Production Technology to Realize Stable Product Supply Leads the Way to the World's Largest Market Share

── Standardization and High-Mix Low-Volume Production in the Rapidly Growing Module Business

Guest: **Mr. Norio Sakai**
Fellow, Communication and Sensor Business Unit
Murata Manufacturing Co., Ltd.
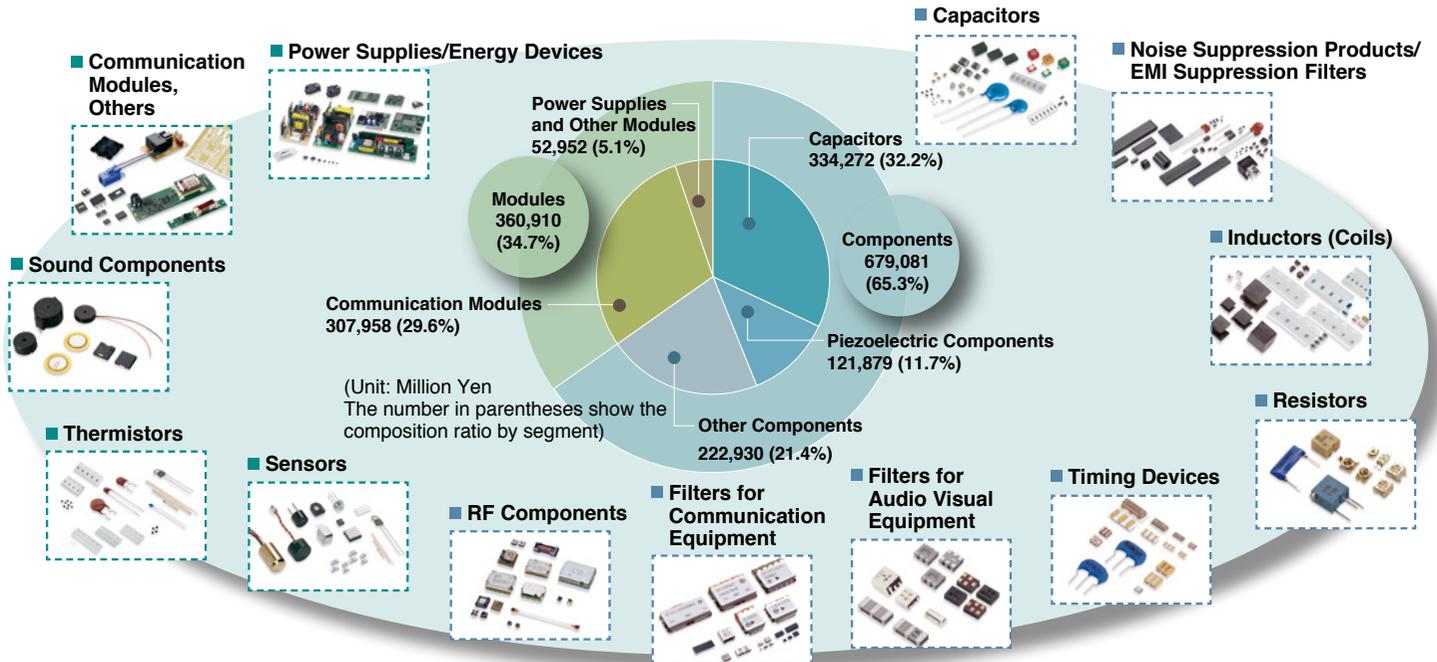
Interviewer: **Mr. Hisaharu Obinata**
President and CEO, ULVAC, Inc.

Murata Manufacturing Co., Ltd. is one of the world's leading manufacturers specializing in electronic parts such as multilayer ceramic capacitors, communication modules, and sensors. It recorded its highest consolidated sales of over one trillion yen in FY2014. Its production technology and product development capabilities are the sources of its continued high-level business results. The production technology realizes low cost, high quality, and a stable product supply, while the product development capabilities allow advanced solutions to market needs to constantly be offered as well as the introduction of products matching such needs. The communication module business for smartphones is the most prominent example of their product development capabilities. For this issue's "Executive Guest" Hisaharu Obinata, President and CEO of ULVAC, Inc., visited Mr. Norio Sakai, Fellow, Communication and Sensor Business Unit, from Murata Manufacturing Co., Ltd. and asked him about the roles of production technology and process development as contributing factors for these good business results.

