ロボット革命イニシアティブ協議会
Robot Revolution & Industrial IoT Initiative

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Forum Industrie4.0
Hannover Messe 2019

Navigation Scheme of Smart Manufacturing System Development for Each Maturity Level Enterprise

An Activity of German-Japan IoT Collaboration PJ

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Background

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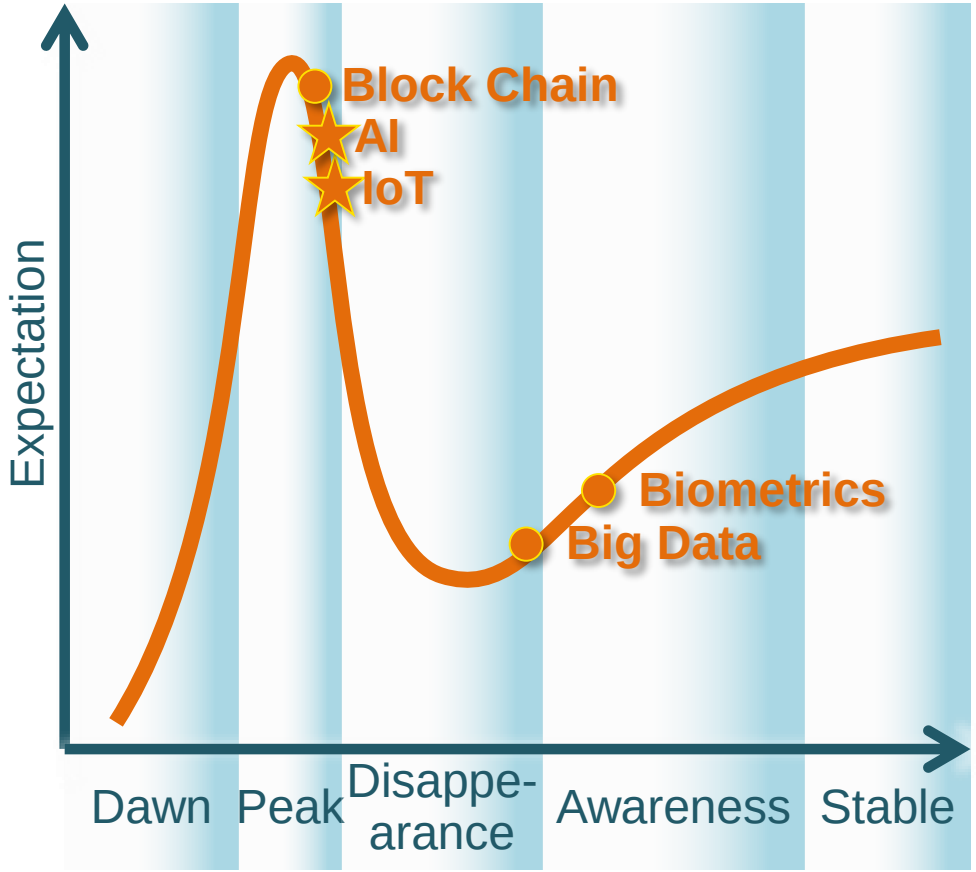
1-1 IoT/AI enthusiasm went away…



Source: Gartner Japan, October 2018

- on IT Hype-cycle, and blind investment has left.
- Players ***who are truly enthusiastic about commercialization, who want to reap the effect survive***, have come into the period to advance steady promotion.
- What should we do to create ***a fair, secure and safe open digital society***, beyond race, culture and disparity in a world where people and things are going to "connect at the world level" ?

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1-2 German-Japan IoT collaboration project

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- Japan-Germany Summit on March 2015
- Agreement on IoT utilization cooperation for Manufacturing

- Joint Statement on April 2016, among German Ministry of Economics and Energy and Japan Ministry of Economy, Trade and Industry
- Joint Working Group of International Standardization for Smart Manufacturing

PLATTFORM INDUSTRIE 4.0 ロボット革命イニシアティブ協議会 Robot Revolution & Industrial IoT Initiative STANDARDIZATION COUNCIL INDUSTRIE 4.0 VDI VDE VDI/VDE Society Measurement and Automatic Control

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1-3 Key for Industrie4.0 open ecosystem

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CeBIT 2017, Germany

- Robot, sensors, controllers, AI, operation system, service tools are gathered from different manufacturers.
- ***System architecture*** is the key in the open digital society.

Today's discussion

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Navigation Scheme of Smart Manufacturing System Development

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2-1 System architecture is the key for open digital society

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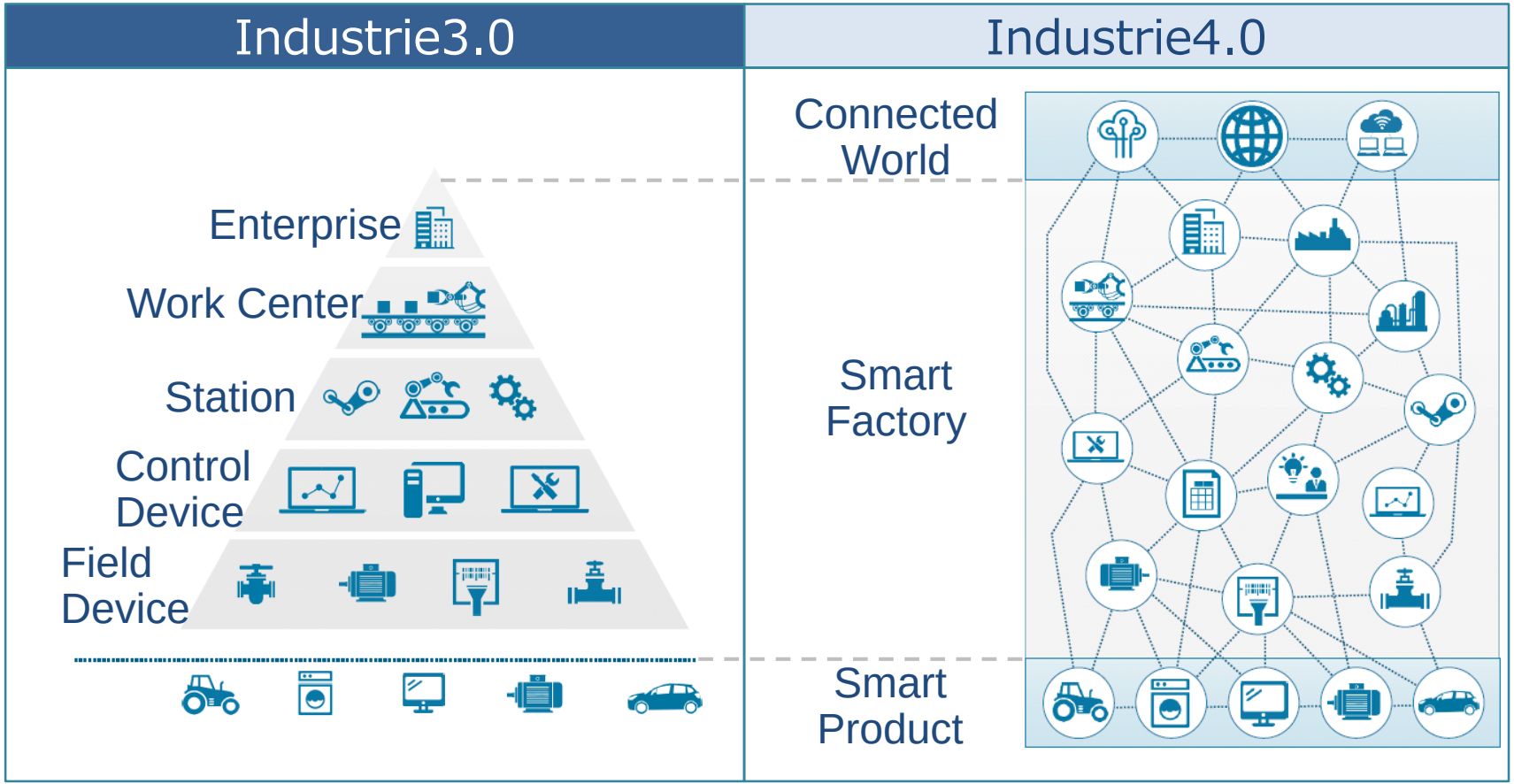

Ref: Reference Architectural Model Industrie4.0 (RAMI4.0) - An Introduction rami40-an-introduction.pdf

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2-2 BUT, the fact is the world has no cohesion

