106 年度臺日技術合作計畫

工業物聯網驅動的製造改變

結案報告書

工業技術研究院

機械與機電系統研究所

中華民國 106 年 8 月

目　　錄

壹、緣起

工業技術研究院機械與機電系統研究所，因應工業4.0、IoT、Big Data時代的到來，聯合產學研各界發起成立「智慧製造聯網數據加值產業聯盟」。此聯盟主要推動建立跨產業/跨領域共通性智慧製造聯網平台，以開發快速收集資料並加以傳輸、分析、儲存、應用等技術，強化產業的國際競爭力。為加速相關技術開發與應用推廣，本案獲得經濟部國合處”台日技術合作計畫”經費支持，邀請到日本推動工業4.0的主要聯盟IVI理事長來台分享日本之推動經驗。

貳、目的

本計畫邀請到日本工業4.0推動聯盟(Industrial Value Chain Initiative，簡稱IVI)西岡靖之理事長來台，介紹擔任日本製造業數位化與連結化牽引角色之IVI的任務與目標，分享了日本的經驗，以提供臺灣產業推動相關政策之參考。IVI除了執行「業務情境製作」及「建立導入步驟」等核心活動外，也建立了連結Cyber & Physical World的IVI Platform。該組織同時提案建構IVRA(Industrial Value Chain Reference Architecture)國際標準，以支援製造現場bottom up作業，並經由各種改善措施建立高生產品質及高效率的ecosystem。透過這一連串的研發活動，才能完整創造符合不同產業規模的製造方案需求。

參、專家來台指導行程

專家來台指導行程表

日期	時間	行程		註記
		活動事項	地點	
Day 1 8/21（一） 住宿:新竹國賓飯店	14:35-17:15	專家搭機抵達台北	台北	
Day2 8/22（二） 住宿:新竹國賓飯店	09:00-09:30	拜會機械所所長	新竹工研院	胡竹生所長、陳炤彰教授、鐘裕亮組長、楊馬田副組長
	09:30-12:00	工研院研討會	新竹工研院	胡竹生所長、鐘裕亮組長、黃俊弘副組長、楊馬田副組長、湯鈞汶經理
	12:00-13:00	午餐	新竹工研院	黃俊弘副組長、楊馬田副組長、陳炤彰教授、陳玉倫副組長
	13:00-13:30	參觀工研院 HQ 展示館	新竹工研院	楊馬田副組長
	13:30-15:00	與機械所團隊進行”物聯網及工業 4.0 技術座談會”	新竹工研院	黃俊弘副組長、楊馬田副組長、楊政城副經理、吳鴻材研究員
	15:30-17:00	參訪盟立自動化公司	新竹盟立公司	林財興協理、楊智超副處長、王淑華副處長、施振裕經理、向德

				成技術監督
	18:00-20:00	歡迎晚宴	新竹	胡竹生所長、陽毅平副所長、鐘裕亮組長、楊馬田副組長
Day 3 8/23（三） 住宿：新竹國賓飯店	10:00-12:00	拜會智慧機械推動辦公室	台中	賴永祥主任、詹子奇副主任、黃志名處長、謝東旭、李廷恩等
	12:00-13:30	午餐	台中	賴永祥主任、詹子奇副主任、黃志名處長
	14:00-17:00	中興大學研討會	台中中興大學	邱顯俊主任等
	18:00-20:00	晚宴	台中	邱顯俊主任等中興大學主管
Day 4 8/24 （四）	09:00-12:55	專家搭機離台	台北	

肆、研討會、參訪暨座談會

一、 IVI 西岡理事長參加工研院研討會並發表專題演講

8/22（二）一早，西岡理事長首先拜會工研院機械所胡竹生所長，現場並有機械所工業物聯網組鐘裕亮組長陪同座談。西岡理事長親自簡介日本 IVI 聯盟之成立緣起、組織現況、及產業合作概況。機械所並回饋已發起之「智慧製造聯網數據加值產業聯盟」，由鐘裕亮組長說明聯盟理念、推動策略、與產業合作現況等。雙方並討論台日兩國智慧製造下的產業需求，及交互合作可能性，並期約未來將以雙方聯盟為介面相互對接，持續找尋具體合作議題以使兩國產業界能相互促成實質合作。

西岡理事長(右 1)拜會機械所胡竹生所長(右 2)

8/22(二)上午機械所舉辦「日本工業 4.0 推動聯盟(IVI)交流研討會」，由西岡理事長擔任主要演講人，其講題為「Challenge of the IVI Platform for Connected Manufacturing Ecosystem」，演講分為四個部分。

首先，介紹在第四次產業革命中，擔任日本製造業數位化與連結化牽引角色之 IVI 的相關業務推動內容，分享日本的發展脈絡與經驗。該聯盟主要著重於協助大企業、及中小企業間的合作與數據整合，以期建構產品履歷、設備運作狀況、製造資訊、技術推展(智財)等皆可追溯的虛實整合製造環境，據此吸引了 215 家企業/520 位個人加入 IVI。

第二部分，說明 IVI 在 2016 年推動智慧製造的情境。IVI 在 2016 年依照製造工程、品質工程、製造管理、維護管理等四項議題展開 25 個工作組，每一工作組都有 10 家企業積極參與。會中細部解說「業務情境製作」及「實際導入步驟」等核心活動，並講述四個工作組的推動案例，使聽者瞭解企業間的分工與合作作法。

第三部分，說明連結 Cyber & Physical World 的 IVI Platform 及使用此平台的系統建構方法論。IVI 採用自下而上的流程以連接製造，再盤點製造流程上的利害關係人，並推演真實世界與虛擬(數位)世界的產品流/資訊流的關係，再以 PDCA（Plan-Do-Check-Act）的品質管理循環進行製造現場的審視，探討人機合作介面。以此分析流程促使各工作組進行內部創意互動，針對核心議題展開四個執行階段，即 Problem Forming / Problem Sharing / Goal Definition / System Implementation，原則上規劃以一年的時間推動與執行。

第四部分，介紹 IVI 正在提案的國際標準 IVRA(Industrial Value Chain Reference Architecture)。IVRA 採用三個維度建立架構，「執行維度」以 PDCA 為核心工作，「管理維度」關注環境、運輸、成本、品質等面向，「資產維度」可展開 4P 個人(Personnel)、流程(Process)、產品(Product)、與工廠(Plant)

等。IVRA 是一個可支援製造現場 bottom up 作業，並透過各種改善措施可提升品質及生產效率的 ecosystem，因此期望與包含台灣在內的各個國家一起討論如何建立有效的合作架構。

透過西岡理事長深入淺出的講解，使聽者瞭解日本以聯盟合作方式推展智慧製造的作法與理念。與會者一致認為參機此活動收獲頗豐，IVI 聯盟會員的合作模式與細部運行作法，足供做為台灣運作合作聯盟及業者投入合作的參考。

西岡理事長(左 3)出席工研院研討會與相關主管、講師合影

西岡理事長出席工研院研討會發表演講

工研院研討會會場

西岡理事長參觀工研院 HQ 展示館

二、IVI 西岡理事長與工研院機械所技術團隊座談會

8/22 下午，西岡理事長與機械所工業物聯網組團隊展開技術交流與討論。機械所黃俊弘副組長針對 IVI 聯盟成員的權利義務如何劃分提出疑問請教西岡理事長。理事長特別說明，IVI 鼓勵聯盟企業成員提出製造或營業現場未能解決問題，再由個別之工作小組 WG(working group)共同想出解決方案。此方案若證明有效就會定期向大會做摘要報告，再公開給聯盟成員參考使用。

原則上，各個 WG 所提出的解決方案都免費開放給聯盟成員使用，但個別公司若有較複雜問題欲採用已公佈之方案執行者，大部分都會再個別與開發方案之企業或研究機構議約委託開發。如此暨 Leverage 了企業資源也保護了個別企業之事業秘密。

西岡理事長同時點出，歐美各國都在提倡將工業 4.0 或 IoT 等技術導入製造業，而環顧全球市場狀況，亞太地區就是世界的製造中心，因此 IVI 期望聯結亞洲國家，善用製造中心的地理與數據優勢，共同創造亞洲版本的第 4 次產業革命技術，以共同爭取全球製造利益。

西岡理事長(右 1)與機械所團隊進行”IoT & 工業 4.0 座談會”

