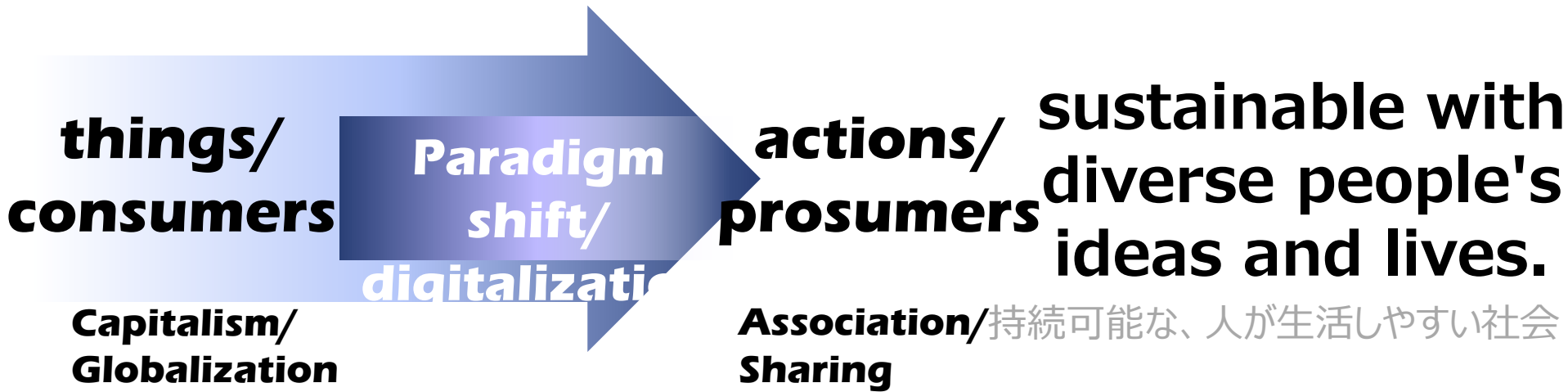# Manufacturing Business Revolution through IoT
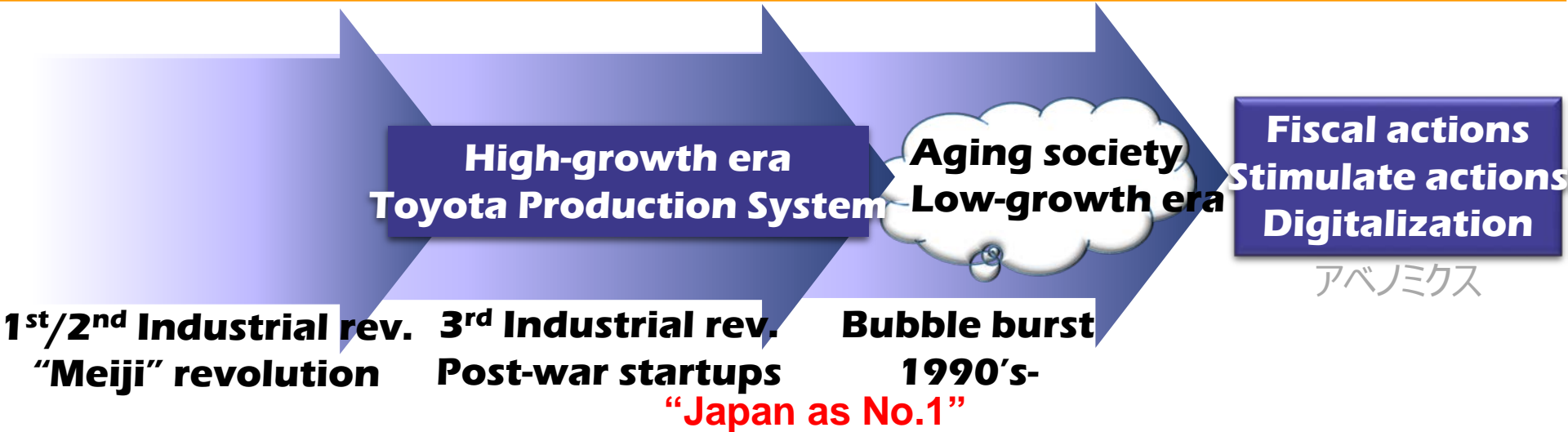
2016-11-24
Robot Revolution Initiative
Secretary General
Tomoaki Kubo

The Society with digitalization should be

things/ consumers → **Paradigm shift/ digitalization** → **actions/ prosumers** **sustainable with diverse people's ideas and lives.**

Capitalism/ Globalization

Association/ Sharing 持続可能な、人が生活しやすい社会

Industries background in Japan

**High-growth era
Toyota Production System**

**Aging society
Low-growth era**

**Fiscal actions
Stimulate actions
Digitalization**

アベノミクス

**1st/2nd Industrial rev.
"Meiji" revolution**

**3rd Industrial rev.
Post-war startups**

**Bubble burst
1990's-**

"Japan as No.1"

Establishment of Robot Revolution Initiative (RRI)

May, 2014   Prime minister Abe stated that "Japan will make a new industry revolution by robot" at the OECD council at ministerial level.