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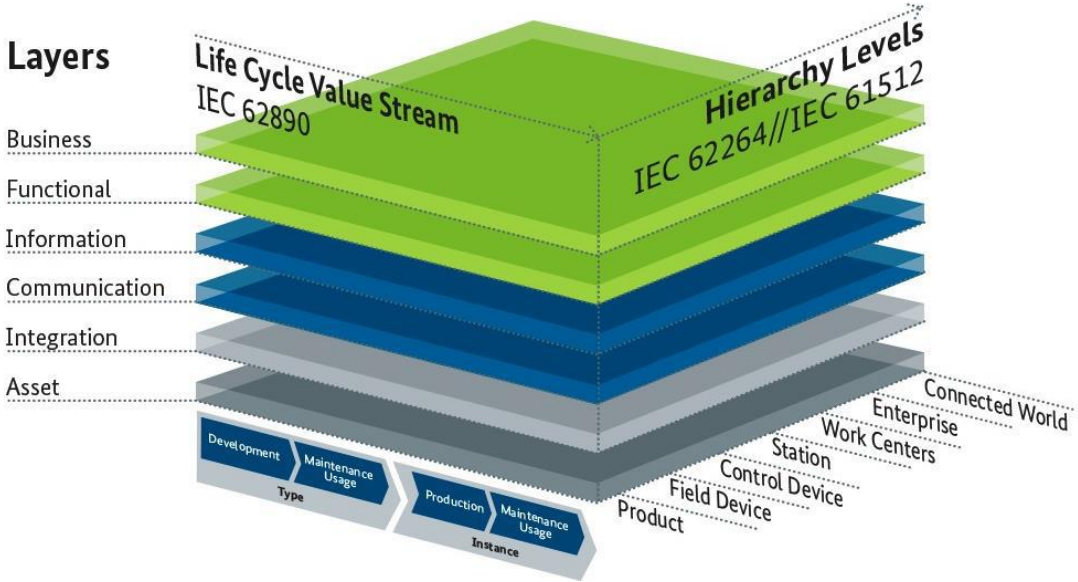
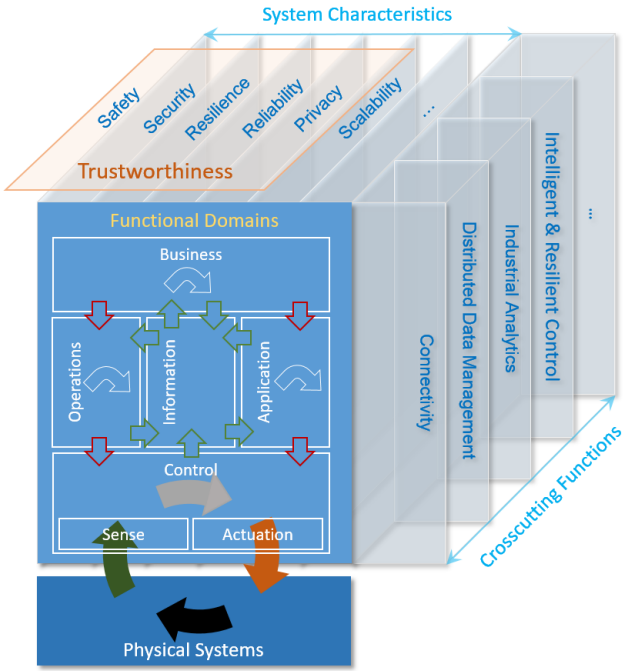
Various Smart Manufacturing reference models / architectures have been promoted…



Germay RAMI4.0 (Reference Architecture Model Industrie4.0)



US IIRA (Industrial Internet Reference Architecture)

Ref: https://www.plattform-i40.de/I40/Redaktion/EN/Downloads/Publikation/rami40-an-introduction.pdf?__blob=publicationFile&v=14
https://www.iiconsortium.org/IIC_PUB_G1_V1.80_2017-01-31.pdf

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2-3 BUT, the fact is the world has no cohesion

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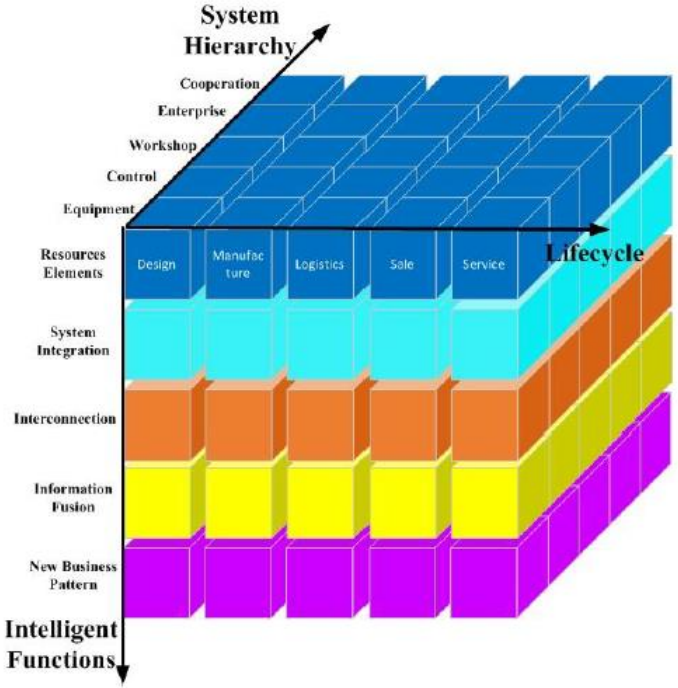
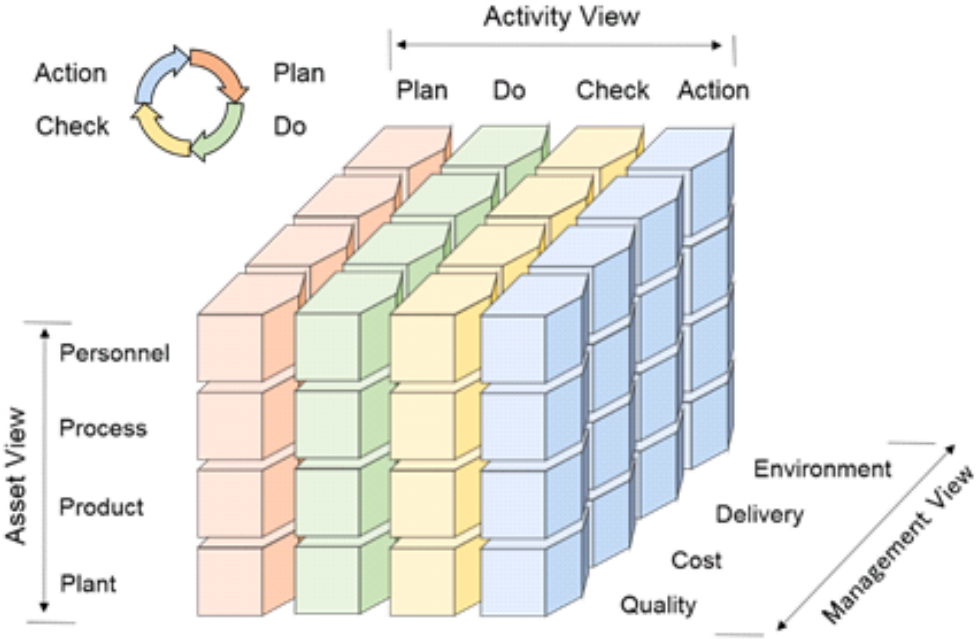
from many countries, many organizations.



China IMSA (Intelligent Manufacturing System Architecture)



Japan IVRA-SMU
(Industrial Value-chain Reference Architecture
-Smart Manufacturing Unit)

Ref: https://ieeexplore.ieee.org/document/8256234/, https://iv-i.org/docs/doc_171127_IVRA-Next-jp.pdf

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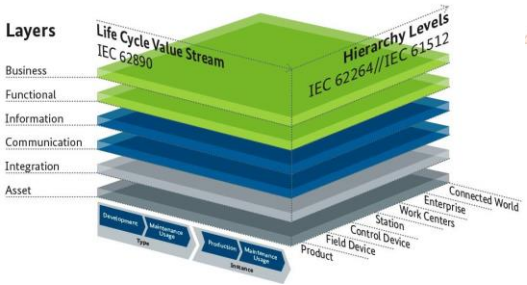
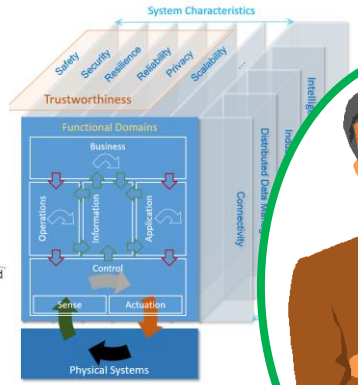
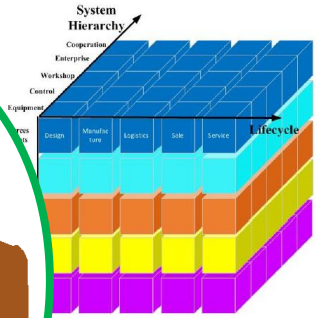
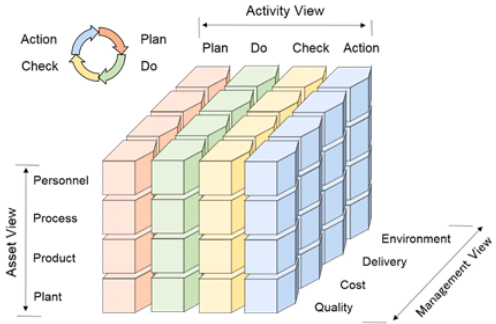
2-4 Hardly unified due to speculation of each country









- I do not care about the difference in the fine method of operation.
- I would like have a guideline on how to use it, how to make a system that can be utilized in the global open digital society.