三、IVI 西岡理事長參訪盟立自動化公司

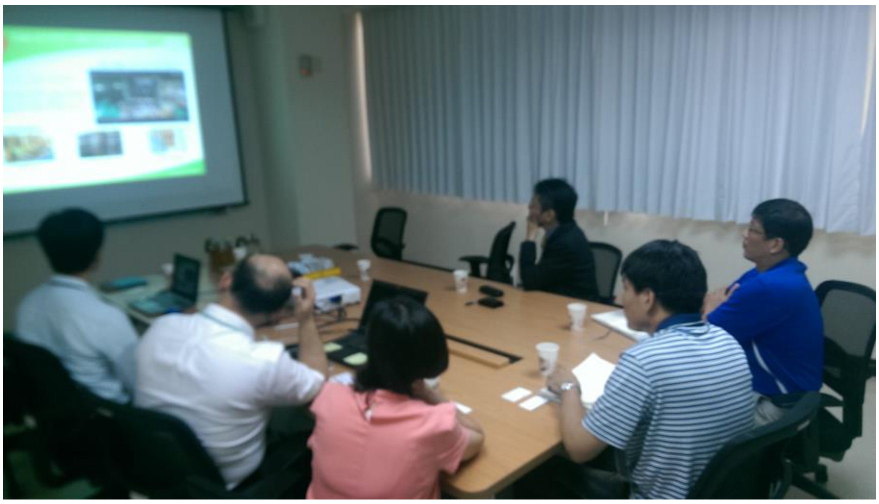
8/22 下午西岡理事長參訪了位於新竹科學園區內的盟立自動化(股)公司，由該公司林財興協理率相關主管接待，並共同交換 IoT 相關計畫執行成果與未來發展方向。

該公司簡介了協助自來水公司開發的全台管路監控、資料收集暨大數據分析智慧系統，此系統可即時因應客訴、管路維修、分區供停水等問題。

西岡理事長建議，可考慮將自來水事業、電信事業、電力事業、瓦斯氣體等公共事業的資料，適度公開給一般民眾使用，並鼓勵大眾運用大數據等分析手法，提出有益改善人類生活之服務方案，相信會因此催生許多新興的服務業務(事實上，美日等國正鼓勵年輕人利用此模式踴躍提出新創事業構想)。

西岡理事長(右 3)參訪盟立公司與林財興協理(左 4)團隊合影

西岡理事長與盟立公司技術討論



西岡理事長與盟立公司技術討論

四、IVI 西岡理事長拜會智慧機械推動辦公室

8/23 上午，西岡理事長由工研院國際中心楊琇瑩博士陪同拜訪位於台中精密機械發展中心內的智慧機械推動辦公室，受到辦公室賴永祥主任、詹子奇副主任等親自接待。

賴永祥主任與黃志明處長首先介紹了台灣機械產業的發展現況及未來展望。緊接著由詹子奇副主任簡介『智慧機械推動辦公室』任務、願景、目標、推動策略與現況成果。

雙方討論了 IoT 於台灣的發展狀況，對於目前台灣 IoT 發展進度雖不及日本與歐美各國，然而台灣已具備相關專業人才，在充裕資源支應與培訓下，相信台灣 IoT 產業應可快速發展。

西岡理事長分享了推動工業 4.0 的以下幾點看法：

1. 針對智慧機械計畫擬推動 PaaS 之構想，西岡理事長認為可能是有難度的。他說明日本是偏於 user-side，著重使用者的需求，強調單機的功能性，而對於智慧機械系統的智慧聯網功能並不太要求。

2. 歐美模式是先建立標準(Standard)，建置成系統後，方進行生產化(Production)；而日本模式則是直接推動生產化驗證，再依據產品面的問題逐一改善，並未強調推動系統的標準化。

接著西岡理事長也參觀了智慧機械展示場域，項目包含：工具機與機械手臂、SKYMARS 實際運作介面、AGV 機器人應用情境、切削實驗室等。

雙方經過深度的意見交換與討論後，西岡理事長針對未來IVI與台灣廠商與研發機構的合作表示強烈意願，並點出初步可能做法包含：

1. 協助台灣廠商發展或導入IoT相關技術
2. 與智慧機械推動辦公室共同舉辦明年度的台日論壇。

西岡理事長(左3)拜會智慧機械推動辦公室賴永祥主任(右3)

西岡理事長與智慧機械推動辦公室交流會議

西岡理事長參訪智慧機械工廠

五、IVI 西岡理事長參加中興大學研討會並發表專題演講

8/23 下午，西岡理事長由工研院國際中心楊琇瑩博士陪同拜會中興大學機械系邱顯俊主任，雙方針對工業 4.0 的技術開發與人才培育需求交換意見，並同意應該鼓勵兩國技術人員與學生，應可加強互動交流，以發揮彼此之長處，才能截長補短共創雙贏局面。

緊接著，邱主任邀請西岡理事長蒞臨該系的演講會場，對眾多出席研討會的產學研專業人士、機械加工與製造領域學生，簡介 IVI 在日本推動工業 4.0 之經驗與策略做法，獲得與會人員之熱烈歡迎與熱情互動，完成此次訪台的最後一場產業技術經驗交流。

西岡理事長(右)與中興大學機械系邱顯俊主任(左)會談

中興大學研討會會場一角

西岡理事長(左)在中興大學專題演講

伍、心得

1. IVI 聯盟推動作法並非直接引進德國 RAMI 4.0 架直接推行，反而是依照日本重視品質的製造文化，建立以 PDCA 為核心的產業合作機制與 IVRA 架構，日本產業界接受度較高而吸引吸引 215 家企業/520 位個人，快速展開 25 個工作組以擴大合作基礎。其抓住的智慧製造的改良，重點是人的思維進化與認知升級此一要點，善用日本既有的製造思維切入，再進行產業合作與數位化導入的疊代升級。此以細部的執行策略確實可做為本國法人推動聯盟合作、及台灣廠商建立產業連橫關係的參考與借鏡。
2. IVI 強調 Bottom Up 由製造現場提出問題，再由聯盟成員共同討論提出解決方案，並分享相關成果。以累積基層製造的解決方案，鼓勵中小企業積極導入應用，並不特別強調建立大系統標準，以擴大數位技術、即時監控、可視化技術等的友善應用環境。此種推動模式，因初期投資成本不大，特別受中小企業主的歡迎，值得學習參考。
3. 環視全球各國針對強化製造業競爭力所提出之重點政策包羅萬象，但基本上不外乎降低成本、提高生產效益。故將製造業的縱向與橫向做最適當之連結，並以各種感測器將人機的作業狀態做最真實之記錄與分析，並以最適合的呈現方式提供給各層級管理主管參考，因而可成就 IoT 或工業 4.0 所期待達成之目標。

陸、附錄

一、專家背景資料

二、IVI 簡介資料

三、研討會簡報

附錄一：專家背景資料

Yasuyuki NISHIOKA　西岡靖之

Department of Engineering and Design, Faculty of Engineering and Design, Hosei University, Professor, Ph.D.
(教授，法政大學-工程與設計學院-工程與設計學系)

Birthdate: April 26, 1962

Education:

1993 –1996, Interdisciplinary Course on Advanced Science and Technology, Graduate School of Engineering, University of Tokyo. Ph.D
(博士，東京大學-工學院-跨領域先進理工學程)

1990 –1992, Graduate School of Systems Management, University of Tsukuba. Master of Engineering
(工程碩士，筑波大學-系統管理學院)

1981–1985,Department of Mechanical Engineering, Faculty of Science and Engineering, Waseda University. Bachelor of Engineering
(工程學士，早稻田大學-理工學院-機械工程系)

Professional Career:

2015 –Present, President of the Industrial Value Chain Initiative
(理事長，產業價值鏈主導權 IVI)

2007 –Present, Professor, Faculty of Engineering and Design, Hosei University
(教授，法政大學-工程與設計系)

2003 –2007,Professor, Faculty of Engineering, Hosei University
(教授，法政大學-工學系)

2003 –2004,Visiting Scholar, Massachusetts Institute of Technology
(訪問學者，麻省理工學院)

2001 –2003,Associate Professor, Faculty of Engineering, Hosei University
(副教授，法政大學-工學系)

1999 –2001,Full-time Lecturer, Faculty of Engineering, Hosei University
(專任講師，法政大學-工學系)

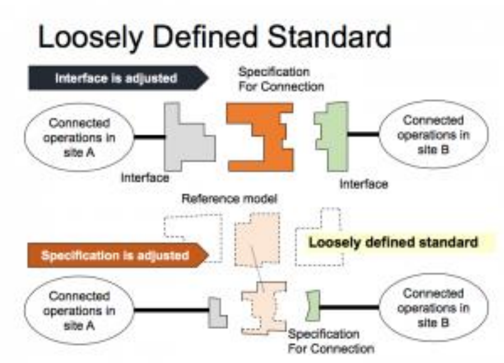
1996–1999,Research Associate, Department of Management Science, Fuculty of Science and Technology, Tokyo University of Science(研究助理，東京理科大學-理工學院-管理科學系)

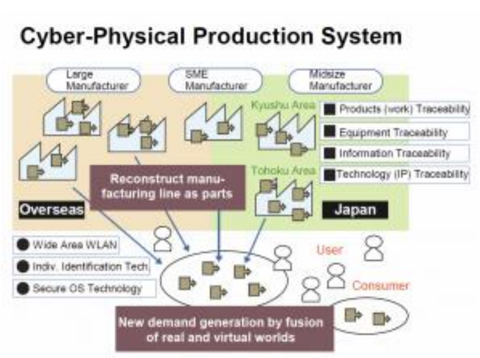
附錄二、IVI 簡介資料

What is IVI?

The Industrial Value Chain Initiative (IVI) is a forum to design a new society by combining manufacturing and information technologies, and for all enterprises to take an initiative collaboratively.

