How We Should Take Advantage of Our Power Semiconductors and Power Electronics to Proceed in Era of Networking and Standardization

—IoT and M2M initiate titanic revolution in manufacturing—

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Today, the Internet of Things (IoT), Machine to Machine (M2M) and Industrie 4.0 are hot topics around the world. In Japan, the Electricity System Reform is also moving forward in full swing. As energy, information, and things are connected in the wake of major transitions in terms of social systems and manufacturing, it's necessary for Fuji Electric, with its core technologies of power semiconductors and power electronics, to shed light on the path ahead. Professor Dr. Shin, a pioneer in control engineering at the University of Electro-Communications, and Dr. Eguchi, Corporate General Manager of Fuji Electric at their Corporate R&D Headquarters, discussed corporate identity and the power of change.

Power semiconductors as a competitive edge in the world

Eguchi: As a pioneer in the field of instrumentation and control technology, Professor Shin has advised Fuji Electric through various opportunities such as the Technology Research Council. We are grateful for your invaluable insights.

Fuji Electric has been active in the area of energy through technological innovations in electric and thermal energy, playing a part in creating a sustainable society. With this in mind, we have focused our development on devices that enhance energy use, such as power semiconductors and power electronics devices.

Focusing solely on components, however, will not lead us to being a big business in the future, and we may also lose our competitive edge. Our current vision is to expand our business field and to offer systematic solutions combining our components.

Today, concepts such as the Internet of Things (IoT) and Machine to Machine (M2M) are being discussed everywhere, and Industrie 4.0 is a hot topic in Europe. Meanwhile in Japan, the Electricity System Reform is moving forward. With the integration of energy, information, and things, we are facing an imminent major change in social systems and manufacturing. How should we proceed with our R&D through this tidal wave of change? We would like your opinions on the progress of instrumentation and control engineering and Fuji Electric.

Shin: I guess you and I have lived through roughly the same industrial periods as engineers. As Intel 4004 was launched in 1971, stirring a major revolution in instrumentation and control engineering, it was an interesting era for engineers.

You mentioned power semiconductors earlier, and Japan has a tremendous competitive power in that regard. Very skillful technology is necessary to ensure a robust structure that can withstand high voltage and large currents, and to manufacture it with stable quality. In my opinion, Japan has the best technology in the world. Fuji Electric has commercialized SiC semiconductors, which is also an achievement.

The mass media says that Japanese semiconductors are inferior, and so many people believe it, but in fact, that is about dynamic random access memories

(DRAM) or processors.

Technology today is moving from small to large powered systems, and Japan is also shifting its balance gradually in this direction. It's a regret that the media does not give comprehensive coverage.

My students are also losing hope for Japanese semiconductors. In fact, power semiconductor manufacturers are in need of human resources, and so a mismatch is occurring.

Eguchi: There was once an era where Japan could sell semiconductor chips well as long as we produced quality products with micro processing. It was shocking to see the end of that era. Meanwhile, power semiconductors have certain analog properties, which need some margin for adjustment. You cannot simply combine the two.

Shin: It certainly requires knowledge of physics and chemistry.

Eguchi: That's true. Semiconductor chips are products of the equipment industry that is driven by micro processing. Therefore, it may be just a matter of time before manufacturers overseas catch up with our SiC chips. As for semiconductor modules, the know-how lies in the composition of packaged components, including cooling systems, wiring, and noise reduction.

Shin: It's not only about the device technology, but also a highly sophisticated combination of technologies for operations, such as inverter circuits and algorithms, as well as the network that connects them.

You mentioned that Fuji Electric focuses on energy, and recently, the company is also working on the coffee makers and donut cases we find in convenience stores. Your enduring vending machine business is also growing into a major success. Fuji Electric is a renowned company with a long history extending its business scope to consumer products, which I think is a significant milestone in the 21st century.

Eguchi: At Fuji Electric, we have five business groups: Power and Social Infrastructure, Industrial Infrastructure, Power Electronics, Electronic Devices, and Food and Beverage Distribution. Our vending machines and coffee makers come under the Food and Beverage Distribution Business Group.

