ISO/TC 184/WD 6, Project ISO 18101 – Automation systems and integration – Oil and Gas interoperability)
- Other relevant ISO/TC 184/SC 5 standards

Dan Carnahan 1 hour

ISO Standards

IEC TC65 & ISO TC184 JWG21
US: Richard Martin

- Attached are:
- 1) a list of eight (8) questions regarding the JWG21 Terms of Reference (Several are naively stated to make sure I understand the intent of the JWG21 effort while others seek to clarify the guidance the Terms of Reference are to provide).
- 2) a spreadsheet based upon ISO 15704 – Requirements for enterprise-reference architecture and methodologies, with an assessment of several documents against conformance with ISO 15704, and
- 3) several articles highlighting aspects of the “smart manufacturing” concept.

No presentation planned

ISO 15704

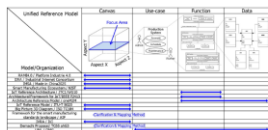
IEC TC65 & ISO TC184 JWG21
CA: Wally Leonard

- currently I have no issues, other than a few concerns that I am hopeful will be addressed by the forthcoming information package... these concerns stem from my initial take on the direction set by the ISO strategic business plan which defines a basis for manufacturing, smart automation and smart manufacturing as a means to extend the enterprise capabilities of a manufacturing organization... at the enterprise level, there are well defined principles and requirements to guide the development of enterprise reference architecture and use of methodologies... it is my experience, that reference models do not become technical rather they break down the concepts of the enterprise into functional components enough to highlight the functional and cross-functional integration points where information flows must be managed to protect the integrity of critical data flow in the life-cycle.
- Finally and most importantly, enterprise reference models provide direction to refine critical integration points to develop information transformational requirements that will maintain the asset, operations and maintenance interoperability...
- Below, I highlight a complete set of the ISO standards that represent what I just summarized for your consideration.
- ISO 15704 – business plan establishes the strategic needs and requirements of the ISO/TC 184 business environment
- ISO 15740 – industrial automation systems, requirements for enterprise reference architecture and methodologies defines the key principles, design considerations and approaches to developing reference architectures/models.
- ISO 15800 – industrial automation systems and integration – integration of life-cycle data for process plants including oil and gas production facilities
- ISO 18101 – Oil and Gas asset management and operations and maintenance interoperability (O&M)

Wally Leonard 1 hour

Canada

IEC TC65 & ISO TC184 JWG21
• Canvas from JP



Noruko 1 hour

Japan

.... Others

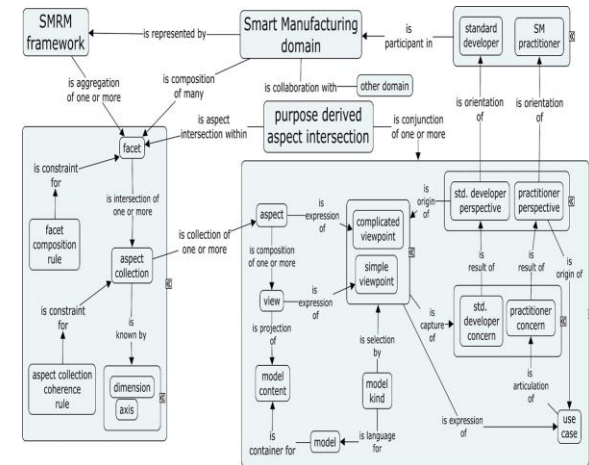
+ Spain

+ UK

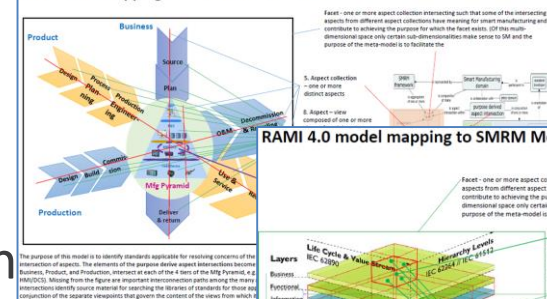
+ Italy

Next Steps

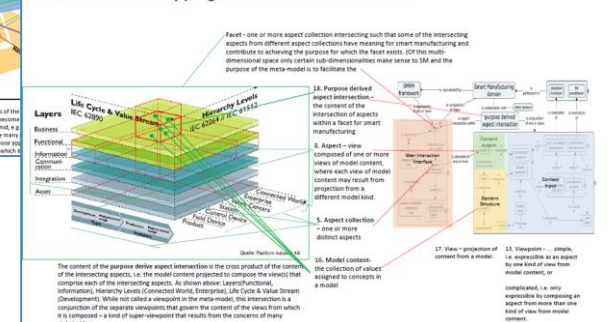
- Complete the Technical Report
 - Early 2019
- Map each model to a common architecture
 - 2019 - 2020
- Evolve the Technical Report to Technical Specification and ultimately a joint standard between ISO and IEC
 - 2020



