7.16 Development of intelligent information processing technology to realize creative collaboration between human and machines

Targets to Achieve:
This program builds a new research area based mainly on information science and technology (related to intelligent information processing technology) in collaboration with disciplines of cognitive science and robotics (intelligence/control system), and aims to achieve the following targets in order to develop comprehensive intelligent information processing technologies that realize creative collaboration between human and machines.

- Development of intelligent information processing technologies for realization of interaction in response to situation and conversation context
- Clarification of the mechanisms of interaction, work, etc., and development of technologies for development of intelligent information processing system which realizes creative collaboration between human and machines

Vision for Reaching Achievable Important Goals in the Future:
Under this strategic objective, obtaining the research results described in “Targets to Achieve” above enables clarification and technology development regarding followings that have not been clarified by the current intelligent information processing technologies, and by integrating developed technologies, a new intelligent information processing technology will be created.

- Intelligent information processing technology for realization of interaction in response to situation and conversation context
- Clarification of the mechanisms of interaction, work, etc., and development of technologies for development of intelligent information processing system which realizes creative collaboration between human and machines
- After the completion of this project, by deploying and advancing the research outcome in a demonstrative manner, the following intelligent information processing systems will be developed by around 2025.
  - Advanced question answering/advisory system (for support of the elderly, individualized education, diagnosis support for doctors, etc.)
  - Advanced decision-making support system (for support of discussion for experts, support of policy/system design, etc.)
  - Autonomous robot (emulation of human works, disaster relief, support of caregivers, etc.)

The intelligent information processing systems, such as listed above will lead to building of an ambient information society and contribute to realization of safe, affluent and high-quality life which is one of the key issues in Japan, creation of new knowledge, generation of new industries and services through innovations.

Specific Content:
(Background)
In the complicated society, humans perform a variety of intelligent activities, such as adequate problem solving, creative activities, etc. based on various information and value judgment. In the field of cognitive science, clarification of the principle of human intelligent processing is underway and in the field of robotics development and practical use of task achievement type robots are being carried out.

In the development of intelligent information processing technology at present, research and development are underway by individual tasks, such as voice recognition, natural language processing, voice interaction, etc. By adding the approaches of cognitive science and robotics (intelligence/control system) to the current approach, a collaborative research system that produces synergistic effects can be created. Additionally, integration of research studies from different fields raises the expectation for creation of innovation.

(Research Theme)
In order to achieve “Targets to Achieve” as described above, this strategic objective aims to build a collaborative research system which consists of the researchers of information science and technology (related to intelligent information processing technology) as its core and the researchers from cognitive science and robotics (intelligence/control system) to develop an comprehensive intelligent information processing technology to realize creative collaboration between human and machines. Specifically, the following research studies are supposed.

1) Development of intelligent information processing technologies for realization of interaction in response to situation and conversation context
   - Technologies for understanding the situation of human by nonverbal information, such as peripheral
environment of a specific person, the behaviors of a person during interaction (attitude, voice inflection, wording, etc.)
- Technologies for understanding the words from human by generating various meanings and interpretations and
  adding deductions based on situation and conversation context
- Technologies of information representation generation and timing control for realizing adequate interaction
  based on the characteristics of a person (character, habit, etc.)

2) Clarification of the mechanisms of interaction, work, etc., and development of technologies for development of
intelligent information processing system which realizes creative collaboration between human and machines
- Technologies for reducing ambiguity and defining problems to be solved through interaction
- Technologies for effectively providing humans with solutions, such as answer, proposal, and advice etc. based
  on the information machine obtained through interaction and/or on the Web
- Information system that behaves adaptively at a semantic level, including the interaction process between
  human and machines

Note that, as for the development of comprehensive intelligent information processing technology, it is required
to incorporate advices and proposals from researchers of the related fields of humanity and sociology at the
research and development phase to consider ethical, legal, and social issues.

Policy Positioning (positioning within the policy system and necessity/urgency in terms of policy etc.):

The 4th Science and Technology Basic Plan (Cabinet Decision on August 19, 2011) states, as “Improvements in
affluence of citizens’ life” in “Realization of a safe, affluent and high-quality life,” that “Toward the realization of
true affluence in citizens’ life, efforts shall be promoted that contribute to the improvement of quality and affluence
of life through science and technology, such as improvement/enrichment of public/private services and
enrichment/deepening of people-to-people links etc. using science and technology of the latest information and
communications technology.’ Also, it states, as “Enrichment and enhancement of common bases for science and
technology infrastructures,” that ‘Research and development shall be promoted for science and technology that can
be utilized over multiple fields in a cross-sectional manner and science and technology of interdisciplinary areas.’

The Comprehensive Strategy on Science, Technology and Innovation (Cabinet Decision on June 7, 2013) states,
as “Realizing the base for next-generation infrastructures” in “Development of next generation infrastructures as a
top-runner in the world,” that “Various infrastructures will be organically and efficiently interlinked, allowing
smooth distribution and circulation of data and information. By taking account of the latent needs by the general
public and companies, it is anticipated that the QOL of the general public will be improved and the economic
activities of companies will be promoted. As a result, a society will be materialized where people can sense safety,
security, and affluence in their life.’

