MITSUBISHI ELECTRIC
Changes for the Better

Society 5.0

- Japan's approach to digitalisation of economic growth -

Mitsubishi Electric Corporation
Corporate Executive
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MITSUBISHI ELECTRIC
Changes for the Better

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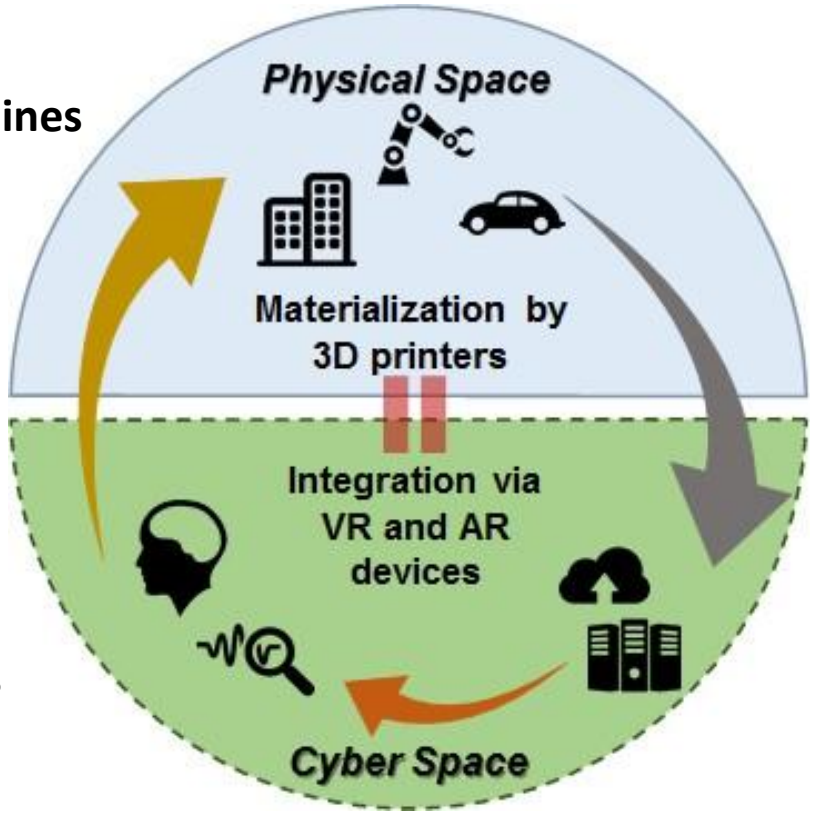
1. TECHNOLOGICAL BACKGROUND

- Creation of new values through the fusion of cyber and physical space (CPS) as the basis for driving innovation and the rapid evolution of ICT
- Leveraging CPS - the creation of value accelerated by AI and robots

Implemented by machines and robots



Data collection via sensors and devices

Analyze with the use of AI, etc.

Big Data

CPS: Cyber Physical Systems
VR: Virtual Reality
AR: Augmented Reality

Source: Japan Business Federation (KEIDANREN)
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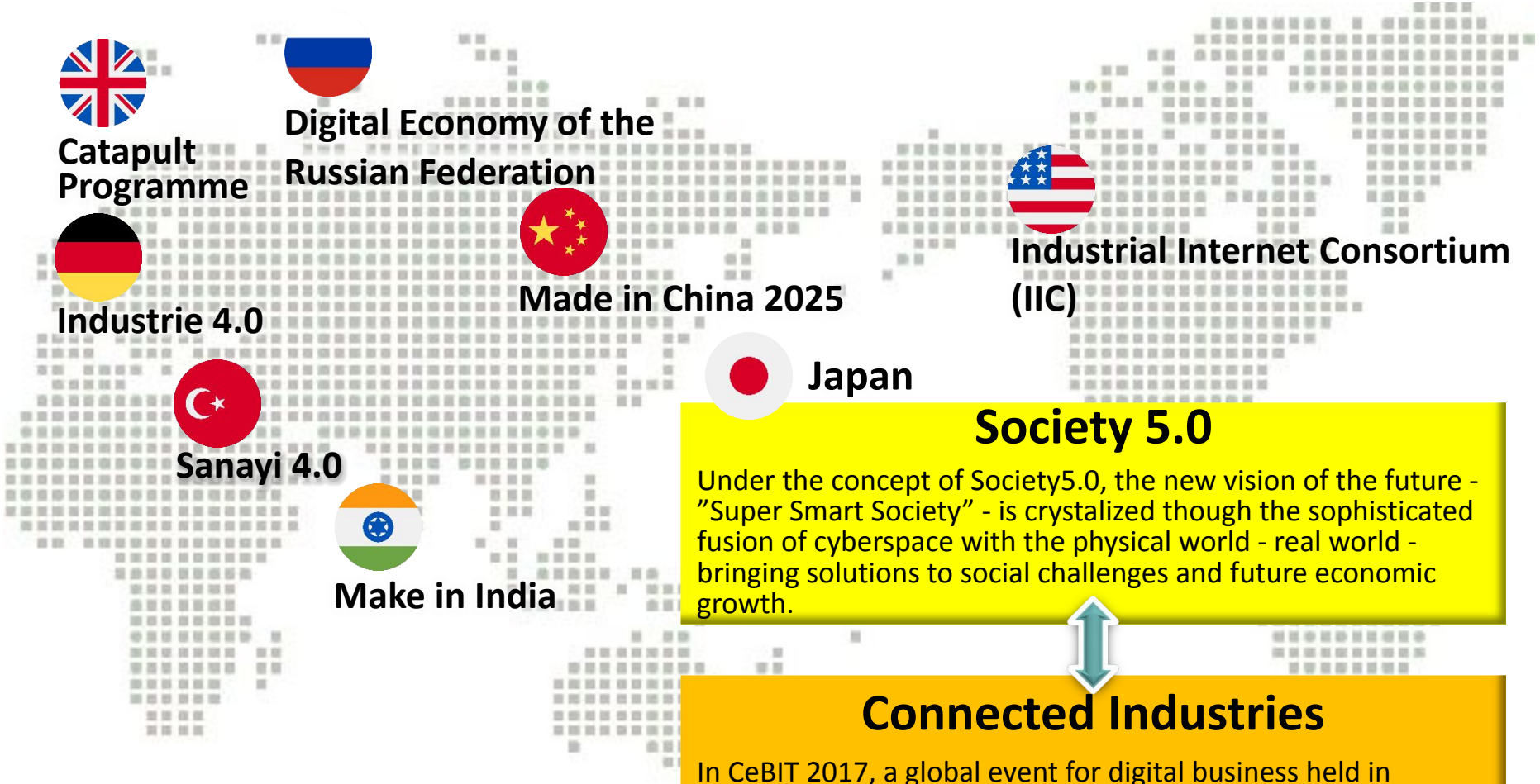
2. DIGITAL ECONOMY INITIATIVES 2-1 Global Trends

Mitsubishi Electric is a Leading Company for promoting Society 5.0



Society 5.0

Under the concept of Society5.0, the new vision of the future - ”Super Smart Society” - is crystalized though the sophisticated fusion of cyberspace with the physical world - real world - bringing solutions to social challenges and future economic growth.

Connected Industries

In CeBIT 2017, a global event for digital business held in Germany, Prime Minister Abe and Minister of Economy, Trade and Industry Seko announced “Connected Industries” as a new vision for the future Japanese industry that will contribute to the achievement of Society 5.0.

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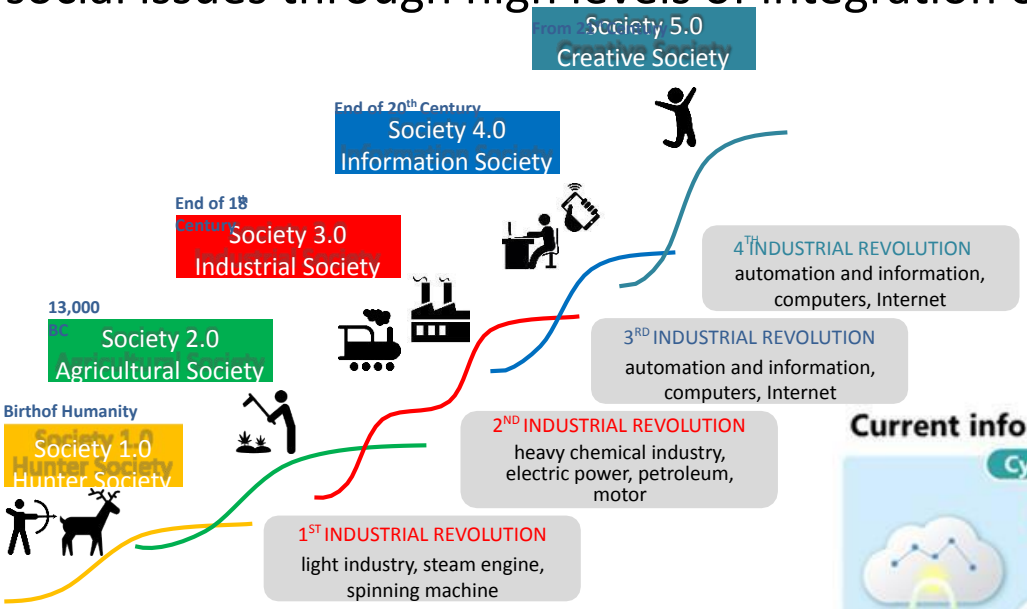
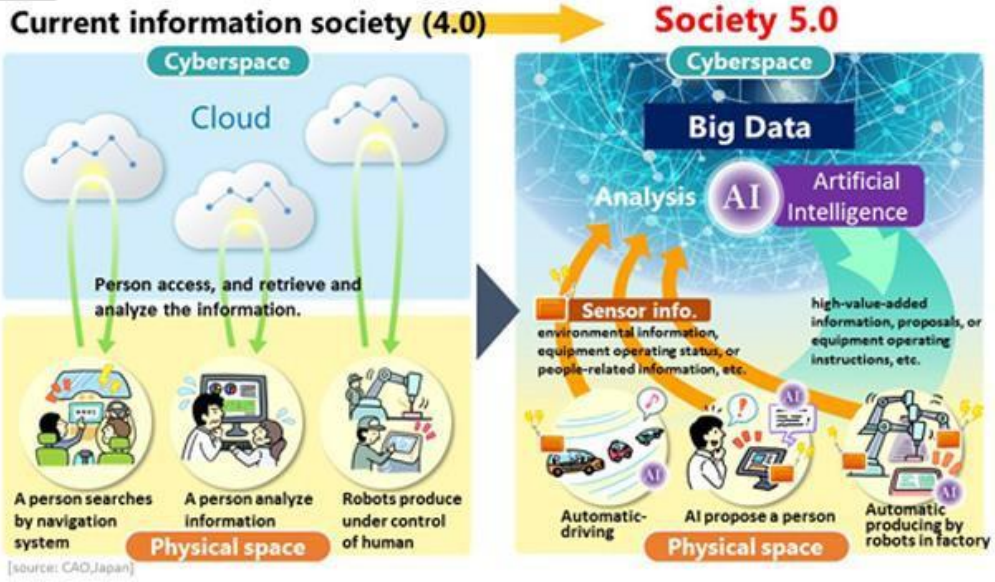
2-2 Initiatives Towards Realizing Society 5.0

Society 5.0 is…

A human-centered society that combines economic development and solutions to social issues through high levels of integration of cyber and physical (real) space.