Sep, 2014   Established "the robot revolution realization council" in the Office of the Prime Minister

Jan, 2014   Published "the robot new strategy" (Japan economic revival headquarters), stated establishment of RRI.

May, 2015   RRI Organizational Meeting with 226 members (associations, companies, individuals), 440 members currently(8,Oct.,2016)

The office of prime minister : http://www.kantei.go.jp/jp/97_abe/actions/201505/15robot.html

RRI Working Groups

RRI

WG1 : Manufacturing Business Revolution through IoT

Manufacturing Business Reformation by IoT, M2M, BigData, etc.

WG2 : Promotion of Robot Utilization in Society

Designing organization or mechanisms of; Matching of user and provider, Local supporting organization, Education, Regulatory reformation, Sharing of best practices

WG3 : Robot Innovation

Technology Development, Rule Preparation, International robot competition.

- Manufacturing business from micro to macro
  - each manufacturing process
  - a set of manufacturing line
  - factories
  - whole lifecycle of a product
    (plan, design, manufacture, deliver, setup, operation, maintenance)
  - whole supply chain
  - new eco-system

- Work with government and research institutes
- Work on major problems

  - Standardization

  - Security

  - SME support

  - Human resource development

  - Regulatory reform

- Work internationally
- Think from macro to detail

RRI-WG1 functions

Robot Revolution Initiative

WG1: Manufacturing Business Revolution through IoT

Steering Committee | Advisory Board

Theme-driven Working Groups — Challenges
- •Visualization
- •IoT for Food Industry, etc

Domain-based Working Groups — Planning
- •Machining Process, etc

Action Groups (AG) — Execution
- •International Standardization
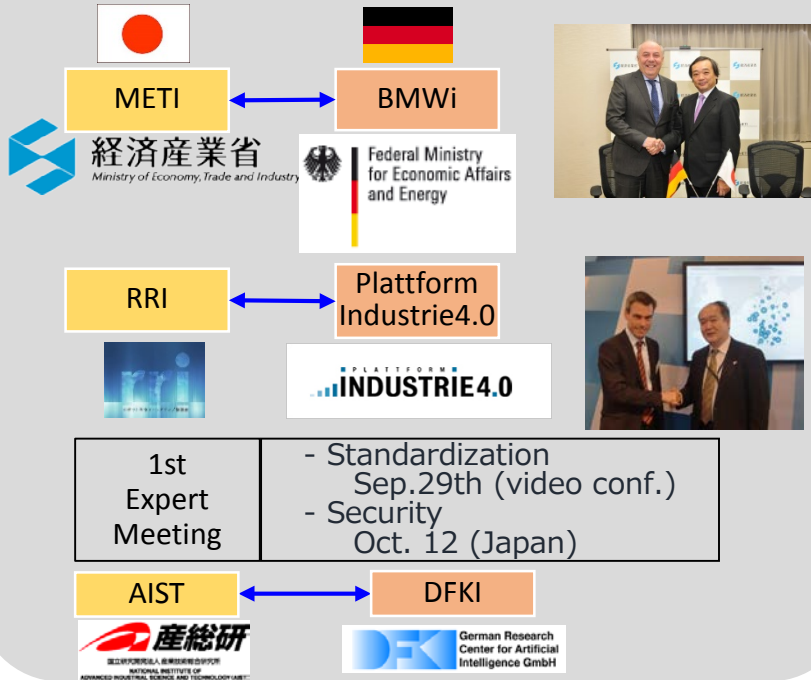- •SME Support
- •Use Case Generation & Utilization, etc

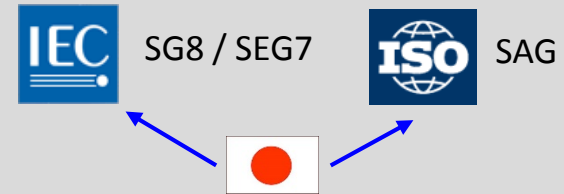SME: Small and Medium Enterprise

8

Major Frameworks of Japan's Intern'l Contribution

Collaboration with Germany

Joint Statement of cooperation

METI ↔ BMWi

RRI ↔ Plattform Industrie4.0

1st Expert Meeting	- Standardization Sep.29th (video conf.) - Security Oct. 12 (Japan)

AIST ↔ DFKI

Collaboration with the U.S.