Actively discussing how human-centric manufacturing will change with IoT, IVI aims at building a mutually connected system architecture, based on collaboration areas between companies. This means, IVI does not start from the area where an enterprise has its own competitive advantage (which should be kept), but investigates scenarios where companies naturally collaborate, and by this step by step gathers a broader understanding of more general connection models (reference models), without an urgency to build THE one general model out of it. This is why we employ the term “loosely defined standard”, as it means an adaptable model instead of a rigid system. A rigid new system would face many challenges in manufacturing environments, which are complex and typically heterogeneous, with a mixture of “old” and “new” elements. A pragmatic reality-based approach, starting from state-of-the-art today, seems therefore the most suitable to develop the next level of manufacturing. So, using the „loosely defined standard“ based connectivity, IVI works to increase the value for each enterprise by cyber-physical production systems.





Activities

Business Scenario Workgroups (WGs)

The Business Scenario WGs build up real-life scenarios connecting different enterprises. These projects lead to connection models, out of which in turn the IVI reference models will emerge. The Business Scenario WGs in 2016 are:

1. Digitalization of process information and knowhow on manufacturing
2. Connection of information on production preparation at design change
3. Utilization of robot program assets by CPS
4. Agile planning of production with real-time data on workers and things
5. Position control system for things at low cost
6. IoT to support workers in flexible manufacturing in kinds and volume
7. Traceability of quality data
8. Real-time management of quality data
9. Promotion of CPS in supply chain with standard interface
10. Promotion of CPS in supply chain with standard interface (outbound logistics)
11. Collaboration among companies through shared process information
12. Managing manufacturing progress and delivery time among plants
13. Sharing technical information for horizontal integration of SMEs
14. Horizontal integration of SMEs and visualization of process information
15. Service for SMEs to notice information on manufacturing progress
16. Manufacturing innovation for interactive growth between human and plant equipment
17. Predictive maintenance of presses and panel transportation devices
18. Inclusive PM / Predictive maintenance for ALL
19. Predictive maintenance system to detect signs of equipment abnormality at low cost
20. Smart maintenance with machine IoT data
21. Smart maintenance with digitalization of knowledge
22. Improvement of productivity by visualization of equipment and workers
23. Mutual accommodation of facilities through shared production information
24. Managing actual operation status of all equipment in a plant
25. Increasing added value of after-sales service

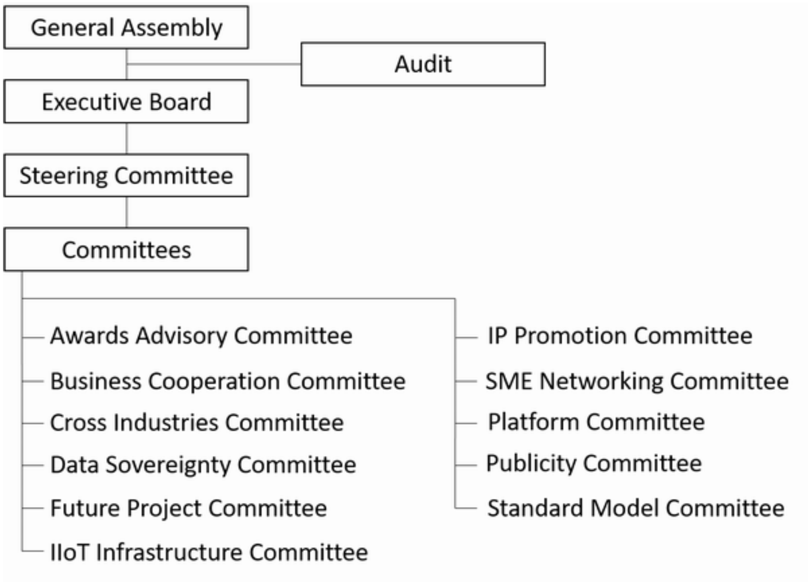
Platform Workgroups

For each of following categories of platforms, the Platform WGs develop reference models specifying items that a platform needs to/should fulfill as requirements from users' points of view. They also evaluate IVI Platforms based on the reference models.

- PF01 Production engineering information platform
- PF02 Quality management information platform
- PF03 Production planning and control platform
- PF04 Supply chain management platform
- PF05 Small sized enterprise information platform

- PF06 Preventive maintenance platform
- PF07 Asset and equipment management platform
- PF08 Maintenance service management platform

Organization



Executive Board Members

- Hiroyuki KUMAGAI
- Hiroyoshi KONNO
- Yasuyuki NISHIOKA
- Osamu HORIMIZU
- Morihiko OHKURA
- Kazuo MIYAZAWA
- Atsushi MORITA
- Yasutaka KOGA

Audit

- Masakazu HANEDA
- Hironori HIBINO

Steering Committee Members

Committees

Business Cooperation Committee

This committee works on the development of business scenarios dealt in the business scenario WG.
The committee members consist of facilitators of each business scenario, and deal with topics such as alignment of scopes among WGs and launch of new WGs.

Standard Model Committee

This committee works on the development of the “loose standard”. The Thing/Object reference model WG, the Information reference model WG, the activity reference model WG and the data reference model WG develop their respective models based on the contents from real business cases.

Platform Committee

This committee promotes IVI platforms by providing requirements and evaluating any candidates whch is proposed by platformers. Platform working groups (PF-WG) are organized for each segment of information exchange environment.Then PF-WG manages a platform that will be used by collaboration scenarion WGs.

SME Networking Committee

This committee plans and conducts seminars promoting IoT to facilitate effort for connected manufacturing by SMEs rooted in local regions in Japan. In cooperation with local government and supporting institutions, it continuously supports the SMEs with verification experiments and networking also after the seminar.

Awards Advisory Committee

This committee gives a direction to IVI so that it can always sustain health as an organization and suit needs of society. The committee provides advices responding to requests from the executive board from an external viewpoint, as well as select members to receive an award set by the committee and give them a prize.

Publicity Committee

This committee works on the development of the policies and concrete plans required for external communication about IVI activities as well as the development of the contents and framework for information sharing with external groups.

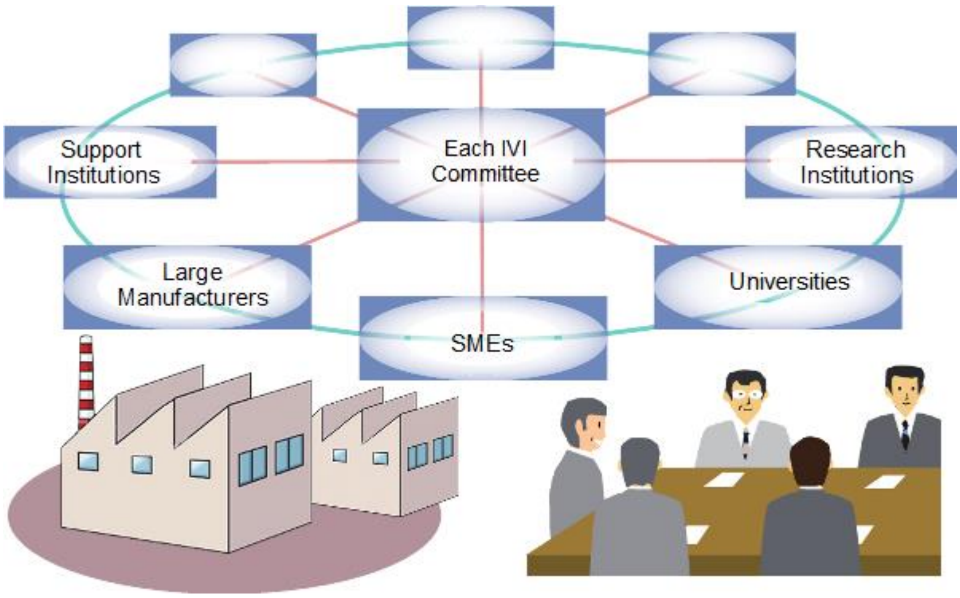
Future Project Committee

IIoT Infrastructure Committee

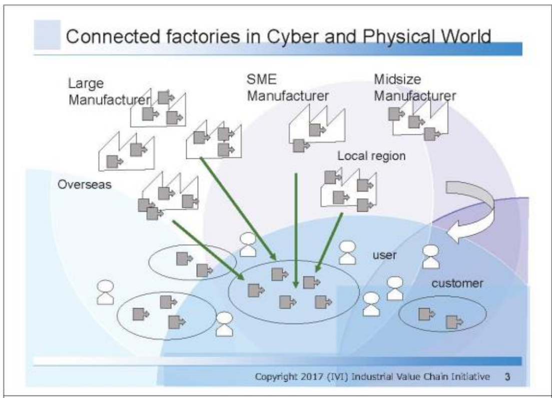
Cross Industries Committee

IP Promotion Committee

Data Sovereignty Committee

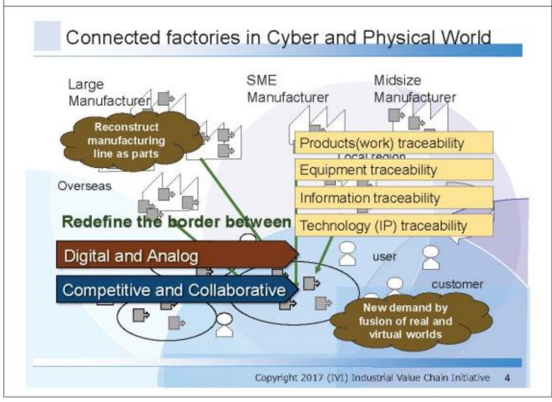


附錄三、研討會簡報



Connected factories in Cyber and Physical World
Large Manufacturer
SME Manufacturer
Midsize Manufacturer
Local region
Overseas
user
customer
Copyright 2017 (IVI) Industrial Value Chain Initiative 3

