

# IoT and M2M — The Transformation of Social and Industrial Infrastructure

— Giving tacit knowledge an explicit form to bring new value to customers —

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The Internet of Things (IoT) and machine-to-machine (M2M) technologies have become diffused and now influence the whole of society. What does the future hold for industrial systems as the IoT and M2M continue to advance? It is crucial for Fuji Electric to identify its fortes in order to take a plunge into this unknown territory with its strengths in industrial infrastructure and power electronics. Professor Hiroyuki Morikawa, a leading IoT specialist from the University of Tokyo's Research Center for Advanced Science and Technology, talks with Naoya Eguchi, Fuji Electric's Corporate General Manager from the Corporate R&D Headquarters, on the importance of having a customer-centered approach in creating new value.

## The IoT and M2M are realities

**Eguchi:** I'd like to take this opportunity to thank you for your ongoing dedication that we are fortunate to witness on various occasions. We appreciate your input in the subject of energy conservation for network devices, and also the interaction we have with your laboratory.

Fuji Electric came into being 93 years ago as a joint venture between Siemens AG and Furukawa Electric Co., Ltd. The company has since developed mainly in the area of heavy electric equipment. We often see the Internet of Things (IoT) and machine-to-machine (M2M) technologies being mentioned today, but Fuji Electric has already been engaging in something close to them for a long time in relation to industrial plants, such as remote facility maintenance systems.

Today, I would like us to discuss this major transformation in industrial systems brought by the IoT, and explore the possibilities of leveraging our resources in this area.

**Morikawa:** At my laboratory, we also set our ultimate goal as the creation of new value from data-oriented technologies such as the IoT, M2M and big data. We

mainly focus on gathering and analyzing data to identify what value we can offer to customers. For example, we are researching data mining in agriculture and the early detection of incipient faults for wind turbine systems. Our endeavor is a combination of two major themes: telecommunications as an infrastructure, and the applied areas such as agriculture and wind power generation.

**Eguchi:** At Fuji Electric, we have a rich resource of sensors, controllers, actuators and other field devices, but we still need to improve on how we leverage the collected data.

**Morikawa:** Sensors and actuators give Fuji Electric the means to gather data. It represents a great advantage for the company. As promoted by the OECD, a data-driven economy is the concept of creating value with data as a starting point to enhance productivity.

To the question of what the IoT is about, I say it is about turning analog into digital. Take wind power generation, for example; we rely on the experience and intuition of skilled engineers to detect abnormalities. The IoT can replace those with digital data.

**Eguchi:** It is about converting tacit knowledge and know-how into digital data.

**Morikawa:** That's right. There is a case in which a bus service operator successfully turned their unprofitable routes into profitable ones through digitization. They equipped their buses with GPS and sensors, and collected data on service execution and passenger statistics from every bus stop. Based on such data, they modified the time table and repositioned their bus stops. This is all they did, and they succeeded in turning operational loss into profit. They gathered data, which had helped them to visualize their operational status, elucidating where the problems were.

Here is another interesting example of digitization that relates to a comedy theater in Barcelona, Spain. They installed cameras on the back of each seat to capture the faces of the audience and generate digital data on how many times a particular audience



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member laughed. This allowed them to introduce a new pricing system. They abolished the admission fee, and instead, they started charging audience members 30 cents every time they laughed. To our amazement, this system has improved the audience satisfaction, and the revenue increased as a result.

As these examples suggest, in the IoT, it is important to do it anyway.

**Eguchi:** We tend to prioritize the cost, and this often prevents us from going further to focus on value creation. We find it difficult to always keep customer-centered perspectives in formulating a new value to offer. On learning that your research starts from thinking about what to offer customers, I see great significance in this approach.

**Morikawa:** In the past, research at universities typically took a linear approach, starting with basic research, followed by studies for practical applications, then deployment in society. Today, however, it is more often the case that we first find issues in the field.

**Eguchi:** It is similar to what we do in the industrial sector.

**Morikawa:** That’s right. Universities also need someone like an analyst who scrutinizes what customers need most.

**Eguchi:** What is the method of your teaching at the research center?

**Morikawa:** Given an increasing awareness of the IoT in agriculture and many other sectors, I sometimes send my students out into the field to find potential needs. Identifying customer needs and then implementing ideas before presenting them to customers; this is the concept of what is called design thinking.

**Eguchi:** We often encourage members of our laboratory to go out into the field with customers more instead of locking themselves in the lab, but it takes a great effort to do just that.

**Morikawa:** I would say it is ideal if about 10% of researchers and engineers were up and about in the field. Even if it does not lead to success, they can simply try again.

**Eguchi:** Our plant factory may be a good example of this approach. We have a 2-hectare strawberry production plant in Tomakomai, Hokkaido, Japan where we experiment with Fuji Electric products and technologies in the agricultural industry. We currently have engineers stationed there to learn from farmers, acquiring their tacit knowledge, aiming to convert it into explicit knowledge. There is also a bell-pepper plant under construction in Kushiro at the moment.