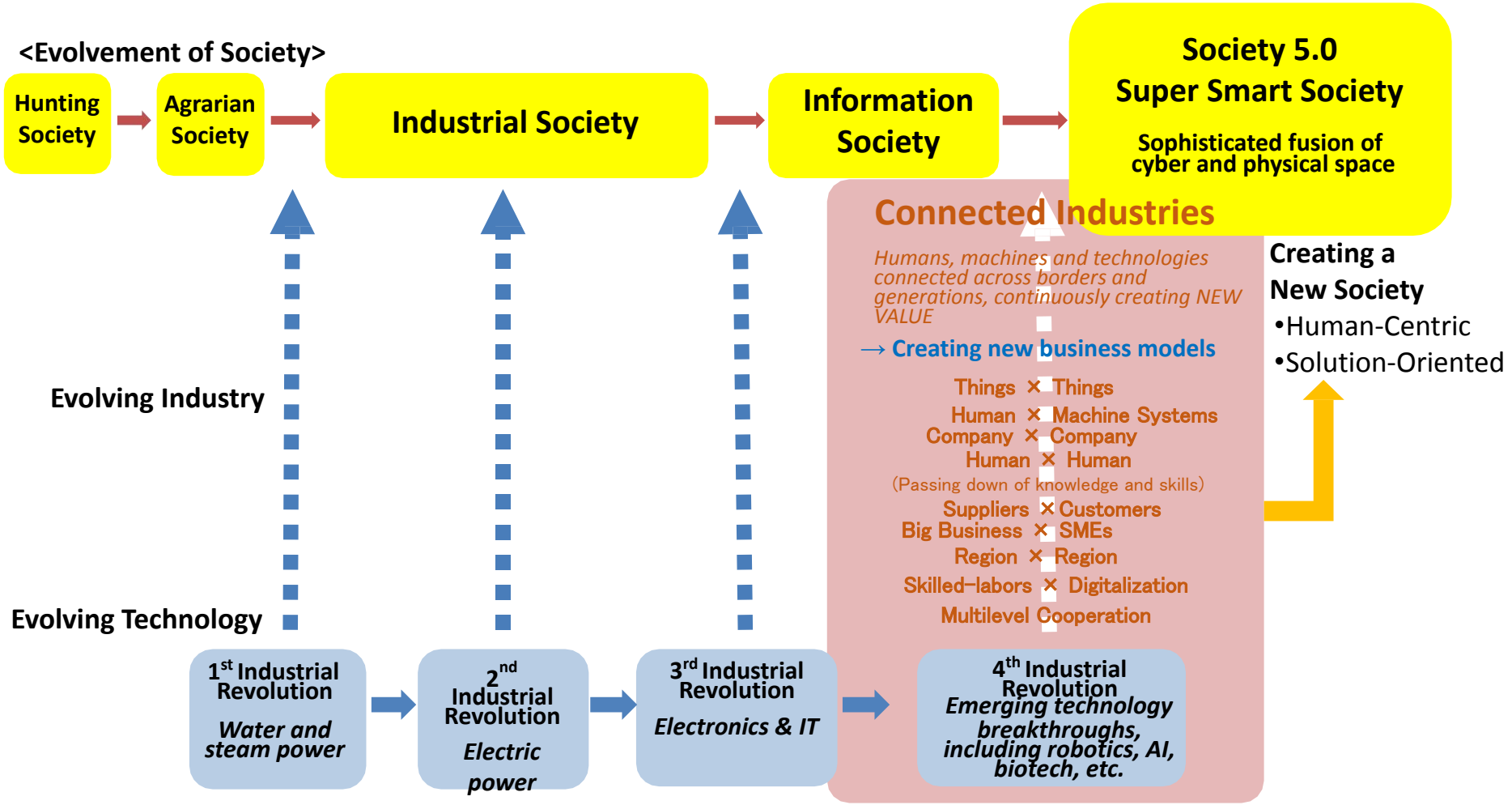
Collection of physical (real) world data via sensors and IoT (Big Data), analysis using artificial intelligence (AI), and feedback of high value information to the physical world.



- *"**Society 5.0**" (Super Smart Society) was defined in "The 5th Science and Technology Basic Plan" that was approved by the Government of Japan's Cabinet Office in January 2016.*
- *"**future investment strategy**" (or, growth strategy) was approved by the Cabinet Office in June 2018, and illustrates the transformation to realizing Society 5.0.*

Source: Government of Japan, Cabinet Office, and Japan Business Federation (KEIDANREN)

2-3 “Connected Industries” Leading to Society 5.0



Source: Government of Japan, Ministry of Economy, Trade and Industry (METI)

2-4 From Society 4.0 to Society 5.0

Source: Japan Business Federation (KEIDANREN)

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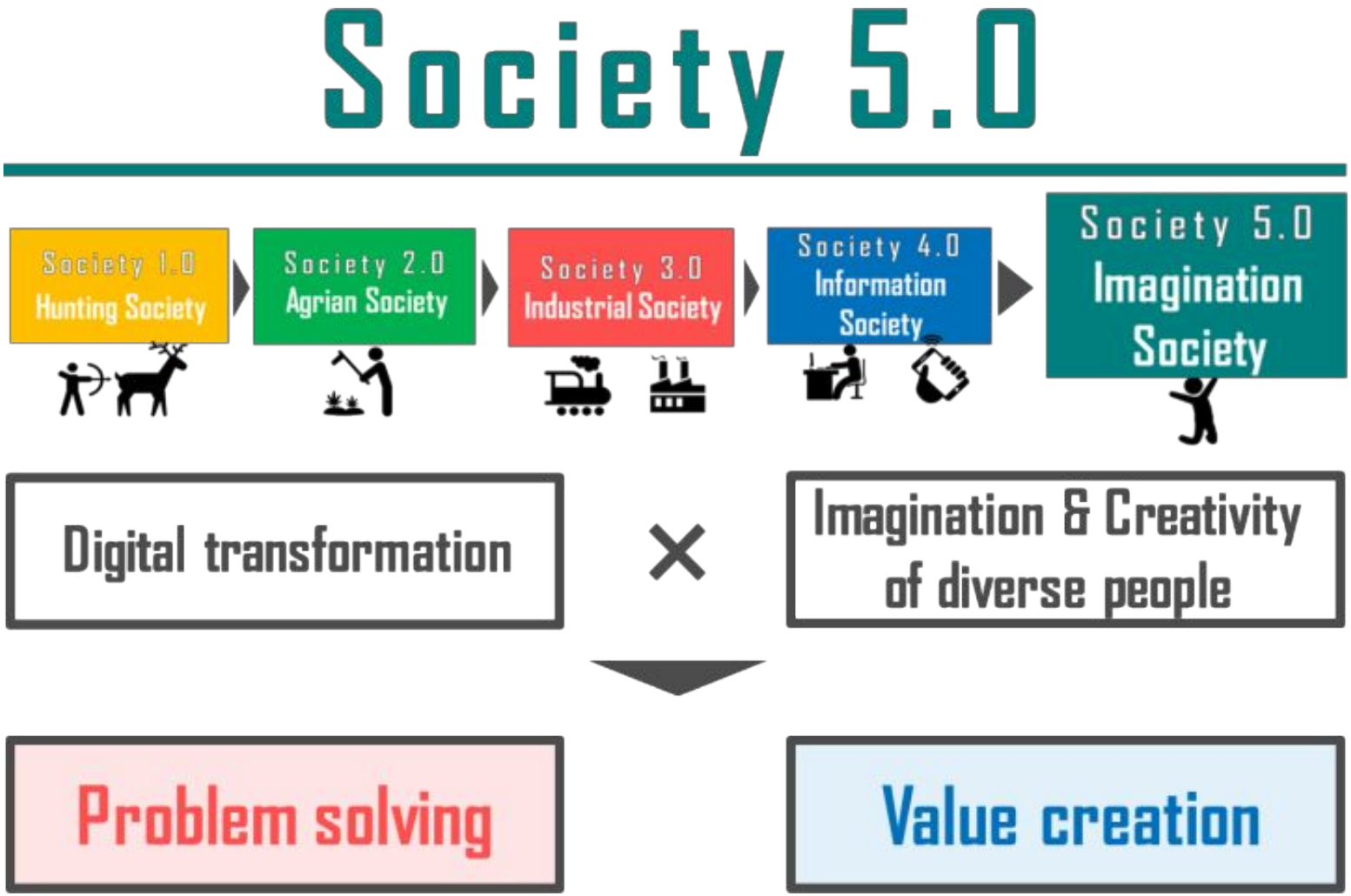
2-5 Society 5.0 “Imagination Society”



Source: Japan Business Federation (KEIDANREN)

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2-6 Society 5.0 Contributing to Economic Growth & Resolution of Social Challenges

Economic advancement

- The demand for energy is increasing
- The demand for foodstuffs is increasing
- Lifespan is becoming longer, and the aging society is advancing
- International competition is becoming increasingly severe
- Concentration of wealth and regional inequality are growing

Resolution of social problems

- Reduction of GHG emissions
- Increased production and reduced loss of foodstuffs
- Mitigation of costs associated with the aging society
- Promotion of sustainable industrialization
- Redistribution of wealth, and correction of regional inequality

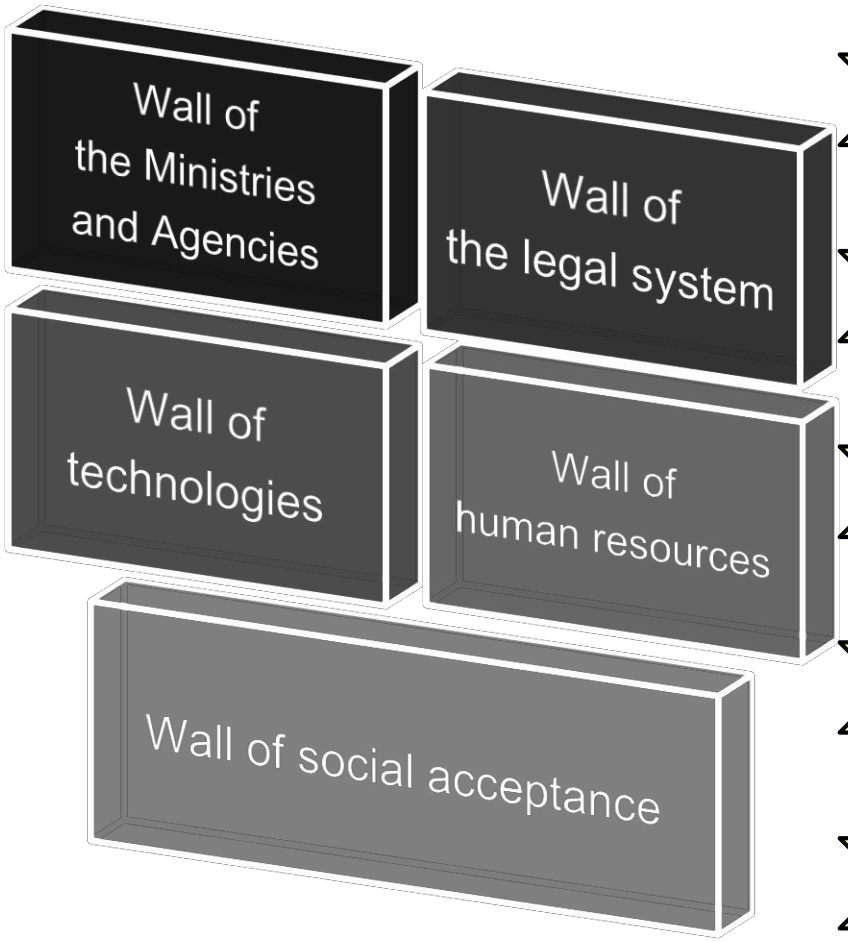
Incorporation new technologies such as IoT, robotics, AI, and big data in all industries and social activities, provide goods and services that granularly address manifold latent needs without disparity

to balance economic advancement with the resolution of social problems

Source: Government of Japan, Cabinet Office

2-7 Breakthrough of the “Five Walls”

- It is imperative to break through the "five walls" to realize the new economy and society in which discontinuous and disruptive changes are expected to occur.



