Le Ministre conseiller pour les affaires économiques   A Tokyo, le 1er juin 2018

Affaire suivie par : Pauline Girot de Langlade, Célia Boffo

Annexes

Annexe 1 : Prévisions du marché de l'IA au Japon 2015-2030

Table 1: breakdown of Japan's AI market by sector (2015 – 2030)

Type of sector	2015	2020	2030
		Unit: billion yen	
Agriculture, forestry & fishery	2.8	31.6	384.2
Manufacturing	112.9	2,965.8	12,175.2
Construction	79.1	1,215.7	5,922.9
Electricity, gas & communications	30.0	521.7	1,881.0
Information services	182.5	824.5	2,373.1
Wholesale & retail	1,453.7	4,684.4	15,173.3
Financial & insurance	596.4	2,261.1	4,731.8
Real estate	4.9	242.6	485.3
Transport	0.1	4,607.5	30,489.7
Distribution	46.5	144.3	503.5
Technical services	9.0	244.0	614.9
Advertising	633.1	1,930.5	3,604.7
Entertainment	226.0	599.0	1,510.4
Education	203.0	503.9	928.5
Medical care and welfare	34.3	576.1	2,182.1
Living-related services	130.8	1,711.1	4,001.5
Total	**3,745.0**	**23,063.8**	**86,962.0**

Source: Ernst & Young Institute

Annexe 2 : Feuille de route gouvernementale pour le développement de l'IA au Japon

(1-1) Artificial Intelligence (AI) Development Phases
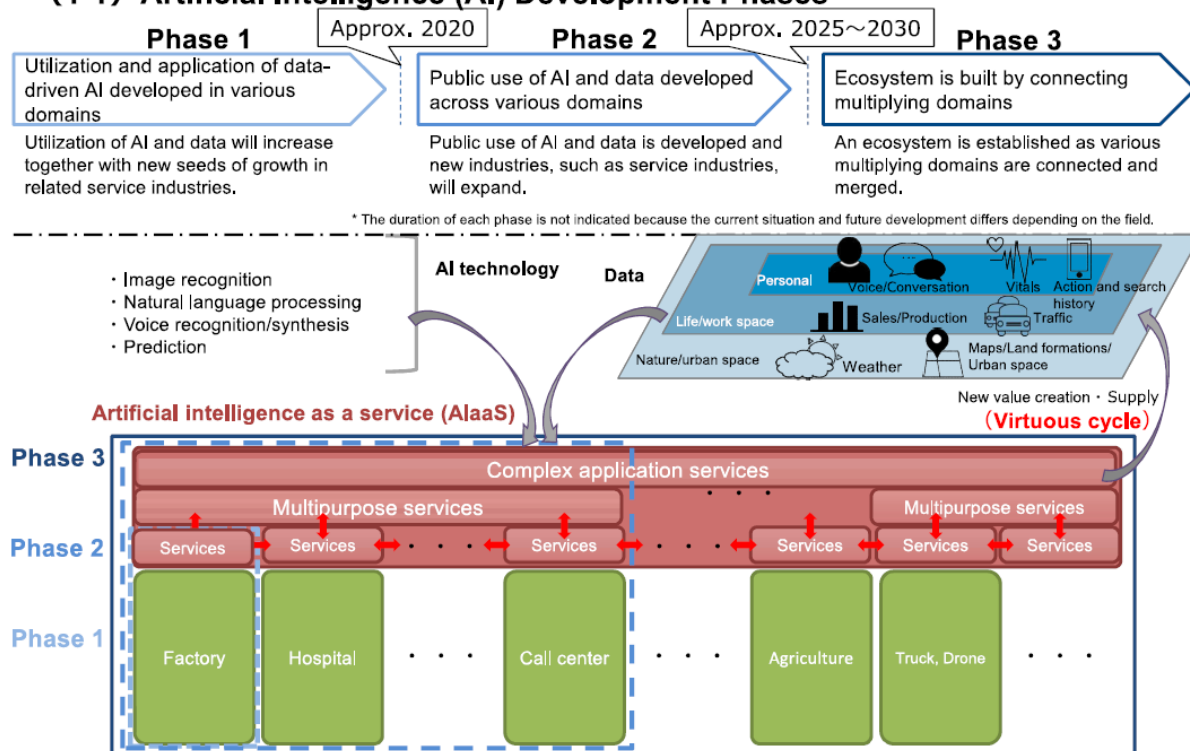
[Attachment 1]