MOU of cooperation

IoT Acceleration Consortium → Industrial Internet Consortium

IoT Acceleration Consortium → OpenFog Consortium

International Standardization

Participating **"Smart Manufacturing"**

IEC — SG8 / SEG7   ISO — SAG

International Forums

RRI international Forum

#1 Feb. 2nd, '16
#2 Oct. 19th, '16

Exhibitions

HANNOVER MESSE

German/Japanese Economic Forum

CeBIT — 2017 Partner Country
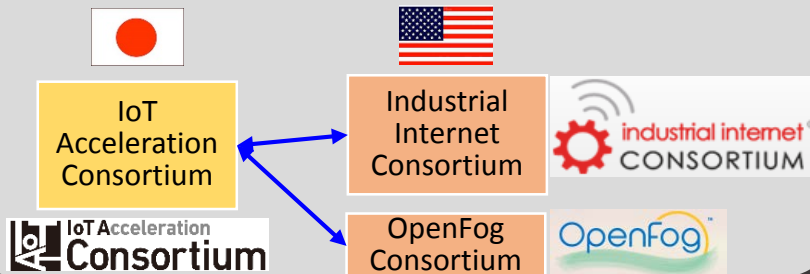
Japan-Germany IoT / Industrie 4.0 cooperation

"The two leaders welcomed the announcement last week of a joint statement by Japan's METI and Germany's BMWi on IoT and Industrie 4.0. The two leaders aim to realize the forth industrial revolution through close cooperation between Japan and Germany"

PM Abe & Chancellor Merkel

Prime Minister ABE, JAPAN-GERMAN Summit, May 4th 2016

> ## G-G joint statement   April , 2016

- METI and BMWi hold **DG-level meeting on IoT/Industrie 4.0 annually**
- Promote Cooperation on:
  - Industrial Cyber Security
  - International Standardization
  - Regulatory Reform
  - Support for SMEs
  - Human Resource Develop
  - R & D
- Invite private organizations interested in IoT/Industrie 4.0

RRI-Plattform I4.0 cooperation agreement

with Mr. Banthien, Secretary General of Plattform Industrie 4.0, 28th Apr.2016

Cooperation Fields
(Listed in the joint statement by the government ministries)

Industrial Cyber Security
International Standardization
International Regulatory Reform
Facilitation for small and medium sized enterprises (SME)
Human Resource Development
Research and Development (R&D)
Others

Mutually participate in working groups, workshops,or common activities of each party.

Joint Statement
Plattform Industrie 4.0 of the Federal Republic of Germany and the Robot Revolution Initiative of Japan agree on cooperation regarding Internet of Things / Industrie 4.0

Thursday 28 April 2016

Digitization and the linking of production processes along the entire global value chain via the Internet of Things (IoT/Industrie 4.0 hold great potential to revolutionize manufacturing. The Plattform Industrie 4.0 of the Federal Republic of Germany (PFI4.0) and the Robot Revolution Initiative of Japan (RRI) recognize that cooperation in this area will increase the competitiveness of the industrial sectors of both countries.

In the field of Internet of Things / Industrie 4.0 the parties intend to create synergy by exchanging information on efforts concerning common challenges and support and promote cooperation among companies and research institutes of both countries.

The parties will cooperate in the fields listed in the joint statement by the government ministries:
- Industrial Cyber Security
- International Standardization
- International Regulatory Reform
- Facilitation for small and medium sized enterprises (SME)
- Human Resource Development
- Research and Development (R&D)
- Others

To promote productive cooperation in the fields above, the parties intend to set up an action plan. And specifically, the parties intend to

(1) establish and maintain a communication channel as appropriate for each topic;

(2) meet annually, alternating between Japan and Germany, possibly in conjunction with meetings between the governments of both countries, in order to exchange information, present results of the cooperation and discuss;

(3) mutually participate in working groups, workshops, or common activities of each party, in line with the respective access regulations.

The cooperation of Plattform Industrie 4.0 and the Robot Revolution Initiative will be active under the conditions given by the joint statement on cooperation between the government ministries regarding Internet of Things / Industrie 4.0.

For more information on the Plattform Industrie 4.0, please contact Henning Banthien, Plattform Industrie 4.0 Secretary General (h.banthien@plattform-i40.de).

For more information on RRI, please contact Tomoaki Kubo, RRI Secretariat Secretary General (tomoaki.kubo@jmfrri.gr.jp).

Japan major initiatives for Smart Mfg.

