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# Message from the President:

## The Role of the IEICE in the Era of Population Decline

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### 1. Introduction

In his essay, “My Resume,” published in the Nihon Keizai Shimbum, Susumu Tonegawa, a Nobel laureate, wrote that his grandfather was the first president of the Institute of Electronics, Information and Communication Engineers of Japan (IECE) [1]. The IEICE has been shaped into what it is today through the dedicated efforts of the first president, Morisaburo Tonegawa, and his successors. I will do my very best, as the new IEICE president, to live up to the privilege of carrying on the legacy of those distinguished predecessors. We must now work hard so that, a few decades from now, people two generations hence won’t deplore the fact that the institute, which formerly enjoyed a membership of 35,000, allowed its membership to shrink and fall into steady decline. The two principal causes for this are the decline both in Japan’s birthrate and in the international competitiveness of its industries, which is the very foundation of the IEICE. There is also no doubt that Japan has already become a society of great longevity coupled with a falling birthrate. This has resulted in the dwindling of the productive population. Figure 1 shows how this population has changed over time [2]. Since the IEICE has traditionally been made up of researchers and engineers active in the front lines, it is only natural that a decrease in the working-age population leads to a decrease in IEICE membership. However, the recent rate of decrease in the membership exceeds the pace of the decline in the productive population. This probably reflects the current stagnation seen in the electronics, information and communications industries. This loss of industrial vigor has far-reaching consequences beyond merely causing a headache for the IEICE because it acts as a disincentive to students who might otherwise want to work in the industry. The share of Japanese

enterprises in the global mobile phone market shrank from 14.2% to 3.6% in just five years [3]. By the same token, the IEICE saw its balance sheet plunge into the red for the first time in fiscal 2012. Both former presidents Yoshida and Inoue were highly alarmed by this trend and embarked on new initiatives, such as transmission of information to society at large, development of human resources, and transformation into a more globally-oriented institute [4][5]. President Inoue built the information infrastructure needed to move the institute forward in a new direction, and proposed far-reaching restructuring measures to strengthen the institute's financial base. Thanks to these efforts, the IEICE is steadily transforming itself into a global institute. One of the important responsibilities of the IEICE is to contribute to the development of the electronics, information and communications industries, which are the cornerstone of Japan's economy, and by extension to the solution of the social problems presently confronting Japan. Now I'd like to share with you my thoughts on how the IEICE can evolve and tackle and solve these problems based on my experience in R&D in NTT Laboratories, education and research in the Tokyo Institute of Technology and my experience over the last two years as a teacher in the life-long education program offered by the Open University of Japan.

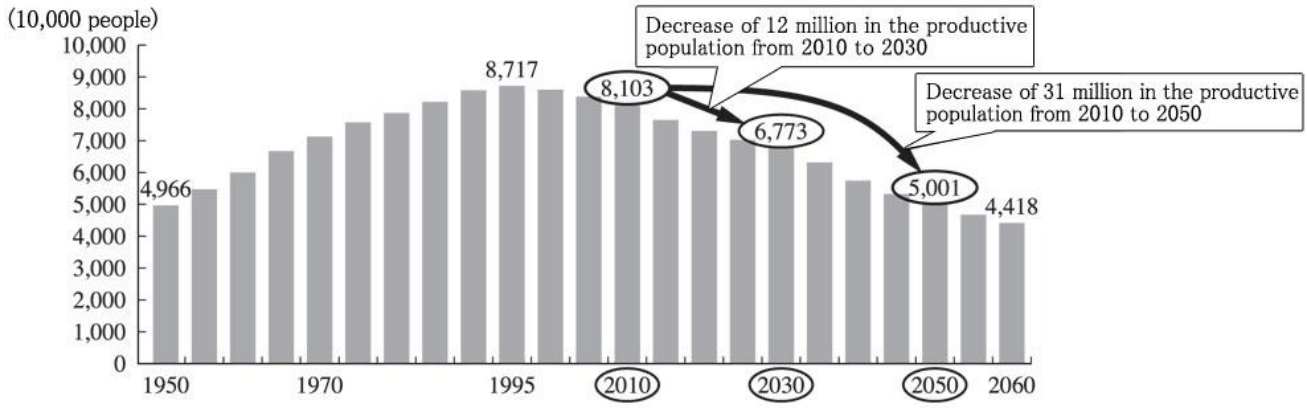


Fig. 1 Change in the productive population [2]

## 2. Changes in the environment surrounding the IEICE

### 2. 1 Globalization of the publication of research results

The IEICE published its first English-language transactions in January 1976. In those days, Japanese-language papers occupied a dominant position with 379 papers published in the Japanese version and only 40 in the English version in the initial year. It was sometimes said then that submitting papers to the English version placed them at a disadvantage because they did not appeal to Japanese readers. For example, if my name is written in Japanese, Japanese readers can immediately recognize my name and know that I have authored the paper, but if it is written as YOSHINORI SAKAI, my name may not register. However, the situation has now completely reversed with 637 papers in Japanese and 1,249 papers in English published in 2013. It is time we reconsidered the wisdom of publishing Japanese-language transactions. The English-language transactions of the IEICE are now in competition with those published elsewhere, and are evaluated according to international criteria, such as the impact factor.