Wall of the Ministries and Agencies

Formulation of national strategies and integration of government promotion system

Wall of the legal system

Development of laws
Toward implementation of advanced technologies

Wall of technologies

Formation of the knowledge foundation

Wall of human resources

Dynamic engagement of all citizens in the new economy and society

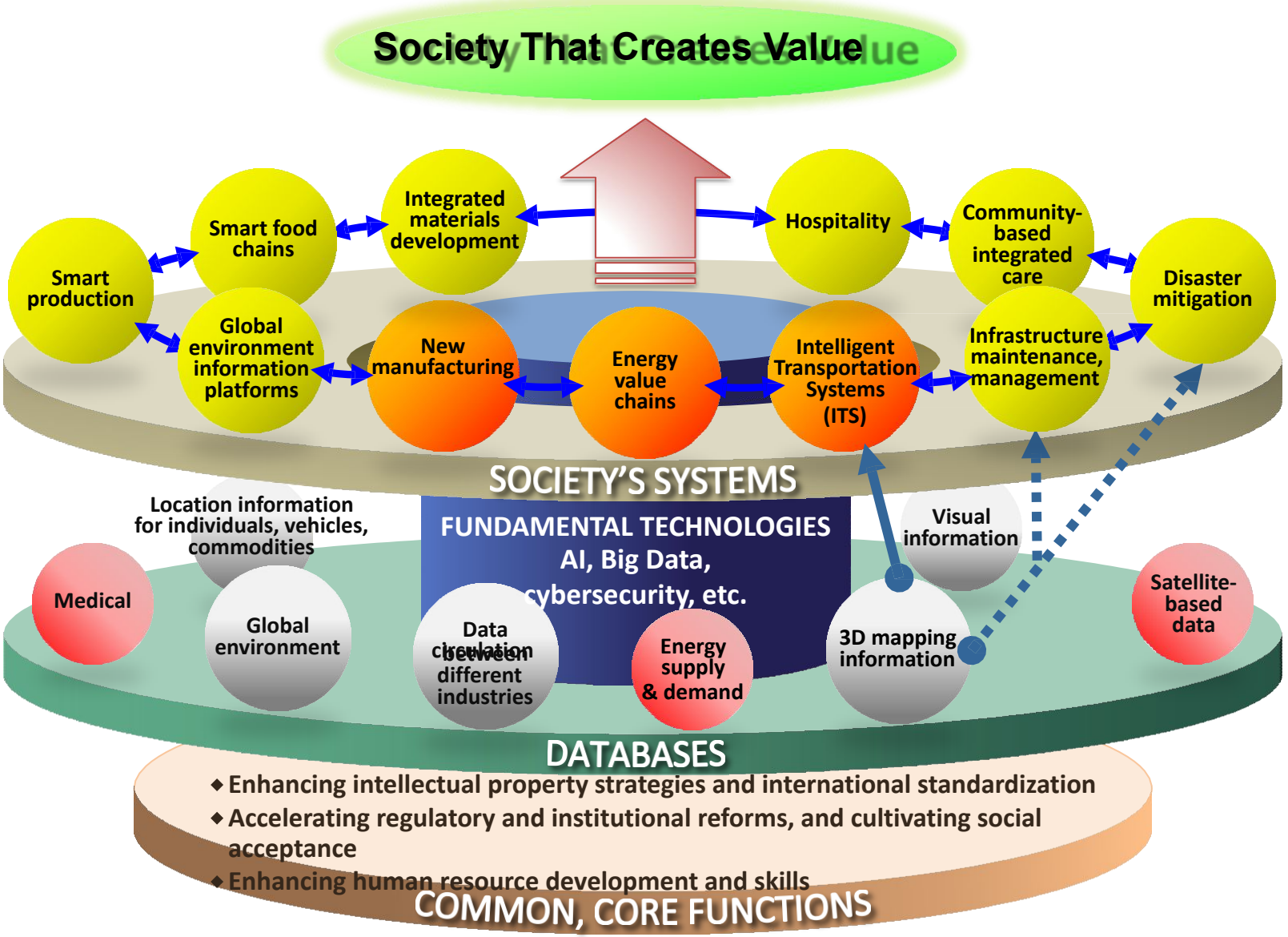
Wall of social acceptance

Wall of social acceptance

Integration of advanced technologies and society

Source: Japan Business Federation (KEIDANREN)

2-8 Society 5.0 Platform



Source: Government of Japan, Cabinet Office. Modified in part by Mitsubishi Electric.

2-9 Mitsubishi Electric's Contributions to Society 5.0 for Achieving SDGs

Source: Japan Business Federation (KEIDANREN)

3. EXAMPLES OF MITSUBISHI ELECTRIC CONTRIBUTION TO SOCIETY 5.0

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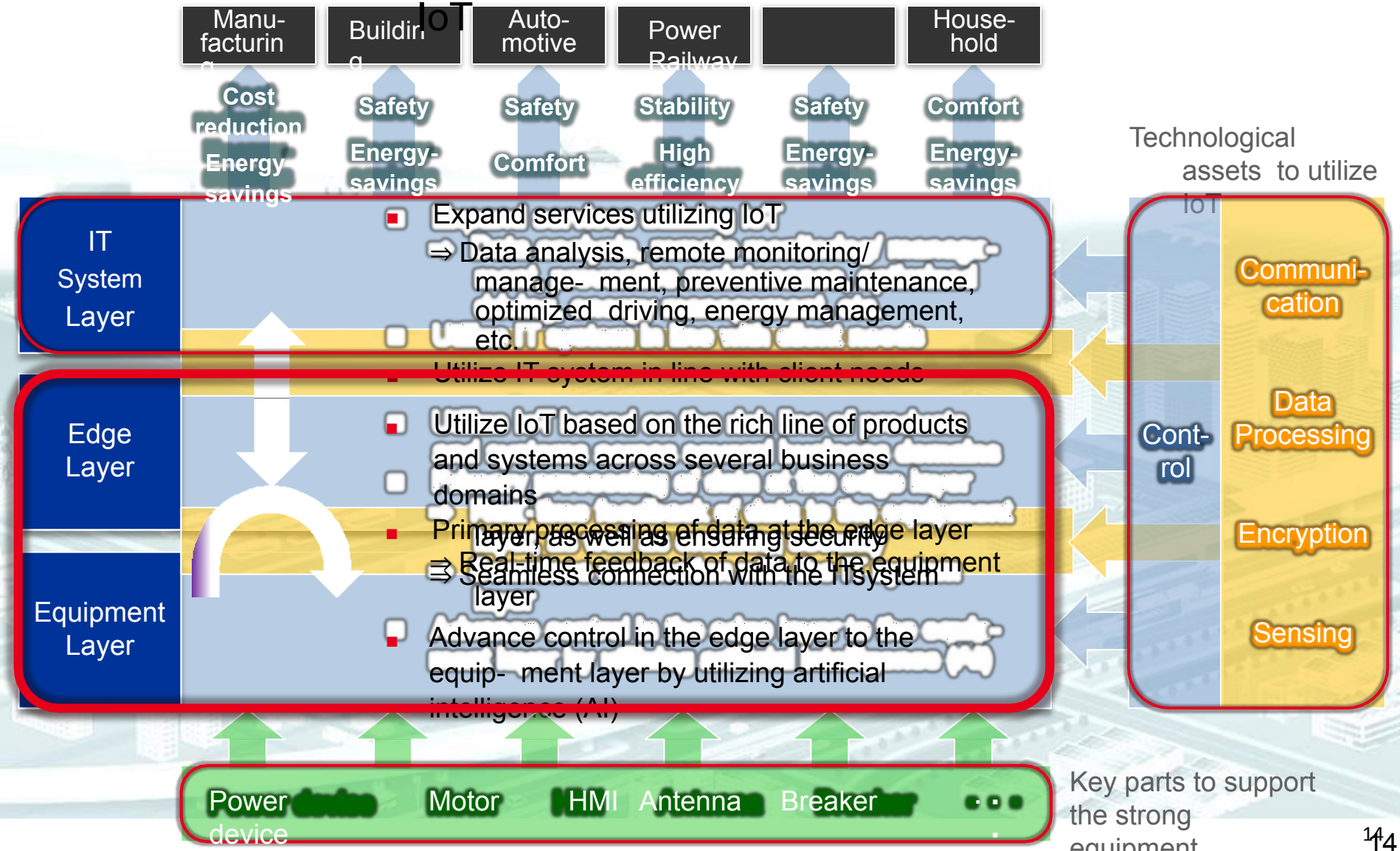
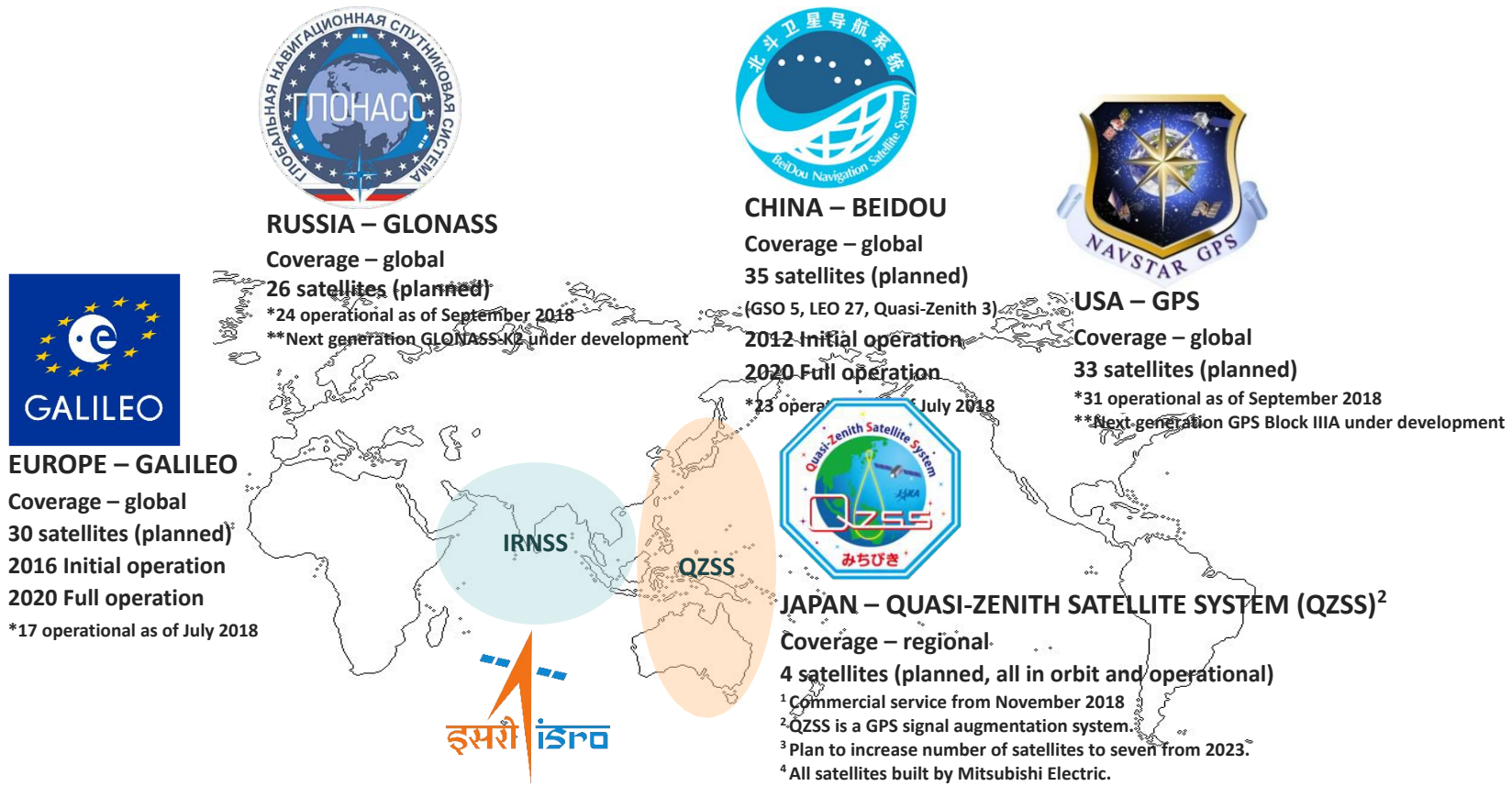
3-1 New Businesses and Services

