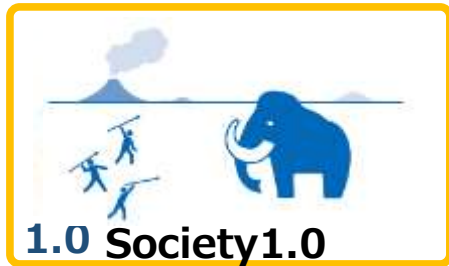Hannover Messe
Forum Industrie 4.0 meets the Industrial Internet

The connected industries: achievements, challenges, and next steps in Japan

25 April, 2018
Tomoaki Kubo
Secretary General
Robot Revolution Initiative

Society 5.0

1.0 **Society1.0**
Hunting & gathering

2.0 **Society2.0**
Agricultural

3.0 **Society3.0**
Industrial

4.0 **Society4.0**
Information

Sustainable Society:
"Society 5.0"

5.0

A human-centered society that balances economic advancement with the resolution of social problems by a system that highly integrates cyberspace and physical space

Connected Industries

Concept

Humans, Machines and Technologies are CONNECTED
Across borders and generations
and NEW VALUE is generated continuously
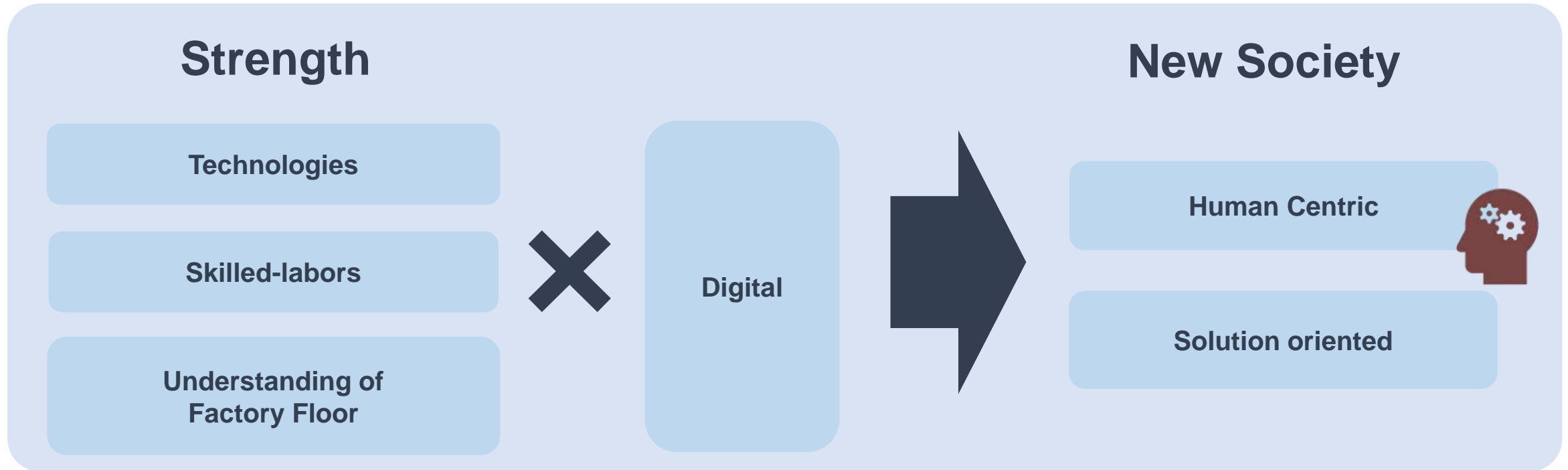
- New vision for the future of Japanese industries -

Examples

Connected-ness

↓

New Value

Things	✖	Things	→	**Internet of Things**
Humans	✖	Machines Systems	→	**Multiplication of human Wisdom, Creativity, Ingenuity**
Companies	✖	Companies	→	**Solutions for global society**
Humans	✖	Humans	→	**Succession of Knowledges and Skills**
Suppliers	✖	Customers	→	**Solutions for business and social agenda**

Connected Industries

Strength × Digital → New Society

- Technologies
- Skilled-labors
- Understanding of Factory Floor

- Human Centric
- Solution oriented

Focusing domains and role of RRI

Focusing domain

🚗 Automated Driving and Mobility Service

🤖 **Manufacturing, Robotics**
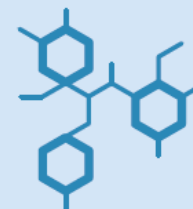
🧪 Biotechnologies and Materials

🚰 Plant/Infrastructure Safety Management

👨‍👩‍👧 Smart Life

RRI (Robot Revolution Initiative)

RRI is responsible for the "Manufacturing and Robotics" domain of CI.

RRI's missions

★ 1）To describe **future images** of horizontal association

★ 2）To list up issues and adjust **International Standards**

★ 3）To facilitate **SMEs** to connect with IIoT eco-system

★ 4）To find out **secure way** for IIoT eco-system

★ cooperating with the international initiatives like;

Hannover Declaration

Japan and Germany cooperate closely, in order to contribute on solving social problems with new technologies.