We're also expanding our business in this field to cover from upstream to downstream, namely, from plant factories to food processing, storage and logistics, and shop floors. In a way, it's the sextiary industry. However, we're fundamentally aligned for safe, secure, and efficient energy usage.

IPv6 accelerating IoT and M2M

Shin: With hydraulic power, coal, and oil, energy sources have changed since the 18th-century industrial revolution, but electricity as an energy form has remained the same. Fuji Electric has been operating in the field of energy all along.

In the 20th century, the concept of information came into play. We understand the 20th-century world model in terms of a three-tiered structure of information, energy, and materials.

The 21st century is an era of restructuring. This is where we come to the topics mentioned earlier: IoT, M2M, and Industrie 4.0.

Eguchi: You mentioned the integration of information, energy and material—I think this is what holds the key to the future of Fuji Electric business.

Shin: Globally, Japanese manufacturers are very technologically advanced. For decades, there have been projects similar to the IoT, such as the building energy management system (BEMS) and the home energy management system (HEMS). To someone with years of experience, like yourself, it must look like a reorganization of what has been around for ages.

There is, however, one crucial difference, and that is the transition of the Internet protocol from version 4 (IPv4) to version 6 (IPv6). With IPv4, there are only 4 billion addresses available. This umber is lower than the global population, so if every person in the world had a smartphone, it wouldn't be able to allocate addresses to all one of them.

IPv6 uses a 128-bit address, which has the capacity to allocate about 10 to the power of 38 addresses. This is more than enough to allocate IP addresses wherever they are required. It would be able to handle the demand for addresses even if everyone had 100 smartphones each.

Although not yet widely known, this is the very reason why the world is getting excited about the IoT and M2M.

Eguchi: I see, that's the fundamental reason.

Previously, it was necessary to wire computers to form an individual network for remote monitoring, maintenance, and other controlling tasks and to extract necessary data at given points, in order to give feedback to work sites.

Today, data is uploaded to the network as much as possible, regardless of its relevance. This process mixes in a variety of data that is irrelevant to the on-site work, like financial data. Data used to be point-based information, but today, it is a matrix, which is completely different.

Shin: "Diversity" is an important keyword. In the 20th century, Fuji Electric, for example, was able to have an encompassing view within the networks it had developed. It was a homogenous environment, so it could pursue design and operation smoothly according to plan. Now, we are handling a variety of elements, some of which are difficult to predict. It's no longer a prescribed harmony. Designing has suddenly become very difficult.

Eguchi: It may become necessary to incorporate data

not only on things, but also on managerial index.

Shin: Factories based on the IoT would be open facilities, so it would be impossible to prepare a production plan independently. In some cases, it may be necessary to take into account what items are selling well in convenience stores, and adjust the production lines accordingly. Weather also has an impact on the sales of certain items.

Eguchi: Your research areas such as autonomous distributed systems for information appliances and wavelet diagnostics are very close to the objectives of the IoT and M2M.

Shin: We have been pursuing these for decades. But 20 years ago, telecommunication capacities were very low. Early digital cellular phones had only 9.6 kbps, so they couldn't send photographic images. In those days, there was a tremendous gap between our ideal system and the reality. Now, even smartphones are capable of communication at several hundred Mbps. This is amazing progress. You can send photos and everything.

Eguchi: Can you tell us about the possible applications of wavelet analysis?

Shin: Many parties today are interested in biosignal analyses. In this case, it goes beyond IoT into the realm of IoE (Internet of Everything). There's particularly great demand for data on body temperature, pulse, sleep, exercise, and other indicators of human health and emotional state. These things can be leveraged to ensure the safety of factory workers.

We have long contemplated ways to integrate humans into the network, but this used to be difficult to realize. In this modern age, where most people have smartphones, individuals are tagged into the network through high-speed connections.

Will humans be consumed by machines?