Create New Value by Utilizing IoT



3-2 Autonomous Driving Technology 3-2a Positioning Satellites

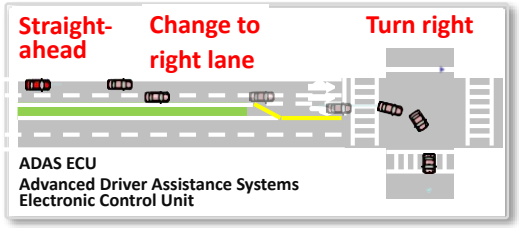
- Positioning satellites provide positioning – or geolocation – information.
- As the third space-based infrastructure following communication and observation satellites, several "GPS" systems are currently deployed or under development by various countries.

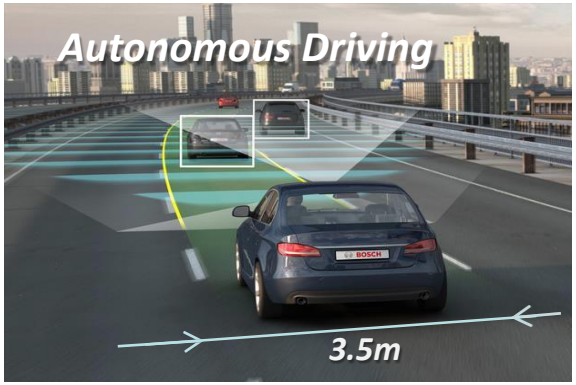


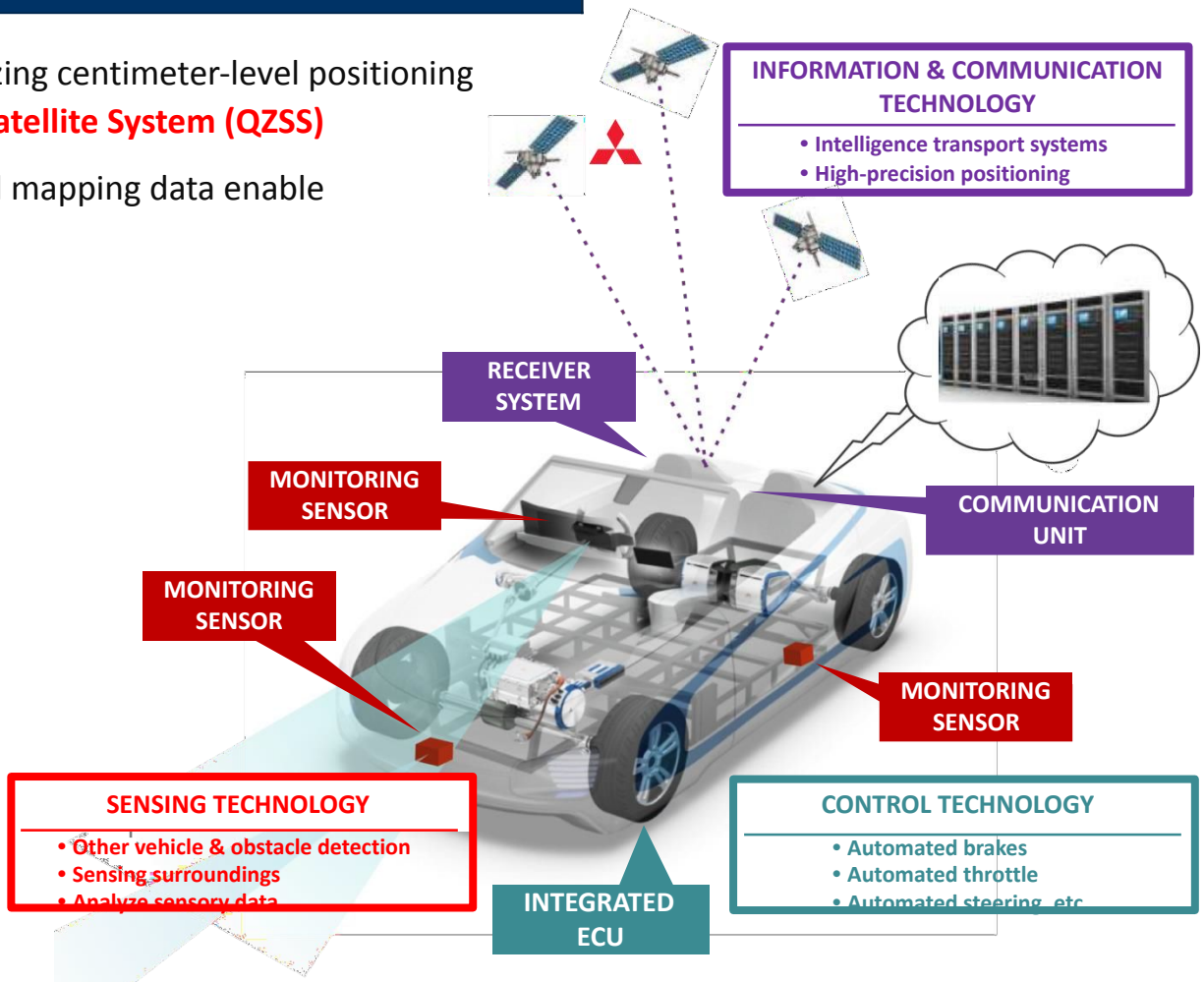
3-2b CLAS
Centimeter-Level Augmentation Service

Key Technology ⇒ High-accuracy 3D positioning in combination with CLAS

- Intelligent autonomous driving utilizing centimeter-level positioning signals from **Japan's Quasi-Zenith Satellite System (QZSS)**
- High-precision signals and lane level mapping data enable automated lane changes







*Mitsubishi Electric conducted highway tests of the world`s first CLAS-based autonomous driving technology on September 19, 2017.
*CLAS became commercially available on November 1, 2018.

3-2c Leveraging a Wide Spectrum of Technologies

Value Creation through Initiatives for Automated Driving

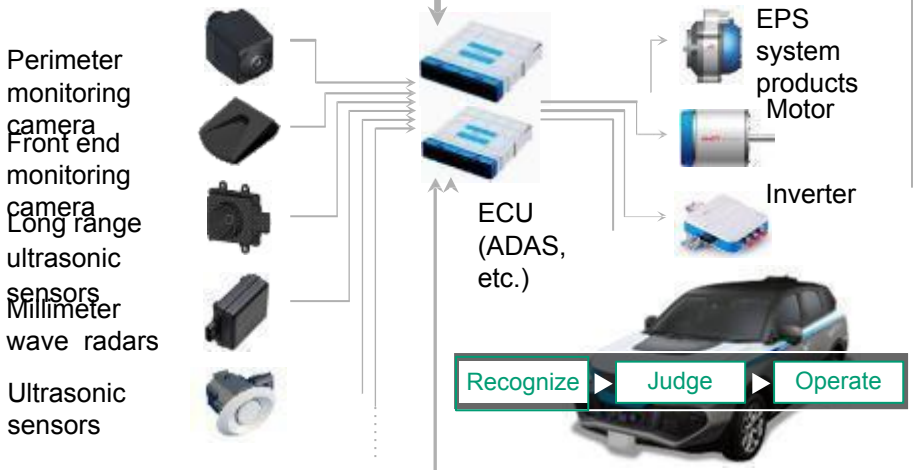
Contribute to realizing a safe and comfortable automated driving society from both “autonomous driving systems” and “vehicle-infrastructure cooperative

Autonomous driving systems

Combination of
sensing technology and vehicle control technology

A system which enables autonomous automated driving by combining automobile mounting devices such as those for control, surveillance, and out-of-vehicle information utilization

- Recognize and judge the surrounding environment of the automobile and anticipating movements through high quality surveillance sensors and sensor fusion
- Through high precision vehicle movement control technology, realize safe and comfortable automated driving



Test drive with the automated driving
concept car “EMIRAI3 xAUTO”

*ITS - Intelligent Transport Systems,
ADAS - Advanced Driving Assistant System

Vehicle-infrastructure cooperative systems

Utilizing information infrastructure such as quasi-zenith satellites and ITS

A system which utilizes information from outside the vehicle, such as satellites, through out-of-vehicle information utilization devices

- Position the vehicle with centimeter-precision utilizing high definition map creation technology and high measuring precision technology


High-precision locator


Quasi-zenith satellites

Ground systems for quasi-zenith satellites

Positioning information at the centimeter level
Positioning performance adaptive to moving objects

Positioning data obtained in a couple dozens of seconds

- Established Dynamic Map Planning Co., Ltd. (Switzerland)
- Development collaboration with u-blox
  ⇒ Develop automobile receiver chip responding to “Centimeter level augmentation service” (promote expanded use of quasi-zenith satellite system)
- Develop automated mapping technology and extraction of transitory technology
  ⇒ Efficiently create and update high precision 3D maps (utilize AI and MMS technology)

- Obtaining real-time information on the road through road-vehicle and inter-vehicle linked communication


C2X onboard equipment


ETC2.0（DSRC）

3-2d 3-D Mapping
- Automated mapping, analysis, functions -

Automated mapping/extraction of transitionsfor high-precision 3D maps (under development)

Utilize AI and MMS technology to automatically produce and refresh high-precision 3D maps.
*MMS: Mobile Mapping System

3D space positioning data by MMS

High-precision 3D map

Automated analysis of camera images

Improve security and disaster prevention for public facilities, buildings, commercial facilities. Provide appropriate services via attribute determination using images.