Ref: https://www.plattform-i40.de/I40/Redaktion/EN/Downloads/Publikation/rami40-an-introduction.pdf?__blob=publicationFile&v=14, https://www.iiconsortium.org/IIC_PUB_G1_V1.80_2017-01-31.pdf, https://ieeexplore.ieee.org/document/8256234/, https://iv-i.org/docs/doc_171127_IVRA-Next-jp.pdf

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2-5 How to define a Smart Manufacturing System ?

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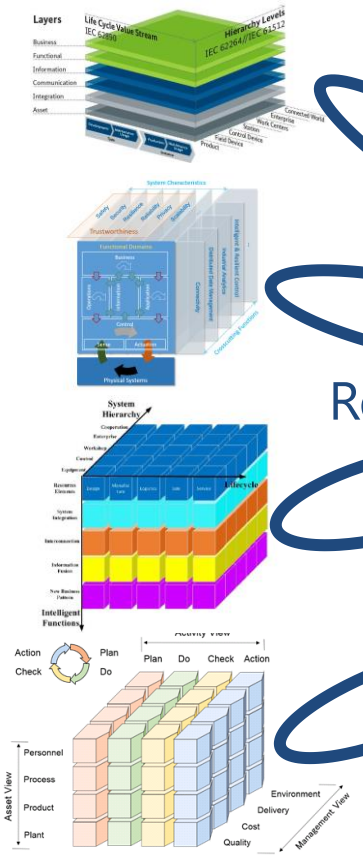
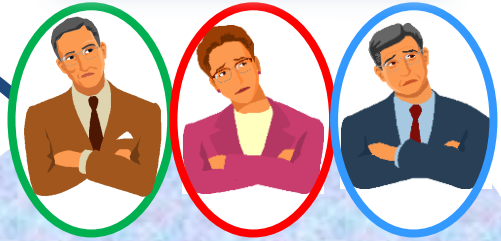
Different stacks on different aspects



Refer

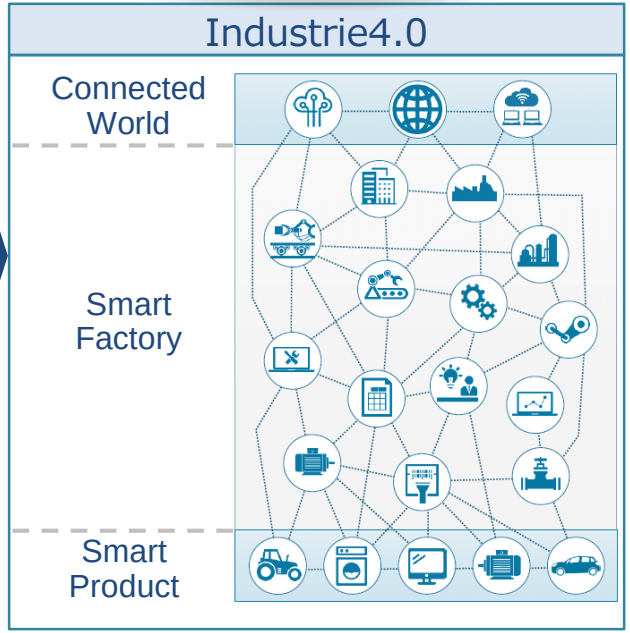
Concern
For each, individually



Standard contents
for the description of
1.Business Scope
2.Use Cases
3.Function
4.Data

Join

Industrie4.0



Ref: https://www.plattform-i40.de/I40/Redaktion/EN/Downloads/Publikation/rami40-an-introduction.pdf?__blob=publicationFile&v=14, https://www.iiconsortium.org/IIC_PUB_G1_V1.80_2017-01-31.pdf, https://ieeexplore.ieee.org/document/8256234/, https://iv-i.org/docs/doc_171127_IVRA-Next-jp.pdf

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2-6 Unified Reference Model – Map and Methodology (URM-MM)

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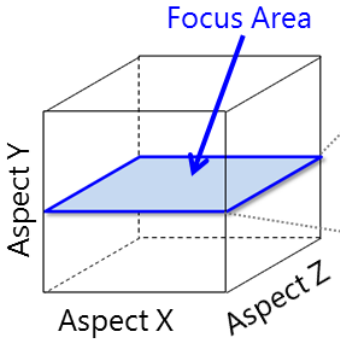
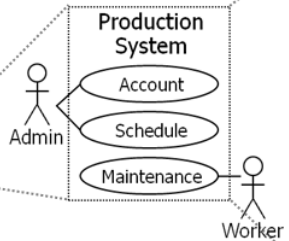
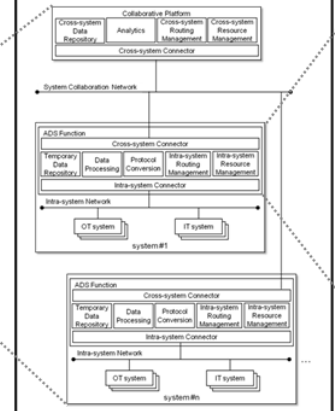
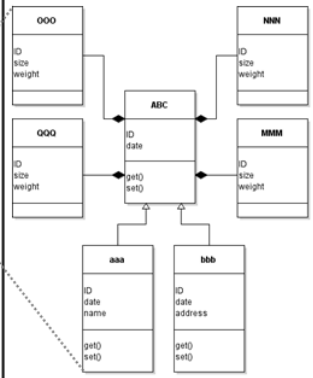
Unified Reference Model - Map and Methodology / Model/Organization	Canvas	Use-case	Function	Data
				
RAMI4.0 / Platform Industrie 4.0	←			
IIRA / Industrial Internet Consortium	←			
IMSA / Made in China2025	←			
Smart Manufacturing Ecosystem / NIST	←			
IoT Reference Architecture / JTC1/WG10			←	
Architectural Framework for IoT/IEEE P2413			←	
Architecture Reference Model / oneM2M			←	→
IoT Reference Model / ITU-T SG20	←			
Big Picture 3D Diagram / ISO TC184	←			
Framework for the smart manufacturing standards landscape / AIF	Clarification & Mapping Method			
IVRA / IVI	←			
Demachi Proposal/ TC65 ahG3	Clarification & Mapping Method			
UML / OMG		←		→

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2-7 Unified Reference Model – Map and Methodology (URM-MM)

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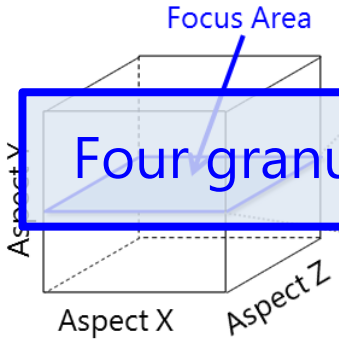
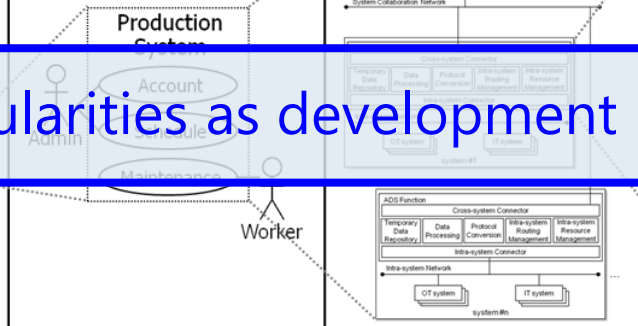
Unified Reference Model - Map and Methodology / Model/Organization	Canvas	Use-case	Function	Data
				
RAMI4.0 / Platform Industrie 4.0	↔			
IIRA / Industrial Internet Consortium	↔			
IMSA / Made in China2025	↔			
Smart Manufacturing Ecosystem / NIST	↔			
IoT Reference Architecture / JTC1/WG10			↔	
Architecture Framework / IEEE P2413			↔	
Architecture Reference Model / oneM2M				↔
Reference Architecture Model / Industrie 4.0	↔			
Big Picture 3D Diagram / ISO TC184	↔			
Framework for the smart manufacturing standards landscape / AIF	Clarification & Mapping Method			
IVRA / IVI	↔			
Demachi Proposal/ TC65 ahG3	Clarification & Mapping Method			
UML / OMG		↔	↔	↔

Four granularities as development processes

List of existing reference models

Applicable area

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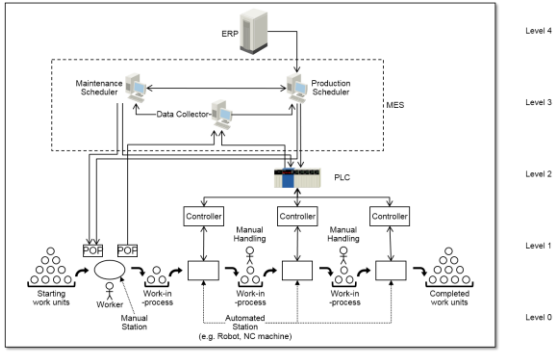
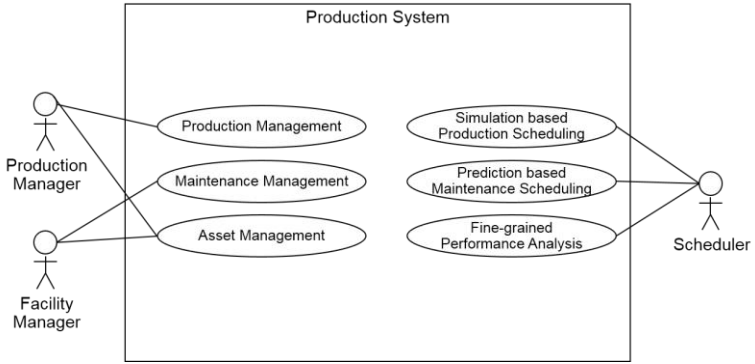
2-8 Application Example of URM-MM