Industrial Technology Research Institute Mechanical and Mechatronics Systems Research Labs
Challenge of the IVI Platform for Connected Manufacturing Ecosystem
August, 2017
Dr. Prof. Yasuyuki Nishioka,
President, Industrial Value Chain Initiative
IVI Industrial Value Chain Initiative



Connected factories in Cyber and Physical World
Large Manufacturer
SME Manufacturer
Midsize Manufacturer
Reconstruct manufacturing line as parts
Products(work) traceability
Equipment traceability
Information traceability
Technology (IP) traceability
Overseas
Redefine the border between
Digital and Analog
Competitive and Collaborative
user
customer
New demand by fusion of real and virtual worlds
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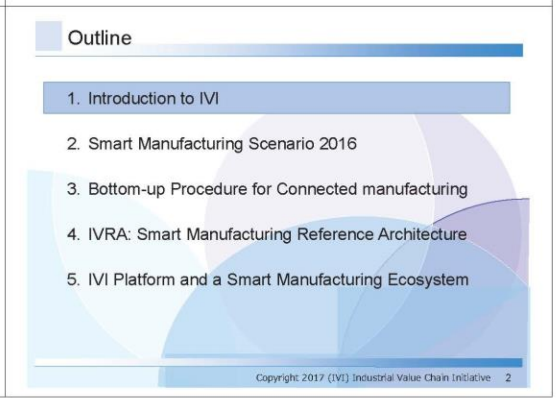

Outline
1. Introduction to IVI
2. Smart Manufacturing Scenario 2016
3. Bottom-up Procedure for Connected manufacturing
4. IVRA: Smart Manufacturing Reference Architecture
5. IVI Platform and a Smart Manufacturing Ecosystem
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215 companies, 520 individuals
SATO
YAZAKI
HONDA
RICOH
Mazak
MITSUBISHI HEAVY INDUSTRIES
MITSUBISHI HITACHI POWER SYSTEMS
Nakamura-Tome Precision Industry
Kojima
FUJITSU
Fuji Electric
IHI
TOSHIBA
OKUMA
MITSUBISHI ELECTRIC
KONICA MINOLTA
mazda
YASKAWA
brother
KOMATSU
SUMITOMO ELECTRIC
BOSCH
TOYOTA
MiSUMi
DAIFUKU
Kawasaki
OMRON
HITACHI
DENSO
YKK
MES
JTEKT
SIEMENS
YOKOGAWA
SONY
NEC
BECKHOFF
Panasonic
NISSAN MOTOR CORPORATION
KOBELCO
Nikon
YAMAHA
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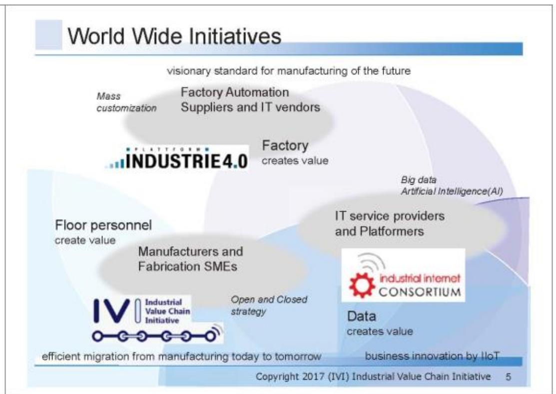

World Wide Initiatives
visionary standard for manufacturing of the future
Mass customization
Factory Automation
Suppliers and IT vendors
INDUSTRIE4.0
Factory
creates value
Big data
Artificial Intelligence(AI)
Floor personnel
create value
IT service providers and Platformers
Manufacturers and Fabrication SMEs
IVI Industrial Value Chain Initiative
Open and Closed strategy
industrial internet CONSORTIUM
Data
creates value
efficient migration from manufacturing today to tomorrow
business innovation by IIoT
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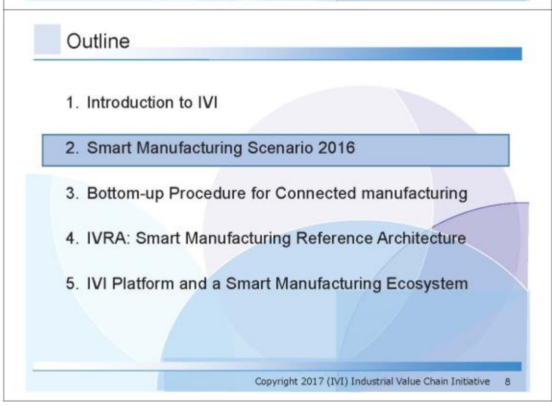

Outline
1. Introduction to IVI
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3. Bottom-up Procedure for Connected manufacturing
4. IVRA: Smart Manufacturing Reference Architecture
5. IVI Platform and a Smart Manufacturing Ecosystem
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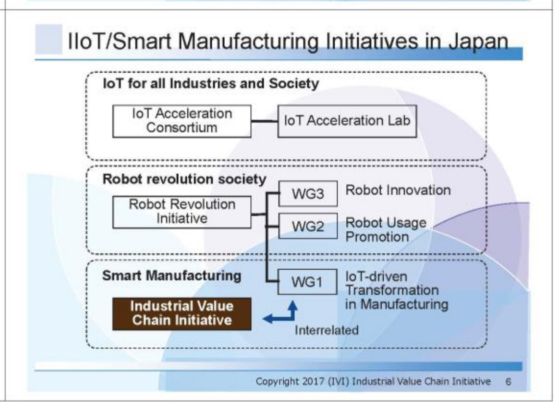

IIoT/Smart Manufacturing Initiatives in Japan
IoT for all Industries and Society
IoT Acceleration Consortium
IoT Acceleration Lab
Robot revolution society
Robot Revolution Initiative
WG3
Robot Innovation
WG2
Robot Usage Promotion
Smart Manufacturing
WG1
IoT-driven Transformation in Manufacturing
Industrial Value Chain Initiative
Interrelated
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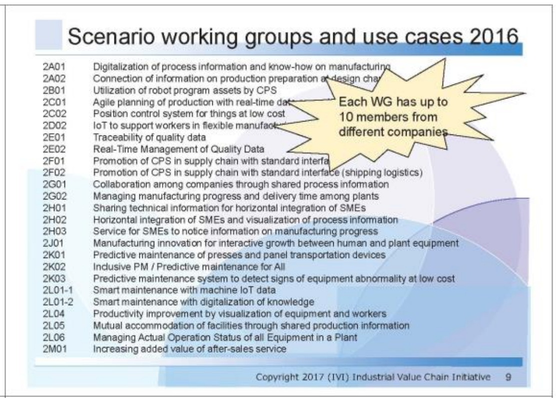
IVI Award 2016
IoT changes SEMs!
Connected SME Project
Copyright 2017 (IVI) Industrial Value Chain Initiative 11