METI
Ministry of Economy, Trade and Industry

Robot Revolution Initiative

AIST

WG1: Manufacturing business revolution through IoT

SmM Reference-model Standardization Project

Top-down Approach: Future vision

Technology Investigation

Interrelated

Industrial Value Chain Initiative

Connected ! Manufacturing

Civilian organizations

Bottom-up Approach: Practical use cases

AIST: National Institute of Advanced Industrial Science and Technology

Mfg. Business Revolution through IoT

- **WG1: Started on 15th, July**

- **147 members**

  Manufacturing business companies(Electric, Electronics, Machinery, Automobile, etc.), IT technology companies, Trading, Insurance, Academia, Industry associations, etc.), including German, French, United States' et. al companies.

- **Co-chair**   Mr. Masayuki Yamamoto, Mitsubishi Electric Corp.

  Mr. Yuichi Hamamura, Hitachi, Ltd.

Started with information sharing, and
- Published the **interim report** on challenges
- Started **small group workings** on detailed topics

Roadmap (Objectives & Scope)

<< Objectives >>

- **To reflect the use-case findings to the international standards;**

    - **Avoiding overwhelmed by de-fact standards of global PFers**

    - **Enacting "Kaizen" (bottom-up process improvement) in them**

    - **Enhancing them to be usable in Process Automation industry**

- **To discuss the way to be flexible real global enterprises with IIoT;**

    - **Not only for SMEs**

    - **Meta-level reviewing (Capability Maturity) might be a key**

<< Scope >>

- **Contributions to build international standards for IIoT**

- **Explorations to paradigm-shift with Start-ups and SMEs**

- **Classifications of use cases for better understanding**

Theme-driven Working Groups (SWG)

Industrial machinery remote maintenance

IoT for food manufacturing industry

System integrator training

Finding Japan's way

Standardization of FA system

Sub WG on IoT in food manufacturing industry

- Low product price, low equipment cost
- Apparatus industry
  (Primary processing such as flour milling,
    mass production as secondary processing)
- Seasonality in raw materials procurement
- Low storage stability of materials
- High level of safety is required

- Increase process repeatability by digitizing the worker's skill
- Create new connection between maker and market by IoT
- Cause-analysis and prevention of process abnormality
- Productivity improvement
- Optimization of logistics and ordering using weather and event info.

- Shortage of robot system or IT system integrators

- Lack of standard process for introducing robot
  or IT system

- Multi work layers with different feature

  - FA devices, - Inter device communication,
  - Data acquisition, - IT/FA collaboration,
  - Smart factory

- Lack of total system integrator

In introducing IoT, current strength of companies should be considered

- Get common understanding of the strength and weakness of Japanese manufacturing companies

- Build a analysis frame work for companies to plan IoT utilizing strategy by considering their strength and weakness

- Build a decision frame of competition / cooperation to make the best use of strength through case studies

Sub WG on IT-FA System Integration by digital collaboration

- Grab status of manufacturing floor by real-time

- Transfer market demand to manufacturing floor

- Information system robust to reconfiguration of manufacturing equipment

- Optimal allocation of data processing (cloud, edge)

- System construction technology that enables collaboration of manufacturing floor and information system

  (modeling of manufacturing floor from view point of information system)

IoT for industrial machinery

- The strength of the Japanese manufacturers lies in its site improvement capability, KAIZEN, accomplishing partial optimization of productivity. Moreover, by realizing Cyber-physical smart factory, the Japanese manufacturers aim at entire optimization.

- Provide the interfaces to be standardized for distribution of data by modeling the data flow on the improvement cycle, to fully utilize the strength of production engineering in Japan.

Smart factory conceptual diagram

(Production management)

(Production engineering)

(D)

ERP
MES
SCADA HMI

(B) Production management data

Information processing (Including intelligent judgement)
- Machining efficiency improvement
- Preventive maintenance

Production engineering data

(C)

[Conventional technique] In the conventional service, a part of the information that indicates the operating state is directly integrated into the production management data from the machine tool.

Machine tool
Machine tool

NC | PLC | Sensor
Machine tool (production system) (A)

-Realization of Cyber-physical KAIZEN
(On-Site Improvement Activities)
-Providing an emergent infrastructure that takes advantage of the strength of the Japanese industry

Interface to be standardized

<Interfaces among (A), (C), and (D)>
Machine tool state signals
(initial, machining preparation, machining, alarm, communication disconnection,)
Machine tool machining state
(machining program, machining mode, start of machining, and stop)
Machine tool motion state (position, speed, acceleration,)
Spindle/feed motor state of machine tool
(position, speed, acceleration, torque, temperature, etc.)
Machine tool alarm state (alarm type and related information)
Machine tool mechanical state
(operation management and volume of states required for predictive maintenance)
Information from sensors
<Interfaces between (D) and (B)>
Operating status of machining cell
(initial, machining preparation, machining, alarm, communication disconnection)
Machine operation state of machining cell
(machining part type, machining quantity, machining time, stop period, etc.)
Machine power consumption of machining cell
Machine alarm state of machining cell and its assumed cause
Machine warning state of machining cell and
predictive maintenance target parts
Information relating to the quality of machining cell parts
(accuracy, surface quality, etc.)