Date   19 March, 2017 in CeBIT@Hannover

New fields of cooperation

（1）Cyber security for IoT /
　　　 Industry 4.0
（2）International standardization
（3）Regulatory reform
（4）Support for SMEs
（5）R&D

（6）Platforms
（7）Digital Skills and training
（8）Automotive industry
（9）ICT Cooperation

Signed by

Minister SEKO, Minister TAKAICHI　　Minister Zypries

Future Images
and
International Standards

Major Standardization Activities

IEC

SMB

SEG7
I4.0/SmM

SyC
SmM

JTF

TC65
Industrial-process measurement, control and automation

JWG21

TC65/ahG3
SmM Sys Architecture

SC65E/ahG1
SmM Info Models

ISO — International Organization for Standardization

TMB

SmM **Coordinating Committee**

TC184
Automation systems and integration

TC292/WG4

JTC 1/SC 41

SMB: Standard Management Board
SEG: Systems Evaluation Group
SmM: Smart Manufacturing
SyC: System Committee
TMB: Technical Management Board
TC: Technical Committee
JWG: Joint Working Group
ahG: adhoc Group
JTF: Joint Task Force

Major Standardization Activities

SMB

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SEG7
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SMB: Standard Management Board
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One usage scenario under discussion in Germany-Japan cooperation project

"Condition Monitoring for early fault detection, rapid fault isolation and/or recovery"

■ **Engineering & setup**

1. **Connection of a machine**
2. Reconfiguration of a machine
3. Development of an analysis algorithm

■ **Operation & reconfiguration & maintenance**

1. **Collection and analysis of usage data of a machine**
2. Recording additional data on spontaneous request
3. Operation of a service platform
4. **Generation of recommendations resp. requests for action**
5. Benchmarking of machines
6. **Execution of recommendation resp. request for action**

Data-driven Services

usage data of machines

Operator of machines | Provider of data-driven services | Operator of service platform | Supplier of machines
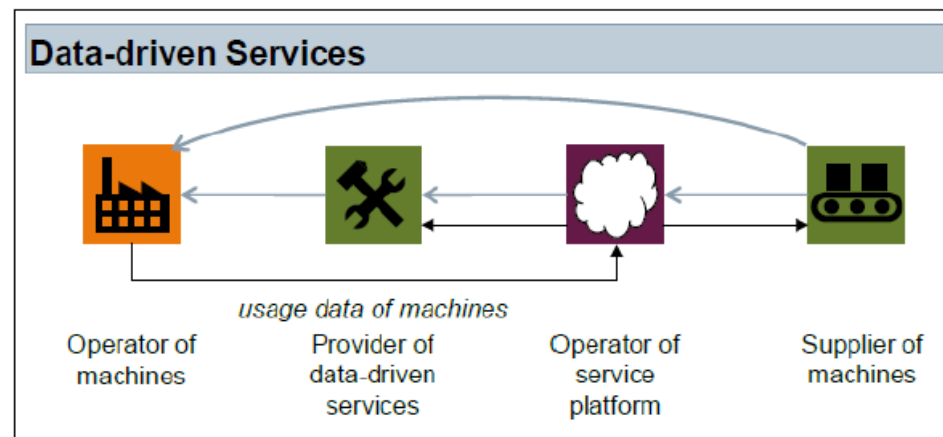
9 activities identified
Blue are core activities

Activities in Usage Viewpoint

- **Engineering & setup**
  1. Connection of a machine
  2. Reconfiguration of a machine
  3. Development of an analysis algorithm

- **Operation & reconfiguration & maintenance**
  1. Collection and analysis of usage data of a machine
  2. Recording additional data on spontaneous request
  3. Operation of a service platform
  4. Generation of recommendations resp. requests for action
  5. Benchmarking of machines
  6. Execution of recommendation resp. request for action
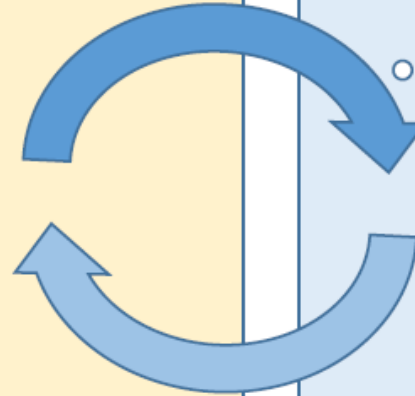
Technical steps in Functional Viewpoint

To identify what standards to be used and/or developed, functional and technical assessment is needed

- **Operation & reconfiguration & maintenance**
  1. Data collection
  2. Data analysis
  3. Fault detection
  4. Fault isolation
  5. Maintenance planning
  6. Maintenance execution

Super Visualization System for Machine Tools by the Intensive Collaboration

Objective

Design and validation of common expression of data obtained from machine tools in context of two cases, where decision makings require integration of the data of machine tools in a (even distributed) production line regardless of tools types and manufacturers

Case 1: Planning and scheduling of maintenance of machine tools

Case 2: Quality control with sufficient traceability of production data

Design and implementation

Identification of data items for visualization of two types of information:

For case 1: When each machine tool should be maintained

19 data items are identified through detailed analysis of six activities for collecting necessary information for estimating the residual life of each component of a machine tool

For case 2: How manufacturing condition changes during a series of production

16 data items that are used for identifying the point of variation in machine shop tool conditions, work setting, and NC programs are identified.

A prototype monitoring/visualization system is developed and demonstrated through an intensive collaboration among members of The Industrial Machinery Steering Committee

DMG MORI   FANUC   FUJITSU   HITACHI   JT-EKT   Mazak   MITSUBISHI ELECTRIC   OKUMA

AIST   WASEDA University

Supported by   METI   JMTBA   NEDO

Super Visualization System for Machine Tools by the Intensive Collaboration

IoT platform

Acquisition of data for rendering the application program

JSON

File upload

Common data file

File upload

Machine tools

Estimating residual life of components, aggregating time variation of manufacturing conditions