Scenario working groups and use cases 2016
2A01 Digitalization of process information and know-how on manufacturing
2A02 Connection of information on production preparation at design cha
2B01 Utilization of robot program assets by CPS
2C01 Agile planning of production with real-time da
2C02 Position control system for things at low cost
2D02 IoT to support workers in flexible manufac
2E01 Traceability of quality data
2E02 Real-Time Management of Quality Data
2F01 Promotion of CPS in supply chain with standard interfa
2F02 Promotion of CPS in supply chain with standard interface (shipping logistics)
2G01 Collaboration among companies through shared process information
2G02 Managing manufacturing progress and delivery time among plants
2H01 Sharing technical information for horizontal integration of SMEs
2H02 Horizontal integration of SMEs and visualization of process information
2H03 Service for SMEs to notice information on manufacturing progress
2J01 Manufacturing innovation for interactive growth between human and plant equipment
2K01 Predictive maintenance of presses and panel transportation devices
2K02 Inclusive PM / Predictive maintenance for All
2K03 Predictive maintenance system to detect signs of equipment abnormality at low cost
2L01-1 Smart maintenance with machine IoT data
2L01-2 Smart maintenance with digitalization of knowledge
2L04 Productivity improvement by visualization of equipment and workers
2L05 Mutual accommodation of facilities through shared production information
2L06 Managing Actual Operation Status of all Equipment in a Plant
2M01 Increasing added value of after-sales service
Each WG has up to 10 members from different companies
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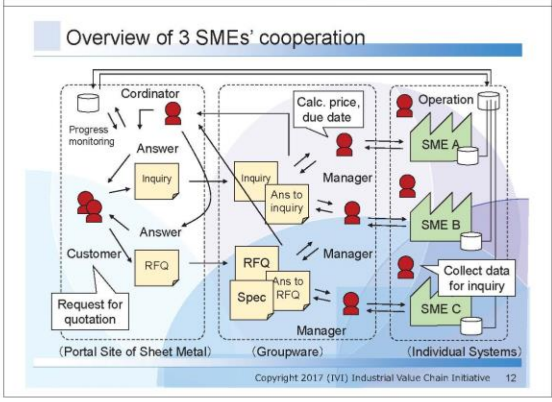
Overview of 3 SMEs' cooperation
Cordinator
Progress monitoring
Answer
Inquiry
Answer
Customer
RFQ
Request for quotation
Calc. price, due date
Inquiry
Ans to inquiry
Manager
RFQ
Ans to RFQ
Spec
Manager
Manager
Operation
SME A
SME B
SME C
Collect data for inquiry
(Portal Site of Sheet Metal)
(Groupware)
(Individual Systems)
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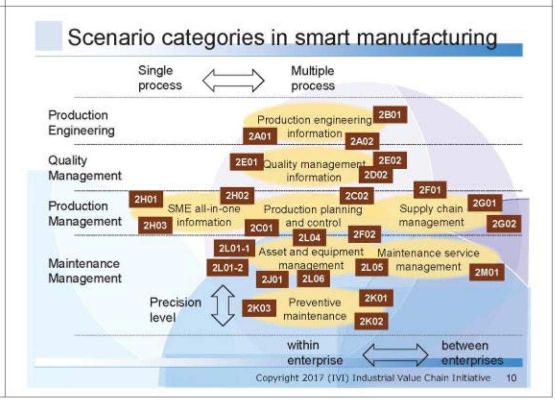
Scenario categories in smart manufacturing
Single process
Multiple process
Production Engineering
Quality Management
Production Management
Maintenance Management
Production engineering information
2B01
2A01
2A02
2E01
Quality management information
2E02
2D02
2H01
2H02
SME all-in-one information
2H03
2C02
Production planning and control
2C01
2L04
2F02
2F01
Supply chain management
2G01
2G02
2L01-1
Asset and equipment management
2L01-2
2J01
2L06
2L05
Maintenance service management
2M01
Precision level
2K03
Preventive maintenance
2K01
2K02
within enterprise
between enterprises
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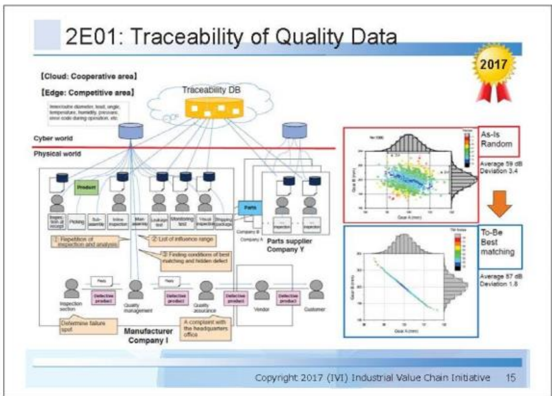
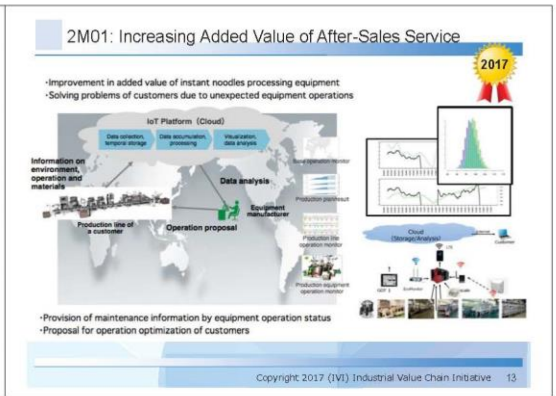

2E01: Traceability of Quality Data
2017
[Cloud: Cooperative area]
[Edge: Competitive area]
Traceability DB
Cyber world
Physical world
Parts supplier Company Y
Manufacturer Company I
As-Is Random
To-Be Best matching
Copyright 2017 (IVI) Industrial Value Chain Initiative 15


2M01: Increasing Added Value of After-Sales Service
2017
・Improvement in added value of instant noodles processing equipment
・Solving problems of customers due to unexpected equipment operations
IoT Platform (Cloud)
Data analysis
Operation proposal
・Provision of maintenance information by equipment operation status
・Proposal for operation optimization of customers
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2K02: Inclusive Predictive Maintenance
2017
Welding is one of many processes we verified
Current issues
• Weld testing:
Now: Destructive sampling
Want: Non-destructive testing on all pieces
• Welding torch replacement:
Now: Replace torch after a number of pieces
Want: Reduce frequency by predicting its lifetime
Goal
• Determine good or bad on a real-time basis
• Improve lifetime
Welding of a fluid control valve
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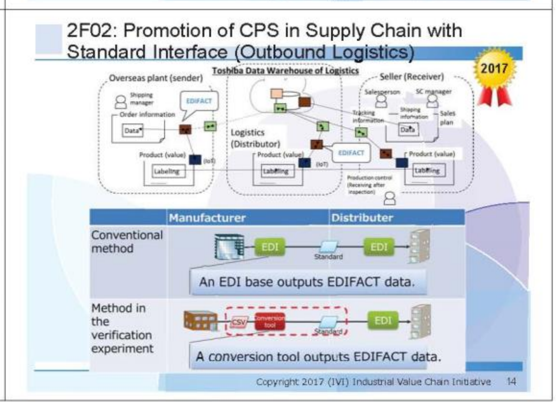
2F02: Promotion of CPS in Supply Chain with Standard Interface (Outbound Logistics)
2017
Toshiba Data Warehouse of Logistics
Overseas plant (sender)
Seller (Receiver)
Logistics (Distributor)
Manufacturer
Distributer
Conventional method
EDI
Standard
An EDI base outputs EDIFACT data.
Method in the verification experiment
A conversion tool outputs EDIFACT data.
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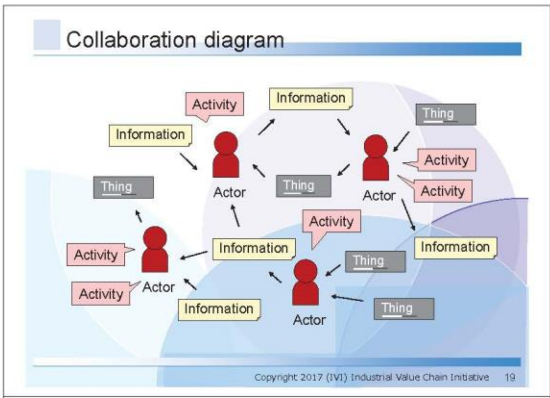
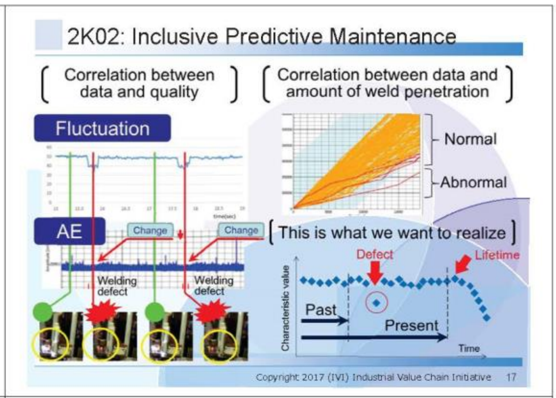
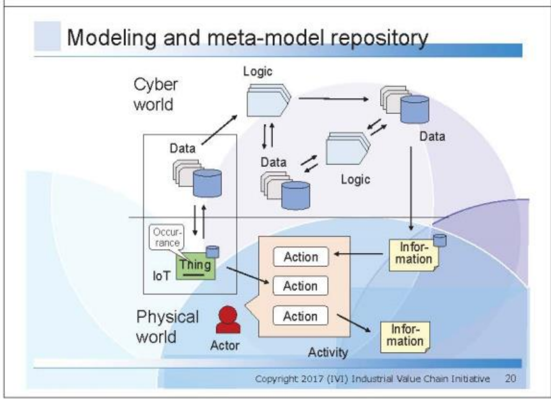
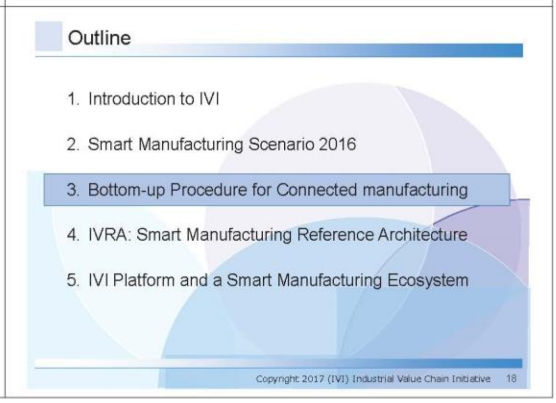

Collaboration diagram
Activity
Information
Thing
Information
Actor
Thing
Actor
Activity
Activity
Thing
Activity
Information
Information
Activity
Thing
Activity
Actor
Information
Actor
Thing
Copyright 2017 (IVI) Industrial Value Chain Initiative 19