Source : AI Technology Strategy, Strategic Council for AI Technology, 2017

Annexe 3 : Exemples de projets de R&D en IA lancés par des start-up et soutenus par la NEDO

Les projets ci-dessous ont été sélectionnés par la NEDO en septembre 2017 pour bénéficier d'un soutien financier sur deux ans respectivement de 1/ 50 M JPY ; 2/ 34 M JPY ; 3/ 38 M JPY ; 4/ 38 M JPY ; 5/ 12 M JPY ; 6/ 8 M JPY.

Sources : http://www.nedo.go.jp/news/press/AA5_100828.html ;
http://www.nedo.go.jp/english/event_20171201.html

1. "Practical applications for 'End-to-End Speech Recognition AI' that recognizes diversified speakers in multiple languages" - Hmcomm Co., Ltd.

Hmcomm is pursuing practical applications for "End-to-End Speech Recognition AI", using "CNN"*3 and "AI comparable to human intelligence" to solve social issues, such as labor shortages due to the aging population and the needs of sophisticated telemedicine.
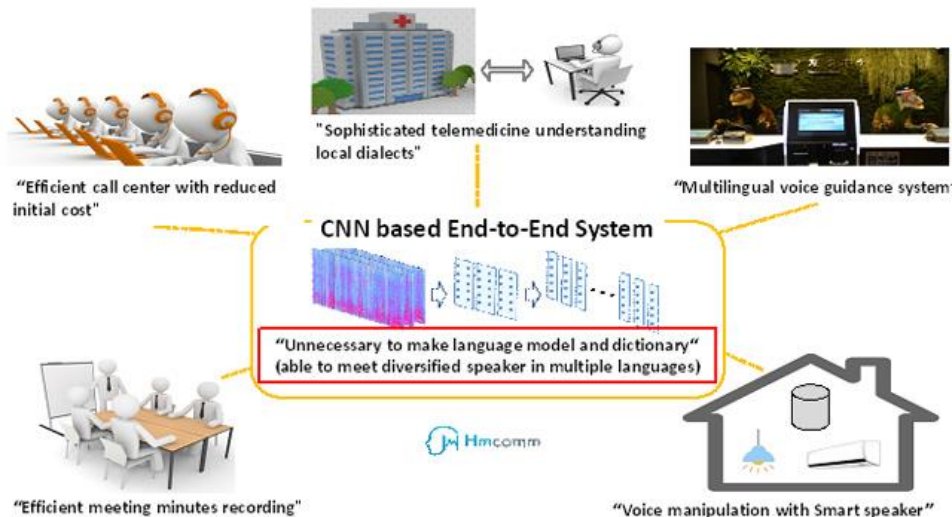
Figure 1. Schematic view of "End-to-End Speech Recognition AI"

2. **"**Research and development on AI's ability to infer optimal clinical departments", AR Advanced Technology, Inc. and SHIMADZU CORPORATION

In this project, AI cloud systems are trained to select the appropriate medical departments for outpatients by acquiring information through an interactive interview. The results of this project could shorten waiting time for outpatients and improve efficiency in medical office work.

Figure 2. Image of "Inferring optimal clinical departments by AI"

3. **"**Personal Artificial intelligence from Japan, cultivating in the smart phone", SOINN Inc.

By automatically learning the privacy settings of an individual smartphone, the "AI Personal Concierge SOINN" program collects information exactly suited to the user's personal needs and operate the smartphone automatically. Because the AI's learning takes place within individual smartphone devices, the risk of the information leaking is greatly decreased.

Figure 3. Image of "Personal Artificial intelligence from Japan, cultivating in the smart phone."

4. **"Research and development on interactive search algorithm based on deep learning to retrieve unstructured enterprise data"** - BEDORE Inc.