The agreement at the 1st expert meeting on standardization under Germany-Japan cooperation on 29 Sep., 2016

- **Scope**
  a. Respect to the scope of;
     ・IEC-SG8 Industry4.0-Smart Manufacturing (SG8)
     ・ISO-SAG Industry4.0-Smart Manufacturing (SAG)

- **Key Topics**

  a. Respect to the recommendations of SG8 and SAG

- **Proposed Approach**

  a. Align with post activities of SG8 and SAG (IEC-SEG7, ISO-CC)

  b. Discussions and analysis of topics of IEC-SEG7 and ISO-CC
     in advance

- Action Plan

  a. Agree Objectives, Scope, Key Topics, and Proposed Approach

  b. Start discussion of individual Key Topics one by one

Small and Med. Enterprise Support AG

Medium-sized company and SME support

・ **Exchange the SME delegations between DE-JP early next year**

相互訪問

<Japan's Progress>

・**Set up 5 smart-manufacturing support teams (at Yamagata, Saitama, Kita-kyusyu, Osaka, Gifu)**

スマートものづくり応援隊

・**Collect smart-manufacturing tools for SMEs (low cost, easy to use)**

スマートものづくり応援ツール

https://www.jmfrri.gr.jp/info/314/ (in Japanese only)

Use Case Generation & Utilization AG

- "Use Case Online Map"   "IoTユースケースマップ"
  - ・Promote business cooperation
  - ・Share best practices
  - ・Visualize achievements

- β version is released at CEATEC
  about 30 cases → about 150 cases at CeBIT in March