2K02: Inclusive Predictive Maintenance
Correlation between data and quality
Correlation between data and amount of weld penetration
Fluctuation
Normal
Abnormal
AE
Change
Change
This is what we want to realize
Welding defect
Welding defect
Defect
Lifetime
Characteristic value
Past
Present
Time
Copyright 2017 (IVI) Industrial Value Chain Initiative 17


Modeling and meta-model repository
Cyber world
Logic
Data
Data
Data
Logic
Occur-rance
Thing
IoT
Action
Action
Action
Infor-mation
Infor-mation
Physical world
Actor
Activity
Copyright 2017 (IVI) Industrial Value Chain Initiative 20


Outline
1. Introduction to IVI
2. Smart Manufacturing Scenario 2016
3. Bottom-up Procedure for Connected manufacturing
4. IVRA: Smart Manufacturing Reference Architecture
5. IVI Platform and a Smart Manufacturing Ecosystem
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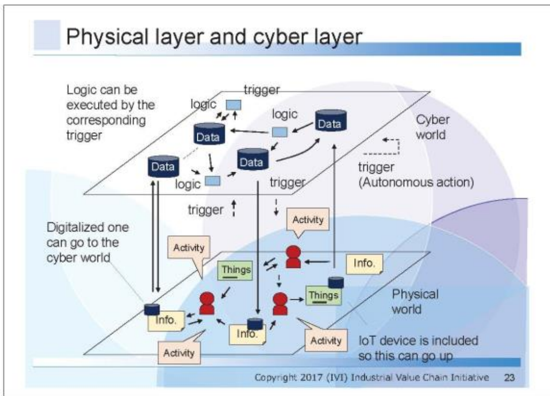
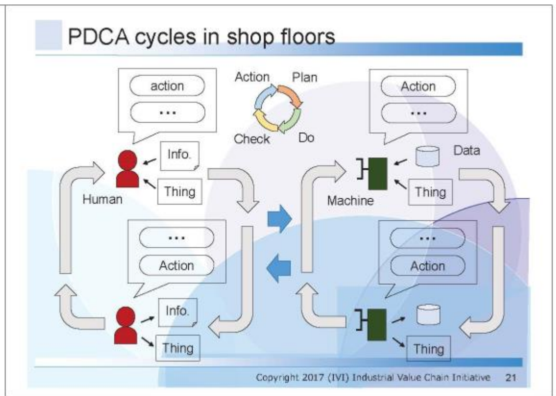
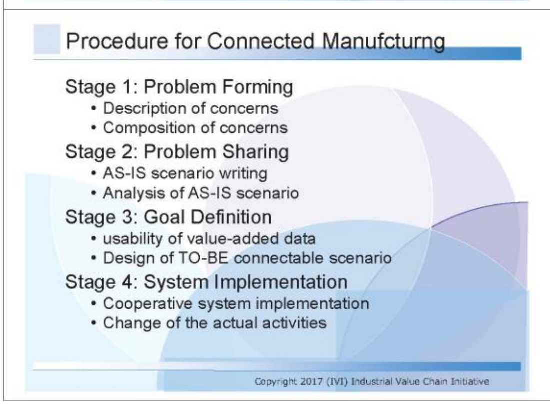

Physical layer and cyber layer
Logic can be executed by the corresponding trigger
trigger
logic
logic
Data
Data
Data
Data
Cyber world
logic
trigger
trigger (Autonomous action)
trigger
Digitalized one can go to the cyber world
Activity
Activity
Things
Info.
Things
Physical world
Info.
Info.
Activity
Activity
IoT device is included so this can go up
Copyright 2017 (IVI) Industrial Value Chain Initiative 23


PDCA cycles in shop floors
action
…
Action
Plan
Check
Do
Action
…
Data
Info.
Thing
Human
Machine
Thing
…
Action
…
Action
Info.
Thing
Thing
Copyright 2017 (IVI) Industrial Value Chain Initiative 21


Procedure for Connected Manufcturng
Stage 1: Problem Forming
• Description of concerns
• Composition of concerns
Stage 2: Problem Sharing
• AS-IS scenario writing
• Analysis of AS-IS scenario
Stage 3: Goal Definition
• usability of value-added data
• Design of TO-BE connectable scenario
Stage 4: System Implementation
• Cooperative system implementation
• Change of the actual activities
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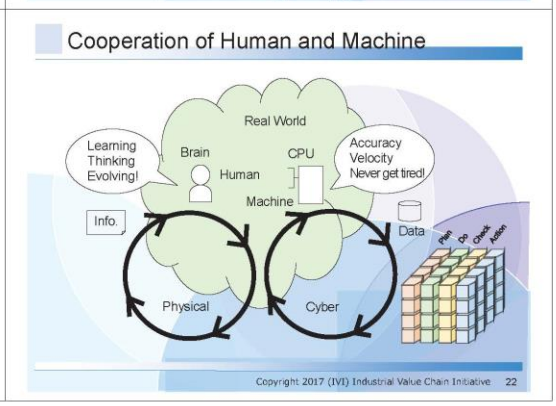
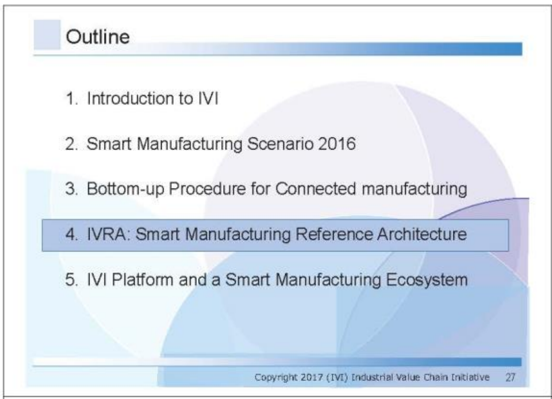

Cooperation of Human and Machine
Real World
Learning Thinking Evolving!
Brain
CPU
Accuracy Velocity Never get tired!
Human
Machine
Info.
Data
Plan
Do
Check
Action
Physical
Cyber
Copyright 2017 (IVI) Industrial Value Chain Initiative 22