| Fujitsu | OKUMA | FUNAC | MAZAK | MITSUBISHI | DMG MORI | JTEKT |

Common data items used in case 1
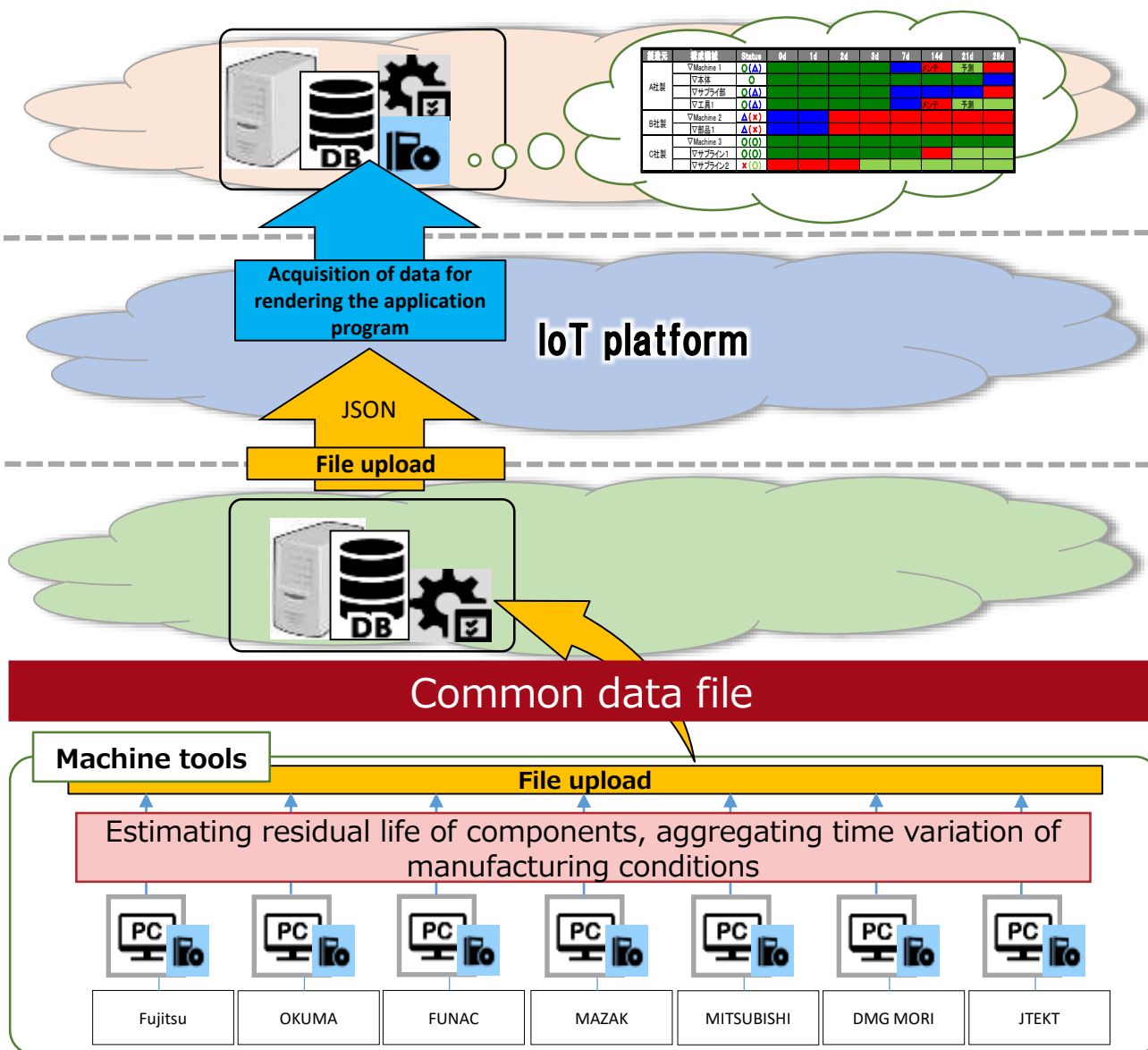
Index	Name	Description
0	ActivityID	Identifier for the type of activity
1	ActivityString	String explaining the contents of activity
2	SubjectID	Identifier for the subject of activity
3	SubjectString	... of activity
4	ObjectID	... activity
5	ObjectString	... of activity
6	Time	The time the activity is executed.
7	ClockID	Identifier for the clock which is used in the activity
8	ClockString	
9	MaintenanceItemID	
10	MaintenanceItemString	
11	MeasuredValue	
12	MeasurementMethod	
13	ResetValue	
14	MaintenanceMethod	
15	ThresholdValue	
16	ThresholdSettingMethod	
17	ComputedMaintenance	
18	ComputationMethod	

Common data items used in case 2

Index	Name	Description
0	DataID	Identifier for the data itself.
1	DataGenerationTime	The time when the data file is created.
2	MachineID	Identifier for the machine tool
3	GetTime	The time when the records of the data are obtained.
4	WorkID	Identifier for the work that is processed in the machine tool at this time
5	TCode	... machine shop tool
6	TCode	
7	Sequence	... gram.
8	ToolID	Identifier for the tool used at this time.
9	ToolOffsetID	Identifier for the tool offset setting at this time.
10	ToolOffsetString	Detailed description of tool offset setting.
11	WorkOffsetID	Identifier for the work offset setting.
12	WorkOffsetString	Detailed description of work offset setting.
13	ProgramID	Identifier for the machine tool program.
14	ProgramString	Description of machine tool program.
15	OperationStatus	Operation status of the machine tool at this time

Super Visualization System for Machine Tools by the Intensive Collaboration

Case 1: Web application program for planning and scheduling of machine tools

Case 2: Web application program for quality control with sufficient traceability of production data