NIST model mapping to SMRM Meta-model v1



RAMI 4.0 model mapping to SMRM Meta-model v1



ISO/TC 184/SC 4

Industrial Data



International Organization for Standardization
 ISO Central Secretariat Chemin de Blandonnet 8 Case Postale 401
 CH – 1214 Vernier, Geneva
 Switzerland

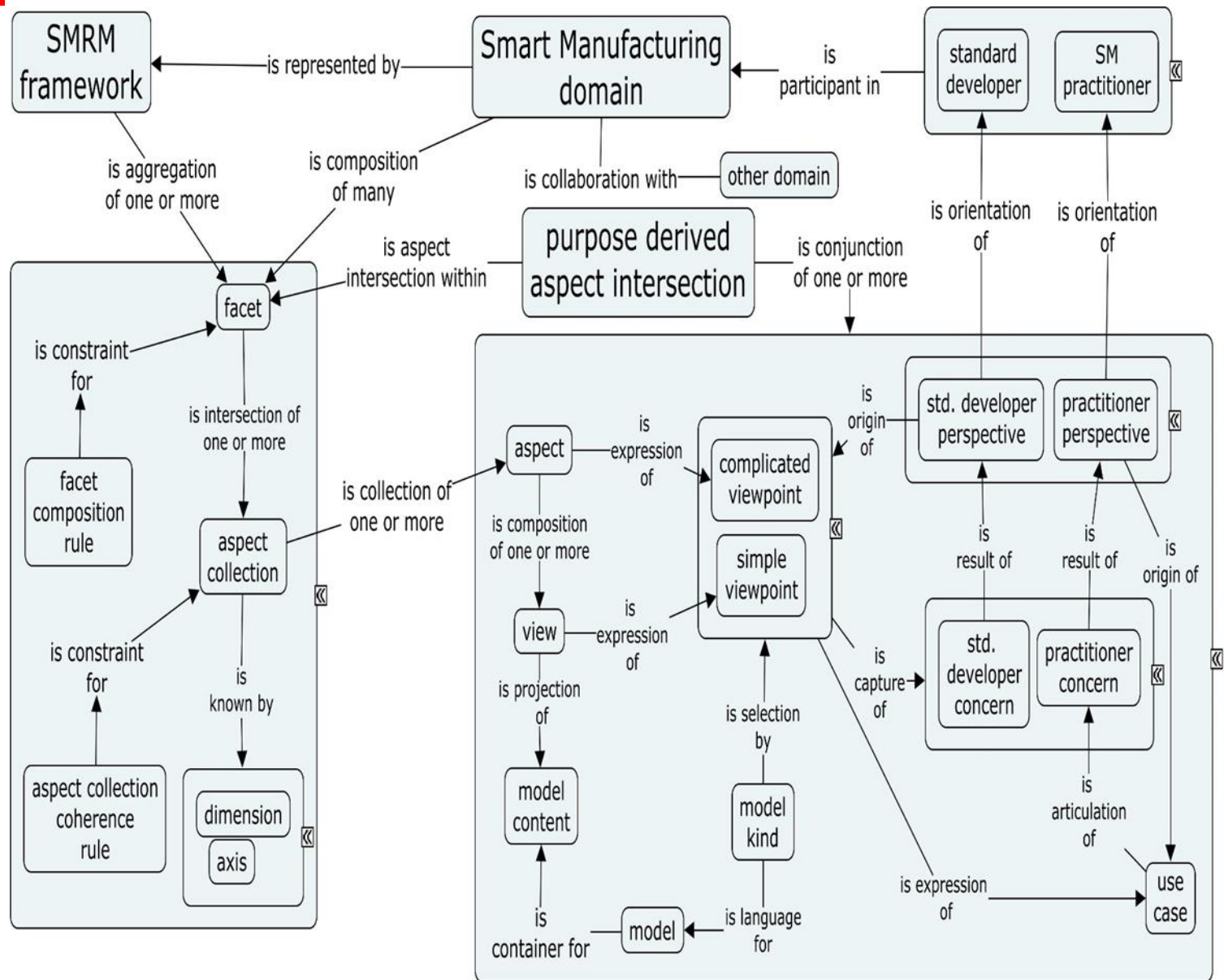
iso.org

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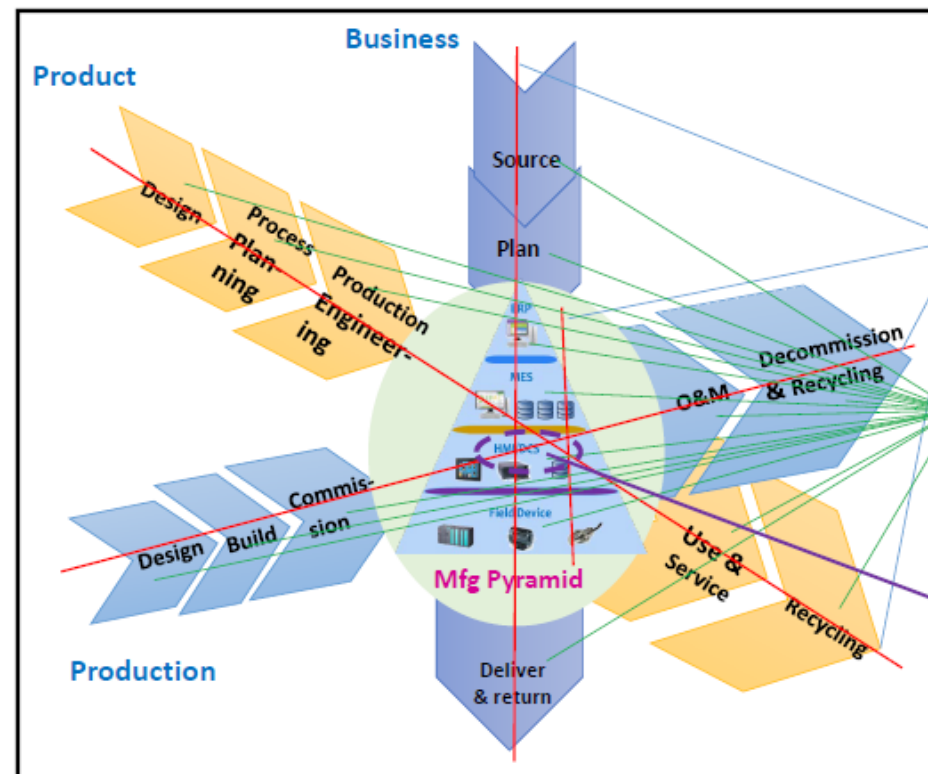
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The
 2007
 Lawrence D. Eicher Leadership Award



NIST model mapping to SMRM Meta-model v1



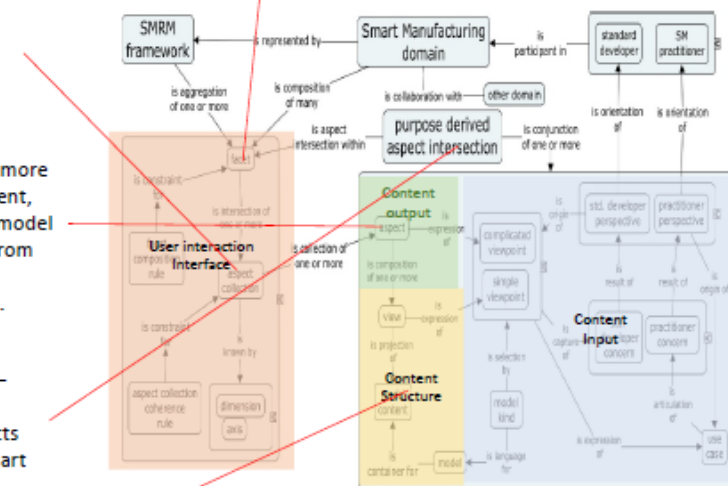
Facet - one or more aspect collection intersecting such that some of the intersecting aspects from different aspect collections have meaning for smart manufacturing and contribute to achieving the purpose for which the facet exists. (Of this multi-dimensional space only certain sub-dimensions make sense to SM and the purpose of the meta-model is to facilitate the

- 5. Aspect collection
 - one or more distinct aspects

8. Aspect – view
composed of one or more views of model content, where each view of model content may result from projection from a different model kind.

18. Purpose derived aspect intersection – the content of the intersection of aspects within a facet for smart manufacturing

16. Model content – the collection of values assigned to concepts in a model (see below)



17. View – projection of content from a model.

13. Viewpoint - simple, i.e. expressible as an aspect by one kind of view from model content, or complicated, i.e. only expressible by composing an aspect from more than one kind of view from model content.

The purpose of this model is to identify standards applicable for resolving concerns of the various aspects of smart manufacturing, particularly those standards that apply at the intersection of aspects. The elements of the purpose derive aspect intersections become the Smart Manufacturing Landscape. Three sets of life cycle phases, one each for Business, Product, and Production, intersect at each of the 4 tiers of the Mfg Pyramid, e.g. {Business manufacture, Product manufacture, Production manufacture, Manufacture HMI/DCS}. Missing from the figure are important interconnection paths among the many aspects of smart manufacturing useful in capturing its digital thread. In total these intersections identify source material for searching the libraries of standards for those applicable at the intersection, i.e. the Smart Manufacturing Standards Landscape is a conjunction of the separate viewpoints that govern the content of the views from which it is composed and an articulation of the standards pertinent to that context.

RAMI 4.0 model mapping to SMRM Meta-model v1