⇒ＵＲＬ : http://usecase.jmfrri.jp/#/en

- Use case online map

- IoT tools for SME

Overview of the map

http://usecase.jmfrri.jp/#/en

Detail view of the map

Use case types (by approaches)
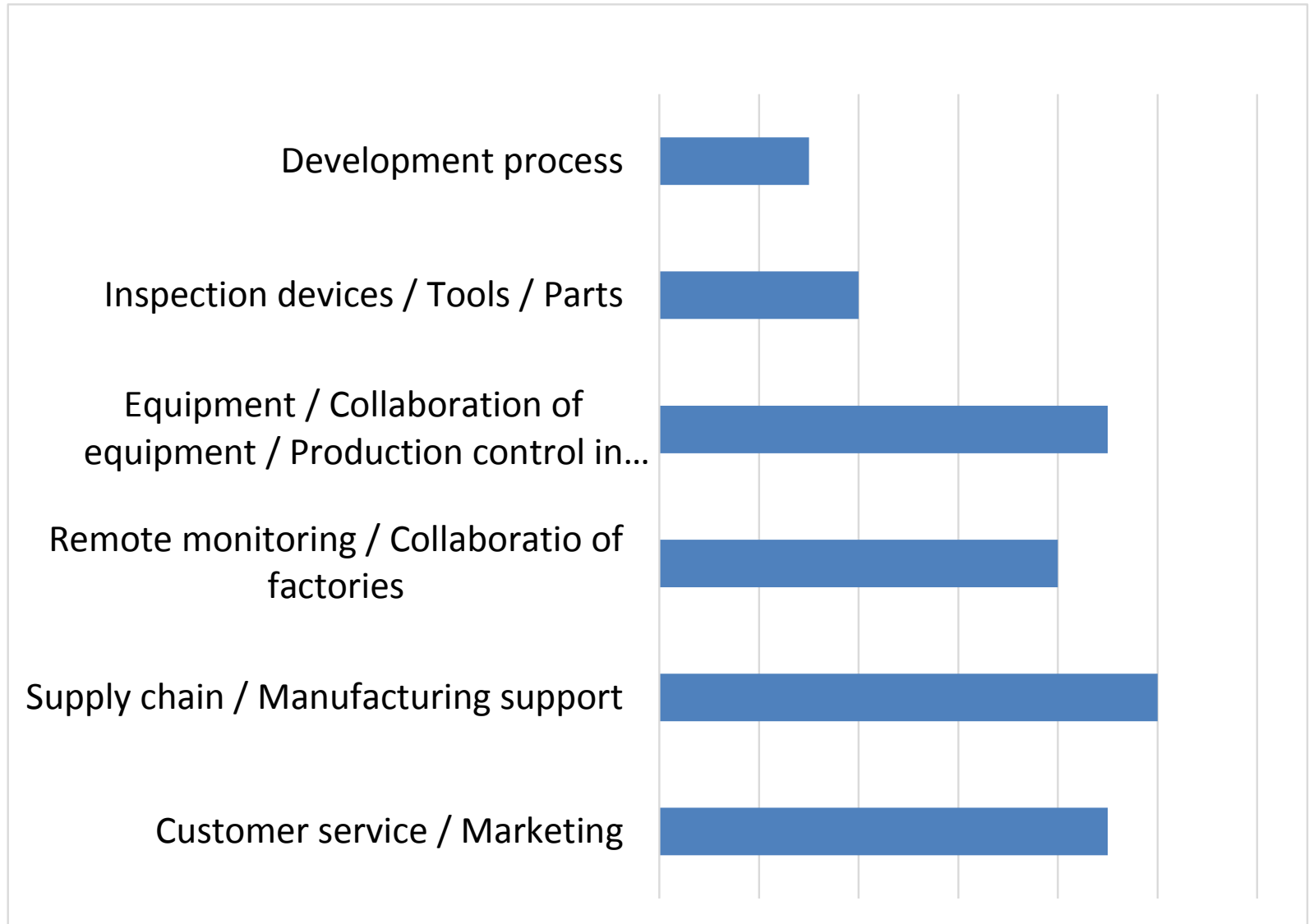
Use case types (by keywords)
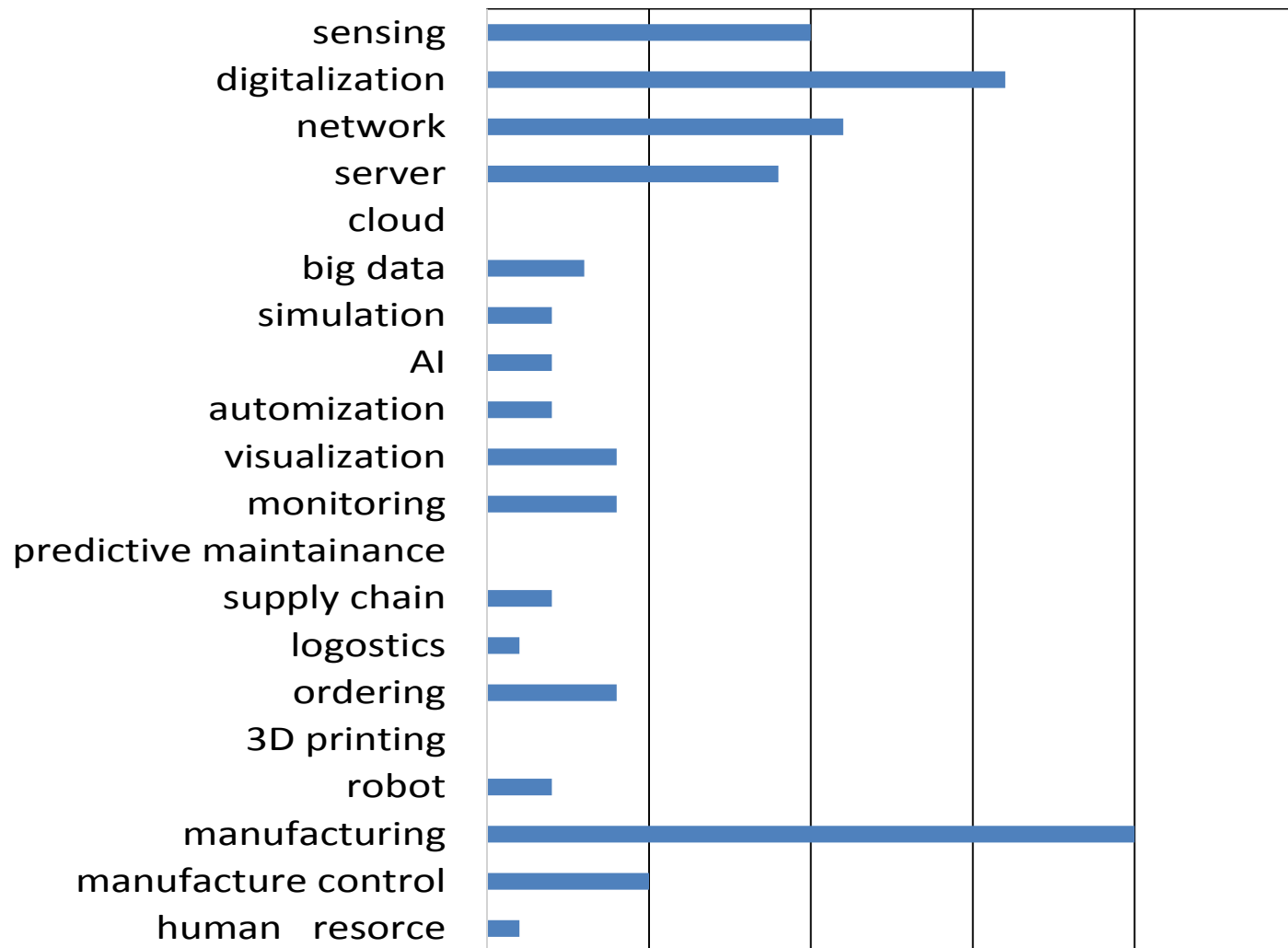
-- Improve company's operation