Residual life of each component of machine tools over multiple sites over different stakeholders is indicated.
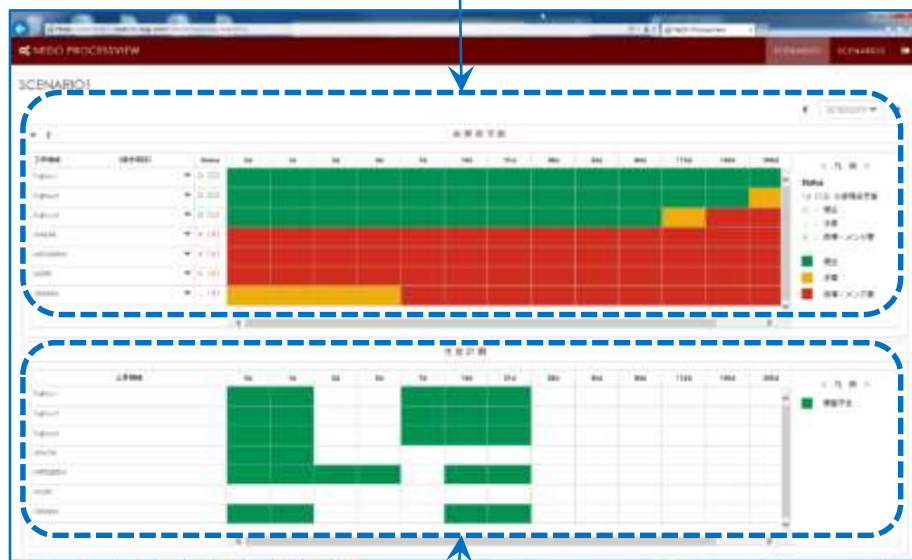
Task assignment of each machine tool for next six months is also indicated so as to determine optimal maintenance schedule considering their availability.

The report will be available soon at on https://www.jmfrri.gr.jp/english/info/867.html.

Point of variation in production condition of each machine tool (e.g., machine shop tool conditions, work setting, and NC program) is plotted in correlation with works.
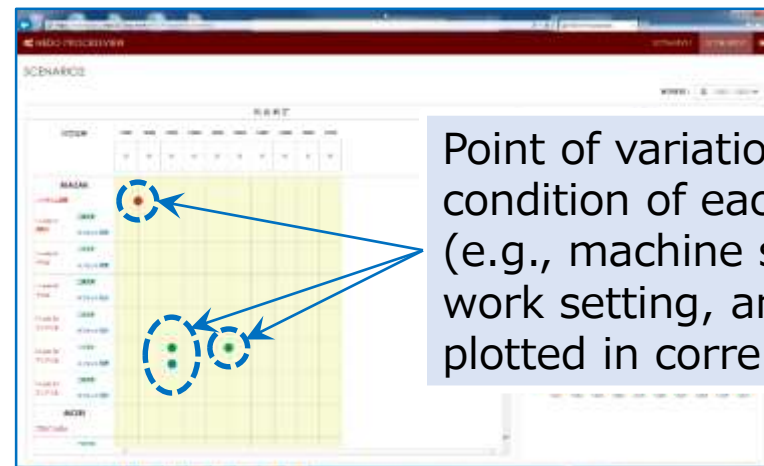
Inspection result of each work.

Interrelationship between the quality of work and point of variation in production condition can be found.
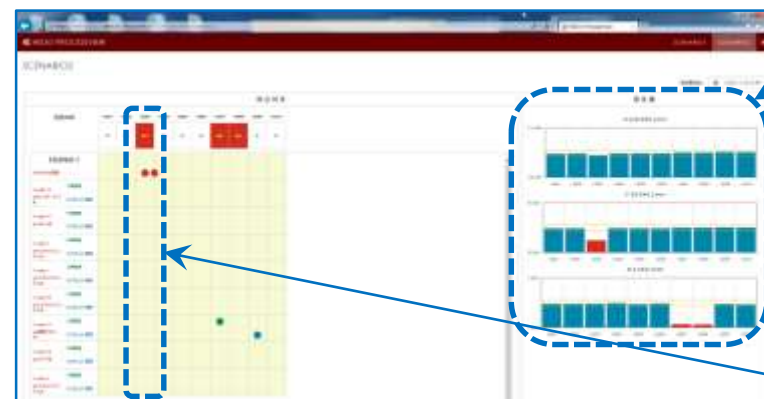
This work is based on results obtained from a project commissioned by the New Energy and Industrial Technology Development Organization (NEDO).

SMEs Facilitation

**25 cities or prefectures
(Osaka, Kita-Kyushu, Gifu, etc.)**

Building of Nationwide Network

Build a nationwide network by collaborating with local supporting organizations

Aiming to collaborate with supporting organizations at each local area, we consider how to

1) Enhance networking

2) Share common knowhow

3) Extract common problems

As the first step, support the "Smart Monodukuri Supporting Organizations Nationwide Liaison Conference" (organized by METI) was held in Dec. 1, 2017

- **Objectives of online map cooperation**
  - ✓ Visualize achievements
  - ✓ Share best practices
  - ✓ Promote business cooperation

- Japan: https://www.jmfrri.gr.jp/english/430.html
- Germany: http://www.plattform-i40.de/I40/Navigation/EN/InPractice/UseCases/use-cases
- France: http://exemples-aif.industrie-dufutur.org/