**Morikawa:** Speaking from the viewpoint of the data-driven economy that we spoke about earlier, it sounds like a viable business prospect. It should be possible to roll out greenhouses throughout Asia, and aggregate the data from them in Japan to formulate know-how on greenhouse management.

**Eguchi:** That is exactly the IoT in practice.

## Will hardware be empty in value?

**Eguchi:** It is very inspiring to learn about new-value creation deriving from findings based on clusters of voluminous data. Meanwhile, it would be unlikely for an enterprise to decide to gather data without specific purposes.

**Morikawa:** There may have to be certain assumptions for data collection. Nonetheless, insights may also be gained from the data outside such assumptions. For this reason, it is advisable not to eliminate apparently irrelevant data segments.

**Eguchi:** Does that mean that we should upload all the data from sensors straight to the cloud? Alternatively, we could pre-process the sensor data before uploading it to the cloud for further in-depth analyses.

**Morikawa:** One point for consideration is whether the network and storage space can cope with the entire data volume. Monitoring camera data is a good example. Another point is the timeliness of the data. If it takes time to upload all the data, it may adversely affect the immediate decision-making and control execution. If this is the case, it would be necessary to prepare the data in a local environment.

**Eguchi:** Today, many global giants are putting their fingers in the IoT pie. Fuji Electric is a small competitor compared to them, and our greatest concern is how we should proceed in the IoT business. The question is whether we go for a one-stop service option to cater to all needs, or opt for a more organic, collaboration with several enterprises, forming an ecosystem where Fuji Electric is one contributor. In either case, we will need to be aware of our playing field. Otherwise, if in the future the time comes that all there is to do is to upload data, then what we do will lose its value. We must avoid falling into such a situation.

**Morikawa:** It is very important to be prepared for future risks such as this. As we know, a very well-known US electrical manufacturer decided to call itself a software company. They did so because hardware was losing its value in business. This is a global trend. We will need to have a bilateral approach between hardware and software. Differentiation in hardware will

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also be important in the future.

**Eguchi:** This presents us with another concern as to whether we should introduce some level of intelligence into the field devices, even if not AI.

**Morikawa:** Possibly. Fuji Electric products are widely used in clients' field devices. That means you have field-based know-how. This point should be given thorough consideration.

The value of thinking cannot be overemphasized. In Germany, Industrie 4.0 is an initiative based on government-industry-academia partnership. I hear that most of the 30 billion yen's worth of government funding is spent not on the development of technology, but on organizing meetings and community events. They allow a large portion of that money to be spent to ensure opportunities for thinking about the interfaces in order to connect devices via the Internet. Many stakeholders come together in this, including business rivals and small- and medium-sized enterprises representing the majority. In Japan, we tend to be happy to dedicate resources for technological development, but very little is done to ensure there are proper opportunities to think.

**Eguchi:** We think that Industrie 4.0 presents a great threat to us if they succeed in leading the standardization. Japan must show strong leadership.

**Morikawa:** As the IoT enhances connectivity, having an ecosystem approach is ever more important than today. It is no longer viable for a single company to tackle the whole enterprise. Teamwork is the key, including us universities.

Corporations in North America and Europe are advanced on this front. For example, the Industrial Internet Consortium (IIC) is a platform launched by a group of US companies. While the German Industrie 4.0 focuses on manufacturing, the IIC covers the areas of energy, healthcare, manufacturing, public services and transportation. They present themselves as being an open organization, with the top management recruited from outside. Today, more than 100 corporations participate in it from across the world.

I am sure that Japanese electrical manufacturers also share an awareness about the importance of collaboration. Today, we live in a demanding era where teamwork is indispensable even to develop a business ecosystem in order to fare well amid international competition.

**Eguchi:** When it comes to making our presence felt in a team, we need to have something that is globally outstanding.

**Morikawa:** I agree. If I may digress a little, Ferrari is one of the most outstanding manufacturers. They reduced production while hiking unit prices, and yet succeeded in expanding sales. In a Japanese context, a typical approach would be to lower prices to sell in large quantities while the product is in demand. Ferrari has been successful by doing the opposite. I think that engineers today must have this kind of per-

spective. They can no longer be indifferent to matters concerning sales and marketing.

**Eguchi:** I agree. Japanese firms tend to be prone to price competition. It was the case with memories, LCD and solar cells. They all lost in the price competition against overseas competitors in the end. Fuji Electric has power electronics and power semiconductors as its core technologies. Regarding power semiconductors, we are mindful of not falling into a price competition. Because power semiconductor is an analog technology with an accumulation of know-how, it cannot be easily copied as long as secrets are kept.

## In the wake of industrial structure transformation

**Eguchi:** Are you working to develop network devices and sensors at your laboratory?

**Morikawa:** We use sensors, wirelessly collect data, and what follows is the area of our research. Currently, we are looking at multi-hop technology. By involving several wireless hops, it is possible to extend the reach outside the range of one-hop communication. A multi-hop configuration is rather laborious to set up, so we are trying to achieve differentiation by simplifying the system so that it is easier to adjust and use.