Scenario: Maintenance Scheduling Optimization

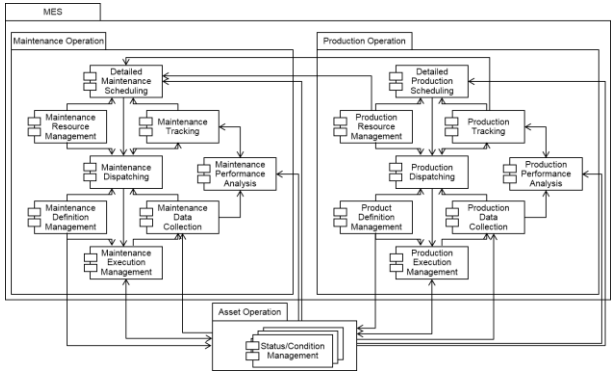


ERP: Enterprise Resource Planning, MES: Manufacturing Execution System, PLC: Programmable Logic Controller, POP: Point Of Production

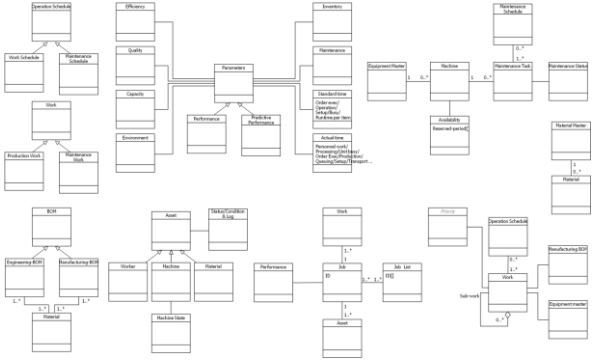
Canvas



Use-case



Function



Data

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2-9 Application Example of URM-MM

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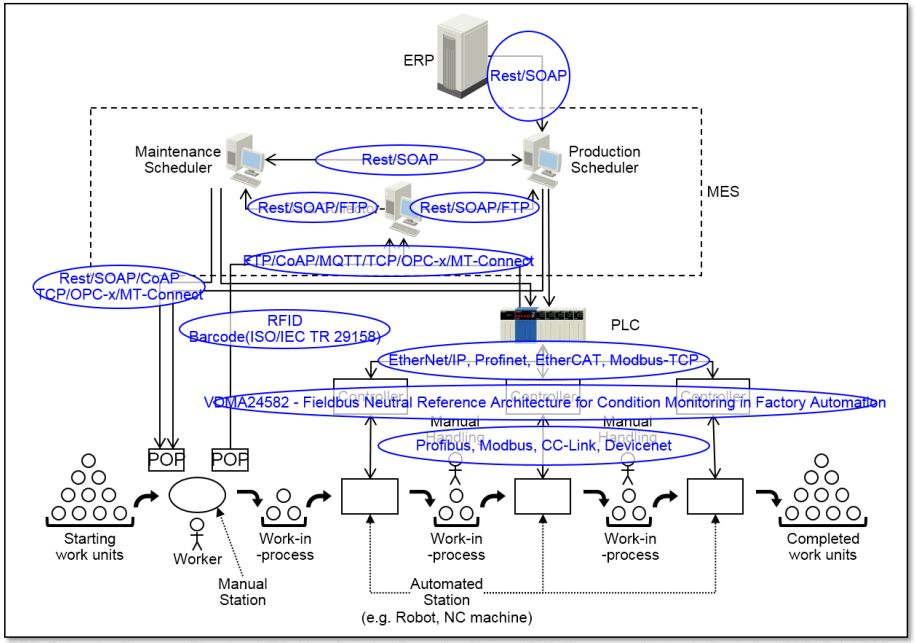
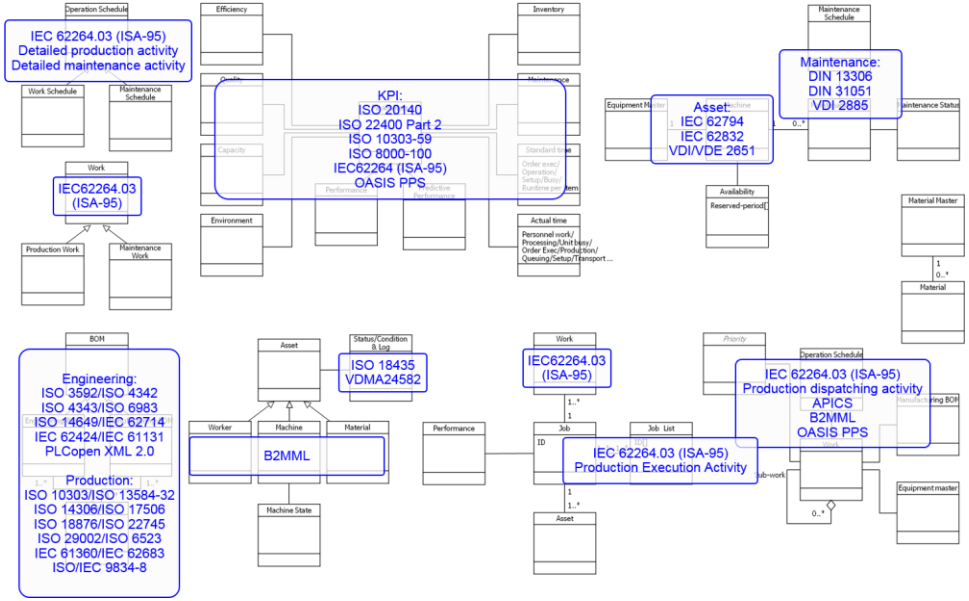
Scenario: Maintenance Scheduling Optimization



ERP: Enterprise Resource Planning, MES: Manufacturing Execution System, PLC: Programmable Logic Controller, POP: Point Of Production



Canvas

Data

Related standards can be mapped from various reference models.

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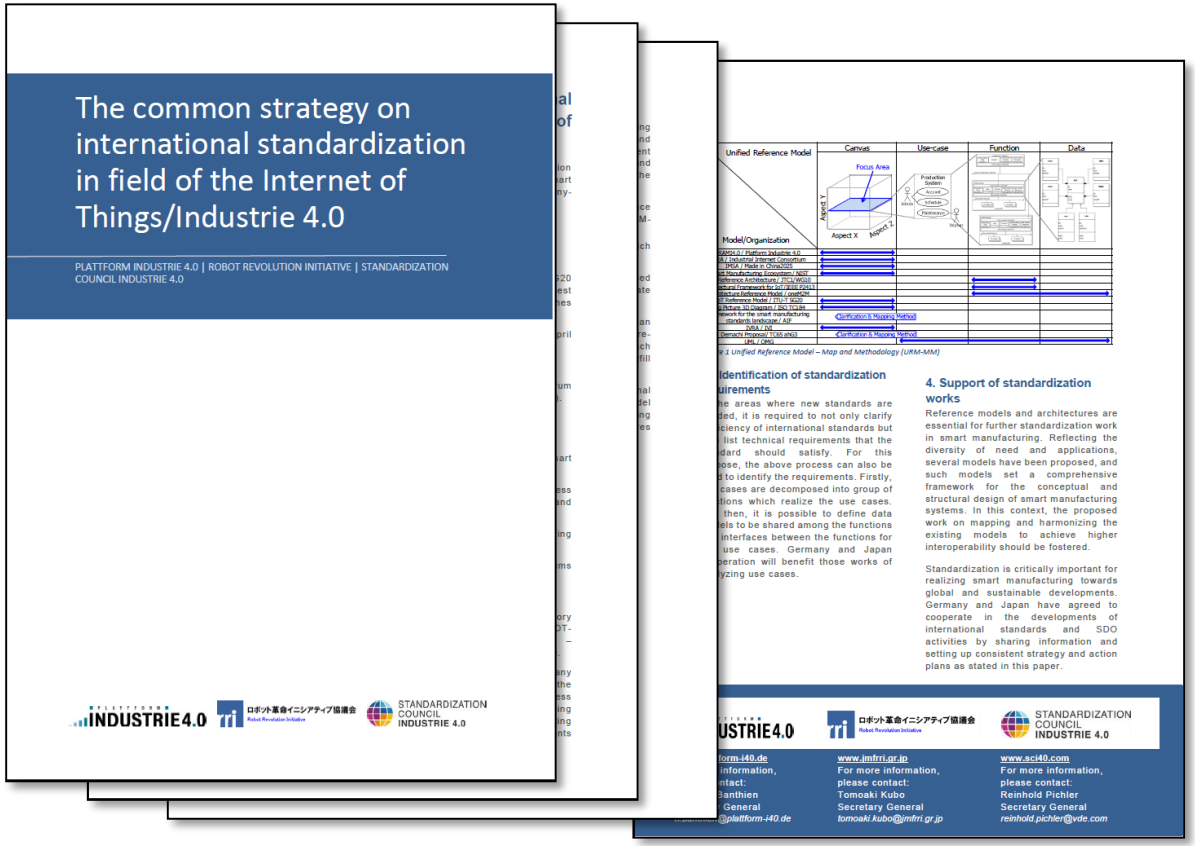
2-10 History of URM-MM activity



1. Published in the joint paper of German-Japan IoT Collaboration project
2. Introduced to IEC Systems Evaluation Group 7 Smart Manufacturing (SEG7)
3. SEG7 Task Team 3 evaluated the effectiveness with some cases.