### 2. 2 Development of the electronics, information and communications industries and how this influenced the IEICE

Thanks to the enormous efforts made by our predecessors, the electronics, information and communications industries of Japan have developed to their present level. It is said that the Japanese are good at developing things for which there is a clear goal. This may not always apply to the field of telecommunications, in which the concept of service is of primary importance. While the Internet was born in the U.S., Japan is the country in which broadband networks have spread most rapidly. NTT's INS concept impacted the U.S. policy on the construction of broadband networks. Japan has the world's highest level of penetration of broadband networks, as shown in Fig. 2 [6]. This explains why the nominal domestic product of the information and communications industries is significant as shown in Figs. 3 and 4. Although it has been decreasing since 2008, these industries still represent 9% of the nominal gross domestic product. There is no doubt that the massive scale of these industries sustain the country. However, as can be seen in the diminishing share of Japanese vendors in the global mobile phone market, the decline in these industries is also apparent. The IEICE has expanded along with this growth, and today it faces the risk of decline as the industry heads into a steep decline.

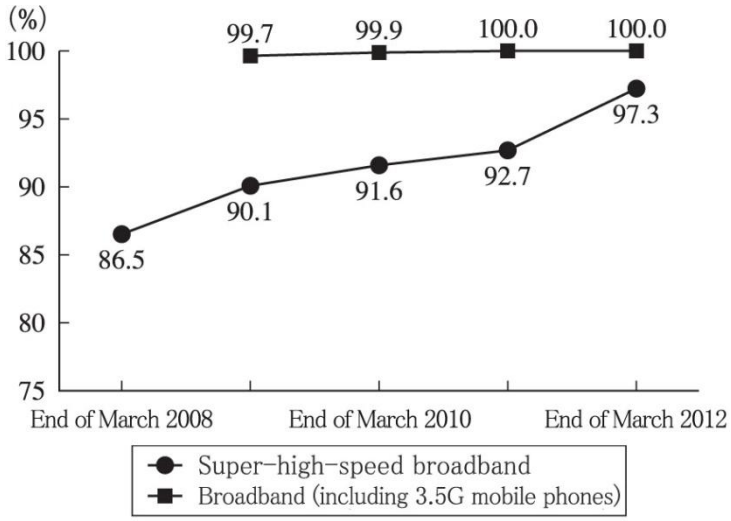


Fig. 2 Change in the broadband infrastructure [6]