Shin: I'm so fortunate to have lived in this exciting era of human-machine coexistence. But there are two regrets.

One is to do with security issues. Another is the fact that people don't have a sufficient understanding of the mechanisms.

The latest smartphones operate on 64-bit octa-core processors, which are as good as personal computers. With gigabyte memories installed, they can now communicate on the level of gigabyte per second. Now, it's possible that this is already beyond human intelligence. My students know how to use their smartphones, but they have no idea about their internal mechanism.

Eguchi: Perhaps no one understands it perfectly.

Shin: Smartphone software has over 40 million lines of code, which is almost equal to Windows XP. I'm teaching the embedded system of smartphones to students who have just finished high school.

So, this is what I always tell them; engineers who develop a product do not understand the whole mechanism because they work in specialized areas of expertise.

Eguchi: Troubleshooting methods are also different from old days.

Shin: In our day, we relied on our senses of hearing and smell. Today's engineers need computers instead. Observation doesn't work for them, so they plug their computers into a system and follow the instructions on their displays.

Eguchi: Therefore, the IoT and M2M technologies must establish methods of absorbing data on sound and smell through sensing technology, uploading them onto the Cloud, and leveraging this data for specific diagnostics or preventive measures.

Shin: That's certainly an important point. However, I want young engineers to know what it's like to work without these appliances before they become familiarized with them. If they knew how difficult it was, they would inevitably consider the benefits of information technology. Let me give you an example. Imagine a person who has never used a ruler to draw a line. He might be able to do some design using a CAD system. To my mind, however, he's missing a fundamentally important experience as a human being.

In the grand scheme of IoT and M2M, humans will be totally overwhelmed by machines without appropriate understanding of the mechanisms. As you know, Doraemon is a main character of a popular cartoon. It is a cat robot but also a friend of a boy called Nobita. This robot has many magical gadgets to get rid of troubles on Nobita. In a Doraemon analogy, the technology is Doraemon, who solves all of poor little Nobita's problems. But I believe there are some things humans have to be responsible for.

Role to play in the Electricity System Reform

Eguchi: The Electricity System Reform is moving forward in Japan. The full retail competition will be introduced in April 2016, and in 2020, the trans-

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mission and distribution sector will be unbundled. Could you tell us your opinion on the future direction for Fuji Electric, from the points of view of the IoT, M2M, and information control technology?

Shin: As we've mentioned, I think the keyword is "diversity."

While an energy company regulates the entire process, it doesn't need to fully automate the power grid switching. In order to bring in natural sources of energy, such as wind power and photovoltaic generation, it's necessary to automate supply systems to monitor and command route changes and so on. This connection with natural energy is where diversity comes in, and this requires major investment.

When the sectors are divided between supply, transmission, and distribution, then different players may have different agendas. In this situation, the power voltage and frequency must be maintained to ensure a stable energy supply. This is where Fuji Electric can leverage its expertise and development capabilities.

Eguchi: We need to perform comprehensive information management.

Shin: Absolutely. Changes in the weather directly affect energy productivity. In this situation, we would need to know to what extent thermal power plants should be operated.

Eguchi: We have already begun operating supply/demand forecasting incorporating meteorological data, and we find that the cycle is very long.

Shin: Measures against spontaneous torrential rain are indispensable. Among the systems that operate for safety combining short-cycle systems with diversity, the system that survives will be one that has some flexibility for different enterprises to carry out their own businesses.

Eguchi: The safety of the system will be increasingly important. It's easy to take safety for granted. But can safety itself be an asset to add value to the system?

Shin: Companies should use risk analysis to learn the risks of withholding investments, and leave the decision to the management.

Eguchi: That's a kind of insurance scheme.

Shin: Absolutely. Insurance companies offer policies to cover damage compensation if a company is held liable due to an accident or environmental pollution. It's like car insurance which offers lower premiums for automobiles with airbags. Corporate insurance premiums are reduced by nearly 40% if the company is certified with an information security management system (ISMS) for server systems.