Outline
1. Introduction to IVI
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5. IVI Platform and a Smart Manufacturing Ecosystem
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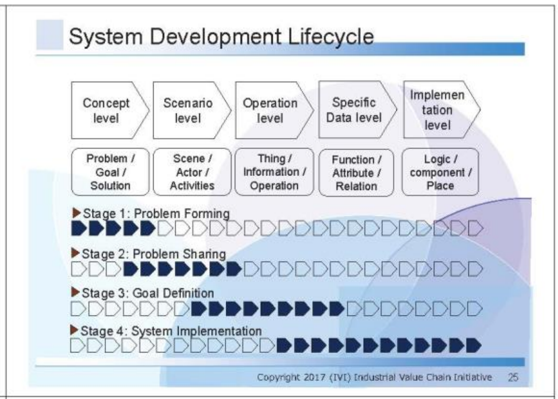
System Development Lifecycle
Concept level
Scenario level
Operation level
Specific Data level
Implementation level
Problem / Goal / Solution
Scene / Actor / Activities
Thing / Information / Operation
Function / Attribute / Relation
Logic / component / Place
Stage 1: Problem Forming
Stage 2: Problem Sharing
Stage 3: Goal Definition
Stage 4: System Implementation
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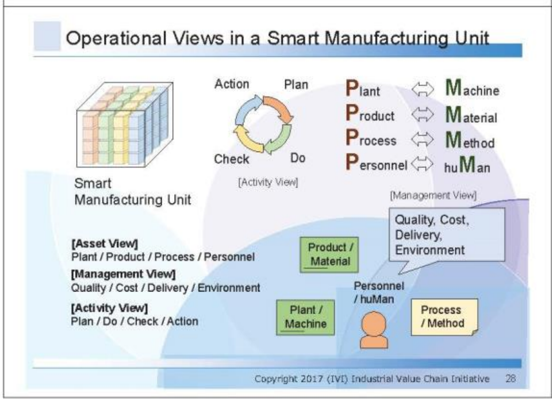
Operational Views in a Smart Manufacturing Unit
Action
Plan
Check
Do
[Activity View]
Smart Manufacturing Unit
Plant ⇔ Machine
Product ⇔ Material
Process ⇔ Method
Personnel ⇔ huMan
[Management View]
Quality, Cost, Delivery, Environment
[Asset View]
Plant / Product / Process / Personnel
[Management View]
Quality / Cost / Delivery / Environment
[Activity View]
Plan / Do / Check / Action
Product / Material
Personnel / huMan
Plant / Machine
Process / Method
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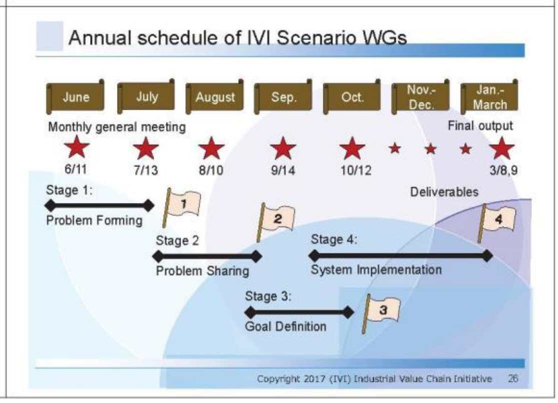
Annual schedule of IVI Scenario WGs
June
July
August
Sep.
Oct.
Nov.-Dec.
Jan.-March
Monthly general meeting
Final output
6/11
7/13
8/10
9/14
10/12
3/8,9
Stage 1:
Problem Forming
Deliverables
1
2
4
Stage 2
Problem Sharing
Stage 4:
System Implementation
Stage 3:
Goal Definition
3
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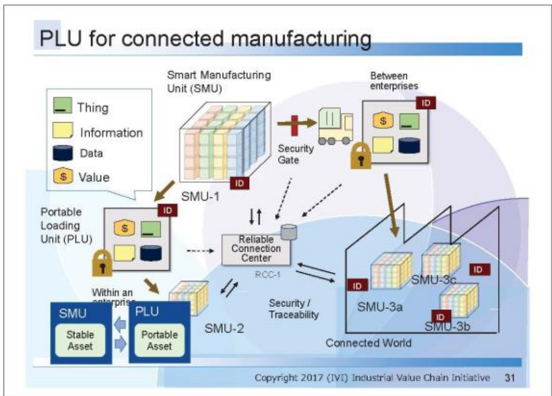
PLU for connected manufacturing
Smart Manufacturing Unit (SMU)
Between enterprises
Thing
Information
Data
Value
Security Gate
SMU-1
Portable Loading Unit (PLU)
Reliable Connection Center
RCC-1
Within an enterprise
SMU
Stable Asset
PLU
Portable Asset
SMU-2
Security / Traceability
SMU-3a
SMU-3c
SMU-3b
Connected World
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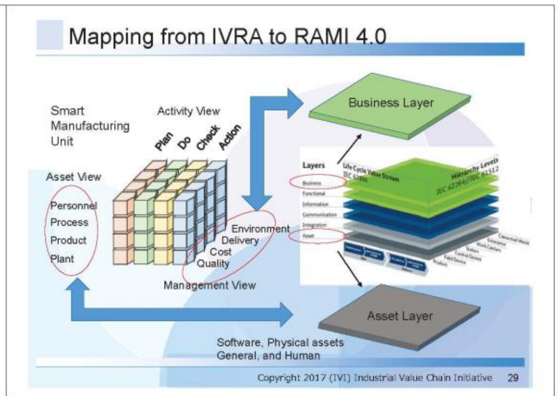
Mapping from IVRA to RAMI 4.0
Smart Manufacturing Unit
Activity View
Plan
Do
Check
Action
Asset View
Personnel
Process
Product
Plant
Environment
Delivery
Cost
Quality
Management View
Business Layer
Asset Layer
Software, Physical assets
General, and Human
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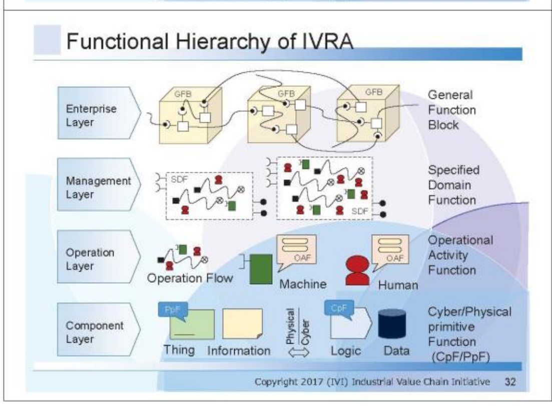
Functional Hierarchy of IVRA
Enterprise Layer
GFB
General Function Block
Management Layer
SDF
Specified Domain Function
Operation Layer
Operation Flow
OAF
Machine
Human
Operational Activity Function
Component Layer
PpF
CpF
Thing
Information
Physical
Cyber
Logic
Data
Cyber/Physical primitive Function (CpF/PpF)
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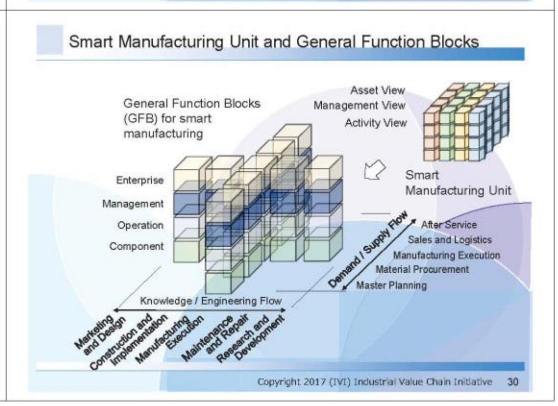
Smart Manufacturing Unit and General Function Blocks
General Function Blocks (GFB) for smart manufacturing
Asset View
Management View
Activity View
Smart Manufacturing Unit
Enterprise
Management
Operation
Component
After Service
Sales and Logistics
Manufacturing Execution
Material Procurement
Master Planning
Demand / Supply Flow
Knowledge / Engineering Flow
Marketing and Design
Construction and Implementation
Manufacturing Execution
Maintenance and Repair
Research and Development
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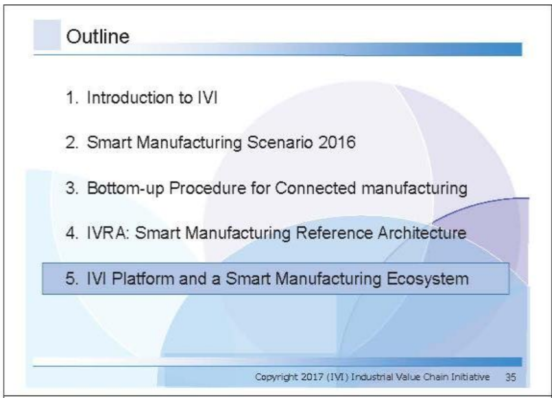
Outline
1. Introduction to IVI
2. Smart Manufacturing Scenario 2016
3. Bottom-up Procedure for Connected manufacturing
4. IVRA: Smart Manufacturing Reference Architecture
5. IVI Platform and a Smart Manufacturing Ecosystem
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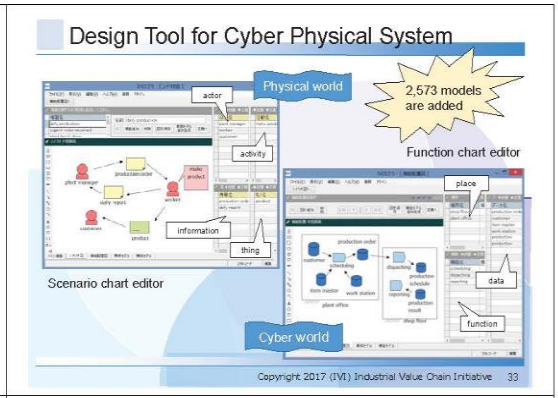
Design Tool for Cyber Physical System
Physical world
2,573 models are added
actor
activity
information
thing
Function chart editor
place
data
function
Scenario chart editor
Cyber world
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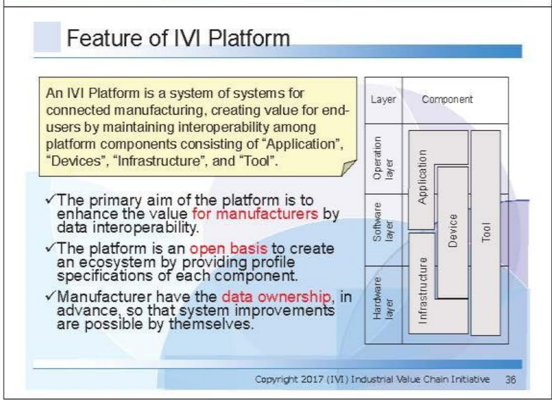
Feature of IVI Platform
An IVI Platform is a system of systems for connected manufacturing, creating value for end-users by maintaining interoperability among platform components consisting of "Application", "Devices", "Infrastructure", and "Tool".
✓The primary aim of the platform is to enhance the value for manufacturers by data interoperability.
✓The platform is an open basis to create an ecosystem by providing profile specifications of each component.