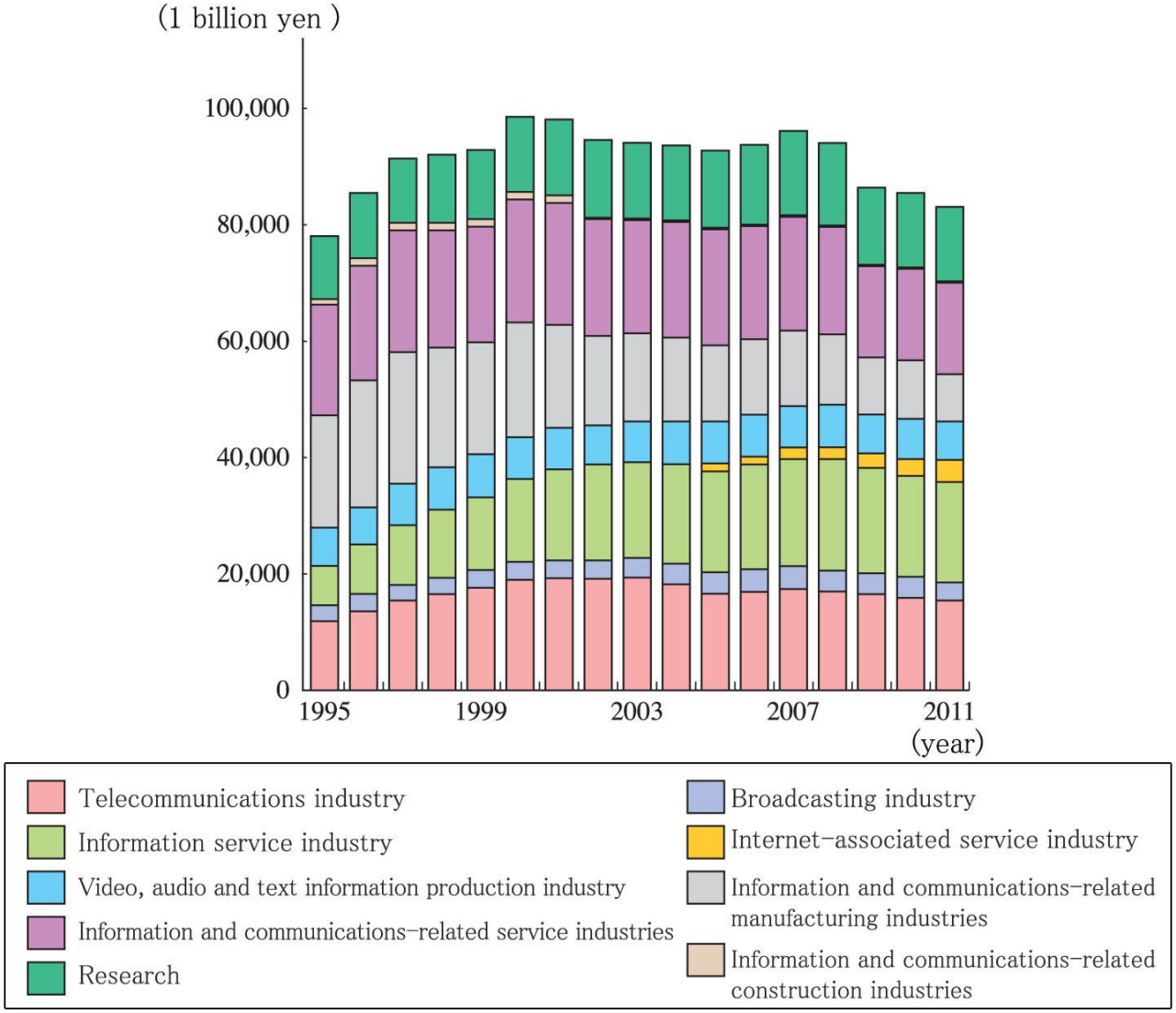


Fig. 3 Change in the market size of the information and communications industries (nominal domestic production) [6]