**Eguchi:** Fuji Electric is striving to enhance sensor usability. Leveraging our strengths in the areas of cordless, low-power consumption and miniaturized devices, we develop products such as gas sensors that can be installed almost anywhere.

We are also working on applying micro electro mechanical systems (MEMS) technology to develop self-power feeding sensors. As our technologies cover areas beyond sensors, such as inverters, motors and actuators, we want to create something out of a combination of these technologies that stands out in the world. I think it is crucial in order to survive.

**Morikawa:** It seems to me that the idea of combining something leads to success more often than not. I think it is an important point. However, we also need to develop what works for businesses, otherwise we cannot write papers that leave a strong impression.

**Eguchi:** Making an impression is important.

**Morikawa:** In the old days, there was not much that technology could do, and therefore even a performance improvement of 5% to 10% made an impression. Today, most things can be made possible with technology, as long as one can afford it. This has changed people's perception, and enhancing performance that much does not get the same amount of attention.

**Eguchi:** We would be grilled by the management about cost performance if we were to propose a 5% to 10% improvement in performance.

**Morikawa:** Exactly. And so, our ambition would be to aim for a 10-fold improvement.

I may not be accurate, but I say that the IoT is a result of IT and ICT matured as technology, and it is now beginning to extend its realm into many different

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sectors such as agriculture, civil engineering and transportation. It is only the beginning.

Eguchi: So, the transformation has just begun.

Morikawa: My opinion is that the mainstream digitization will unfold over a long period in the coming decades.

Eguchi: M2M is literally communication between machines, and new values are created through that. It is possible that the future M2M will involve human behaviors and other complex interventions. There, we may find more new values.

Morikawa: IT and ICT are the future “general-purpose technology,” to borrow an economics term. The industrial structure may well undergo a major transformation.

Take steam engines as an example of general-purpose technology. Peter Drucker pointed out that the invention of steam engines was significant not in that they brought locomotives into the world, but in that this infrastructure led to the rise of various industries such as banks, newspapers and postal services, transforming the industrial structure. It is also argued that the invention of the steam engine led to the rise of giant railway companies, which in turn necessitated the procurement of large funds, and gave birth to the Wall Street economy. Another aspect of this is that the major railroad companies created many middle-management positions, and the employees needed education, so business schools emerged.

In a similar sense, IT and ICT have paved the way to new infrastructure such as sensors and cloud computing. Changes will take place in various aspects of industries, and that will then lead to a transformation of industrial structure. I imagine that, in 30 years’ time, we will be looking back at today and thinking that things were different in those days.

You’re lucky if you can identify a transformation in the early days. If I did, then I would resign as professor. I often advise my young students to have flexible perspectives.

Eguchi: Would you say that the Japanese are not good at flexible thinking? We are somehow unable to further our imagination without having things built first.

Morikawa: I believe that the Japanese are also capable of having a creative imagination. We can if we try. I would like to see Fuji Electric also explore the frontiers with its strategic excellence.

It cannot be done if researchers are cocooned in their labs. They should venture out more to find challenges on behalf of the management, who are responsible for protecting the business. This is one of their purposes.

Eguchi: I absolutely agree.

Morikawa: I often mention RTB and CTB. These are financial terms; they stand for running the business or running the bank and changing the business or changing the bank. In the context of the IT division in the financial sector, for example, securing an IT system



falls into RTB. Introducing a new financing system such as FinTech (Financial Technology) would be CTB.

In order to protect the company, it is crucial that RTB ensures a profit. If RTB takes a chance and fails, then the company loses its foundation.

In this sense, the IoT and the lab belong to CTB.

Eguchi: I agree that it is in the CTB domain. It is important to take chances.

Morikawa: In reality, however, many researchers, who should be in CTB, tend to be conservative. We need more researchers with a challenging spirit.

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### Silicon Valley is not an enemy

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Eguchi: It has been inspiring to learn from this talk that we are at the beginning of a transformation of industrial structure through the IoT. Lastly, if you can, please tell us what you expect of Fuji Electric.

Morikawa: If I dare say, Fuji Electric is a bland company. I would like to see that this blandness is turned into the company’s strength.

In my opinion, the IoT should be technology that will be made smart in shade. Since Fuji Electric has a rich resource of know-how and tacit knowledge, which many startups lack, I believe that such a resource can be transformed into an advantage by converting it into explicit knowledge.

Eguchi: We take great care to diligently follow up on our customers’ requests, and that is the DNA of Fuji Electric. I understand your suggestion to be that we should compete not in terms of quantity, but in terms of agility.

Morikawa: Silicon Valley is not your rival. They will not try to encroach on your market territory because it is too bland for them.

Eguchi: This year, we have put “prioritize customer value” at the top of our R&D policies. It means that we cannot advance research without knowing our customers.

Morikawa: That is a good idea. Researchers should be constantly reminded of the significance of this.

Eguchi: It has been such an eye-opening discussion today, to learn that Fuji Electric can turn its bland nature into an advantage. Thank you for your time today, and we are looking forward to our future collaborations.



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