The Japan Revitalization Strategy – JAPAN is BACK – (Cabinet Decision on June 14, 2013) states, in
“Realizing safe/convenient life environment through IT utilization,” that ‘In order to realize society where people
can live safely/conveniently by utilizing big data, etc., the government will make efforts to solve important
cross-sectional issues by utilizing IT through collaboration among relevant ministries.’

The Declaration to be the World’s Most Advanced IT Nation – New IT Strategy under the Second Abe
Administration (Cabinet Decision on June 14, 2013) states, in “Encouraging research and development and
collaboration among the results of research and development,” that ‘It will be necessary to conduct research and
development while monitoring developments in the telecommunications-based society and to promptly and
accurately link the results of research with IT strategies so that cutting-edge technologies that lead to innovations.’

Coordination with Related Policies, Division of Roles, and Differences in Policy Effects:

Japan Science and Technology Agency (JST), CREST “Creation of Human-Harmonized Information Technology
for Convivial Society” (started in FY 2009) aims to build the basic technologies to realize “harmonious interaction
of human and information environments” through fusion and integration of elementary technologies, such as
real-space communication, human interface and media processing. Additionally, JST PRESTO “Information
Environment and Humans” (started in FY 2009) aims at ubiquitous computing, evaluation research on intelligent
functions for users such as usability testing and statistical analysis, and networking research on intelligent
functions. Meanwhile, this strategic objective aims at not only human-machine interfaces, but also improvement of
the quality of human intelligent activities, realization of creative collaboration between human and machines, and
building of support tools and common fundamental technologies for human intelligent activities by extracting
“knowledge” from information. Therefore, synergetic effects are expected from this effort through collaboration
with other related policies.
Scientific Justification for the Research and Development Goals (need, urgency, achievability etc. based on domestic and international research trends)

In Europe, the EU’s Seventh Framework Programme for Research and Technological Development (FP7) took up the natural language analysis technology as one of the Work Programs and an annual budget of 50 million euro (approx. 6.5 billion yen) has been allocated to projects, such as interoperation of language analysis tools and machine translation as related efforts.

Also, in the United States, the DARPA has set natural language processing and technology for understanding of deep meaning of image as its key targets and huge amounts of budget are allocated for programs, such as the Machine Reading Program (20 million dollar or approx. 2 billion yen per year). Additionally, giant IT companies, such as Google, Amazon, Apple and IBM are not only overwhelming the world by the IT business, but also leading the world in the information and communications technologies through the most advanced research and development. In particular, as for the fields related to the intelligent information processing technology, IBM developed its question answering system “Watson” and beat the world chess champion at the time in 1997. In 2011, Watson produced results, such as overall victory over human in a quiz program “Jeopardy!” Furthermore, IBM announced in January 2014 it would invest one billion dollar to make “Watson” as a full-fledged business. Now it plans to apply the business not only to diagnosis support system for doctors, but also to a wide range of businesses, such as finance, retailing, and public offices.

In Japan, as an interdisciplinary effort for the realization of intelligent ICT, there is the “Can a Robot Get into the University of Tokyo?” project by the National Institute of Informatics. This is an attempt to realize a comprehensive AI that can pass the entrance examination at a level of the University of Tokyo without the help of human. In the development of intelligent information processing technology at present in Japan, research and development are underway by individual tasks, such as voice recognition and natural language processing to realize human intelligent activities. Therefore, in order to apply intelligent ICT to the society, research and development efforts in a human-participation-type framework in which creative collaboration between human and machines is realized becomes important in the future.

If we continue to allow a huge lead of the United States and Europe as they are in the research and development of intelligent information processing technology, we will fall behind in the speed of research and development in all the academic and technological fields and this will affect the national strength of Japan. Therefore, we should not waste a minute in the research and development.

Background to Deliberations:

In an overview activity over the information science and technology field by JST’s Center for Research and Development Strategy (CRDS), intelligent information processing technology, cyber-physical system, and big data were selected as three key items of the research and development emerging to create new social values. Then, for the intelligent information processing technology, a core member meeting by expert was held (in April 2013) and the contents to be addressed in this strategic objective were discussed.

In July 2013, the CRDS held the Workshop for Future Strategy of Science and Technology with domestic and foreign expert attendees. The contents of the effort were refined, and interdisciplinary collaboration and the community of researchers were strengthened there. In this workshop, several proposals were made, such as the creation of intelligent information processing system, collaboration of human and machines, and building of a knowledge system to stimulate human in order to increase people related to, intelligent activities.

This strategic objective was prepared based on the results through these considerations.

Other

When implementing this research and development, it is necessary to form a comprehensive research system so that each research team will not only develop its independent elementary technology throughout the project.

Additionally, since this project aims to create a new intelligent information processing technology by integrating the developed technologies and to develop intelligent information processing systems after the completion of the project, it is important to promote the research areas so that the services of specific fields can be demonstrated as the results of research and development.