BEDORE is creating a deep learning-enabled interactive search system that can retrieve documents and answer questions. Enterprise search systems have lagged behind web search engines, which are highly optimized in their use of big data and machine learning. The proposed interactive search system aims to make enterprise searches more efficient.
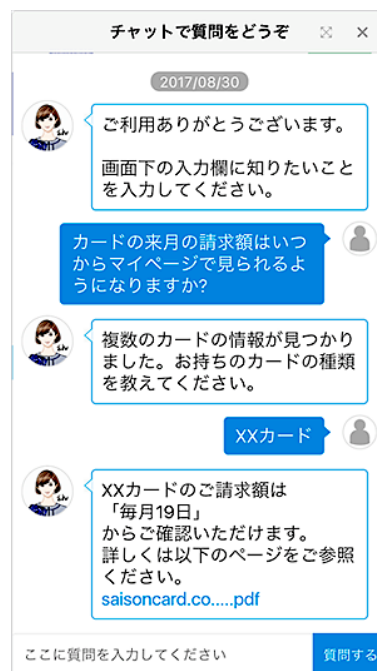
Figure 4. Image of proposed deep learning-enabled interactive search system

5. "Development of a 'Five Senses' AI-enabled camera" - Earth Eyes Co., Ltd.

Earth Eyes is developing an AI system that prevents accidents and criminal activity with a sophisticated combined-sensing feature comparable to human capabilities (image processing, sound processing, olfactory sensing, sound source recognition, and more), combined with analysis by AI. A primary goal

is to use the technology to develop retail stores with AI features, such as automated shoplifting prevention.

<Camera applications> 1CAM: Customer count 2・3CAM: Suspicious behavior detection
4CAM: Replenishment order 5CAM: Large quantity merchandise movement alarm
6CAM: Cashier queue alarm 7CAM: Workforce management

Figure 5: Image of 'Five Senses' AI-Enabled Camera (at retail store)

6. "Research and development on an AI engine to increase the productivity of back office contract review work", Cinnamon K.K.

Cinnamon is creating an AI document reader to increase the productivity of office workers.

Reduce office routine work by AI engine to extract data from unstructured document to process them into database.
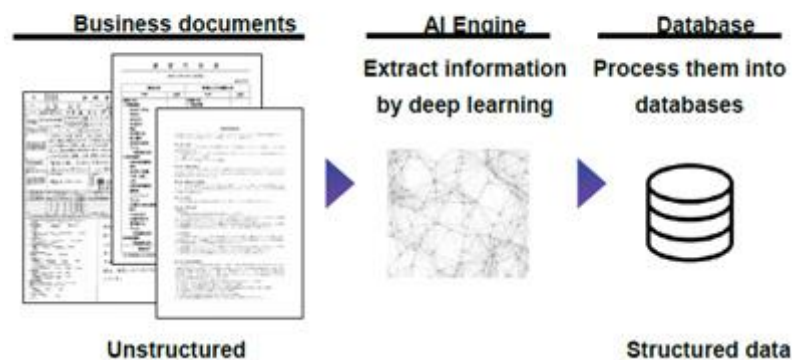
Figure 6: Image of "AI engine to increase the productivity of back office contract review work"

Annexe 4 : Impact de l'IA sur l'emploi d'après le Ministère des Affaires Intérieures et des Communications

Le MIC considère que l'IA devrait 1- être utilisée pour répondre au problème démographique, notamment pour réaliser certaines tâches pénibles et répétitives (comptabilité, chaînes d'assemblage….) ; 2- ouvrir de nouvelles perspectives sur l'emploi, en offrant la possibilité de travailler à des horaires plus **flexibles**, par exemple ; 3- permettre **l'apparition de nouveaux métiers** utilisant l'IA ou préparant l'introduction de l'IA dans une entreprise. L'Introduction de l'IA aurait donc également pour conséquence un environnement de travail plus favorable pour les femmes et les personnes âgées.