- Analyze image data taken by cameras with AI
- Sort out characteristics that were derived and determine the attribute of people/ objects

Attribute data

Movement

Physical appearance

Objects

Determine behavior/ attributes

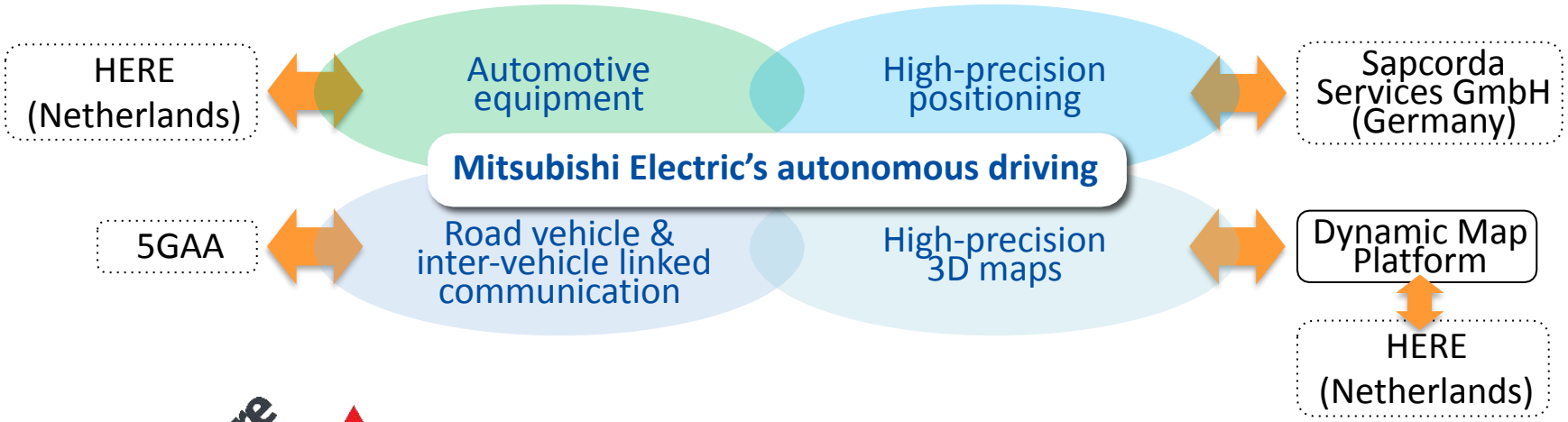
- someone staggering
- someone squatting
- someone with a cane
- someone pushing a stroller
- shopping carts

etc.

3-2d Autonomous Driving
- Technology Partnerships -

Mitsubishi Electric's autonomous driving technologies and major business development partnerships

Strengthening competitiveness, global expansion, and standardization through cooperation with partners in Japan and across the globe.



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Services to support cars with ADAS (advanced driver assistance systems) to fully autonomous vehicles of the future.

Support services for smart lane-level guidance based on real-time traffic conditions and incidents.

Targeting other industries beyond the automotive market.

Sapcorda Services GmbH
BOSCH Geo++ MITSUBISHI ELECTRIC u-blox

High precision GNSS positioning services to mass market applications

Offer globally available GNSS positioning services via internet and satellite broadcast to enable centimeter-level positioning

Real-time data correction service to be delivered in a public, open format, not bound by hardware or systems.

5GAA: 5G Automotive Association
Sapcorda Services GmbH: joint venture established by Mitsubishi Electric, Bosch, Geo++, and u-blox (August 2017)
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3-3 Next-Generation Industrial Systems

CHALLENGES TO BE TACKLED

- Shortage of human resources in manufacturing
- Changeover from the sale of goods to services & solutions

AIMING FOR A SOCIETY IN WHICH…

Data links between in-house and machines at other factories *optimize productivity and supply chains*, help attain *greater levels of safety*, and foster the *creation of new and innovative* products and services

DIGITAL TECHNOLOGY ◆ ROBOTICS ◆ IoT

REALIZING UNPRECEDENTED NEW SERVICES & SOLUTIONS

PRIVATE SECTOR APPROACHES

- Exemplifying data linkage between companies

Edgecross FIELD stem

- Established in May 2018
- 150+ partner companies
- Real-time data collection & management across factories & industrial PCs for production site modeling & monitoring

EDGECROSS CONSORTIUM

- Domestic service started in October 2017
- Proven operation
- 400+ partner companies
- Real-time data analysis and control on the 'edge computing side' by connecting machines across production sites

FANUC

DATA LINK IN ACTION

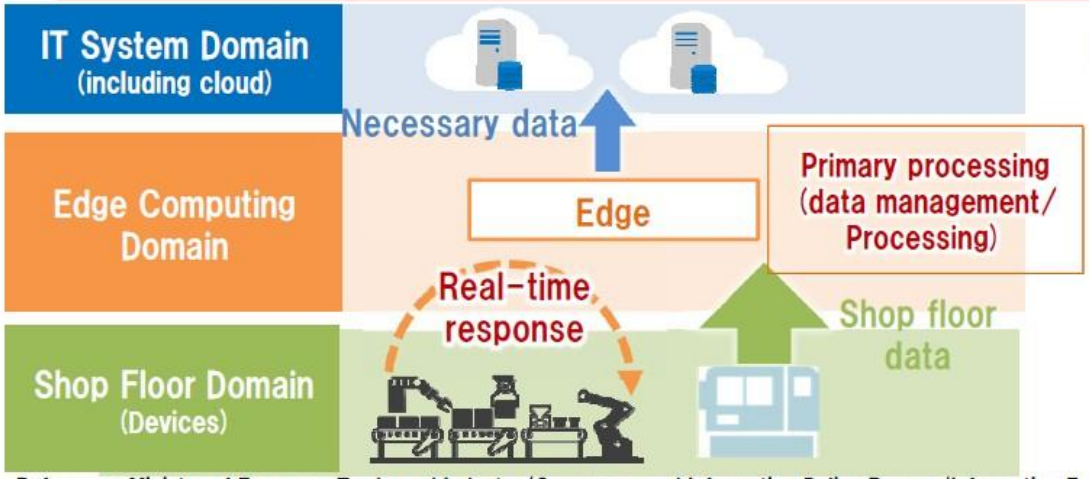
Autonomous Tractor

Autonomous tractor
Source: University of Hokkaido

- Quazi-Zenith Satellite System ("Michibiki") signals used for tractor navigation
- Greatly improved efficiency of upstream industries such as producers, and downstream industries such as distributors and retailers

3-4 Smart Manufacturing

Edge Computing – The Key to Using IoT



Primary processing of shop floor data
Feedback made close to shop floor

①Simultaneous operationsimproved
② Security ensured
③ Communication volume reduced

Reference: Ministry of Economy, Trade and Industry/Commerce and Information Policy Bureau/Information Economy Subcommittee/Industrial Structure Council's "Working Group on Distribution Strategy (First Session)"

Open Software Platform for Edge Computing Domain

EDGECROSS

Edgecross is an open software platform for the edge computing domain, which originated in Japan. It was created by Edgecross Consortium members, who interact outside the boundaries of corporations and industries with the aim of achieving FA-IT collaboration.

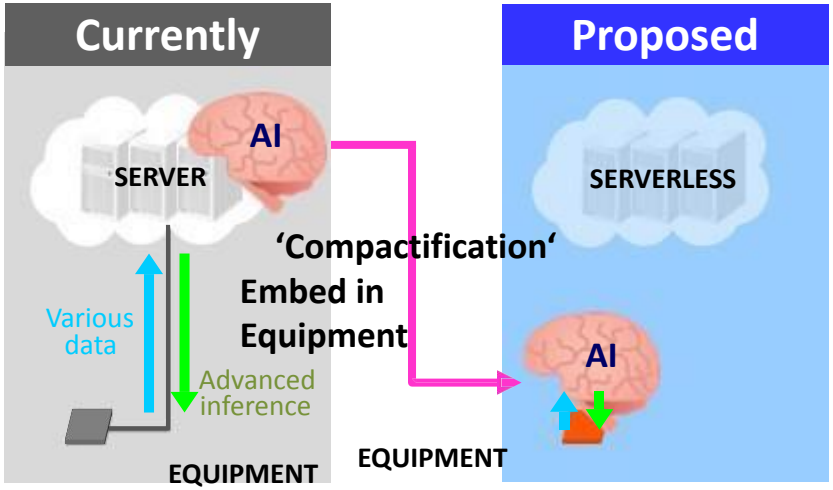
- Operates on any industrial-use computer regardless of manufacturer
- All data on shop floor collected
- Real-time diagnosis and feedback

Source: Edgecross Consortium

- Modeling shop floor
- Seamless connectivity between FA and IT systems
- Utilizing wide variety of applications in the edge computing domain

3-5 Embedded AI

Embed AI into Equipment



Create efficient network structures and calculating methods for inference processing

Develop an algorithm for new machine learning, and reduce the amount of calculation and memory volume for AI learning and inference processing.

*Inference processing: a process of identification, recognition and forecasting of unknown matters by utilizing knownmatters.

'Compactification' of AI

Achieve the learning process in embedded equipment, a process previously accomplished on the server (IT system layer)

Reduce the amount of calculation and memory volume (up to 1/30 of current volume) by combining "high-speed training algorithm for deep-learning" (compared to current capabilities)

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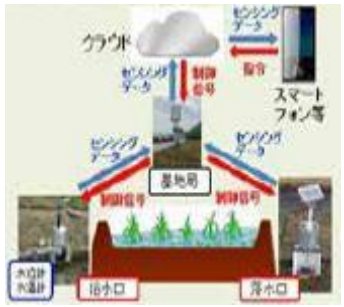
3-6 Smart Agriculture
- Strengthening farming competitiveness -

- ***In Japan, utmost efforts are under way to reform entire agricultural sectors – such as farmland consolidation being undertaken by the Farmland Intermediary Management Institution – as well as reducing the cost of agricultural materials.***
- ***AI and robotics are also emerging that will allow conventional, yet precise, agricultural techniques to take place that work in union with farmers' know-how and experience.***
- ***Vital to accelerate "smart agriculture" for the sake of agricultural reform in fusion with advanced technologies.***

SMART

NEW, AUTONOMOUS AGRICULTURE MACHINERY FOR ENERGY SAVINGS AND EFFICIENT PRODUCTION WITH THE USE OF ROBOTICS AND ICT

- Autonomous tractor scheduled to be commercialized in 2018.
- Remote-controlled, unmanned rice transplanter under development.