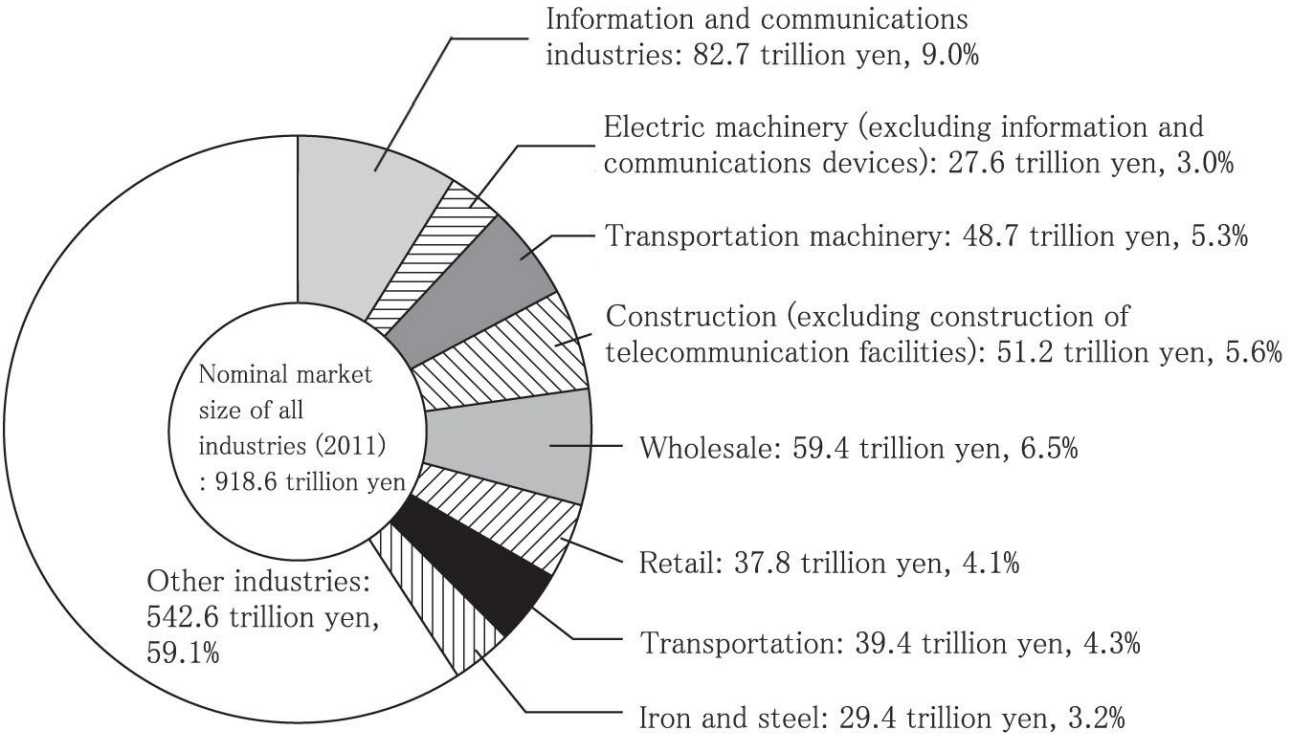


Fig. 4 Change in the market value of major industries
(nominal domestic production) (breakdown) (for 2011) [6]

2. 3 Changes in the external environment

Tables 1 and 2 show keywords representing areas of national priority as identified in reports issued by the Council for Science and Technology in 2001 and 2013 [7][8]. The 2001 report identified all the fields that are covered by the IEICE (information and communications, nanotechnology, and materials) as high priority areas. In sharp contrast, all these keywords disappeared from the 2013 report. The change is not just due to the fact that information and communications are not given priority because the council no longer focused on technologies per se but rather on how technologies can contribute to society. It is understandable that, confronted by a mountain of difficult problems related to earthquakes, energy, food supply and healthcare, the government no longer focuses solely on the development of technologies. Following this new policy, the ICT growth strategy of the Ministry of Internal Affairs and Communications [9] selected, as keywords, the areas to which ICT could be applied, such as super-mature society, resource problems and geo-space. Even in universities, the bastions of basic research, there is a groundswell of opinion that higher priority needs to be placed on a clear definition of the areas where research results will be applied.

Table 1 Report from Council for Science and Technology Policy (2001)

| | |
|---|---|
| Four priority areas | Life science |
| | Information and communications |
| | Environment |
| | Nanotechnology and materials |
| Information and communications | Advanced networking technology |
| | High-speed computing technology |
| | Human interface technology |
| | Devices and software to be used as a platform |

Table 2 Report from Council for Science and Technology Policy (2013)

| | |
|---|---|
| Clean energy system | |
| Healthy long-lived society | |
| Construction of next-generation infrastructures | |
| Regeneration of regional communities based on local resources | |
| Restoration from the East Japan Earthquake | |
| Use of smart technology | ICT, knowledge processing |
| Systematization | Convergence of multiple technologies (e.g., smart community) |
| Globalization | Welcoming overseas funding and human resources from outside Japan |

## 3. Directions in which the IEICE should proceed

### 3. 1 Finding new fields of research

Information communication networks have been getting faster, larger and more complex in recent years. In addition to technologies needed to build high-capacity networks, technologies needed to facilitate the use of a large volume of data and large systems, such as Big Data analysis, and software designed networks (SDN), are gaining in importance. The IEICE's roadmap includes a forecast of how society will evolve up to 2040 and of the technologies that will become important around that time [4]. The list of required technologies includes some that are new and attractive, such as multi-language translation, brain-machine interface (BMI), and robots. The roadmap forecasts that the IEEE is likely to become the preeminent organization in the fields of bio-engineering and healthcare engineering [10]. Researchers tend to select research topics that are attractive, involve many problems that need solving, and can attract research funding. Even researchers in universities adjust the directions of their research to suit the prevailing societal preoccupations. There is an endless debate about the wisdom of switching research topics because

there are many faculty members who have stuck to a single theme and made great achievements as a result of this intensive focus. The fundamental units of activity in the IEICE are its technical committees. They are critical for the institute. In my view, the time when they ebb away will be the time when the IEICE disappears from the world stage. While the IEICE encourages the forming of time-limited technical committees to tackle new themes, regular technical committees have been changing their names or broadening their target research areas, or new regular technical committees have been established to address emerging technical issues. Table 3 lists regular technical committees that have been created since 1998. These committees were voluntarily created by those who were active in the technical committees that existed at the time. The job of the executive members of the IEICE is to provide an environment that facilitates the creation of new technical committees, while leaving the selection and study of technical topics to members at the forefront of research.