✓Manufacturer have the data ownership, in advance, so that system improvements are possible by themselves.
Layer
Component
Operation layer
Software layer
Hardware layer
Application
Device
Infrastructure
Tool
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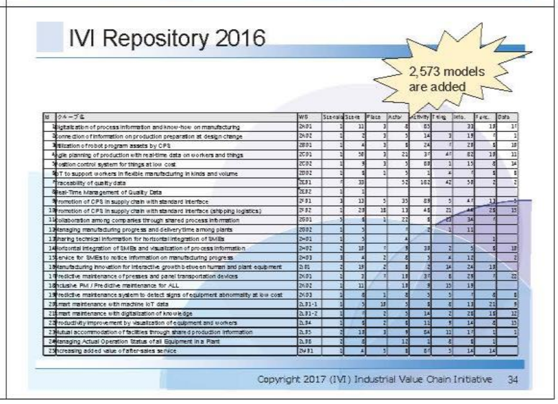
IVI Repository 2016
2,573 models are added
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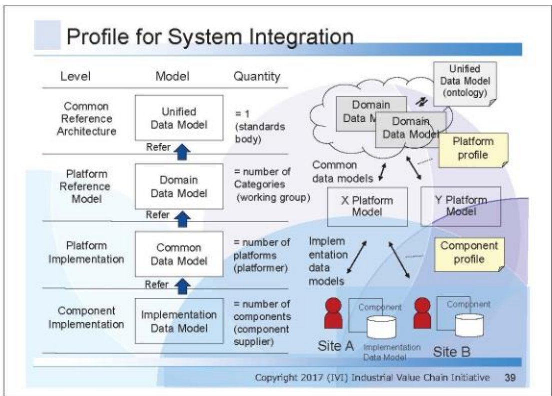
Profile for System Integration
Level
Model
Quantity
Common Reference Architecture
Unified Data Model
= 1 (standards body)
Refer
Platform Reference Model
Domain Data Model
= number of Categories (working group)
Refer
Platform Implementation
Common Data Model
= number of platforms (platformer)
Refer
Component Implementation
Implementation Data Model
= number of components (component supplier)
Unified Data Model (ontology)
Domain Data Model
Domain Data Model
Platform profile
Common data models
X Platform Model
Y Platform Model
Implementation data models
Component profile
Component
Component
Site A
Implementation Data Model
Site B
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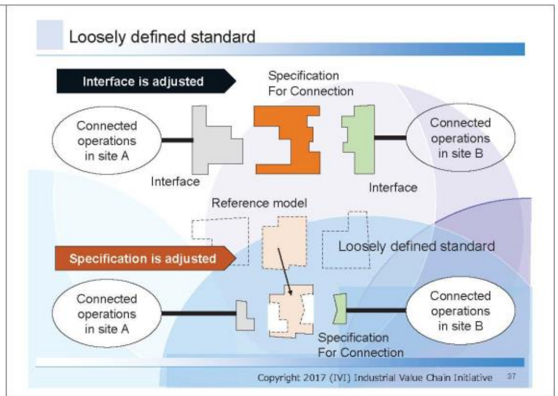
Loosely defined standard
Interface is adjusted
Specification For Connection
Connected operations in site A
Connected operations in site B
Interface
Interface
Reference model
Specification is adjusted
Loosely defined standard
Connected operations in site A
Connected operations in site B
Specification For Connection
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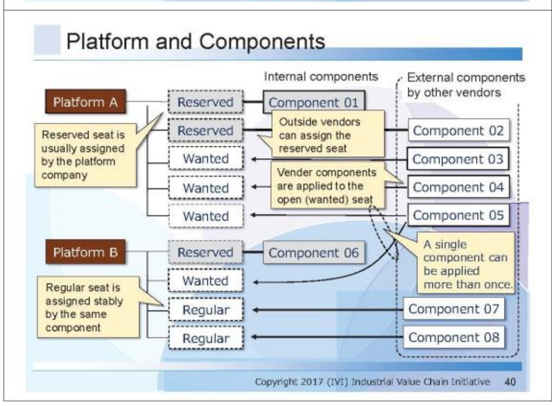
Platform and Components
Internal components
External components by other vendors
Platform A
Reserved
Component 01
Reserved
Outside vendors can assign the reserved seat
Component 02
Wanted
Component 03
Wanted
Vender components are applied to the open (wanted) seat
Component 04
Wanted
Component 05
Reserved seat is usually assigned by the platform company
Platform B
Reserved
Component 06
A single component can be applied more than once.
Wanted
Regular seat is assigned stably by the same component
Regular
Component 07
Regular
Component 08
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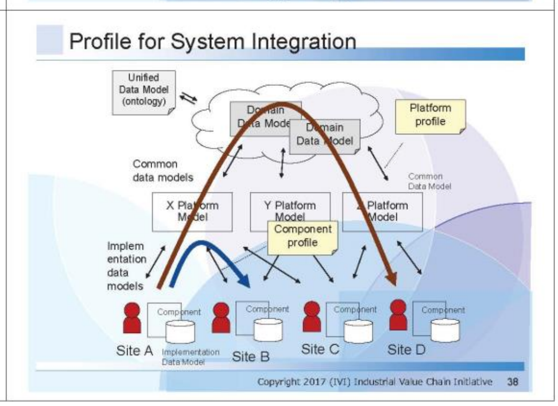
Profile for System Integration
Unified Data Model (ontology)
Domain Data Model
Domain Data Model
Platform profile
Common data models
Common Data Model
X Platform Model
Y Platform Model
Z Platform Model
Component profile
Implementation data models
Component
Component
Component
Component
Site A
Implementation Data Model
Site B
Site C
Site D
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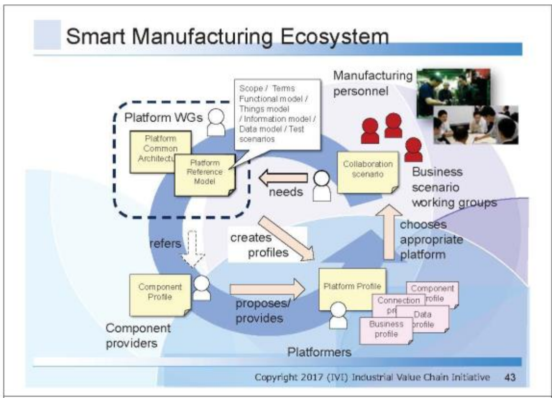
Smart Manufacturing Ecosystem
Manufacturing personnel
Platform WGs
Scope / Terms
Functional model / Things model / Information model / Data model / Test scenarios
Platform Common Architecture
Platform Reference Model
needs
Collaboration scenario
Business scenario working groups
refers
creates profiles
chooses appropriate platform
Component Profile
proposes/ provides
Platform Profile
Component Profile
Connection profile
Data profile
Business profile
Component providers
Platformers
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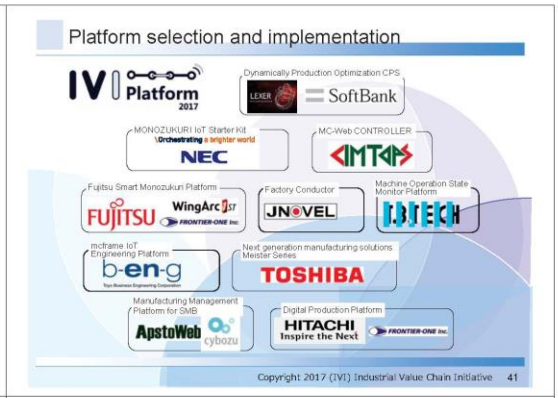
Platform selection and implementation
IVI Platform 2017
Dynamically Production Optimization CPS
LEXER
SoftBank
MONOZUKURI IoT Starter Kit
NEC
MC-Web CONTROLLER
Fujitsu Smart Monozukuri Platform
FUJITSU
WingArc 1st
FRONTIER-ONE Inc.
Factory Conductor
JNOVEL
Machine Operation State Monitor Platform
mcframe IoT Engineering Platform
b-en-g
Next generation manufacturing solutions Meister Series
TOSHIBA
Manufacturing Management Platform for SMB
AptoWeb
cybozu
Digital Production Platform
HITACHI Inspire the Next
FRONTIER-ONE Inc.
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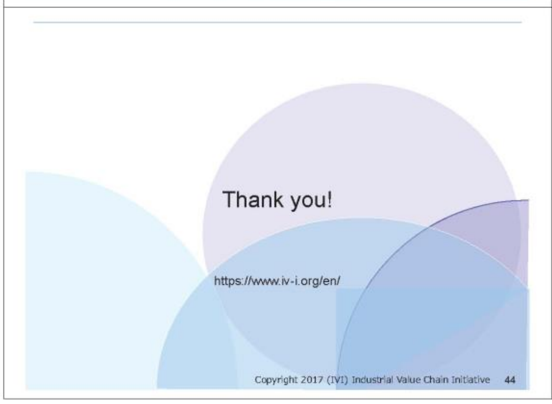
Thank you!
https://www.iv-i.org/en/
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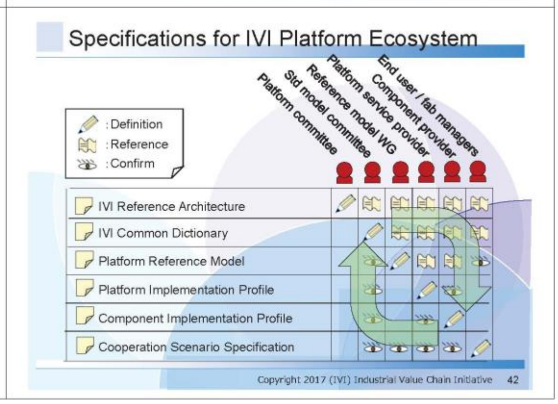
Specifications for IVI Platform Ecosystem
: Definition
: Reference
: Confirm
Platform committee
Std model committee
Reference model WG
Platform service provider
Component provider
End user / fab managers
IVI Reference Architecture
IVI Common Dictionary
Platform Reference Model
Platform Implementation Profile
Component Implementation Profile
Cooperation Scenario Specification
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