Features of use-cases

Process in Engineering Chain
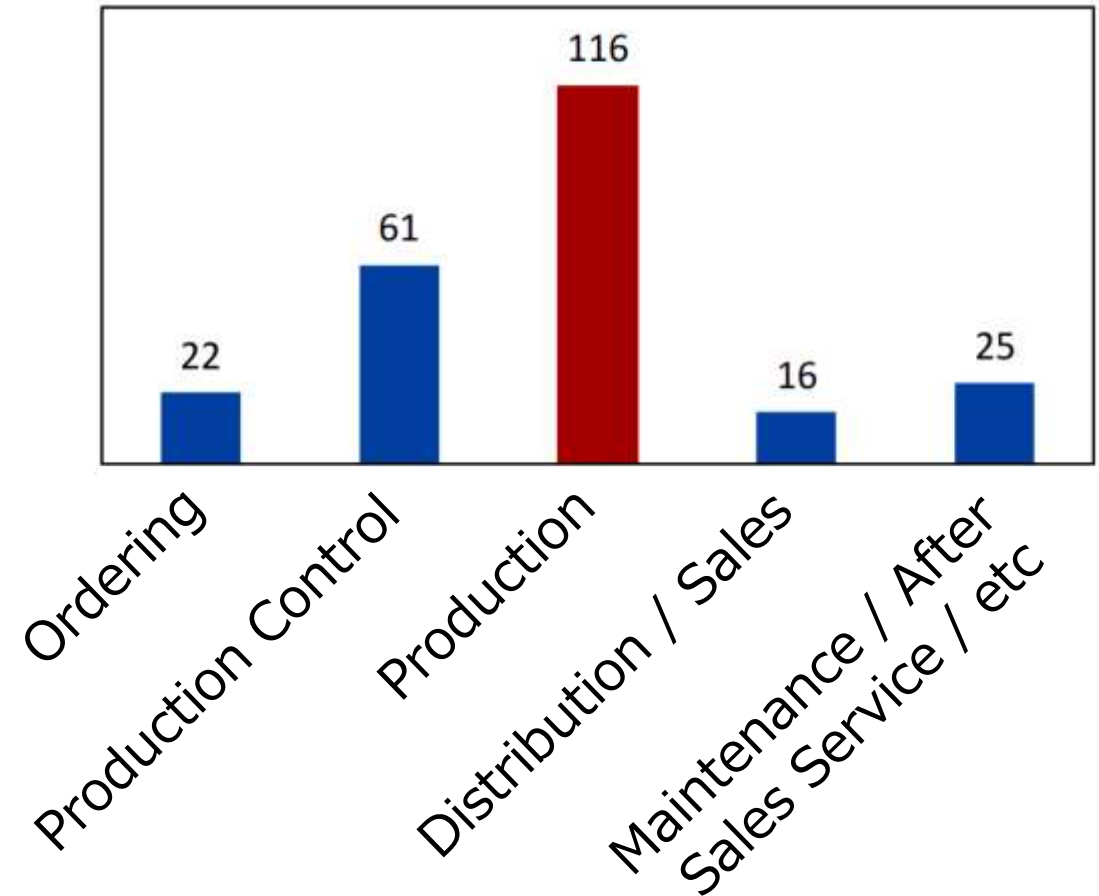
Process in Supply Chain

Source： New Energy and Industrial Technology Development Organization
Mizuho Information & Research Institute, Inc.

Features of use-cases

Objectives of Digitization

Quality Improvement 15%
Cost Reduction 20%
Productivity Improvement 38%
Product Lead Time Reduction 4%
Human Resource Development 5%
New Value Creation 12%
Others 6%

Level of Digitization

Control, Optimization 11%
Analysis, Prediction 17%
Collection, Accumulation, Visualization 72%
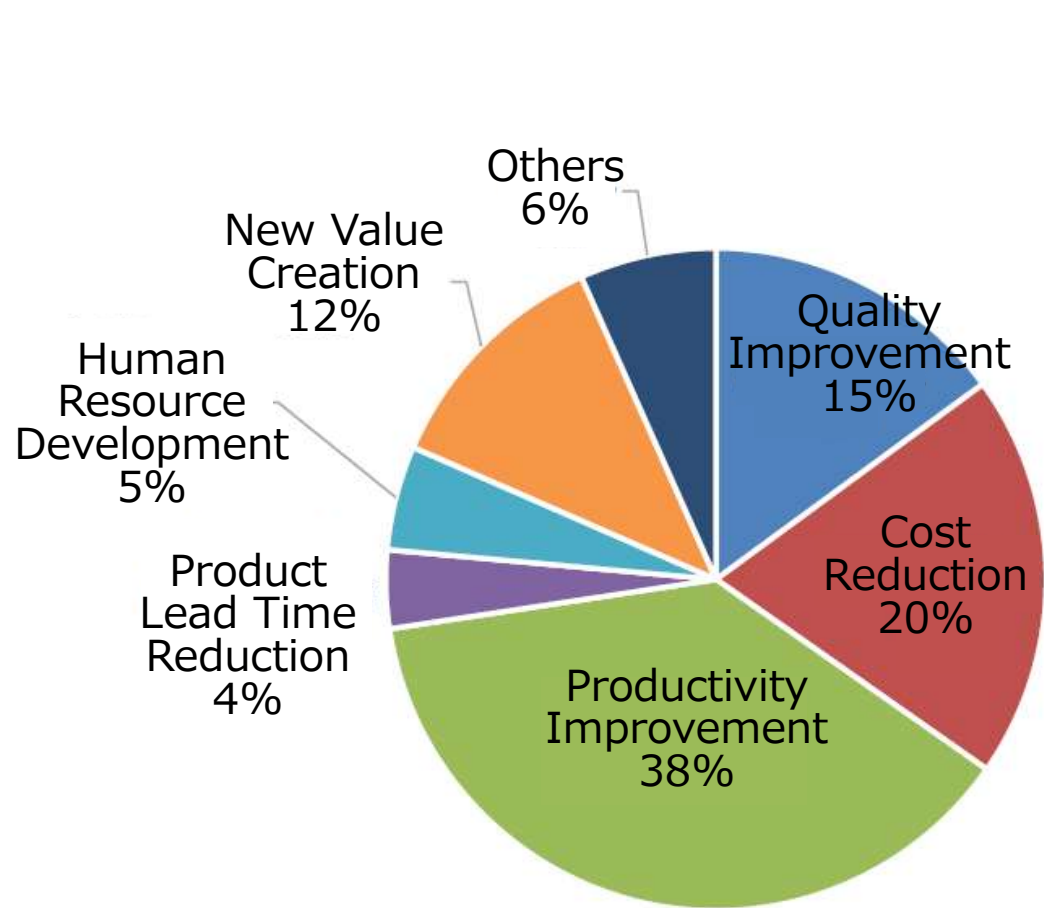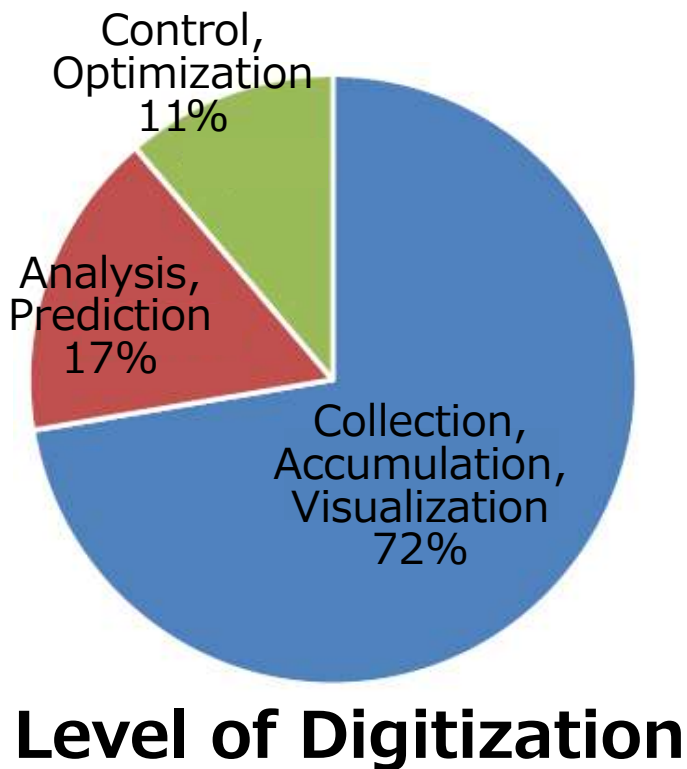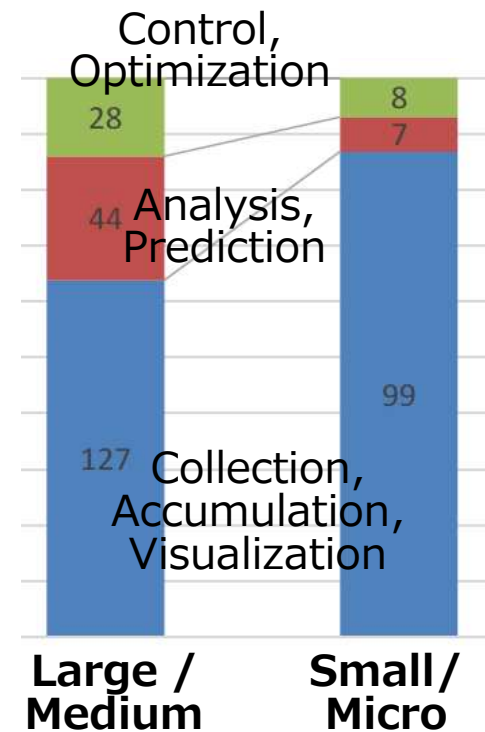
Objectives of Digitization by Enterprise Scale