Table 3 Newly created regular technical committees

| | |
|---|---|
| 1998 - 2001 | Photonics in Switching, Optical Fiber Technology, Information and Communication Management, Medical Imaging, Intelligent Transport Systems Technology, Safety, Mobile Multimedia Communications, Internet Architecture, Software Interprise Modeling, and Well-being Information Technology |
| 2002 - 2004 | Smart Info-media System |
| 2005 -2008 | Software Radio, Reconfigurable Systems, Ad Hoc Networks, and Ubiquitous Sensor Networks |
| 2009 -2012 | Information and Communication System Security, Information-Based Induction Sciences and Machine Learning, Image Media Quality, Electronics Simulation Technology, Microwave and Millimeter-wave Photonics, Enriched Multimedia, Cloud Network Robotics, and Service Computing |
| 2013 | Short Range Wireless Communications, and Ambient Intelligence and Sensor Networks |
| 2014 | Reliable Communication and Control, Biometrics, Healthcare and Medical Information Communication Technology, and Wireless Power Transfer |

3. 2 Issues arising from the needs of society

Choosing research subjects that address social problems is not easy for researchers, in particular, for those in universities. However, in modern society, which must now confront issues that threaten the very existence of human beings, technologies that cannot contribute to solving these issues are of minor significance. ICT is expected to play a key role in solving these issues.

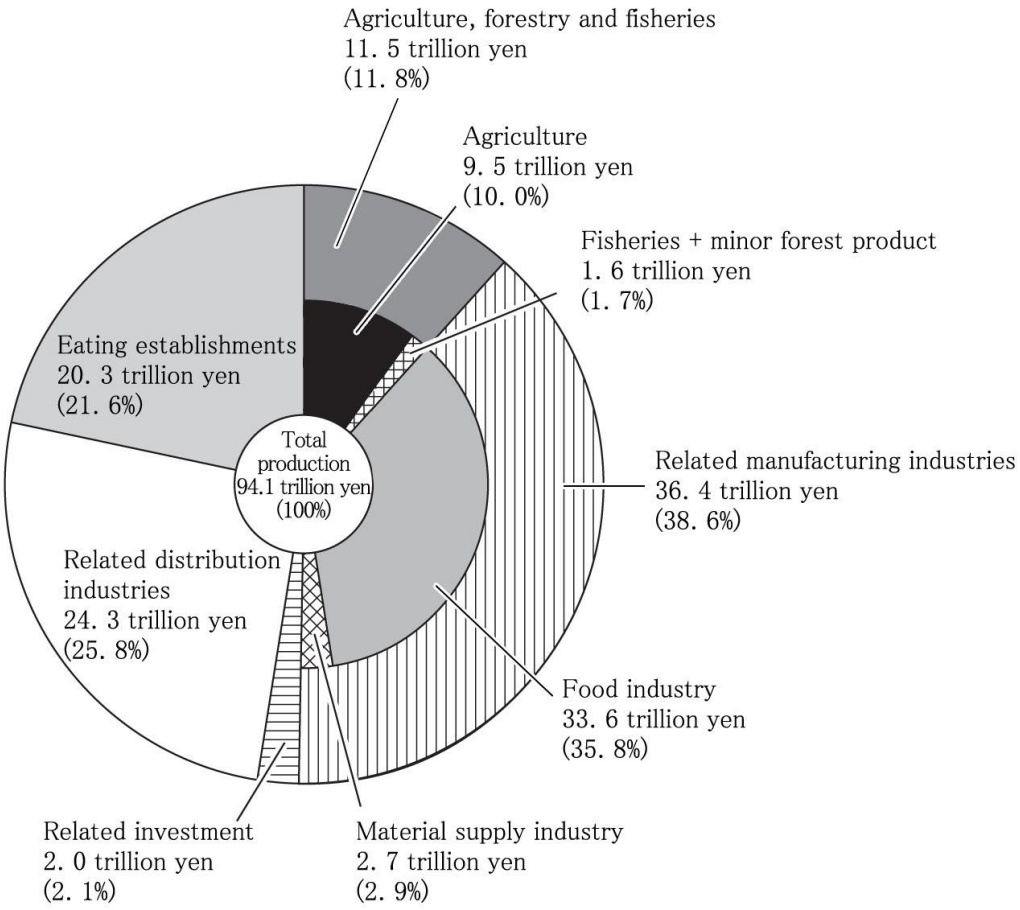


Fig. 5 Breakdown of domestic production of industries related to agriculture and food [11]

(1) Food supply

Japan can currently meet only about 40% of its food requirements with domestic production, and the average age of an agricultural worker is 66. The average annual income of a farmer is just above 1.2 million yen. These data signal that the country's agriculture is teetering on the brink of a major crisis. On the other side of the coin, agricultural management entities whose annual sales top 100 million yen have been emerging, and more and more young people are showing interest in agriculture. As shown in Fig. 5, the value of domestic production of food-related industries exceeds 90 trillion yen. This equals the corresponding figure for the information and communications industries albeit the figure for the latter, as shown in Fig. 4, is 'nominal' domestic production. What is of concern to me is that the figure for the value of agricultural production, which is the foundation of the country's food supply, is as low as 10 trillion yen [11]. Food self-sufficiency is fundamental to a country's survival. Considering that Japan has a severely limited supply of farmland, it is essential to improve food production using ICT and the Ministry of Agriculture, Forestry and Fisheries accordingly plans to strengthen agriculture by incorporating this technology [12]. It is a key ingredient of "The Next-Generation Agriculture, Forestry and Fishery Industry Creation Technology," which is a candidate for selection of "projects that run across different ministries and agencies."