We are currently appealing to Japanese government to create a similar framework for control systems that allows a more advantageous insurance policy for companies with cyber security management system (CSMS) certifications.

Eguchi: Certifications will become very important. You're the President of the Control System Security Center. Does the center have any certifications?

Shin: We do, but not without credentials. We are accredited by the Japan Accreditation Board (JAB), and we also base our certification on international standards. Insurance providers can also reduce their risks through third-party certification with certain credentials.

Eguchi: There have been cases where webcam users connect their devices to the Internet without changing the default settings, and end up having their privacy invaded. In view of the coming age of the IoT and M2M, how should we view security, and what can we do to raise awareness among the general population?

Shin: Cyber security is a game of cat and mouse between attackers and countermeasures. This is not to say that there's nothing to be done, but it's important to acknowledge the situation. It's important to acknowledge that even top-range products become vulnerable over time, so it's crucial to equip updatable features.

For example, flash memories are mounted on smart meters in case a software update is required when a problem occurs. Therefore companies must figure out how much flash memory they need and how to configure their in-house systems in case updates fail and devices need replacing.

The 20th century was epitomized by mass production and consumption, but in the future, it looks like products will be maintained and cherished for long periods of time. Therefore, we should base our efforts not only on manufacturing, but also on the service-oriented industry.

Integration of physics and statistics—indispensable for big data analysis

Eguchi: In the wake of the machine networks with IoT and M2M as well as big data analysis, global business is changing dramatically. I believe that Fuji Electric has resources with which it can contribute.

Shin: Sufficient resources. And you should make contributions.

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2010: Director and Managing Executive Officer, Fuji Electric Systems Co., Ltd.
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Eguchi: In-plant products and systems have been our forte. We have actuators and controllers as well as network technology. Big data analysis, however, is primarily a mathematical practice, at which information and communication technology (ICT) companies are adept. We are a company that's adept at handling physical phenomena, so where do you think we can make contributions?

Shin: Big data analysis is basically statistical analysis. I think there will be a highly reliable conclusion if integration is successfully executed between physical approaches, at which Fuji Electric excels, and statistical approaches.

Analyses without physical principles can be dangerous. Finance is a good example. There is a differential equation in probability called the Black-Scholes formula, which is often employed in investment, but the company founded by Mr. Scholes went bankrupt.

Eguchi: At present, ICT companies lead the IoT business. To be honest, we have the know-how based on on-site experience, and our pride will not allow us to simply be swallowed up in the big-data system. As you suggest, ideal integration may make it possible to gain more than what we can offer.

Shin: There must be so much to gain.

Take cars, for example. It wouldn't be so much fun if absolutely everything was put under computerized control. There are some things a driver wants to control. Without computers, on the other hand, the risk of accidents would be higher. Therefore, we need to delineate the domains of autonomous human control and computerized safety assurance.

As you know, many corporations today have business continuity plans (BCP) in place to prepare for eventualities such as accidents and natural disasters. But if the plan had to be very rigid, there would be very little room for innovative ideas.

I would question the value of uploading the company's on-site know-how straight into the Cloud. As you can imagine, parents wouldn't be able to resist the temptation to interfere if they knew all about what their children were up to. That wouldn't be good for the children's development.

Eguchi: That's a very good analogy.

Live independently, live better connected

Eguchi: Admittedly, there is a gray area in terms of the directions IoT and M2M are going to take, but in any case, Fuji Electric hopes to strive in maximizing our component business, and offer new solutions by combining them with instrumentation and control technology.

Shin: What you just said provides a conclusion for today's discussion. It's important to be connected, but it's equally important to polish ourselves. If you connect with others without having any particular identity to assert, you will simply be absorbed.

Eguchi: It reminds me of when I was involved in the smart-grid project. It's no longer possible for a single company to handle all IoT-related requirements. So open innovation and lateral collaborations are becoming increasingly important. Distribution of responsibilities will be a difficult task. But I also feel that as Japanese manufacturers, we must compete as a team, with concerted efforts, in the world arena.