Source: https://www.bmwi.de/Redaktion/DE/Downloads/G/gemeinsame-strategie-fuer-die-internationale-standardsetzung-im-bereich-industrie-4-0.pdf?__blob=publicationFile&v=2

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2-11 Status of URM-MM activity

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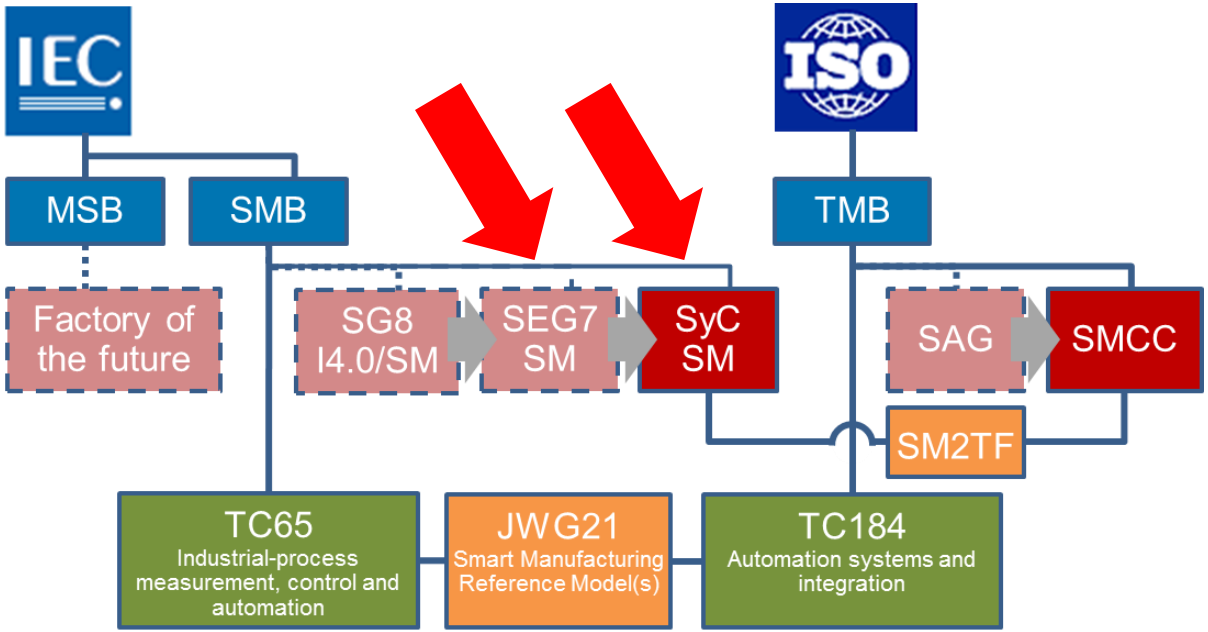

1. In the final report of SEG7, specification work of a "domain navigation" tool requirements was recommended to the new System Committee Smart Manufacturing (SyC SM), using the SEG 7 Task Team 3 results as an initial input, for the collaboration with the IEC SRG to develop and implement.

2. SyC SM established AdHocGroup 4 to define the need of "domain navigation" tool.

IEC: International Electrotechnical Commission
ISO: International Organization for Standardization
MSB: Market Strategy Board
SMB: Standard Management Board
TMB: Technical Management Board
SG: Strategic Group
SEG: Systems Evaluation Group
I4.0: Industrie4.0

SM: Smart Manufacturing
SyC: System Committee
SAG: Strategic Advisory Group
SMCC: Smart Manufacturing Coordinating Committee
SM2TF: Smart Manufacturing Standard Map Task Force
TC: Technical Committee
JWG: Joint Working Group
SRG: System Resource Group

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Beyond URM-MM
Sustainable Growth Scheme of Smart Manufacturing System

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3-1 Well then? What should I do?

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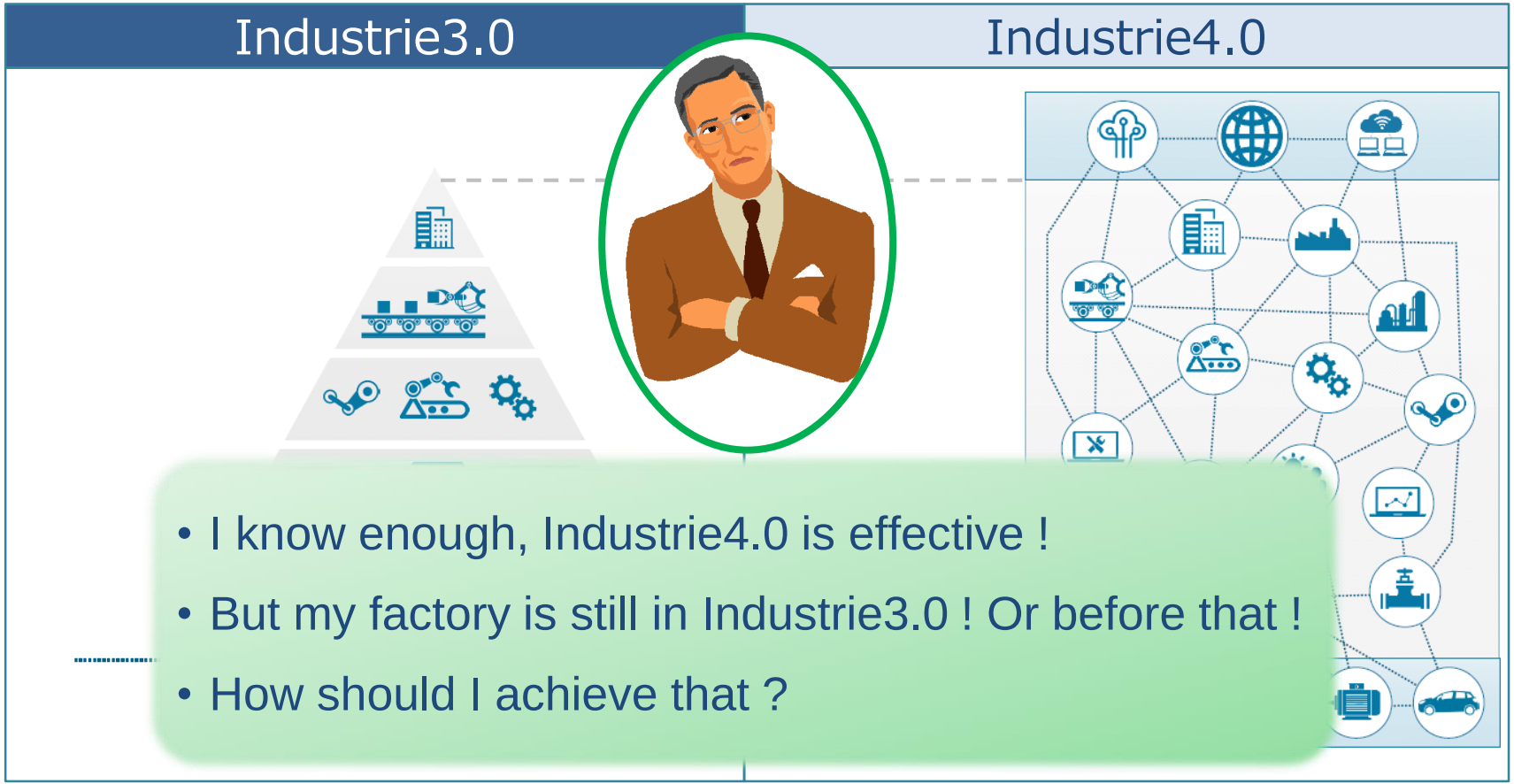

- I know enough, Industrie4.0 is effective !
- But my factory is still in Industrie3.0 ! Or before that !
- How should I achieve that ?