Control, Optimization
Analysis, Prediction
Collection, Accumulation, Visualization

Large / Medium — 28, 44, 127
Small / Micro — 8, 7, 99

Source : New Energy and Industrial Technology Development Organization
Mizuho Information & Research Institute, Inc.

Online IoT tool library for SME's

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

https://www.jmfrri.gr.jp/event/seminar/618/694.html(Japanese only)

By target field

Source : IT Coordinators Association

By objectives
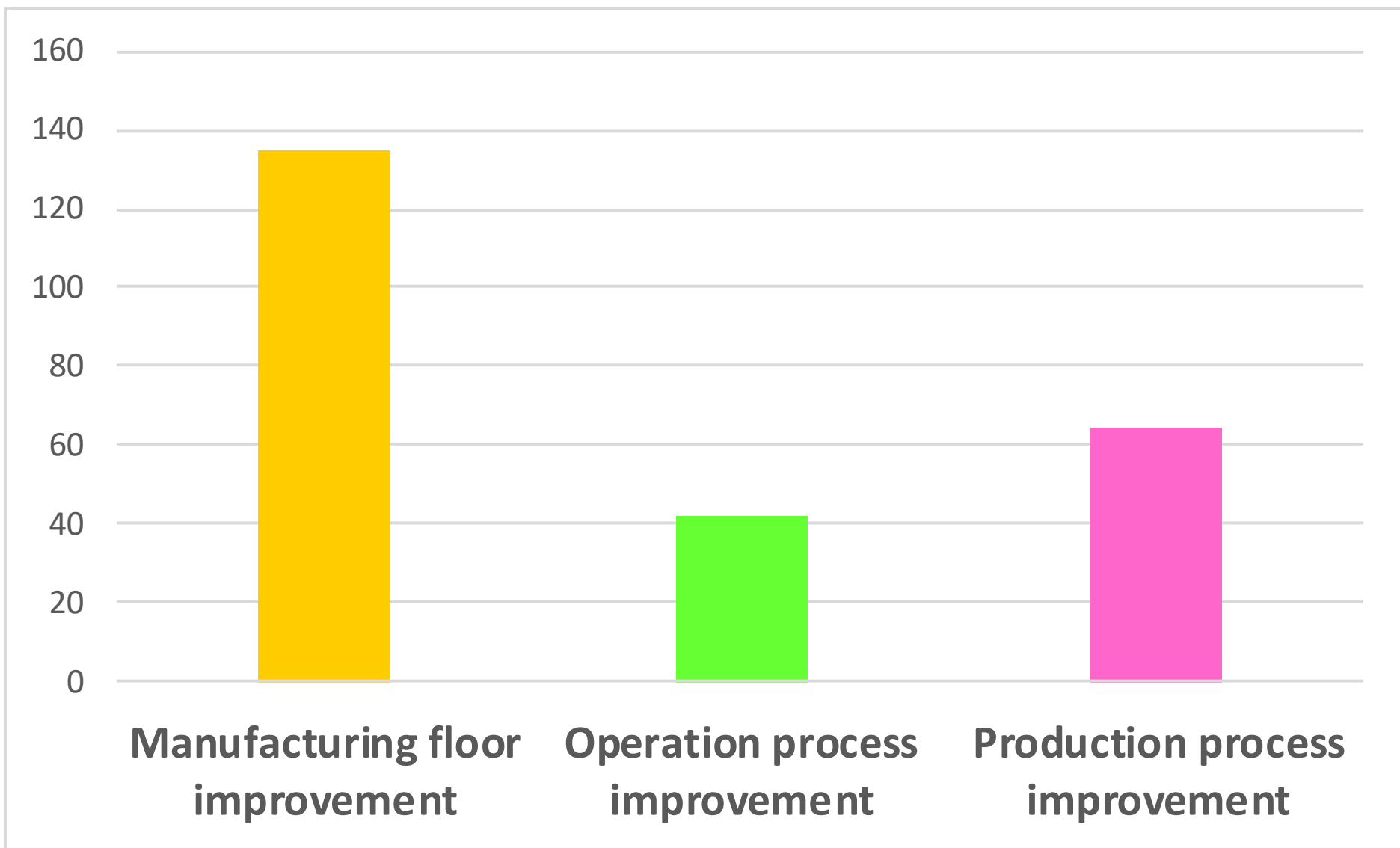
Manufacturing floor improvement
- Quality improvement
- Productivity improvement / Cost reduction