Figure 4-3-1-4   Envisioned impact of AI adoption on employment
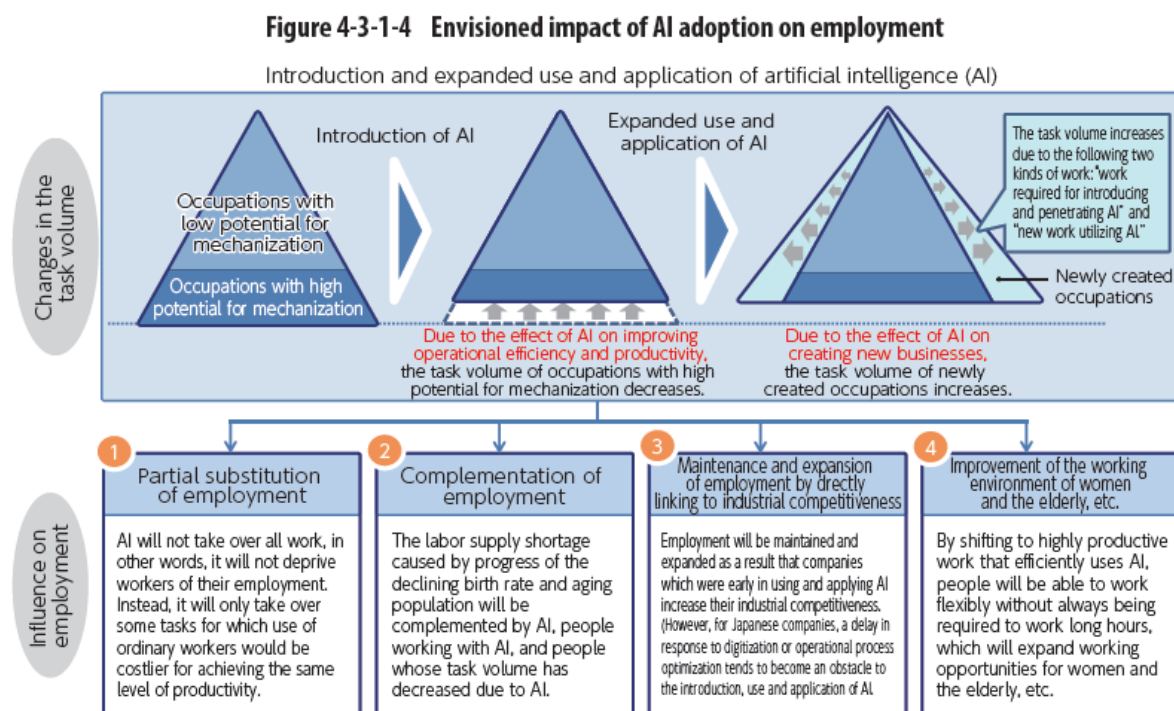
(Source) "Study Report on the Impact of ICT Progress on Employment and Work Styles" (2016), MIC

Annexe 5 : La nécessité de renforcer les ressources humaines spécialisées en IA.

Necessity of Fostering Human Resources Who Play a Role in R&D and Industrialization of AI [Attachment 3]

- As a shortage of AI personnel has been pointed out in realizing the research objectives and Industrialization Roadmap, **it has become a pressing need to foster top-level AI personnel as immediate assets, based on strong industry-academia-government collaboration**, particularly in Phase 1.
- As utilization of AI technology is anticipated in a broad variety of industries in Phases 2 and 3, it is also necessary to foster human resources who can disseminate the value created by AI technology as industries.

Future estimates for "leading IT human resources" (People)

	2016	2018	2020
Scale of potential human resources (a+b)	112,090	143,450	177,200
Number of human resources lacking as of the current point in time (b)	15,190	31,500	47,810
Current number of human resources (a)	96,900	111,950	129,390

* Source: Created by the secretariat based on Ministry of Economy, Trade and Industry "Results of Study of Recent Trends and Future Estimates Concerning IT Human Resources" (March 2016, commissioned to Mizuho Research & Information Institute) p.218, Figure 4-183
* "Leading IT human resources" refers to human resources engaged in big data, IoT, and AI (ibid., pp. 84 and 218)

Survey on needs for human resources in AI technology sector in the industrial world

With regard to AI human resources at various companies, Study commissioned to NEDO that was implemented at human resources fostering TF
the trend is that there are many companies that do not have any at all, companies that are unable to comprehend this, and companies that have not even examined this,

Example of provisional calculation of the annual training scale at universities (People)