Ref: Reference Architectural Model Industrie4.0 (RAMI4.0) - An Introduction rami40-an-introduction.pdf

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3-2 Maturity Model for positioning & step-forwarding

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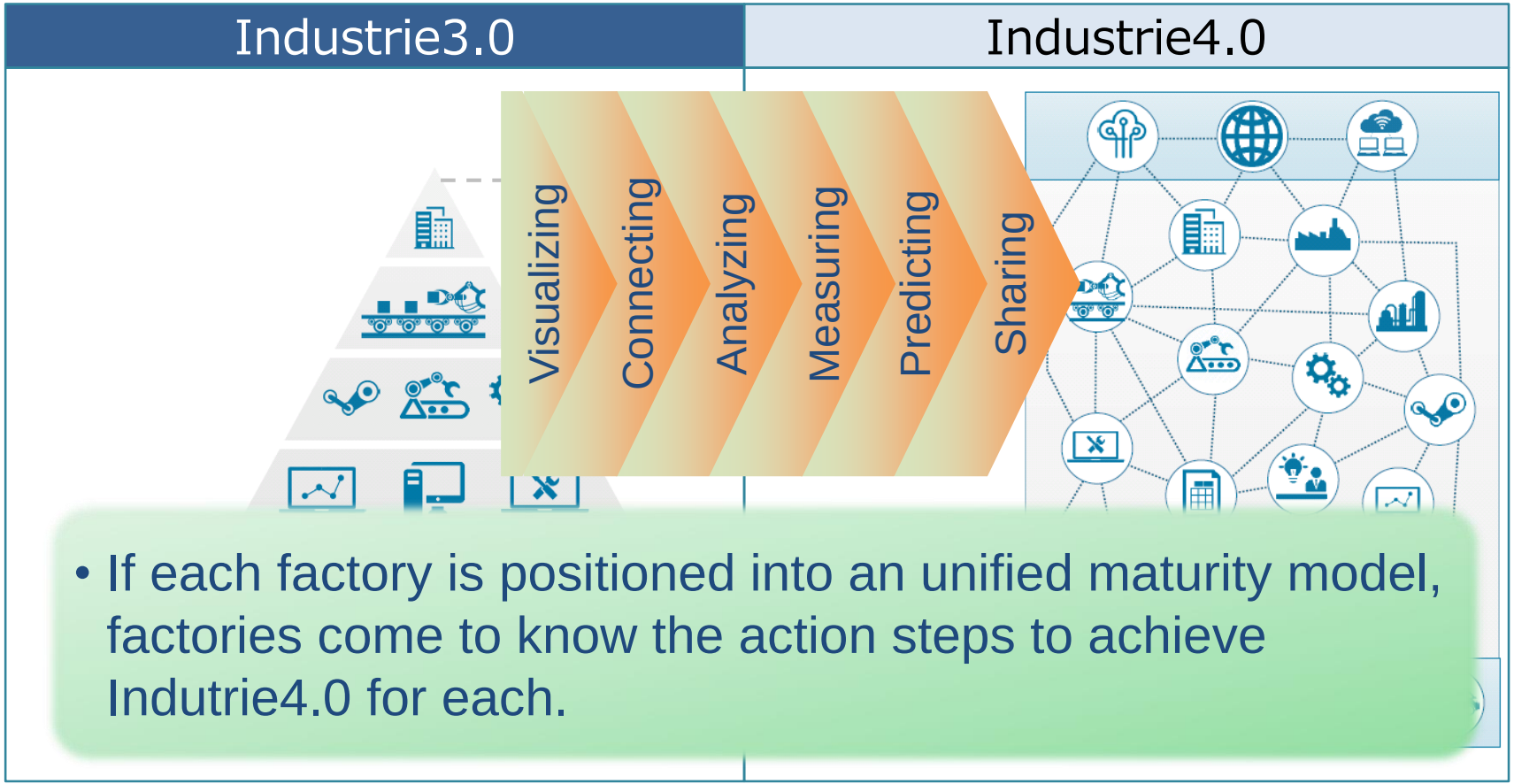

- If each factory is positioned into an unified maturity model, factories come to know the action steps to achieve Indutrie4.0 for each.

Ref: Reference Architectural Model Industrie4.0 (RAMI4.0) - An Introduction rami40-an-introduction.pdf

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3-3 Hitachi Maturity Model for Smart Manufacturing Systems

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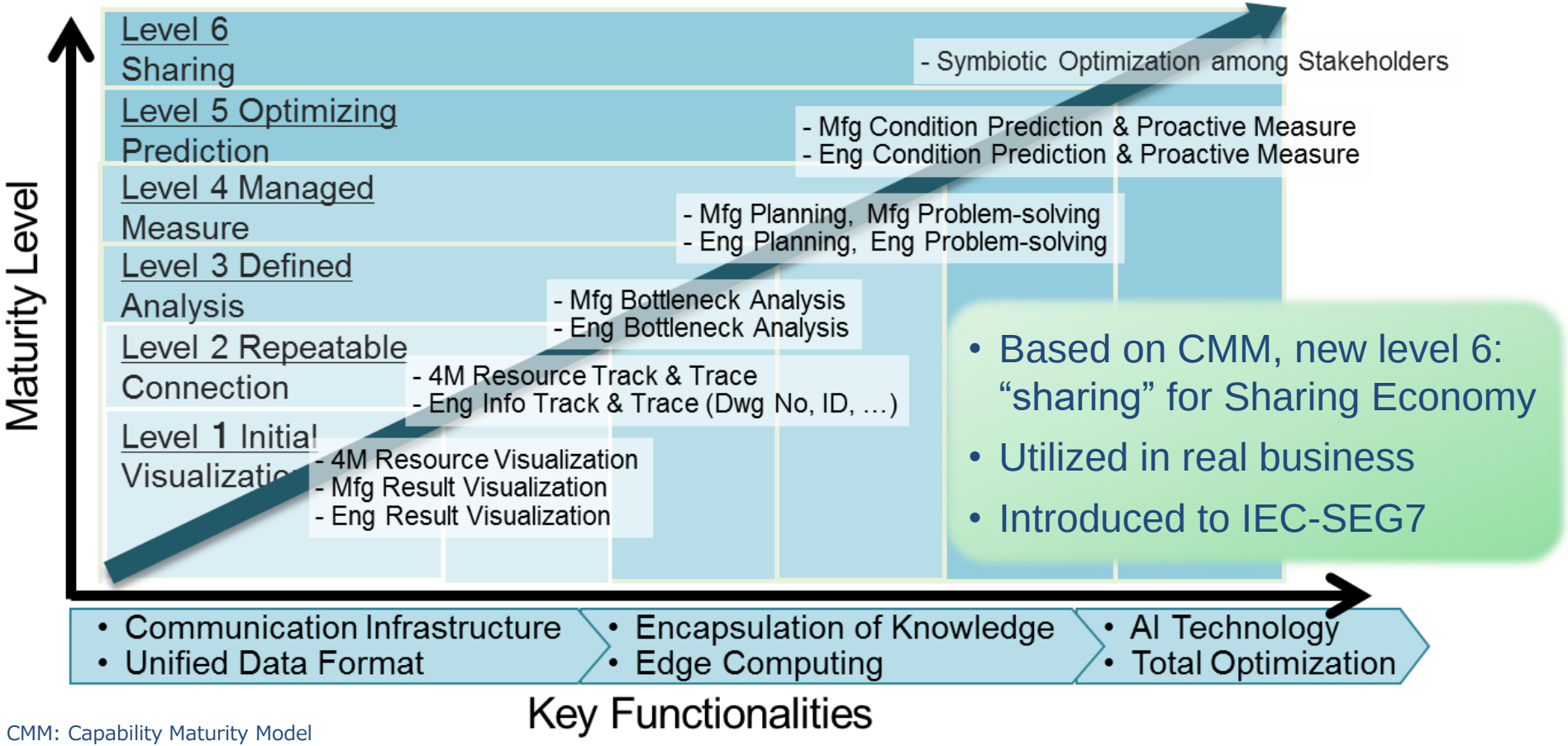

CMM: Capability Maturity Model
SEG7: Systems Evaluation Group 7 Smart Manufacturing

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3-4 Sustainable Growth Cycle for Smart Manufacturing System

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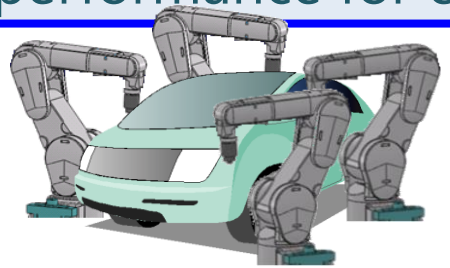
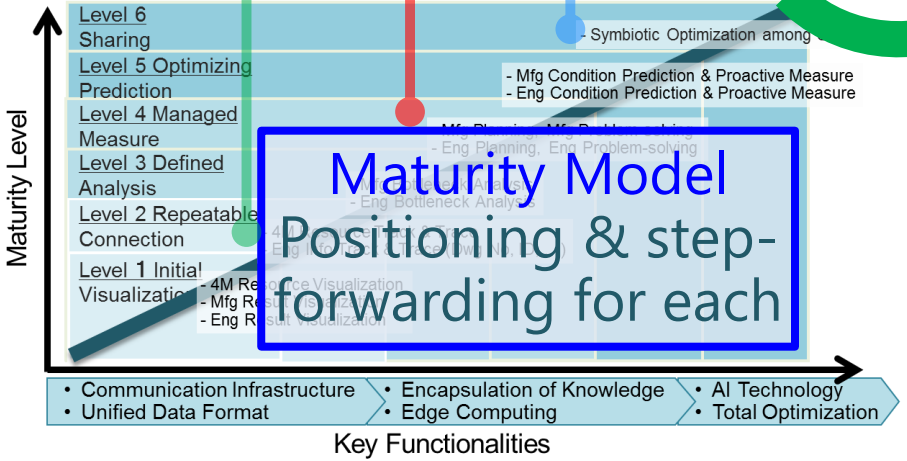
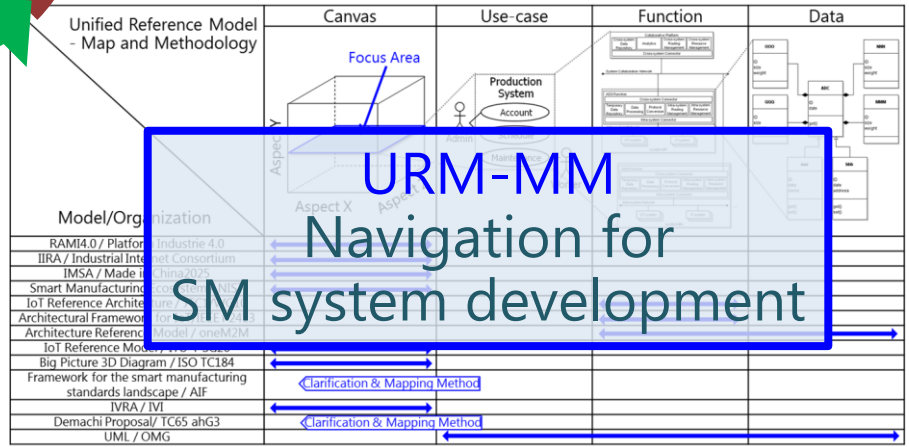
Concern
For each, individually