- System created that enables remote and automated water supply management of paddy fields
- 80% reduction in water supply management man-hours

- **Using drones for sensing and precise management of paddy field and crops.**
- **Precision fertilizer application contributes to high-value added, branded produce with better flavor.**

LARGE SCALE, CONSOLIDATED FARMLAND

Hyper-energy savings achieved by unprecedented large scale farmland management

CREATING A MOTIVATED FARMING WORKFORCE

Facilitate farm skill education and new, young human resources

HIGH-QUALITY PRODUCTS THAT BRING COMPETITIVENESS TO THE GLOBAL MARKET

Disseminate world-famous Japan brands with stable production of high-quality agricultural products

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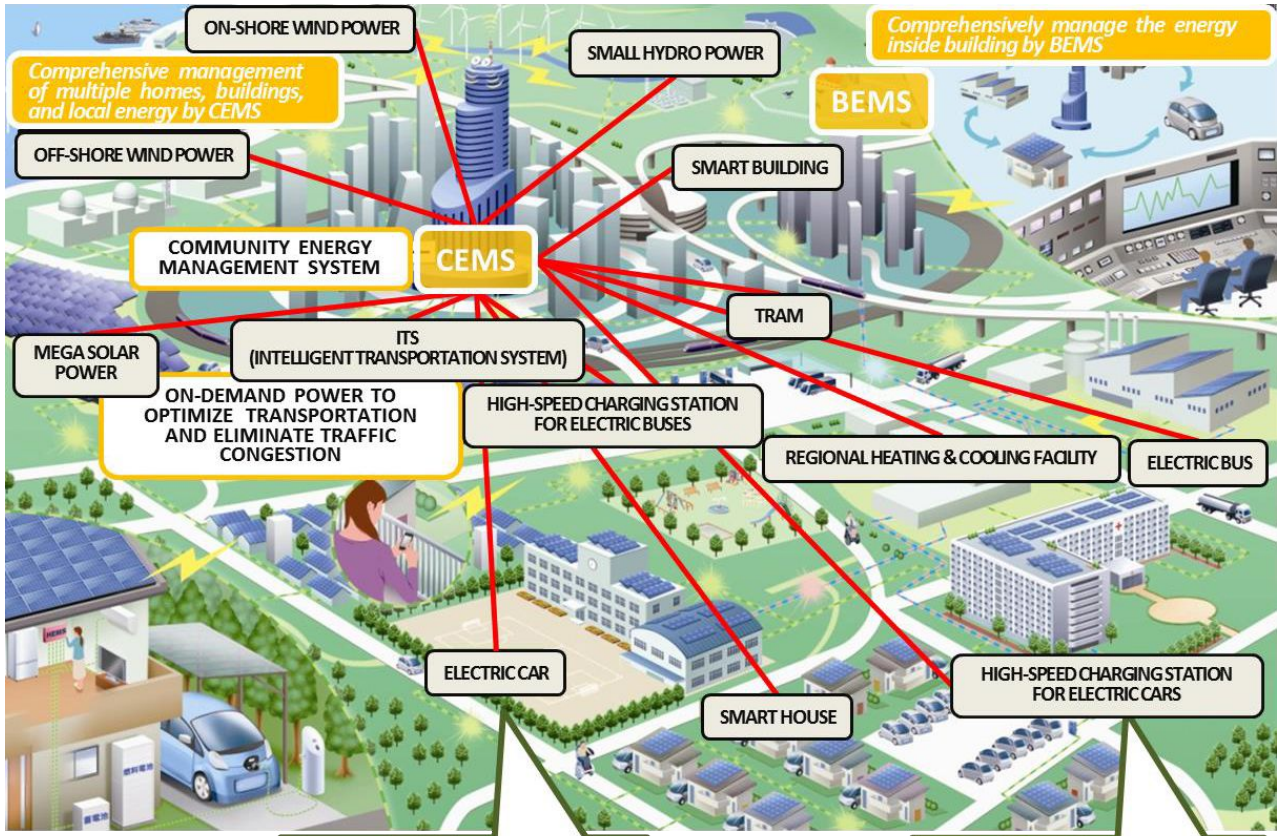
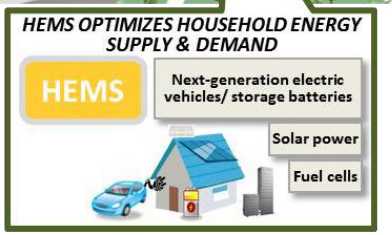
3-7a Smart Community
- The Big Picture -

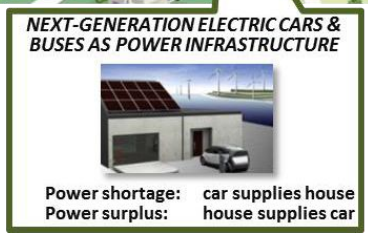
New social concept of comprehensive energy supply and demand management, and optimized energy consumption, within communities with decentralized energy systems such as renewable energy, co-generation systems, IoT, and storage battery control.



HEMS OPTIMIZES HOUSEHOLD ENERGY SUPPLY & DEMAND



NEXT-GENERATION ELECTRIC CARS & BUSES AS POWER INFRASTRUCTURE



3-7b ZEB Technologies
Test Facility

Mitsubishi Electric aims to realize net Zero Energy Buildings (ZEB) that generate all necessary primary energy to enable independent operation. Furthermore, Mitsubishi Electric will accelerate technology development and tests based on our original *ZEB+** concept to create further added value.

Opening June 2020

**ZEB+ is a registered trademark of Mitsubishi Electric Corporation.*

In addition to ZEB, ZEB+ aims to create added value in efficiency, ease of use, and comfort to offer a sustainable building solution and services that cater to the life cycle of buildings

Location: 5-1-1 Ofuna, Kamakura City, Kanagawa Prefecture (inside Mitsubishi Electric's Information Technology R&D Center)

Floor Space & Structure: Office floor space: approx. 2,000m^2; Facility area: approx. 6,000m^2; Steel-framed building featuring four floors

3-7c Shirasagi Denki Kogyo

Advancing net Zero Energy Buildings (ZEB) to reduce greenhouse gas emissions

- ZEBs are buildings with zero – or close to zero – *annual primary energy consumption* via energy-saving methods such as:
  - ✔ Effective thermal insulation
  - ✔ Solar radiation screening
  - ✔ Use of natural energy, such as solar power
  - ✔ High-efficiency devices

- As the electronics industry's first ZEB Planner*, Mitsubishi Electric supplied equipment and systems for Shirasagi

Shirasagi Denki Kogyo New Head Office

*Registration system established by Japan's Ministry of Economy, Trade and Industry(METI) in FY2017 to promoteZEBs

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3-8 i-Construction

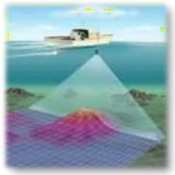
- Transforming work sites into technology forefronts -

- ***i-Construction* = ICT-integrated construction*** *Trademark of Ministry of Land, Infrastructure, Transport and Tourism (MLIT)
- ***Leverage 3D data at all stages of construction: surveying, building, maintenance, and repair***
- ***Accelerate the use of new technologies by introducing concurrent engineering[1] and front-end loading[2]***

i-Construction

Laser Scanner

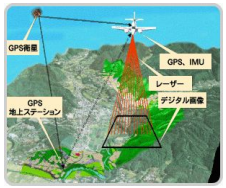
UAV



Narrow Multibeam Sonar

3D SURVEY DATA ACQUISITION

ICT-CONTROLLED EARTHMOVER



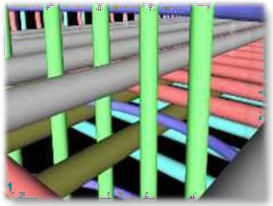
EARTHMOVER CONTROL USING AIRCRAFT-BASED LASER DATA

• Geological survey company • Surveying company	Consultant	Construction Company	Customer	Construction Company Consultant

SURVEY → DESIGN/ PLANNING → CONSTRUCTION → INSPECTION → MAINTENANCE/ REPAIR

DESIGNED WITH 3D CAD

OPTIMIZED ROUTES



OPTIMIZED PIPING

SITE SURVEY USING GNSS ROVERS

CHECKING INTEGRITY OF SUBMERGED STRUCTURES BY ACOUSTIC VIDEO CAMERAS

[1]**Concurrent engineering** - method where different stages in [2] **Front-End Loading (FEL)** includes robust product design and development are done simultaneously, planning and design early in a project's lifecycle rather than consecutively, to reduce development time and (i.e., the *front end* of a project). [Wikipedia] costs. [Wikipedia]

4-1. e-F@ctory SOLUTIONS IN RUSSIA
Russian Railways (1/2)

CHALLENGES

- Wagon maintenance facility at Magnitogorsk
- Extraordinary distances and the most extreme conditions on the globe result in enormous stress on components
- Need for complex tasking and scheduling for parts testing, quality data acquisition, and overhaul

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4-2. e-F@ctory SOLUTIONS IN RUSSIA
Russian Railways (2/2)

e-F@ctory Solutions

- *RFID-based traceability throughout processes*
- *Shop floor NC machinery and handling machines connected directly to IT MES layer*
- *Simplified configuration reduces time dedicated to engineering*

Zero
data missed

3,000+
wagons/yr

5. INNOPROM 2017

Second Time to Participate in INNOPROM

- Booth showcased MER's existing businesses such as factory automation, air-conditioning & refrigeration, and visual information systems, that contribute to Society 5.0
- With Japan a Partner Country in 2017, MER also displayed businesses with which it aims to enter the Russian market in the medium- and long-term in sectors such as transportation, power, among others