*Personal changes on July 1, 2015   ***All product trademark notices are omitted in this document.**

■ Figure 1. Murata's product lineup and sales breakdown
(consolidated accounting period from April 1, 2014 to March 31, 2015)

■ Communication Modules, Others

■ Power Supplies/Energy Devices

■ Capacitors

■ Noise Suppression Products/ EMI Suppression Filters

Power Supplies and Other Modules
52,952 (5.1%)

Capacitors
334,272 (32.2%)

Modules
360,910
(34.7%)

Components
679,081
(65.3%)

■ Sound Components

■ Inductors (Coils)

Communication Modules
307,958 (29.6%)

(Unit: Million Yen
The number in parentheses show the composition ratio by segment)

Piezoelectric Components
121,879 (11.7%)

Other Components
222,930 (21.4%)

■ Resistors

■ Thermistors

■ Sensors

■ RF Components

■ Filters for Communication Equipment

■ Filters for Audio Visual Equipment

■ Timing Devices

Production Engineering Division as a Part of the Research and Development Division

Obinata: Before we start, I would like to take this opportunity to express our sincere gratitude to Murata Manufacturing ("Murata") for our long-term business partnership. Thank you.

Now, Murata is a manufacturer specialized in multilayer ceramic capacitors and piezoelectric materials. Many of your products dominate the global market. Meanwhile, your smartphone modules and fine electronic parts, using advanced materials technology, are further expanding your business.

Mr. Sakai, you are responsible for the module technology, so let me ask about the module-related process development and production technology. For our readers, Kazuya Saito (Executive Director and the head of the Research and Development Planning Department), Directing Manager of our Research and Development Department, is also joining us today.

Which divisions are involved in production?

Sakai: For the most part, the same divisions as in any other company—general administration divisions such as the Human Resources and Accounting Divisions, business divisions such as the Component, Device, and Module Divisions, the New Business Division in charge of new businesses, divisions in charge of new products, and the Sales Division.

What makes our production unique is the Research and Development Division. While most research and development divisions focus on fundamental research on materials and such, ours has a Production Engineering Division. The Production Engineering Division has approximately 1,000 employees.

Obinata: That's a lot! When did the Production Engineering Division become the part of the Research and Development Division?
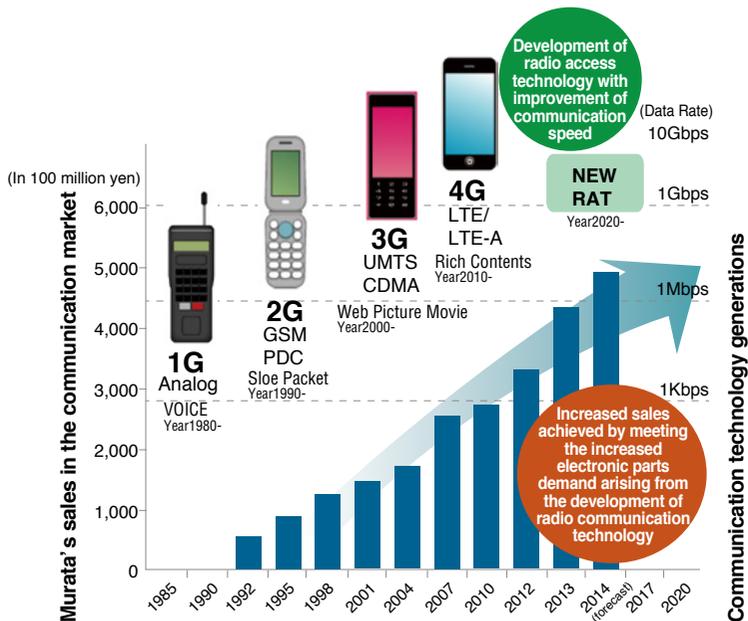
Sakai: About 15 years ago.

Murata is originally an electronic parts manufacturer that processes materials, so it used to place importance on electronics and chemistry but not as much on machinery. This changed when Akira Murata, the founder became the president. He placed the highest importance on production engineering and positioned it as a type of research and development. He said, "We are making our own materials now. In order to differentiate us from competitors, we should also make our own production equipment." The production engineers now support production from the Yasu Office.

Obinata: Mr. Murata was far-sighted.

Sakai: Since the semiconductor business is a major business, many manufacturers like your company sell production equipment. While thin films are produced in the semiconductor business, we produce thick films. Since thick film production is such a small market, there was almost no production equipment on sale. A manufacturer in the Chukyo region used to produce it for a while, but the company was gone before we knew it.