System
A performance for each





Maturity Model
Positioning & step-forwarding for each



URM-MM
Navigation for SM system development

SM: Smart Manufacturing, KPI: Key Performance Indicator

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3-5 Status of Sustainable Growth Scheme

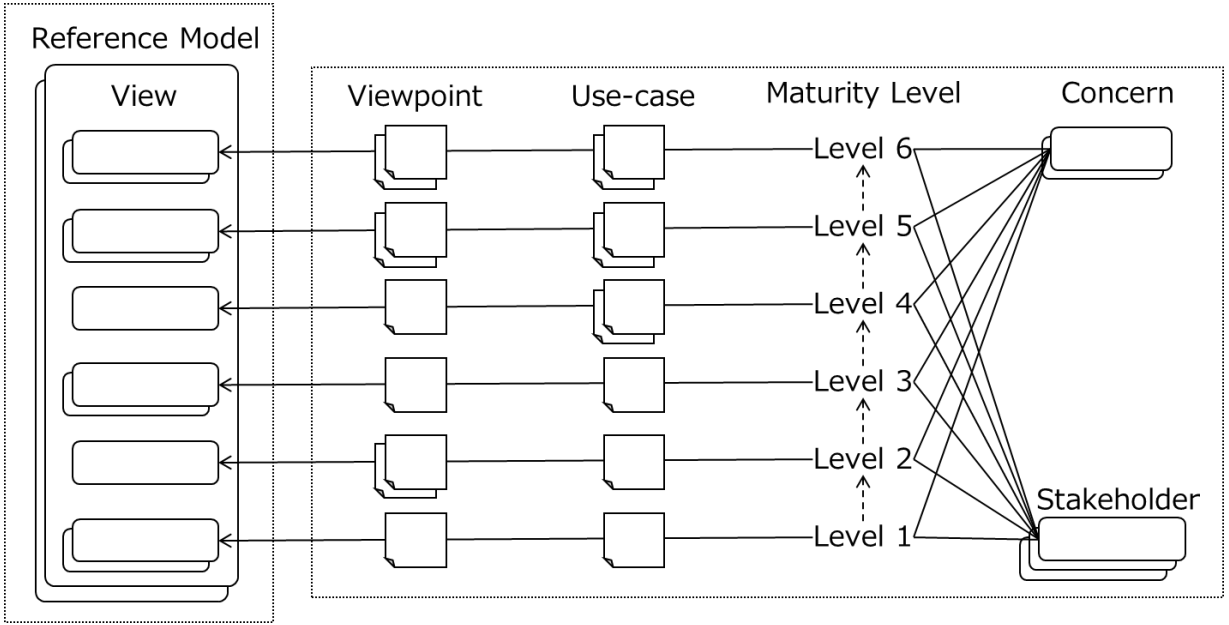

Fig. Overall image of the systematic scheme

- Japan ISO-TC184NC made a draft for DTR.
- Japan requested a collaboration to Germany for the DTR activity as one of the IoT collaboration themes.
- The discussion has started.

NC: National Committee, ISO: International Organization for Standardization
TC184: Technology Committee Automation systems and integration, DTR: Draft Technical Report

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Application Example:
OKUMA-Hitachi Collaborative Creation

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4-1 OKUMA-Hitachi collaborative creation

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OKUMA

Machine tool manufacturing know-how

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Industrial system building know-how

High efficiency factory in super high-mix low-volume production

OKUMA Dream Site. Aichi Pref.. Japan

Ref: https://www.okuma.co.jp/smart-factory/dreamsite.html, http://www.foresight.ext.hitachi.co.jp/_ct/17131854

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4-2 Initial step: Fab-wide real-time visualization

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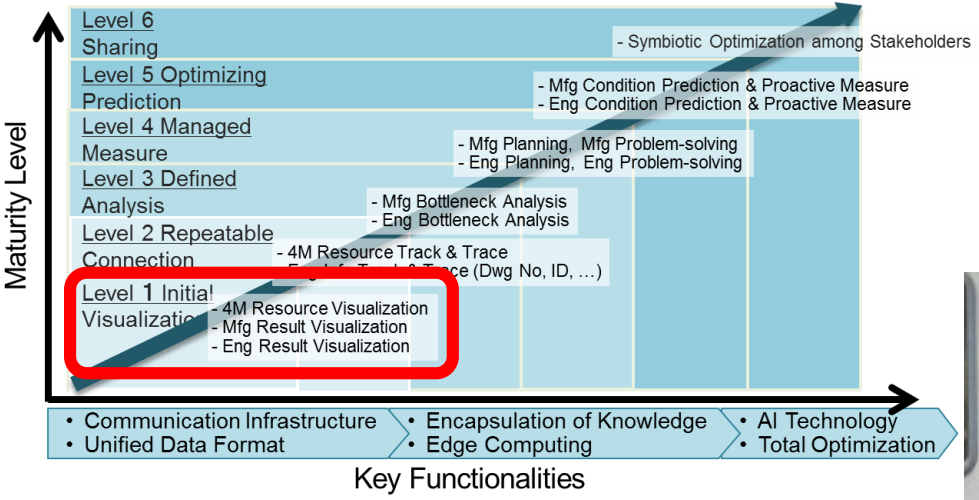

- In the initial step as “Level 1: Visualization”, OKUMA-Hitachi focus on 4M resource real-time visualization.

  4M: Man, Machine, Material, Method

- OKUMA-Hitachi developed a fab-wide real-time visualization dashboard.

http://www.hitachi.com/New/cnews/month/2017/05/170516.html
https://www.youtube.com/watch?v=s8AJ0iyAvc0

Ref: http://www.foresight.ext.hitachi.co.jp/_ct/17131854

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4-3 Second step: Digital encapsulation of mfg know-how

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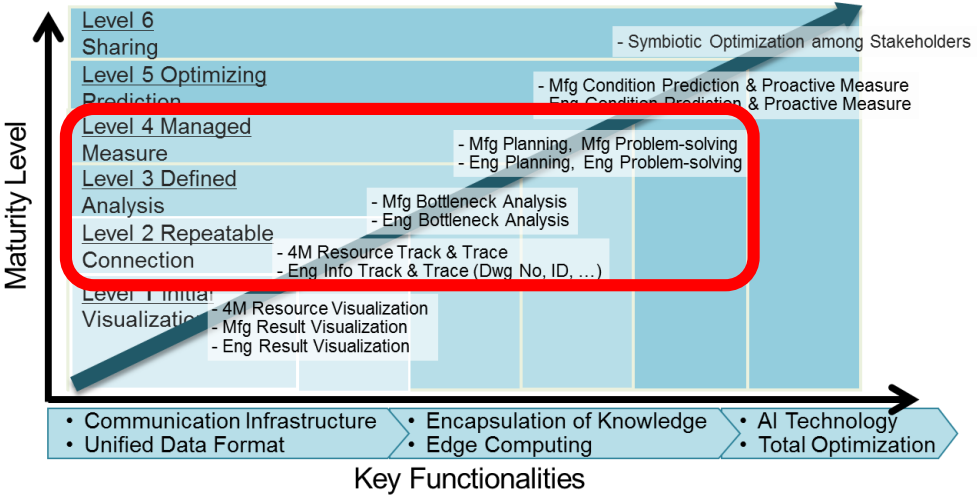
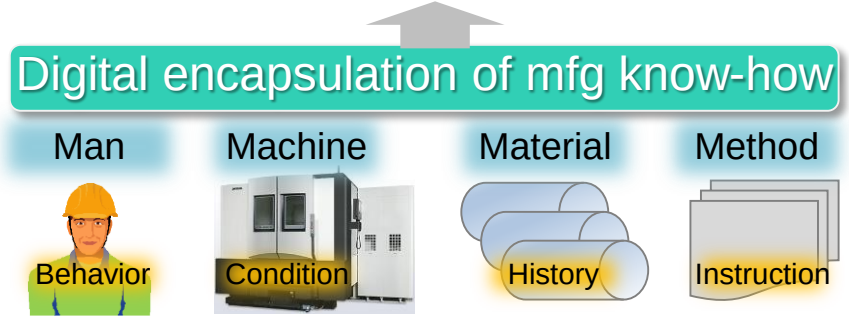
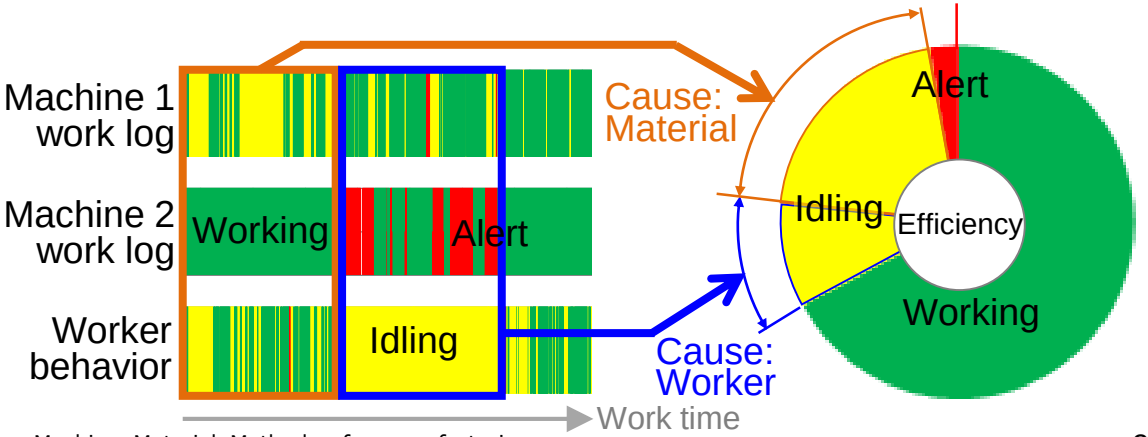