Operation process improvement
- Productivity improvement / Cost reduction
- Coutomer base increase

Production process improvement
- Quality improvement
- Productivity improvement / Cost reduction
- Skill transfer
- Lead time reduction
- Coutomer base increase

Source : IT Coordinators Association

Online IoT tool library for SME's
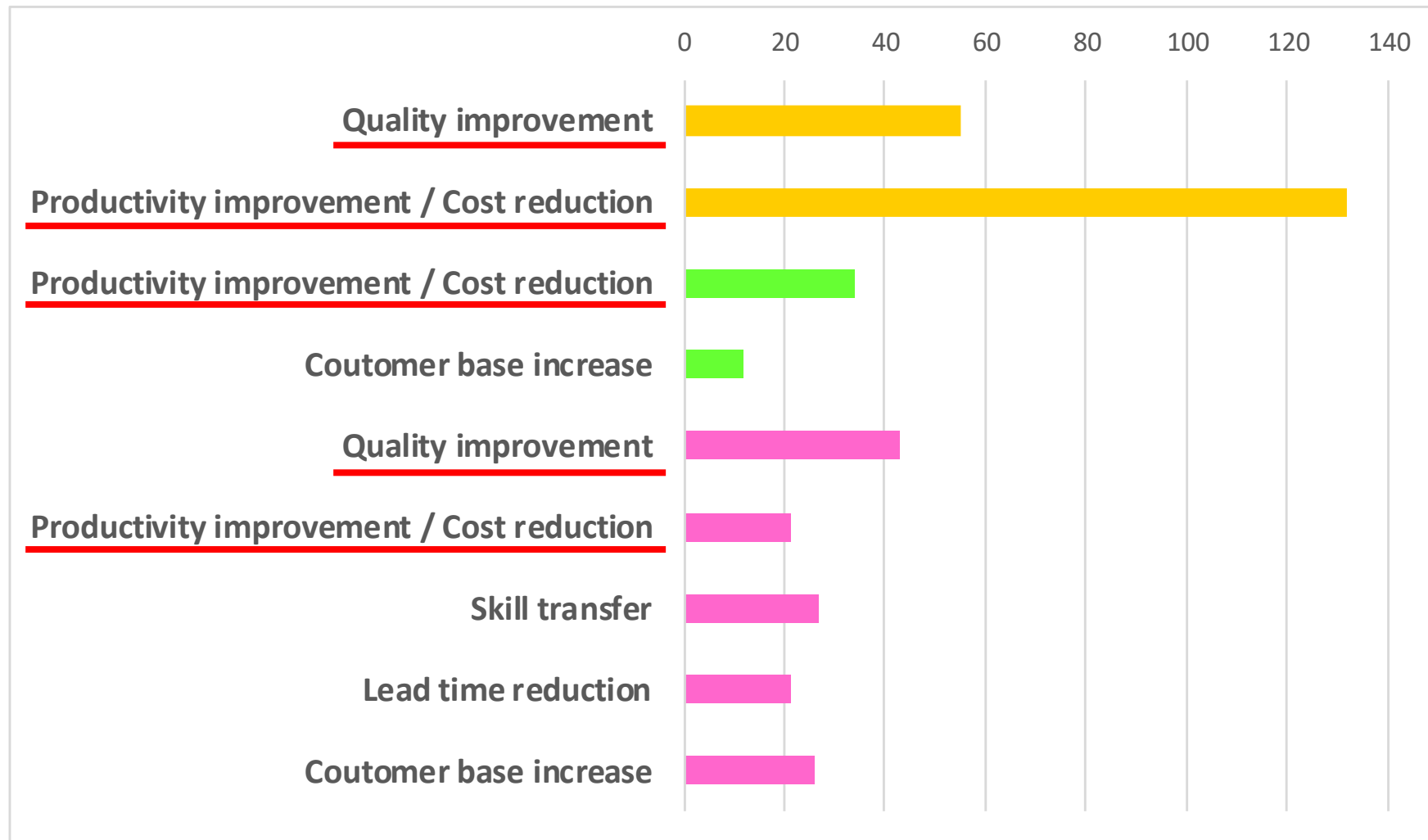
Tools w/ human error
detector for assembling
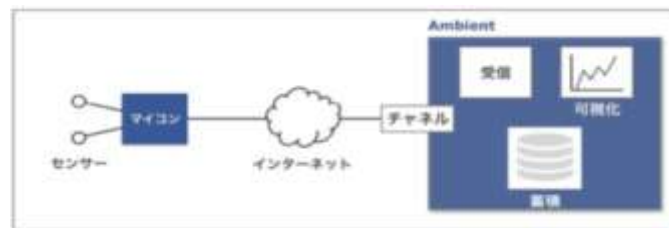
Cloud service for visualization of
sensor data