(2) Energy

Japan's self-sufficiency in energy is less than 20% and can thus become the country's most vulnerable point. Considering that atomic energy is associated with several profound problems, it is important to enhance energy self-sufficiency through energy saving and the development of sustainable forms of natural energy. As represented by smartgrids, it is difficult to think of any solutions without ICT. Energy should therefore be one of the main issues to be addressed by the IEICE.

(3) Aging society

In a special article in the January 2014 issue of Journal of the IEICE, Dr. Hiroshi Komiyama stressed the importance of extending healthy life expectancy [13], and argued that it is urgent to address issues arising from an increase in the number of elderly people living alone. The percentage of elderly people living alone was 5% for males and 15% for females in 1990. These figures had increased to 11% and 20% respectively by 2010, and are expected to rise further. There are various applications of ICT that can assist these people. One example is a remote caring service that helps those living alone to live safely. In addition, there are many proposals on how ICT can be applied to nursing care in facilities for senior citizens. Such a service cannot be effective unless the system developer has a deep understanding of those who will use the service, i.e., the care recipients and the caregivers. The IEICE should endeavor to work with these users in addition to working with the system developers.

(4) Disasters

Since the great earthquake that struck three years ago, anti-disaster technologies have come into the limelight and are now ranked among the top priority engineering fields. Electronics, information and communications technology cannot directly contribute to the prevention of tsunamis. After all, there is a limit to what humans can do to prevent natural disasters. Moreover, some of the countermeasures, such as the construction of gigantic tide barriers, can have adverse effects on the ecosystem. Some argue that for the Japanese, who live in a country highly prone to natural disasters, it is more important to attempt to detect disasters and minimize damage than undertake efforts in a vain attempt to prevent disasters. Since detection and the transmission of information are two of the great strengths of electronics, information and communications technology, expectations are high with regard to the IEICE.

(5) Education

Information oriented education is both an old and new issue in the application of ICT. Open provision of university lectures was started by MIT and followed by others under the name of opencourseware (OCW), and has since spread to Japan as well. Massive open online courses (MOOC) have emerged as an alternative form of education in recent years. These courses can have a significant impact on the educational framework of universities. The technology used for this purpose is classic yet novel educational engineering. Educational engineering, which began with video lectures, may create a new form of education backed by the progress being made in Big Data analysis and human-machine interface (HMI).

(6) Future direction of engineering

The U.S. National Academy of Engineering defines engineering as “designing issues, products or systems to produce preferable results while satisfying the existing constraints.” The Engineering Academy of Japan tries to go beyond conventional needs-based problem solutions, and is studying how to find relations between social issues and specific engineering fields, a process called meta-engineering by the Academy [14]. The Academy argues that it is important to shift from the stance of recognizing social issues and then developing solutions to them to the stance of creating social value on the basis of recognized social issues. It is a matter of urgency for the IEICE to develop guidelines on the future direction of engineering.

(7) Research that is rooted in social issues

A look at the list of new technical committees shown in Table 3 reveals that many of those listed are oriented towards new technologies. Issues that stem from an approach that emphasizes the identification of areas to which research results are to be applied tend to be adopted by industry and government. The important future task of the IEICE is not to wait until members of the institute

propose what issues should be tackled but to collaborate with industry and government to identify issues, spread information about these issues to its members, and support the establishment of frameworks for collaboration with entities in the affected fields.

3. 3 Expansion of the age group of the IEICE members

The age range of the productive population is between 15 and 64 (Fig. 1), meaning that I already fall outside that range. However, as Dr. Komiyama insists in his article, it is essential for Japan to expand its workforce. Table 4 shows the average remaining life expectancy of 40-year-old Japanese men, the generation most active in society and in the IEICE. Conventionally, typical members complete their education in their 20s, and work until they are around 60 and then gradually retire. However, people in the mid-career stage (age 40) live on for more than 20 years after they reach 60. It is reasonable to assume that the age range of the productive population will still begin at 15 but extend up to 70 years in the near future. The types of activities conducted by the IEICE must change accordingly. I myself currently work for the Open University of Japan (OUJ), as well as being a member of the Committee of Validation and Examination for Degrees, National Institution for Academic Degrees and University Evaluation (NIAD-UE). The OUJ provides lifelong education while the latter organization is the sole non-university institution in Japan that is authorized to award bachelor's, master's and doctoral degrees. Students with a wide variety of backgrounds, different from the backgrounds of most IEICE members, learn and receive degrees in these institutions. The breakdown of OUJ students by age group is shown in Fig. 6. It is indicative of the future of Japanese society [15]. Many people earn credits in different educational institutions and receive degrees from NIAD-UE. People enroll at OUJ for the following purposes:

(i) Have graduated from a senior high school, junior college or vocational schools and want to receive a bachelor's or other degree.
(ii) Want to become licensed as a nurse, psychologist, etc.
(iii) Have retired but want to study subjects that interest them.
(iv) Want to study subjects outside their expertise to broaden the scope of their work.