Shin: I agree.

Eguchi: You're involved in the Technology Research Council. In a sense, you're leading Team Japan. How do you think Japan would fare today compared to the traditional convoy system?

Shin: Some time ago, when Fuji Electric developed an autonomous decentralized network and brought it to an international standard, I was given the task of explaining the concept of autonomous decentralized systems at the ISO committee. The concept of decentralization is pretty self-explanatory, but autonomous control was not so easy to explain. The situation may be similar to the open innovation of today.

At the committee, I explained that while you can live independently, you can live better if you're connected with others.

First of all, we need engineers who can survive without information devices. We need to train engineers so that they can design things with a pencil. Then they can leverage useful tools in order to perform better.

This is the idea I have long held in education at the university.

The same goes for collaboration. Fuji Electric can survive on its own. If it keeps that core part intact, it can deliver better results by collaborating with other contributors.

Excellent technology to sell for high prices

Eguchi: There was a time when the scope of Fuji Electric's business was over-extended, but today, it has a clear vision about its business direction.

Shin: I think it's a regret that you don't brag about your excellent technology enough. This is typical of Japanese engineers. However, you cannot have this attitude in open innovation. I want good technology to be appreciated for its value so that it benefits consumers across the world.

Eguchi: The international market brings in the issue of pricing. Cheaper products cost as little as a half of prices in Japan.

Shin: Price wars are a result of the unskillfulness to promote your own core technology properly. Given the high cost of labor, Japanese firms will lose in price wars.

Instead, you need to explain what justifies the high prices. As we know, there are so many users who opt for cheaper products and end up in a cul-de-sac.

Eguchi: Cheaply made products often have short lifecycles.

In this sense, Fuji Electric's product development is different, as it focuses on the company's strong core technology with added value. For example, we make a pressure sensor that withstands super-deep-sea pressure. There are many unique products like this one. There is great demand for this sensor in African countries.

We have also co-developed a domestic gas detector with Osaka Gas Co., Ltd.. This is the world's first battery-powered gas detector with a micro gas sensor, and we applied our unique micro electro mechanical systems (MEMS) technology to the device, reducing its power consumption to less than a thousandth.

We also have a range of controllers, from a distributed control system (DCS) to a programmable logic controller (PLC). As for wireless networks, we have developed an ad-hoc transmission module jointly with Tokyo Gas Co., Ltd. and other firms.

We are seeking ways to develop further by combining this high technology with our components, power electronics and actuators.

There is great potential, but we are not quite in tune with world trends. Sometimes, we have been so far ahead of the times that when the times finally caught up with us, we had reached the point of exhaustion.

Asia to become the third power in international standards

Eguchi: It's very disturbing that international standards are so Euro-centric. We Japanese manufacturers always have to be on the defensive.

Shin: Technology is very advanced in the U.S.A., and Europe is adept at systematization. It's true that in the 20th century Japan had to assimilate to either Europe or America in terms of standardization. But as we know, Asia is showing remarkable growth. It may well become the third major power in terms of international standards. This puts Japan in a different situation. In this sense, Japan has gained a third approach; that is, to propose new standards from the Asian perspective.

Eguchi: Is movement from Asia going strong?

Shin: Yes, it is. The OLE for Process Control (OPC) Foundation is pursuing activities at King Mongkut's Institute of Technology Ladkrabang in Thailand. ISO/IEC requires support from five countries in order to make a new work item proposal. Therefore, we are currently using our university connections to network and gain five affiliates among the ASEAN member countries.

Because the current Japanese government is proactive in infrastructure exports, there have been notable changes in the international climate.

Eguchi: Another point of concern regarding standardization is differentiation. In your writing, you use the phrase "a module, but a module with a margin for adjustment." What do you mean by this?

Shin: As there are many different approaches to Industrie 4.0, I see it as applying 3D technology to information. For example, one automotive manufacturer is pursuing their development using a 3D CAD system. In the 3D domain, they input everything from the production system to people, machines, and PLC, and execute the whole program in the virtual realm to generate a manual. This manual is then distributed to plants across the world, and they launch the new car simultaneously. Here, the 3D CAD acts as the mother plant. What I mean by "a module with a margin for adjustment" is a module equipped with a variety of know-how.