	Hokkaido University	Tohoku University	University of Tokyo	Tokyo Institute of Technology	Nagoya University	Kyoto University	Osaka University	Kyushu University	University of Tsukuba	Waseda University	Keio University	Total
Master's program (estimated) *2	54,5	50,9	118,0	116,0	51,0	81,7	90,6	56,4	98,4	83,0	63,3	863,8
Doctoral program (estimated) *3	9.0	13.6	19.3	23.0	6.0	20.5	19.1	12.6	16.9	9.0	6.4	155.4

*1 Strategic Council for AI Technology Council study at human resources fostering TF. For Tsukuba and Waseda, the numbers represent the number of new students in FY2015, and for all other universities, the number represent the number of people completing the programs in FY2015.
*2 The number of human resources engaged in AI technology were calculated for the graduate schools/specializations related to AI technology at each university based on "Number of new students or graduates for the corresponding graduate schools/specializations" × "percentage of research laboratories conducting research related to AI within the corresponding graduate schools/specializations" (If the actual number of students affiliated with a research laboratory engaged in AI technology is known, calculations are made based on this actual number),
*3 The number of human resources in doctoral program s was also calculated using the same method as for those in master's programs.

In order to concretely realize research objectives and the Industrialization Roadmap, it is necessary to foster human resources who, as persons bearing responsibility, possess the three skills/knowledge below.

1) Solving the problems of AI technology
   (Various knowledge related to AI, ability to discover valuable problems, formularize them, and indicate a path towards solving such problems)
2) Realization of AI technology
   (Knowledge of computer science, programming techniques)
3) Utilization of AI technology
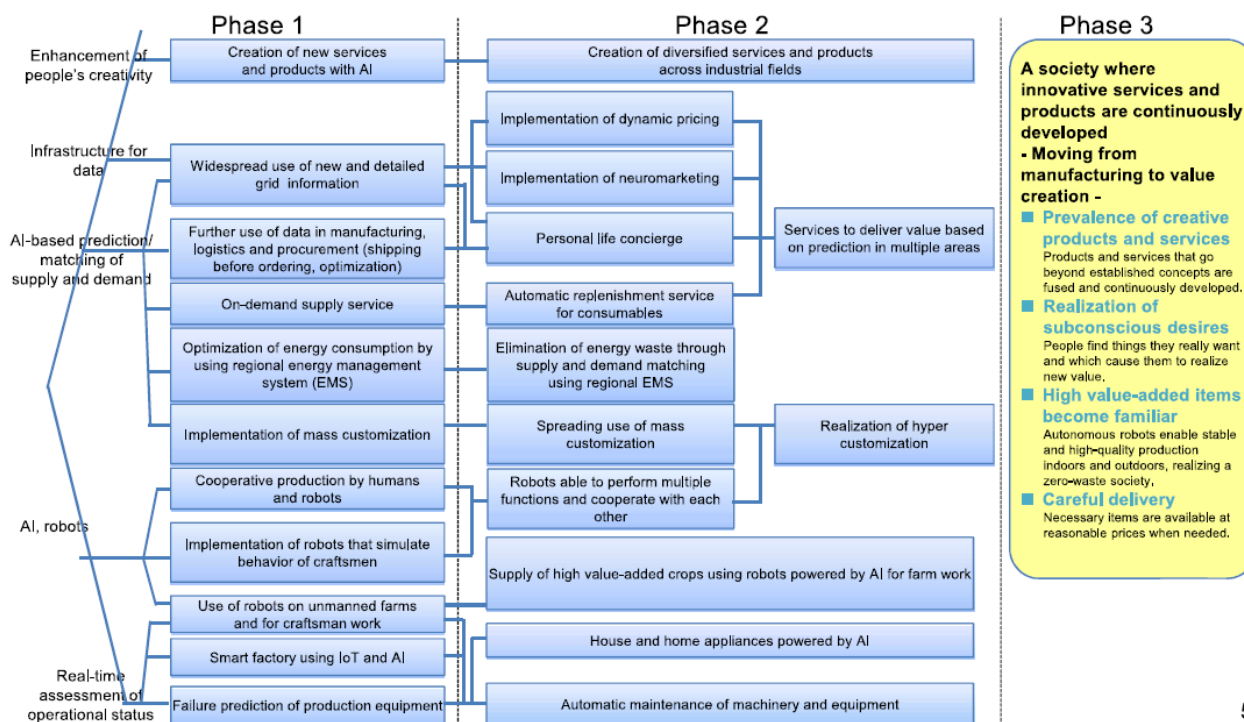   (Capacity to apply AI technology to concrete social issues)

In addition, to exhibit the effects of fostering AI human resources, it is important to secure opportunities for AI human resources to participate actively, from the perspective of developing an environment to attract AI human resources.