Transform iPad into remote
control panel

Digitize legacy machine
status by camera

Wrist band to detect worker's
status

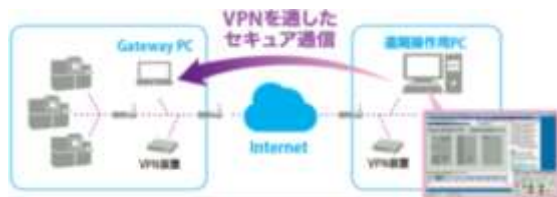Retrofit current and
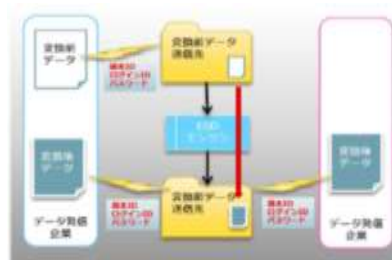temperature sensors

Universal data collector
for PLC
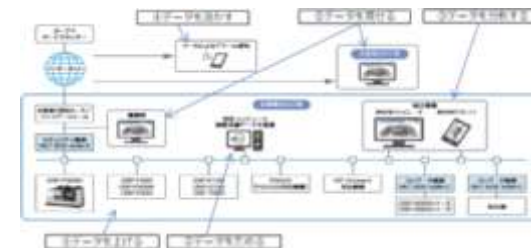
Detect, alert w/
countermeasure instruction

Visualizing system for
product shipping w/ NFC
card

Online IoT tool library for SME's

Remote diagnostic system for quick repair

Universal data transformer for various EDI systems

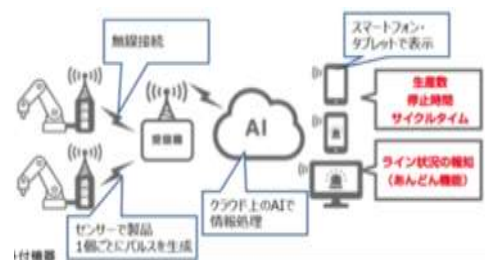Universal data collector for different machine makers

Worker tracking sensor w/ camera built in ceiling light

Rental sensor box w/ cloud service

Toolkit for sensor and cloud

Machine status monitoring system

Machine status monitoring system

RFID for backside of metal

Online IoT tool library for SME's

Machine motion counter by smartphone

Universal data collector for different machine makers

Universal data collector for different machine makers

Universal data collector for different machine makers

Industrial Security

Industrial Security （Hypothesis of RRI）

- It is impossible to avoid cyber attacks if legacy devices are included

- **Invaded by unknown thread -> 97% of enterprises**

- **Average days to detect invasion -> 205**

- **Malwares that cannot be detected by anti-virus software ->55%**

Having expert meetings with Germany

Also discuss at
**Securing Global Industrial Value Networks –
Synchronising international approaches**
in May at **Berlin**

International Cooperation

International Cooperation Overview

Europe

International Standardization

International Symposia

U.S.

Exhibitions

3rd Intn'l Symposium（Nov. 30, '17）

WORLD ECONOMIC FORUM

MADE IN CHINA 中国制造 2025

INDUSTRIE4.0

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

industrial internet CONSORTIUM

AIOTI

Connected Industries

| Future image of Manufacturing and Service with IIoT | Harmonizing Smart Manufacturing Standards with usecases | Extracting Industrial Security Issues with usecases |

- IoT/I4.0 is a story of systems, not only in a factory, so start-ups and SME have to be involved.
- Human is sovereign, not AI
- The role of government and universities are very important
- Global eco system is important

Standardization:
It is important that all the people should participate in the activity directly or indirectly because thousands of related standards already exist and future work strongly depends on people's requirement for new business scenario. And we expressed the importance of thinking international standard from business scenario view point.

We would like to invite the world
to join the next symposium in this year!
Oct. 19th, Tokyo

Collaborations with Related Organizations

RRI intends to enhance collaboration with the following organizations

- **Industry Associations**
    - **Electric**
    - **Machine**
    - **Information**
    - **Electronics**
    - **User / Operation Technology**
- **Learned Societies**
- **SME Supporting**
- **Cross-cutting / Other related organizations**

At Hall 7

Japan Electrical Manufacturers' Association

Industrial Value Chain Initiative

Robotics

World Robot Summit 2018
@Tokyo Big Sight Oct.17-Oct.21

World Robot Summit 2020
@Aichi(October)&Fukushima(August)

World Robot Challenge (WRC)

Industrial Robotics Category
Service Robotics Category
Disaster Robotics Category
Junior Category

*Teams from universities, research institutes, companies, or other entities for Industrial Robotics, Service Robotics and Disaster Robotics Categories; Teams of members aged 19 or younger for Junior Category.
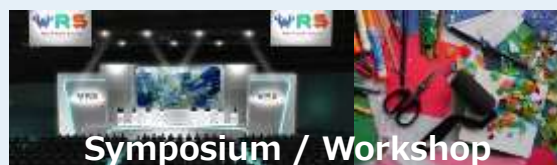
World Robot Expo (WRE)

In conjunction with the Challenge, an Expo will be held to present cases of applied robotics to the world.

In addition to companies, universities and research institutions, the government will exhibit the latest robotics-related examples.

Symposium/Workshop Program

Symposium / Workshop

International Forums by academia, presentations and workshop by companies supporting WRS are planned.

Side Events

Side Events

Various side events are planned.
(e.g. participatory and experiential events)