As people's healthy life expectancy becomes longer, they adopt a more diverse range of learning approaches. While universities, junior colleges, technical colleges and vocational schools continue to play an important role, open universities are gaining in importance. Under these circumstances, it will be useful for the IEICE to provide its members who are not researchers with suitable opportunities for professional training.

Table 4 Trend towards longer life expectancy (of 40-year-old men)

| | Average survival after age 40 (years) | Average survival after age 60 (years) |
|---|---|---|
| 1947 | 27 | 7 |
| 1960 | 31 | 11 |
| 1970 | 33 | 13 |
| 1980 | 35 | 15 |
| 1990 | 38 | 18 |
| 2000 | 39 | 19 |
| 2010 | 41 | 21 |

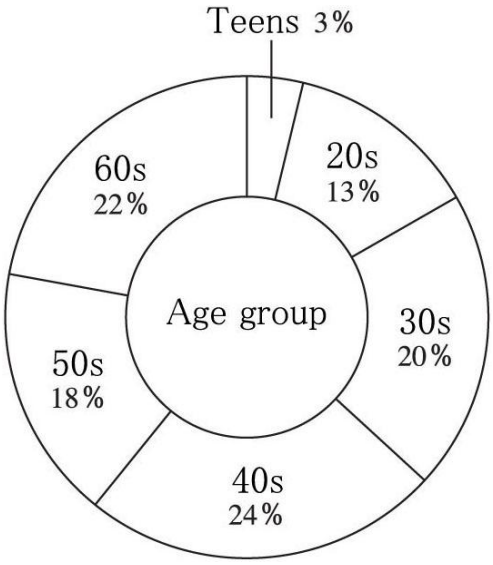


Fig. 6 Age groups of students attending the Open University of Japan [15]
Total of undergraduate and graduate schools for the second semester of 2013

3. 4 Institute as a guild of engineers

I still remember the time when a friend and telecommunications engineer frankly expressed his criticism of the IEICE. He said that the IEICE had not been useful in his own case because he was not a researcher. It may be true that engineers can acquire most of the knowledge they need without joining the IEICE. The benefit of being a member may be further reduced if they have little need to exchange information with researchers in other companies. I suspect that the situation is quite different in medical societies. Most doctors around the country belong to a medical society of some form or another and participate in its meetings. These societies not only provide opportunities for the presentation of research results, but also endeavor to protect and enhance the special status of their members, for example, by establishing a system of certifying specialists. Whether the IEICE can adopt a system of certifying special engineers in the electronics, information and communications fields is unclear and many issues will need to be overcome before this becomes a reality. Having said that, I believe that it is worthwhile to ponder how the IEICE can help to enhance the professionalism of its members. It seems that medical societies often provide guidelines on the ethical issues that doctors confront in their daily practice, and they are also eager to transmit information to the general public. Akira Ikegami, a well-known TV commentator, gave a lecture at the Tokyo Institute of Technology, where he works as a professor, in which he held a discussion with students on sensitive topics. He used Japanese engineers who used to work in Japanese companies and later found employment in Korean companies as an example. Although the students did not have sufficient experience to talk about the topic with much authority, they were nevertheless earnestly engaged in the discussion [16]. This event made me realize that the IEICE may have deliberately avoided sensitive issues and that the raison d'être of the IEICE should be to concern itself with issues that worry engineers. Society embraces many issues that require the professional knowledge and insight of engineers. The IEICE selects and recommends expert examiners from among its members to serve as expert witnesses in court cases that involve intellectual property rights. This is a typical example of the institute's efforts to meet the needs of society. When the government develops a policy, they require professional knowledge and insight. I myself have had opportunities of this sort in committees sponsored by the Ministry of Internal Affairs and Communications. It seems reasonable that such professional knowledge and insight should be provided not in our capacity as individuals but in the name of the IEICE.