1

Source : MIC, 2017 http://events.science-japon.org/dlai17/doc/MIC%20-%20France-Japan%20Symposium%2020171025.pdf

（3-1）Industrialization Roadmap Projected by the Fusion of AI and other related Technologies (Productivity)
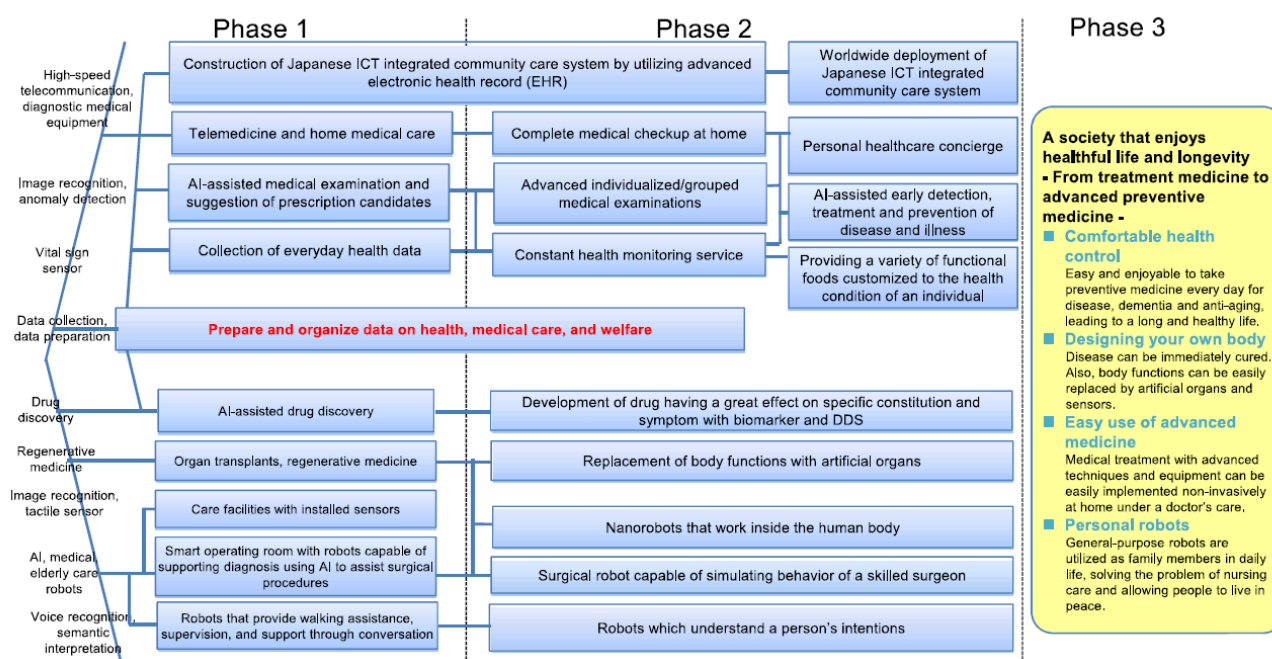
- To realize hyper customization through the realization of automation and optimization of production systems, efficiency improvement and optimization of service industries, and matching needs with goods and services, leading to the integration of manufacturing, distribution and services for items such as energy and food, which allows for the establishment of an ultimate ecosystem that will enhance productivity in society as a whole.
- To enhance people's creativity, leading to a society where innovative services and products can be continuously created.