JAPAN
Partner Country 2017

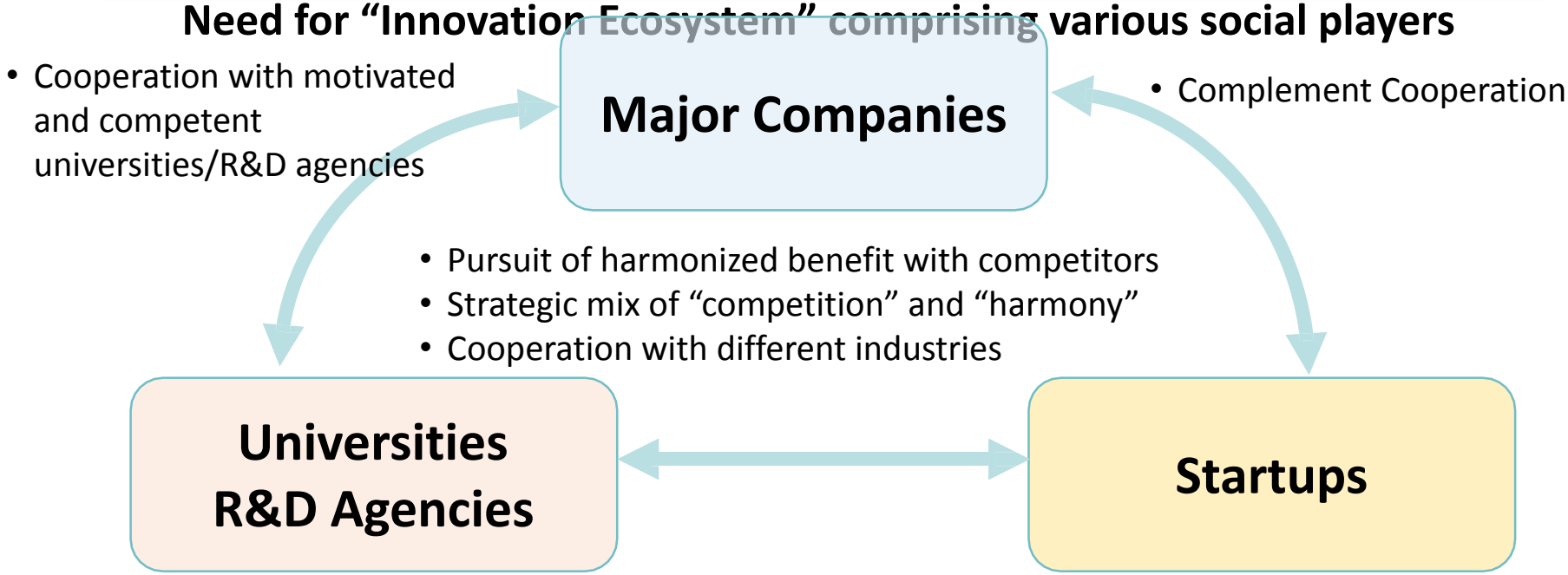
4. TOWARD CONSTRUCTION OF AN INNOVATION ECOSYSTEM

- One of the keywords toward Society 5.0 is “diversity”.
- Construction of innovation ecosystem comprising diversified players is essential for Society 5.0.

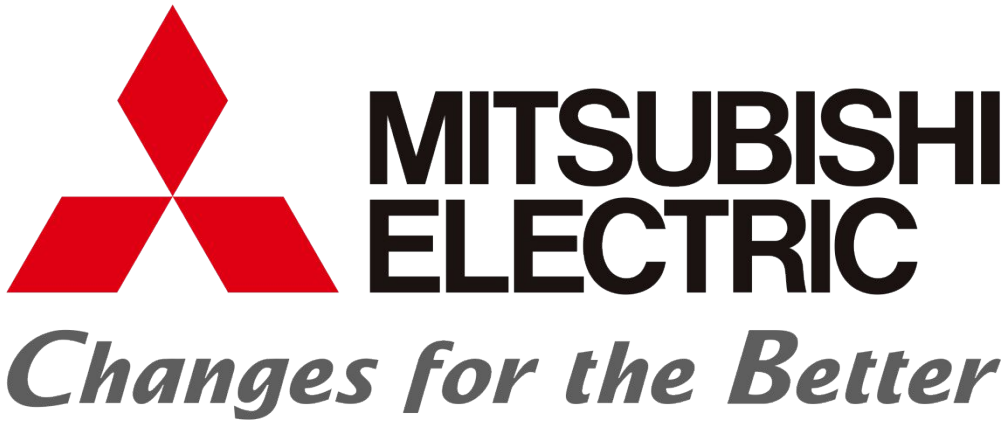
Surviving Paradigm-shift optimization

Creating Society 5.0, which realizes social-wide

Need for “Innovation Ecosystem” comprising various social players



Source: Japan Business Federation - Keidanren’s Proposal (2018.2.20)



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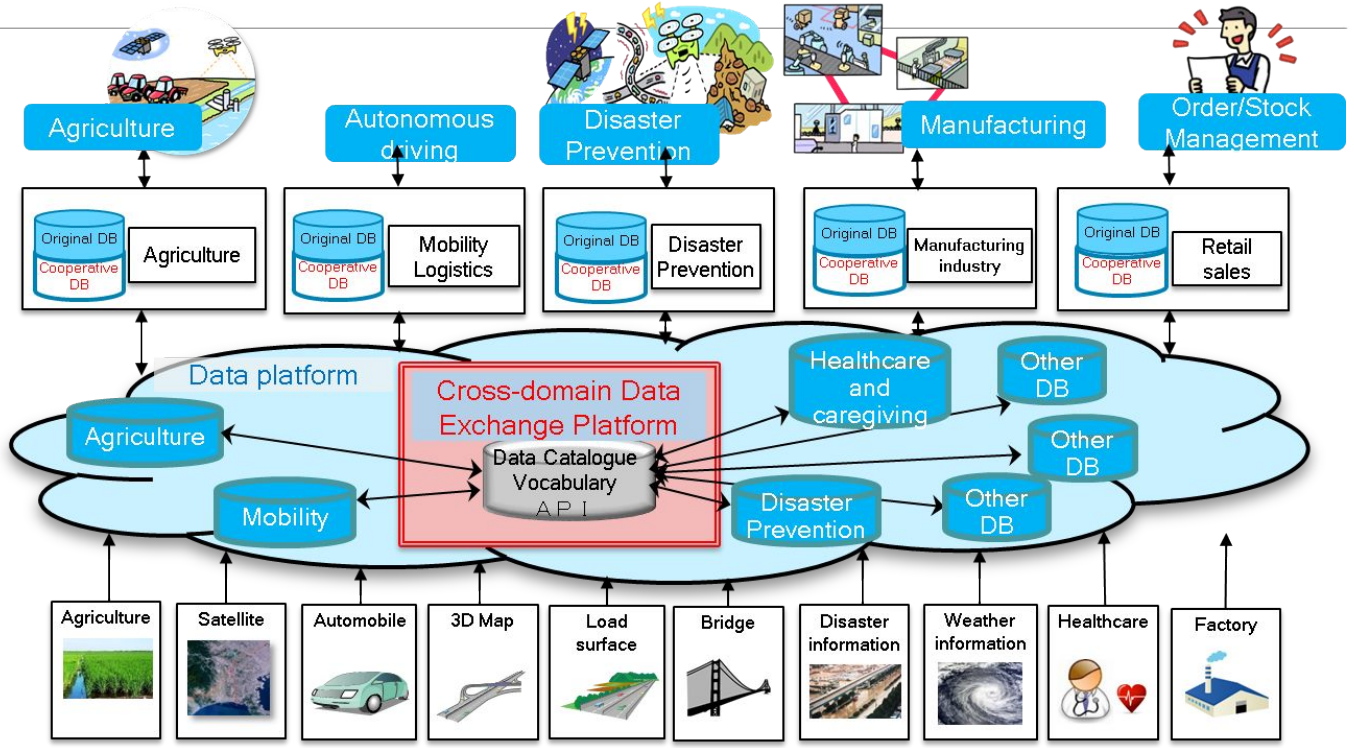
APPENDIX

Data from Japanese Government Cabinet Office

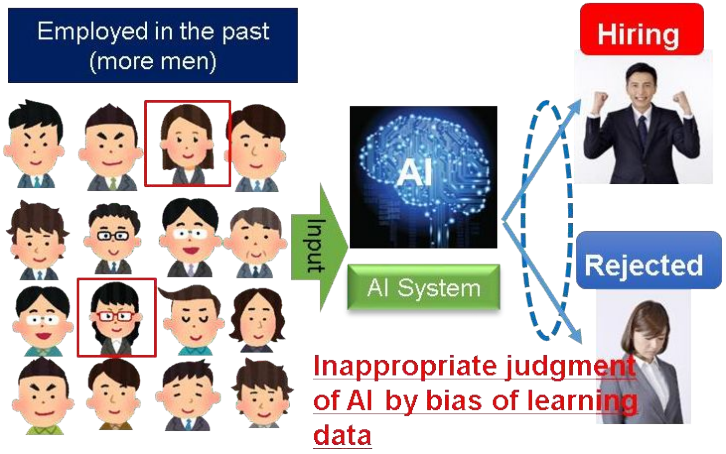
S 5.0 Data Platform

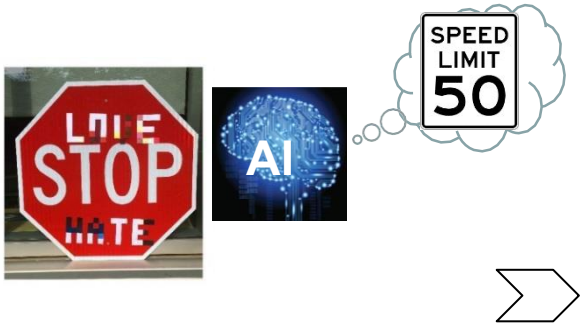
Establishment of "Cross Domain Data Exchange Platform" that enables all data to be used safely and at an AI level.



In order to implement safe and reliable social packaging of AI, Trusted data is required to ensure trustworthy AI products and services.

■ Improper judgment by past data





Example of misreading a STOP sign as the speed limit sign by attaching tapes of characters

MITSUBISHI ELECTRIC
Changes for the Better

Actions for Smart City in Japan

Society 5.0

- Smart City = Place for advanced implementation of Society 5.0

Leading Organizations

- CSTI: - Research and development in SIP
  - Building inter/intra-field data cooperation infrastructure
  - STI project in Tokyo Olympic and Paralympic Games
- Growth Strategy Council: Proposal of Smart City vision for growth strategy
- Office for Promotion of Regional Revitalization: Proposal of Super City vision

Ministry	Project	Summary	City
MLIT	Smart City substantiative research / Smart City support project (2019)	Improvement of citizen's life, city activity, and efficiency of infrastructure management	Sapporo, Toshima
MIC	ICT-based city development project / Data-based Smart City project	Support of city development with ICT	Sapporo, Kakogawa, Takamatsu, Aizuwakamatsu
METI	Smart community verification project / Grant for smart community vision	Management of distributed energy system with IT and battery technology	Yokohama, Toyota, Keihanna, Kitakyusyu

Business community

- COCN: "Development of Digital Smart City" project
- Japan Business Federation: Society 5.0 action plan, consultation with MLIT Minister (2018/11)

