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
1-1 IoT/AI enthusiasm went away...

- 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"?

Source: Gartner Japan, October 2018
1-2 German-Japan IoT collaboration project

• 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
1-3 Key for Industrie 4.0 open ecosystem

• Robot, sensors, controllers, AI, operation system, service tools are gathered from different manufacturers.

• **System architecture** is the key in the open digital society.

CeBIT 2017, Germany
Navigation Scheme of Smart Manufacturing System Development
2-1 System architecture is the key for open digital society

Industrie3.0

- Enterprise
- Work Center
- Station
- Control Device
- Field Device

Industrie4.0

- Connected World
- Smart Factory
- Smart Product

Ref: Reference Architectural Model Industrie4.0 (RAMI4.0) - An Introduction rami40-an-introduction.pdf
2-2 BUT, the fact is the world has no cohesion

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
2-3 BUT, the fact is the world has no cohesion from many countries, many organizations.

China IMSA (Intelligent Manufacturing System Architecture)

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

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.

2-5 How to define a Smart Manufacturing System?

Concern
For each, individually

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

Different stacks on different aspects

Industrie 4.0

Connected World

Smart Factory

Smart Product


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

### Model/Organization
- RAMI 4.0 / Platform Industrie 4.0
- IIRA / Industrial Internet Consortium
- IMSA / Made in China 2025
- 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
- IVRA / IVI
- Demachi Proposal / TC65 ahG3
- UML / OMG

### Canvas
- Focus Area
- Aspect X
- Aspect Y
- Aspect Z
- Admin
- Worker

### Use-case
- Production System
- Account
- Schedule
- Maintenance

### Function
- Clarification & Mapping Method

### Data
- Hitachi
- Hitachi
- Hitachi
- Hitachi

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Four granularities as development processes

List of existing reference models

Clarification & Mapping Method
2-8 Application Example of URM-MM

Scenario: Maintenance Scheduling Optimization
Scenario: Maintenance Scheduling Optimization

Related standards can be mapped from various reference models.
2-10 History of URM-MM activity

The common strategy on international standardization in field of the Internet of Things/Industrie 4.0

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
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.
Beyond URM-MM
Sustainable Growth Scheme of Smart Manufacturing System
3-1 Well then? What should I do?

- I know enough, Industrie4.0 is effective!
- But my factory is still in Industrie3.0! Or before that!
- How should I achieve that?
If each factory is positioned into an unified maturity model, factories come to know the action steps to achieve Industrie4.0 for each.
3-3 Hitachi Maturity Model for Smart Manufacturing Systems

• Based on CMM, new level 6: “sharing” for Sharing Economy
• Utilized in real business
• Introduced to IEC-SEG7
3-4 Sustainable Growth Cycle for Smart Manufacturing System

**Concern**
For each, individually

**System**
A performance for each

**Maturity Model**
Positioning & step-forwarding for each

**SM: Smart Manufacturing, KPI: Key Performance Indicator**
3-5 Status of Sustainable Growth 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.

Fig. Overall image of the systematic scheme
Application Example:
OKUMA-Hitachi Collaborative Creation
4-1 OKUMA-Hitachi collaborative creation

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

Machine tool manufacturing know-how

Industrial system building know-how

OKUMA Dream Site. Aichi Pref., Japan

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

- 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.

Ref: http://www.foresight.ext.hitachi.co.jp/_ct/17131854
http://www.hitachi.com/New/cnews/month/2017/05/170516.html
https://www.youtube.com/watch?v=s8AJ0iyAvc0
4-3 Second step: Digital encapsulation of mfg know-how

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
4-4 Future step: Manufacturing service for sharing economy

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

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

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

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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.
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 Digitalization 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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April 2\textsuperscript{nd}, 2019

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