Suppose you have certain models, and you know that some combination of patterns thereof will produce a car. The systematic technology that brings about these combinations embodies a certain type of know-how. Other than this, the components themselves are important. Some models may be gold, and others copper. These differ in terms of energy consumption, durability, and so on.

Recently, wearable devices in the form of wristwatches have been released. The cheapest one is made of aluminum. Then there is stainless steel one, and the top of the range is 18 karat gold, costing more than a million yen. So, you can also make distinctions according to the materials. In the future, differentiations according to component combinations and make-up will be an area of competition.

Eguchi: So, Japan must retain some areas of competition in this way.

Shin: Fuji Electric's deep-sea pressure sensor is a winner. You can't measure deep-sea pressure with a sensor mounted on a smartphone.

Open/close strategies of technology

Eguchi: How do you envision the factories and society of the future?

Shin: I hear that President Obama is also very inter-

ested in 3D printers. I think we are leaving behind the era when products are produced by professional manufacturers. The time is coming when customers will be able to make products with a CAD system and a 3D printer at hand. If none of the cars in a catalog appeal to you, you will be able to design a car with a CAD and print it out. You will also be able to modify the car's design according to the growth or changes in your family members.

This means that there will be a variety of laypersons entering into manufacturing. That's why our task will be to systematically ensure that such products are safe and secure even when they are made by laypersons.

In the 19th century, factories and houses were located together. It was the Ford production system that initiated a new trend, and then industrial and residential areas became separate. In the future, this boundary will once again become ambiguous. Factories will appear in downtown areas. A 3D printer is a handy thing to have in a household. If you want to give your wife a nice ring, you can make one on the spot. While there is the issue of printing materials, the machines are available at mass retailers for 100,000 yen.

Eguchi: That will be the ultimate initiative in local production for local consumption. Then what will become of manufacturers?

Shin: I think that manufacturers will actually become more important. There must be someone pulling the strings in the background so that unskilled laypersons can produce proper products. Models are what set the basis for that.

Some parts manufacturers have 3D models of their screws which can be downloaded. Using this system, their clients can install the models in their CAD systems, and confirm the correct specifications for the parts before they place actual orders.

Eguchi: There are similar attempts for certain aspects of power semiconductors. It makes it possible to check switching loss and other functions using downloadable models.

Shin: Today there's great demand for data that shows whether the device works properly in a reference circuit, or to visualize the heat generation or the fluctuations in electricity currents. There's an electronics manufacturer that provides free CAD software for LCR active circuits. With this software, customers can simulate the properties of the manufacturer's capacitors in advance.

I think Fuji Electric has many advantages due to the many excellent components. So, the sensors and power semiconductors should be compatible with other manufacturer's standards for the IoT. As for protocol, it's desirable to use Application Programming Interface (API) rather than unique protocols.

Eguchi: You're suggesting that we should make part of our trade openly accessible.

Shin: I'd say that this is an open/close strategy. You may want to close off your valuable assets, but open the parts that can be utilized by other companies. From a different perspective, this means that Fuji Electric products can spread into the realms of other companies.

Eguchi: There are far more opportunities than before to speak with people from different lines of work, such as machinery manufacturers and ICT companies. In this situation, it's easy to lose sight of where we're headed if we don't maintain a clear sense of our identities.

Shin: Each member comes up with their own proposals, all of which are combined to make a successful project. That would be an ideal alliance.

Engineering as an aspirational vocation—developing talent through industry-academia collaboration

Eguchi: Fuji Electric deals in sensors and controllers, but it needs to strengthen its control technology front. I have the impression that it's difficult to train specialists in this field. You need an object to control in order to learn how it works, so theoretical education alone is not enough. How do you teach control technology in your university?