Phase 1 / Phase 2 / Phase 3

Enhancement of people's creativity
- Phase 1: Creation of new services and products with AI
- Phase 2: Creation of diversified services and products across industrial fields

Infrastructure for data
- Phase 1: Widespread use of new and detailed grid information

AI-based prediction/ matching of supply and demand
- Phase 1: Further use of data in manufacturing, logistics and procurement (shipping before ordering, optimization)
- Phase 1: On-demand supply service
- Phase 1: Optimization of energy consumption by using regional energy management system (EMS)
- Phase 1: Implementation of mass customization
- Phase 2: Implementation of dynamic pricing
- Phase 2: Implementation of neuromarketing
- Phase 2: Personal life concierge
- Phase 2: Automatic replenishment service for consumables
- Phase 2: Elimination of energy waste through supply and demand matching using regional EMS
- Phase 2: Spreading use of mass customization
- Services to deliver value based on prediction in multiple areas
- Realization of hyper customization

AI, robots
- Phase 1: Cooperative production by humans and robots
- Phase 1: Implementation of robots that simulate behavior of craftsmen
- Phase 1: Use of robots on unmanned farms and for craftsman work
- Phase 2: Robots able to perform multiple functions and cooperate with each other
- Supply of high value-added crops using robots powered by AI for farm work

Real-time assessment of operational status
- Phase 1: Smart factory using IoT and AI
- Phase 1: Failure prediction of production equipment
- House and home appliances powered by AI
- Phase 2: Automatic maintenance of machinery and equipment

Phase 3: A society where innovative services and products are continuously developed — Moving from manufacturing to value creation —
- **Prevalence of creative products and services** Products and services that go beyond established concepts are fused and continuously developed.
- **Realization of subconscious desires** People find things they really want and which cause them to realize new value.
- **High value-added items become familiar** Autonomous robots enable stable and high-quality production indoors and outdoors, realizing a zero-waste society.
- **Careful delivery** Necessary items are available at reasonable prices when needed.

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（3-2）Industrialization Roadmap Projected by the Fusion of AI and other related Technologies (Health, Medical Care, Welfare)

- To be the leader in medical care and welfare technologies by utilizing big data together with AI as Japan becomes the world's most rapidly aging society.
- To be the leader in industries for health and longevity by advancing preventive medicine to avoid diseases.
  In 2030, over 40% of the population will be elderly, and at the age of 80, people who are willing can work actively. This will not only increase individual life satisfaction but also reduce social security expenses and address the social issue of a shrinking workforce.

Phase 1 / Phase 2 / Phase 3

High-speed telecommunication, diagnostic medical equipment
- Phase 1: Construction of Japanese ICT integrated community care system by utilizing advanced electronic health record (EHR)
- Phase 1: Telemedicine and home medical care
- Phase 2: Worldwide deployment of Japanese ICT integrated community care system
- Phase 2: Complete medical checkup at home
- Personal healthcare concierge

Image recognition, anomaly detection
- Phase 1: AI-assisted medical examination and suggestion of prescription candidates
- Phase 2: Advanced individualized/grouped medical examinations
- AI-assisted early detection, treatment and prevention of disease and illness

Vital sign sensor
- Phase 1: Collection of everyday health data
- Phase 2: Constant health monitoring service
- Providing a variety of functional foods customized to the health condition of an individual

Data collection, data preparation
- Prepare and organize data on health, medical care, and welfare

Drug discovery
- Phase 1: AI-assisted drug discovery
- Phase 2: Development of drug having a great effect on specific constitution and symptom with biomarker and DDS

Regenerative medicine
- Phase 1: Organ transplants, regenerative medicine
- Phase 2: Replacement of body functions with artificial organs

Image recognition, tactile sensor
- Phase 1: Care facilities with installed sensors
- Phase 2: Nanorobots that work inside the human body

AI, medical elderly care robots
- Phase 1: Smart operating room with robots capable of supporting diagnosis using AI to assist surgical procedures
- Phase 2: Surgical robot capable of simulating behavior of a skilled surgeon

Voice recognition, semantic interpretation
- Phase 1: Robots that provide walking assistance, supervision, and support through conversation
- Phase 2: Robots which understand a person's intentions

Phase 3: A society that enjoys healthful life and longevity — From treatment medicine to advanced preventive medicine —
- **Comfortable health control** Easy and enjoyable to take preventive medicine every day for disease, dementia and anti-aging, leading to a long and healthy life.
- **Designing your own body** Disease can be immediately cured. Also, body functions can be easily replaced by artificial organs and sensors.
- **Easy use of advanced medicine** Medical treatment with advanced techniques and equipment can be easily implemented non-invasively at home under a doctor's care.
- **Personal robots** General-purpose robots are utilized as family members in daily life, solving the problem of nursing care and allowing people to live in peace.