Technology transfer to other sites, next generation



Example:

Automatic cause identification by cross-4M analysis for work-center efficiency



Ref: https://www.okuma.co.jp/product/mm2/vtm-yb.html, 4M: Man, Machine, Material, Method, mfg: manufacturing

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4-4 Future step: Manufacturing service for sharing economy

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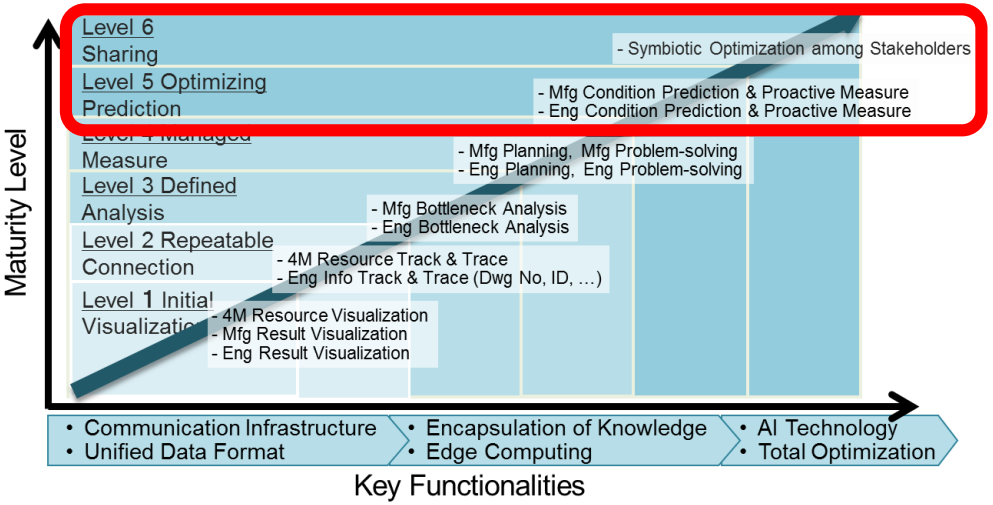
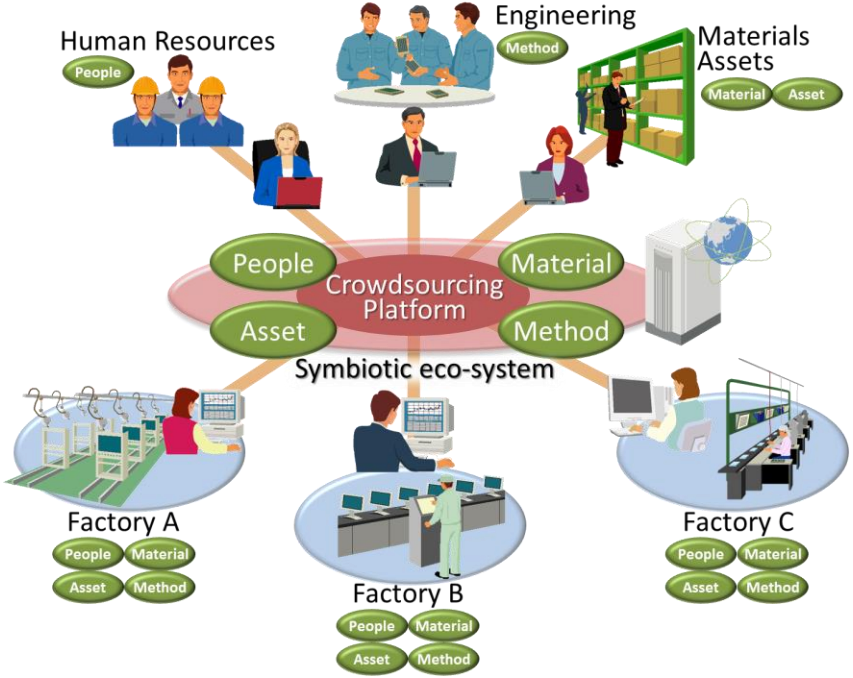


Published in
IEC-MSB Whitepaper
“Factory of the future”

http://www.iec.ch/whitepaper/futurefactory/
October 2015



Crowd Manufacturing

“Symbiotic” manufacturing ecosystem to interchange the production resources with sharing production information between companies

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Conclusion

1. Navigation scheme of smart manufacturing system development for each maturity level enterprise was presented.

2. German-Japan IoT project keeps the deep collaboration for the establishment of open digital society.

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Robot Revolution & Industrial IoT Initiative

Activities

● Forum Industrie 4.0 (meets RRI) *@ Hall 8*

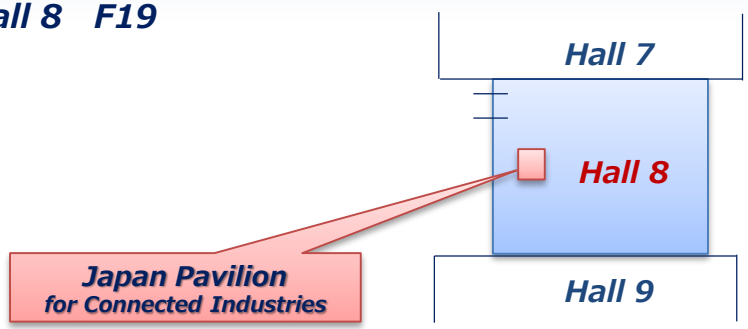
- Monday, 1 April, 12:30-13:00,
  "IoT Design Approach by Adapting Framework", Mr. Hiroshi YAMAMOTO, Toshiba Corp., Corporation Digitaization CTO
- Monday, 1 April, 14:00-14:30,
  "Connected Industries Open Framework for Industrial Value Chain Transformation", Dr. Yasuyuki NISHIOKA, Industrial Value Chain Initiative, President
- Tuesday, 2 April, 16:00-16:30,
  "Navigation Scheme of Smart Manufacturing System Development for Each Maturity Level Enterprise",
  Dr. Youichi NONAKA, Hitachi, Ltd., Senior Chief Researcher
- Wednesday, 3 April, 10:00-10:30,
  "German-Japan Collaboration for Standardization in Smart Manufacturing", Dr. Fumihiko KIMURA, The University of Tokyo, Professor Emeritus
- Wednesday, 3 April, 11:00-11:30
  "Toward Realization of Smart Manufacturing Systems",
  Dr. Shinsuke KONDOH, National Institute of Advanced Industrial Science and Technology, Group leader

● 13th German – Japanese Economic Forum *@ Hall 27*

Wednesday, 3 April, 13:45–14:30

- "IIoT Security: The role of trustworthiness in international value chains", Ms. Masue SHIBA, Toshiba Corp.
- "Standardization Activities in Germany-Japan Cooperation for Smart Manufacturing", Dr. Youichi NONAKA, Hitachi. Ltd.

● Japan Pavilion for Connected Industries *@ Hall 8 F19*



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END

Navigation Scheme of Smart Manufacturing System Development for Each Maturity Level Enterprise

An Activity of German-Japan IoT Collaboration PJ

April 2nd, 2019

Youichi NONAKA

Senior Chief Researcher
Center for Technology Innovation - Production Engineering
Research & Development Group, Hitachi, Ltd.

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