Shin: When I was a student, it was often said that mathematics has no use in engineering. But everything that I studied at university is very useful today because in this modern age, inverters and other components are all based on formulae. Students in my class on Fourier transformation might see the lecture as no more than general knowledge, but everyone in engineering today uses this method on a daily basis. These days, even models are designed using differential equations.

Eguchi: You're suggesting that basic theories are the key to learning control engineering.

Shin: These days, an increasing number of universities are strengthening their ties with corporations. Since 2006, the University of Electro-Communications

has been running a special master's degree course—the Advanced IT Specialist Specialized Training Program—as part of a program endorsed by the Ministry of Education, Culture, Sports, Science and Technology. We have seven or eight enterprises currently taking part in this course as lecturers. They talk about the theoretical aspects of control engineering, introduce students to mathematical analysis software to handle digital signal processing, lecture on security issues, and so on. Teaching staff may introduce subjects saying, "This is used in society," but it's hard to get the students interested. On the other hand, if corporate personnel as lecturers say, "We use this in our company," then the students suddenly perk up. I would love it if Fuji Electric came to take part in our course.

Eguchi: That supports my impression that universities and corporations must work together to provide education.

Shin: In the past, it was difficult for universities to impart the practical knowledge that companies require. In our Advanced IT Specialist Specialized Training Program, the companies themselves have the opportunity to participate in training young talent.

Eguchi: The importance of education cannot be overemphasized. One of our female employees has been sent to Denmark to study at Aalborg University. I went to pay her a visit recently, and saw her confronting control theoretic study head-on. I would like to have more talented personnel like her. We must create more opportunities for education and training, maybe at your university, too.

Shin: As an educator, I am all for inspiring young people about the future. Through high school education, students learn things that have "correct" answers. But this does not cultivate aspirations. Changing their frame of mind at university is a hard task. I often tell them, "Humans don't really know very much about the world. So, you can take your own initiatives and create new products or make new discoveries. It's actually easy to create new things."

Eguchi: Younger generations are becoming increasingly conservative compared to before. Do you think this is a result of the declining birth rate?

Shin: It's because Japan is such a comfortable country to live in. Perhaps that's because Fuji Electric has made the country's infrastructure so solid. Jokes aside, I think engineers have contributed greatly to making Japan such a comfortable country.

Eguchi: I've read articles where you said that engineers were not treated well in Japan.

Shin: When you and I were younger, engineering was an esteemed career. Around the time of the economic bubble, however, many people who were talented in the sciences chose finance as their career path. Personally, as an engineer, I would like my students to experience the sense of achievement unique to engineering, that there's something they contributed in its creation, be it the development of a certain technology or plant construction. It would be unfortunate for an engineer not to have a single successful experience.

Eguchi: In this sense, engineering is an inspiring career.

Shin: As a company with a long history, Fuji Electric has overcome dramatic times of difficulties and changes, as represented by the IoT. It has survived by transforming its corporate structure, or by selecting and focusing its resources. All these experiences form the company's foundation today. The company has its sustainability and identity firmly established, and yet it maintains the ability to adapt to current global trends. These qualities must be acknowledged more widely in society as well as among students.

The same can be said about our University of Electro-Communications. We renamed ourselves after WW II. Other names proposed at the time include things like "University of Radio" and "University of Communications." I think the name "University of Electro-Communications" showed great foresight. Many other national universities are named after their regions, such as the University of Tokyo or Tohoku University. Our university is the only one without a place name in the title. It signifies that engineering is our identity.

I believe that the 21st century will be epitomized by electro-communications. Electronics and communication are crucial components of the IoT. We hope to strive hand in hand with Fuji Electric in making our contributions for the future of Japan.

Eguchi: Today, you taught us that we must be more self-assertive so that our excellent technologies will be more widely acknowledged and appreciated. We hope to continue making progress in the future by enhancing our ability to communicate our strengths, while valuing talented personnel and experts so that we can contribute to Japanese society and the world. Thank you for your time today, and we are looking forward to our future collaborations.