Promotion of Smart City

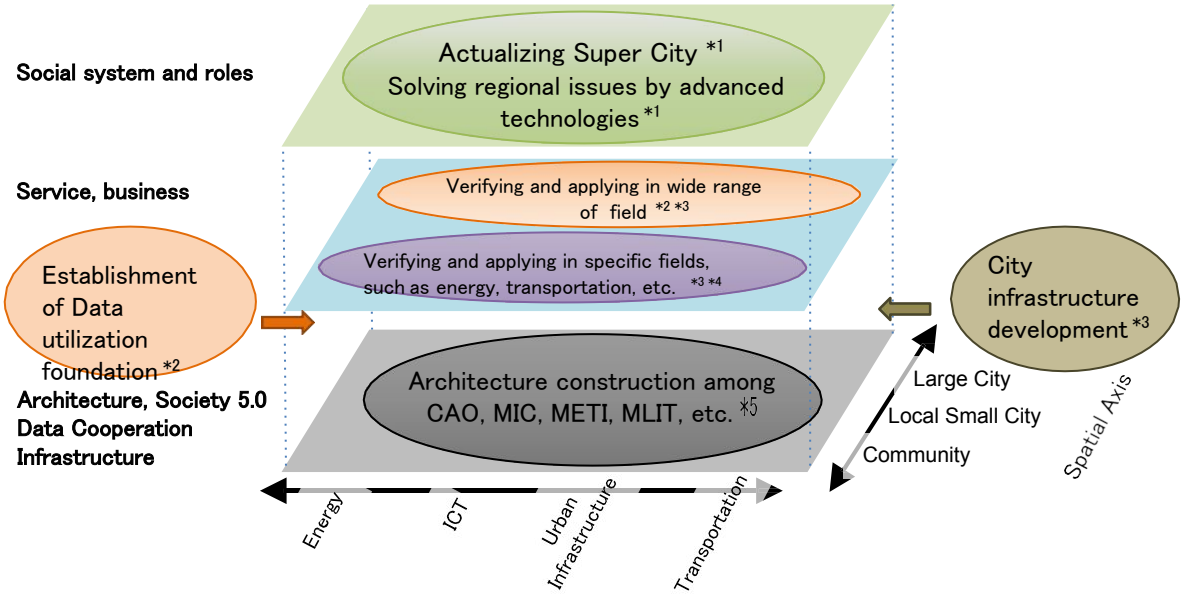
(adopted at the 'Integrated Innovation Strategy Promotion Council' on March 29)

- Common Basic Principles, Strengthen the global Smart City collaboration

Common Basic Principles

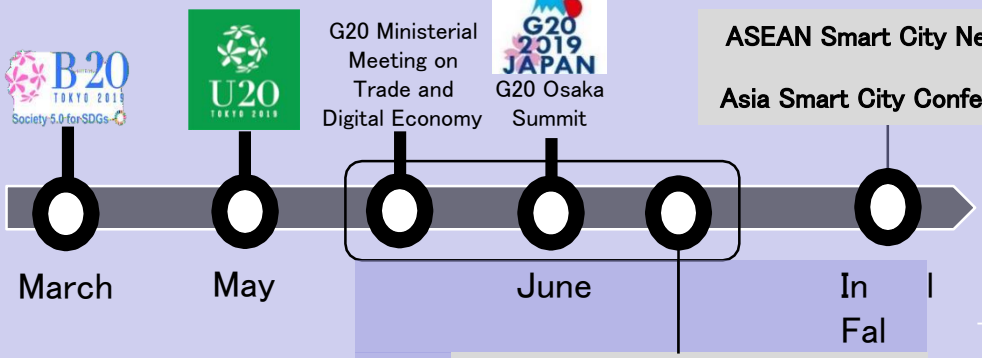
- Clarification of Visions
- Overview based on Architecture
- Securement of Interoperability
- Securement of Extensibility
- Development of organization and structure

Implementation & Collaboration



*1 Office for Promotion of Overcoming Population Decline and Vitalizing Local Economy in Japan, Cabinet Office (CAO)
*2 Ministry of Internal Affairs and Communications (MIC)
*3 Ministry of Land, Infrastructure, Transport and Tourism (MLIT)
*4 Ministry of Economy, Trade and Industry (METI)
*5 CSTI, Cabinet Office (CAO)

Int'l Conferences



ASEAN Smart City Network High Level Meeting

Asia Smart City Conference

Smart City/Super City Forum 2019

Int'l Collaboration on Smart City

Through multilateral and bilateral collaborations, knowledge including
- Good practices in each country
- Basic principles on data linkage platform, etc.

will be shared.

Proposal to G20: Global Smart City Coalition

Smart City (Including Megalopolis, City, Region) = The answer for achievement of **SDGs** in Digital era

SDGs × Digitalization = **Society 5.0**

Society 5.0 × Realization = **Smart City**

Smart City × Global Inclusiveness = **Global Smart City Coalition**

G20 economies must call for establishment of
Global Smart City Coalition

MELCO's contribution to Society 5.0
Satellite Solution【Intelligent Transportation 】

cm Level High-precision positioning Data Utilization

- Cm level High-precision positioning Data could create Innovative Services & New Industries for Smart City InstallationAuto（Autonomous Driving ・Safety driving support）/Railway（Ope. Control）/Farming Machine（IT Farm）/Construction Machine（i-construction）/Tourism ・Personal Services

Smart City Projects　MLIT：Smart City Pro.

「Advanced Model Project」15 projects

・supported by Smart City Experiment Budget

・analyze project results & their bottle neck problems for TTL

「Prioritized Business model project」23 projects

・accelerate business model start by Specialist dispatchment, Project Plannning

MLIT、MIC、CO cooperates for projects prosecution

*　Smart City Installation Phase

1	北海道	札幌市	市の中心部および郊外
2	秋田県	仙北市	市全域
3	茨城県	つくば市	市全域
4	栃木県	宇都宮市	市全域
5	埼玉県	毛呂山町	町全域
6	千葉県	柏市	柏の葉キャンパス駅周辺
7	東京都	千代田区	大手町・丸の内・有楽町エリア
8	東京都	江東区	豊洲エリア
9	静岡県	熱海市 下田市	熱海地区・下田地区
10	静岡県	藤枝市	市全域
11	愛知県	春日井市	高蔵寺ニュータウン
12	京都府	精華町 木津川市	精華・西木津地区
13	島根県	益田市	市全域
14	広島県	三次市	市川西地区
15	愛媛県	松山市	市中心市街地西部

1	宮城県	仙台市	泉パークタウン
2	茨城県	守谷市	市全域
3	群馬県	前橋市	市全域
4	埼玉県	さいたま市	高層地区、大宮駅周辺地区
5	東京都	大田区	羽田空港跡地第1ゾーン
6	神奈川県	横浜市	みなとみらい21地区
7	神奈川県	川崎市	新百合ヶ丘駅周辺地区
8	神奈川県	横須賀市	市全域
9	新潟県	新潟市	市全域
10	福井県	永平寺町	町全域
11	岐阜県	岐阜市	市全域
12	愛知県	岡崎市	乙川リバーフロントエリア
13	大阪府	大阪市	うめきた2期地区、夢洲地区
14	兵庫県	加古川市	市全域
15	岡山県	倉敷市	市中心市街地
16	広島県	呉市	市全域

17	広島県	福山市	市全域
18	徳島県	美波町	町全域
19	香川県	高松市	市全域
20	愛媛県	新居浜市	市全域
21	福岡県	福岡市	九州大学箱崎キャンパス跡地等及び周辺地域
22	長崎県	島原市	島原半島
23	熊本県	荒尾市	市営地地区

Tuskuba Smart City Consorsium

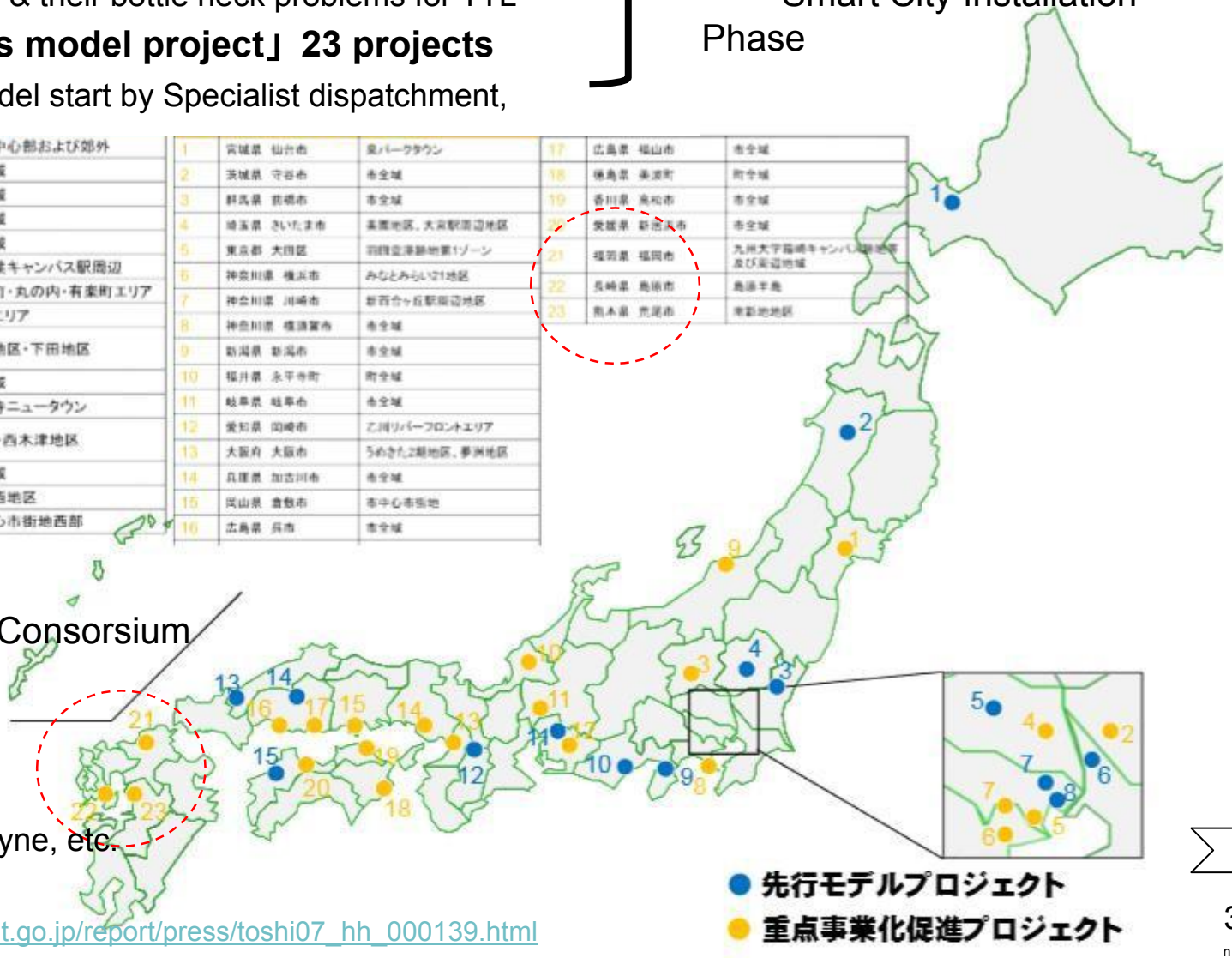
Kashima, KDDI

NEC

Hitachi

Mitsubishi Electric

Kanto Railway, Cyberdyne, etc.



〔国交省資料〕 https://www.mlit.go.jp/report/press/toshi07_hh_000139.html

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