(3-3) Industrialization Roadmap Projected by the Fusion of AI and other related Technologies (Mobility)

- To make travel time and space not just for travel, but for work, life, and entertainment.
- To build a society where anyone can travel safely and freely, and to realize environmentally-friendly travel by building a sharing economy with transportation equipment for both people and goods, leading to a reduction in accidents caused by human error and achieving minimal social cost associated with travel.
- To realize a society where new value is generated by creating high value-added travel, autonomous automatic delivery, and virtual travel.

Phase 1

AI-based supply and demand matching
- Expansion of car-sharing business
- Reservations/services for transportation devices

Real-time collection of location and road information
- Expansion of GPS-related industry
- Collection of travel information and prediction of surrounding environment using AI and sensors

Infrastructure network
- 3D maps/traffic control system

Autonomous driving (ground)
- Level 1, 2 autonomous car

Edge computing

Transportation devices
- Diversification of transportation devices

Autonomous control (air)
- Diversification of spatial transportation devices such as drones

AI, personal data
- Providing valuable space for travelers

VR, communication environment
- Spread of telecommuting with progress in IT

- Expanded peripheral industries utilizing automobile data
- Autonomous transportation/delivery technology such as platooning
- Level 3 autonomous car
- Transportation devices powered by IoT/expanded application maintenance industries
- Industrialization of entertainment in travel
- Virtual office providing face-to-face based pseudo-communication
- Providing full virtual tourism

Phase 2

- Maturity of sharing economy, changing the concept of ownership/use of travel equipment
- Realization of multipurpose use of owned car
- Providing services that realize seamless travel
- Autonomous transportation/delivery services
- Level 4 autonomous car
- Automatic version update of transportation devices while not in use
- Securing various means of travel
- Privatization of travel time and space
- Providing full-scale virtual travel

Phase 3

Society that enables safe and free travel
- From transportation (cost) to personalized space creation (value) -

■ **Reducing the number of people who have difficulty traveling and eliminating fatal accidents caused by human error**
(Accident fatalities: 1.25 million people worldwide; unlicensed people: about 6 billion overseas, 40 million domestic)

■ **High value-added travel**
Maximizing additional value such as sightseeing, sports and personal contact during travel

■ **Fusion of cyber and physical space**
Providing a near-realistic travel experience without traveling

■ **Minimizing time and energy for transportation of people/goods**

7

Source : Artificial Intelligence Technology Strategy, 2017

Annexe 7 : Les lignes directrices sur la R&D en IA proposées par le Japon et étudiées au sein de l'OCDE

Proposal of Discussion toward Formulation of AI R&D Guideline

Referring OECD guidelines governing privacy, security, and so on, **it is necessary to begin discussions and considerations toward formulating an international guideline consisting of principles governing R&D of AI to be networked** ("**AI R&D Guideline**") as framework taken into account of in R&D of AI to be networked.

Proposed Principles in "AI R&D Guideline"

1. Principle of Transparency
Ensuring the abilities to explain and verify the behaviors of the AI network system

2. Principle of User Assistance
Giving consideration so that the AI network system can assist users and appropriately provide users with opportunities to make choices

3. Principle of Controllability
Ensuring controllability of the AI network system by humans

4. Principle of Security
Ensuring the robustness and dependability of the AI network system

5. Principle of Safety
Giving consideration so that the AI network system will not cause danger to the lives/bodies of users and third parties

6. Principle of Privacy
Giving consideration so that the AI network system will not infringe the privacy of users and third parties

7. Principle of Ethics
Respecting human dignity and individuals' autonomy in conducting research and development of AI to be networked

8. Principle of Accountability
Accomplishing accountability to related stakeholders such as users by researchers/developers of AI to be networked

Source : MIC, 2017