4. My responsibilities as president of the IEICE

While I have my personal views on the direction of the IEICE as stated above, there is a limit to what I can do because my tenure is only one year. I will seek to enhance the international standing of the IEICE transactions, and continue with initiatives introduced by my predecessors, presidents Yoshida and Inoue, namely strengthening the institute's information infrastructure, promoting globalization, and improving the balance sheet by taking such measures as reducing the number of

technical committees. Since the IEICE has a far smaller administrative office and information infrastructure than the IEEE, the only way for it to survive is to operate efficiently. It will be vital to the future of the institute to work with other engineering societies in building a large information infrastructure. Although I may have to commit most of my time and energy to these endeavors, I hope to contribute to the IEICE by also taking on the following tasks.

(1) Strengthening the meetings held by technical committees

The foundations of the IEICE's research activities are meetings held by technical committees. I will create a mechanism by which even researchers with a relatively short career can organize a technical committee easily as long as they have the drive to advance the subject area. Researchers can be conservative sometimes. I fear that the core members of existing technical committees may tend to seek the survival of their committees above other considerations. It is often the case that a subject area remains important long after researchers have lost interest in it. For example, research into wireline modulation, which I was engaged in as a young researcher, was terminated by many research institutes because they decided that the technology was unneeded in the age of optical communication. Afterwards, however, it proved to a key technology for ADSL, a major player during the first stage of the broadband era. I remember this unexpected development clearly because I was in a position to promote ADSL in a committee sponsored by the Ministry of Internal Affairs and Communications. There are many technical areas that are important even after they fade from the spotlight. It is one of the obligations of the IEICE's to keep such areas alive. However, it is impossible to determine if a subject area has temporarily lost its fascination for researchers or if it really has become obsolete. To run IEICE activities efficiently, I would like to introduce a mechanism by which technical committees that are losing the interest of researchers are disbanded rather than being deliberately shored up to limp along, and are restarted if they prove to be useful later.

(2) Strengthening opportunities for discussion between industry, academia and government

In order to ensure that not only researchers but also all engineers can reap benefits from being members of the IEICE, I would like to reinforce the environment in which joining the IEICE is synonymous with the ability to access a treasure trove of information. For this purpose, it will be necessary to create a forum in which people from not only academia but also industry and government, even administrative officials of the government, can get together to uncover problem-solving research themes. Such a forum cannot endure for long unless it is clear to all participants that there are benefits to be gained from getting together. I would like to make it a forum in which young engineers in private enterprises can get the kind of information they are not normally exposed to or have the chance to meet people they would not normally encounter. In the forum, members for the government will be able to obtain the information they need to formulate policy and have the opportunity to recruit engineers and researchers who can assist with policy making. It will be a productive endeavor if engineers and researchers from private enterprises and

universities participate in the process of selecting research themes and industrial policies to which the government should give priority.

(3) The IEICE's role in providing learning opportunities

Although I mentioned above the need for the IEICE to assist in lifelong education, it is not as simple as one may expect for the institute to fulfil that role. The IEICE-sponsored paid courses are seeing their enrollments shrinking. Being directly involved in lifelong education, I can tell that the field of electronics, information and communication engineering is not popular, at least not among the general public. Even if someone studies one of these courses, this does not lead to any degree or license. My experience at the Open University of Japan indicates that what people in private enterprises want to learn is not leading-edge technology but practical knowledge, such as accounting and business administration. In creating a learning environment within the IEICE, it will be necessary to determine what its members need rather than what the institute can offer. An effective way to implement this would be to collaborate with social science societies, which would be able to provide their expertise and advice.

5. Road towards the IEICE I envision

When I was a student, this institute was all that I needed to advance my research activities. I may have been like the proverbial frog in the well, but I was able to have technical discussions when I presented my papers, enjoyed evening gatherings, especially when meetings were held in distant cities, and gained confidence in myself when my papers were accepted. The Journal of the IEICE and IEICE technical reports were valuable sources of information for me. I was able to acquire new knowledge just by casually listening to presentations in the IEICE General Conferences. Today, many faculty members and students determine whether they should submit their paper to a domestic conference, an international conference or transactions of engineering institutes depending on their specific purpose. The IEICE General Conferences seem to be largely replaced by different international conferences, which have come to be ranked in order of prestige, making would-be submitters wonder to which publications they should submit their papers. Today, engineers working for private companies can get the new knowledge they need from commercial journals or from the Internet, resulting in the decline of the IEICE's value as a source of information. However, for a lazy person like me, it is simpler if the information source and the arena of activity coincide with each other. Of course, I am not saying that I want members to be active only within the IEICE. It is my hope that the IEICE will become a place of many facets where the members can find the portals to global engineering societies and information, get to meet people who share a common interest, enjoy have exchanges with people from different age groups, even gain some practical knowledge of other fields, and maintain social activities after retirement. In other words, the future role of the IEICE is to be a portal for engineers and researchers in the electronics, information and communication fields.

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