-- Improve inter company

relationship

-- Create new customer value

Connected their own factories in company, and total optimized their factory operation

Usecase Category	Equipment / Collaboration of equipment, / Production control in factories
	Remote monitoring / Collaboration of factories
	Supply chain / Manufacturing support
Size Of The Company	others
Area	Oosaka

Contact

Daicel Corporation
+81-3-6711-8121
ms_hirokawa@jp.daicel.com
JR Shinagawa East Bldg., 2-18-1, Konan, Minato-ku, Tokyo, Japan
http://www.daicel.com

Daicel, a chemical company, has connected manufacturing control systems of their factories which are located each other by long distance, using information technology.

Their productions are based on energy obtained by such as electricity, coal, and heavy oil. They have conventionally been procuring them independently at each factories.

But by connecting factories they are now able to find the optimum schedule of which product to produce at which factory at which amount, and that brought them cost down of production. This is because they can now control their factories as if they have a single virtual factory.

Improve company's operation

Usecase Category	Customer service / Marketing
Size Of The Company	others
Area	Oosaka

Contact

SUNCO INDUSTRIES Co.,Ltd.
+81-6-6539-3537
satou@sunco.co.jp
1-9-28 Itachibori ,Nishi-ku, Osaka, Japan
http://www.sunco.co.jp/

Analyzed huge data of order receiving records, and improved operation efficiency

Sunco industry, a wholesaler who buy screws and sell them to secondary wholesalers, are treating 770 thousand kinds of screws, and has 4,500 customers. Recently they have built a system to analyze their huge record of order receiving. All their customers basically order several times in a day, and Sunco is preparing shipping every day evening for the next day delivery. By analysis they found that there are several patterns in customer's ordering and they succeeded in building a predictive model to determine which is the last order of the customer on the day. By applying this they can now start shipping work tow hours earlier than before and reduced over working cost by half.
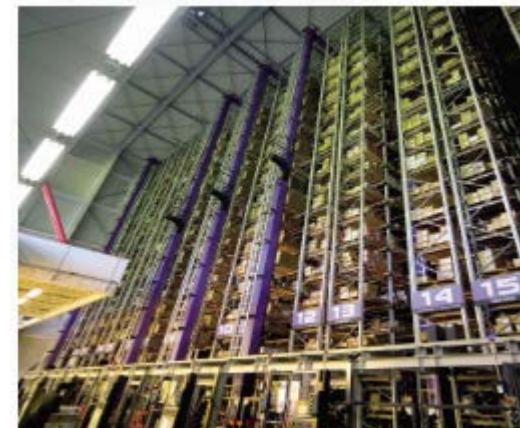
Sunco industry's warehouse

Improve inter company relationship

Usecase Category	Supply chain / Manufacturing support
Size Of The Company	medium-sized enterprises
Area	Tokyo

Contact

Linkers Corporation
+81-3-4334-8201
feedback@linkers.net
Kasumigaseki Building 5th Floor, 3-2-5 Kasumigaseki, Chiyoda-ku, Tokyo
https://linkers.net

Built a business matching system that helps large enterprises and SME's establish relationship

In manufacturing industry, matching is not easy because client companies do not want publish their business idea, and supplier companies do not want to publish their technology know how's even though they need to know them to establish relationship. To solve this dilemma, Linkers built a matching system by using human intelligence and information technology. They built a networking of over 1,700 of coordinators who belong to local governments, financial institutions, universities and knows about local enterprises and university technologies. Since 2014 they have been successful in over 250 highly difficult matching cases that even large company can not achieve by themselves.

Linkers matching website

Create new customer value

Kubota

Usecase Category	Customer service / Marketing
Size Of The Company	others
Area	Oosaka

Contact

Kubota Corporation
+81-6-6648-2111
2-47, Shikitsuhigashi 1-chome, Naniwa-ku, Osaka
556-8601 Japan
https://ksas.kubota.co.jp/

Equipped agriculture machineries with ICT and cloud platform to increase productivity efficiency in agriculture

Kubota has equipped their tractor / rice planter combine with sensors for harvest amount, protein content rate, and water content rate, and also a wifi unit to toransfer these data to cloud service "KSAS" (Kubota Smart Agri System). By this it is possible to obtain characteristic of crops at each farm field, and enabled farmers to make their production plan based on data. According to Kubota's verification project, harvest amount could be increased by 15% in three years and also stable crops taste .

"KSAS" (Kubota Smart Agri System)

- Use case online map

- IoT tools for SME

Online IoT tool library for SME's

Collection of inexpensive and easy-to-use tools for SME's

106 tools in 7 categories for the first collection

Tool for ...

1) solving problems in manufacturing floor
2) solving problems in exchange info. with factories or outside of company
3) solving problems in office work
4) expanding enterprise to overseas
5) equipping products with IoT
6) utilizing data
7) human resource development

Device to visualize machinery operation

Add on to existing signal tower of machineries, monitor operation, analyze the operation ratio. Can monitor different maker's machines.

Example of results at a glance

wireless communication
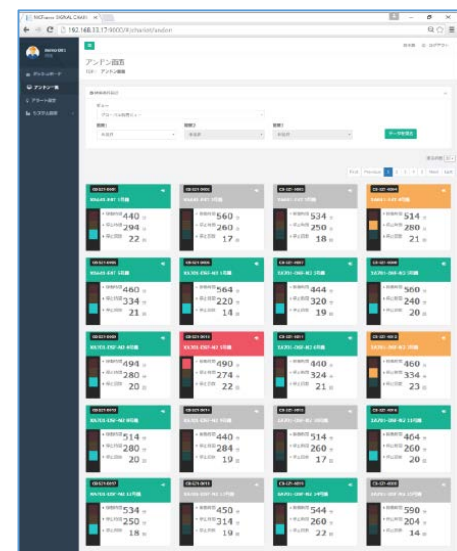
Readable even from backside of the metal parts.

Regular metal tag   metal   Their metal tag   metal
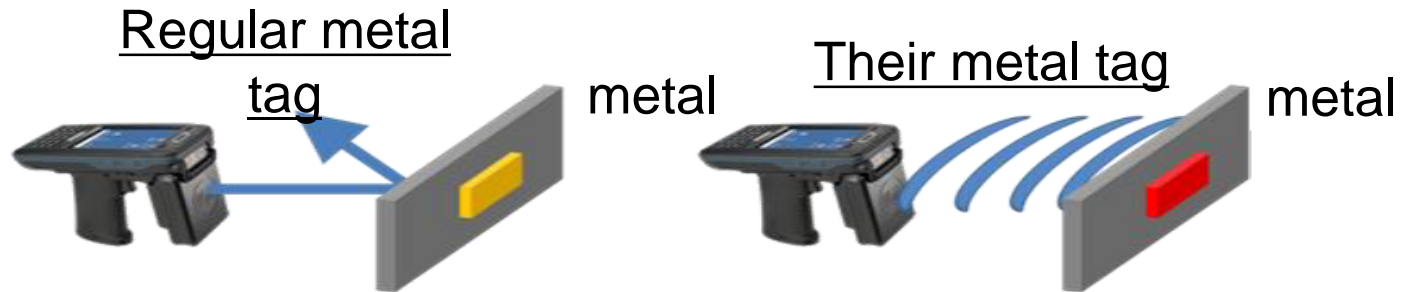
Applicable to ...

Dies   Sheet steel

Help sharing work process procedure with manufacturing floor or back office. Especially useful in teaching new comer, global expansion, outsourcing

Select picture   Add markings   Write explanation   Share

Often stops here

Watch, Detect	Analyze, Notice	Inspect	Trace result	Improve, Further detection

P   D   C   Actionではなく**A**dvance

Take picture with smart phone and input number. Search similar pictures. Reads expiration date. Low initial cost because of cloud service.

Search results

Expiration Alarm

Easy application builder

Tool to relate tables such as combine, expand, limit, transfer. Has an Excel-like user interface and users can build applications to automate office work process by themselves. Can treat existing RDB or CSV files.

Example of sales management system

Example of production planning system

1,2,3,6

Record all communication with customer, and control status. Display name, order history, order status, other info automatically before telephone rings. Enables quick respond for any workers.

② 顧客詳細

Display customer name before telephone rings

Excel, Word, Pdf, Pics

Already delivered

In process

Order received

Provisional order

Only inquiry

42

To make it happen ...