What it came down to is that we had to make it ourselves. This is the background of in-house development as I know it.

■ **Figure 2. Communication technology generations and sales in the communication market**

The "Customer Needs First" Development Policy

Obinata: As represented by the corporate philosophy "Enhance technologies and skills, apply a scientific approach, and create innovative products and solutions," Murata's development is far-sighted and is based on the corporate spirit carried on since its foundation. Would you tell us what makes your development unique?

Sakai: As a ceramics manufacturer, we created new products through materials engineering. As time passed and our operation spread to electronic and communication technologies, however, we started to develop new products for these fields. Our strength is creation of new products through integration of all these technologies.

Obinata: And so you're able to produce such successful products because the new products come into being when technology seeds meet technology needs. Whereas focusing only on the seeds tends to result in development that is nothing more than self-gratification.

Saito: I heard that you make technology roadmaps to develop products systematically. How does making these roadmaps translate into viable business?

Sakai: Development does not always go as planned. A few years ago, our current president Tsuneo Murata defined the most important business philosophy as "continued provision of value which leads to customer satisfaction." What customers want is more important than what we want to provide. I believe that meeting customer needs is the key to the Development Division creating products that contribute to our business.

Obinata: I have been saying the same thing to my employees. I am now proposing regular technical exchanges with our customers to discover their needs.

Sakai: The purpose of a technical exchange is to understand customers' concerns and learn new ways to do things instead of simply going over a technical roadmap with them. Face-to-face conversations should allow issues that did not get solved at events like an exhibition to be identified.

Obinata: That's why it is so important to exchange opinions in person.

The "Asobinin Kinsan" Team for a Free-Minded Search for Technology Seeds

Saito: Not only do we need to engage in short-term development to meet customer needs in 1 or 2 years, but we also have to prepare long-term development for product commercialization in 5 or 10 years. What is your company's approach?

Sakai: Development designed to trigger innovation usually fails to produce the desired result, unfortunately. Our division has a team called "Asobinin Kinsan." We used the

The Production Engineering Division is now a part of the Research and Development Division, and we all understand that it is the combination of materials and production equipment that constitutes the essential part of manufacturing. This understanding drives Murata's development.

Emergence of Smartphones and Rapid Module Business Expansion

Obinata: As I said at the beginning, your sales are increasing in both the material and module businesses. Recent module sales are as high as the sales for multilayer capacitors, which are Murata's signature products.

Sakai: Communication module sales are increasing rapidly with the spread of smartphone use. Capacitors account for 32.8% and communication modules account for 30.8% of recent sales.

We were always told that modules were not profitable and left the module business untouched for a long time. Around 2000, mobile phone motherboards were made with single-chip components known as discrete components. Modules were hardly used.

At one point an assembly manufacturer said to us, "We will not use your modules" and "We would go out of business if we used your modules."

The situation changed as mobile phones became multifunctional and smartphones emerged. The use of modules started because discrete component designers could not meet the requests for super-fine, multifunctional, and highly functional single-chip components. Market needs for integrating these features into a module arose.

Mr.**Norio Sakai**

Fellow, Communication and Sensor Business Unit

Murata Manufacturing Co., Ltd.

Born on March 1, 1958. Graduated with a Master's Degree from Kyoto University Graduate School of Engineering, Department of Mechanical Physical Engineering

1982	Joined the Production Engineering Division of Fukui Murata Manufacturing Co., Ltd. Developed manufacturing methods and equipment for multilayer ceramic capacitors and multilayer ceramic substrates.
1993	Joined the Yasu Division of Murata Manufacturing Co., Ltd.
2005	Took office as General Manager of the Package Engineering, Communication Business Unit.
2008	Also took office as General Manager of the 1st Manufacturing and Materials Engineering Division of the New Product Unit.
2012	Took office as a Research Fellow.
2014	Also took office as General Manager of the Functional Board Product Division of the Communication Business Unit and Director of the Engineering Group of the Communication Business Unit.

name "Kinsan" but it could be "Ginsan" or anything else for that matter. It is a team of selected employees—five from a group of 100 employees, for example. Those chosen are released from all of their work assignments. Whatever they have, they give it to other employees. Then, they use their free time to start something new. They can come up with anything and do anything. And it doesn't affect their work performance evaluation. After giving them some advice, we just wait until they submit a report. We never force them to do anything.

It is impossible to drive fundamental changes while working on regular assignments. Furthermore, speed is so important that we tend to only think of immediate

achievements. For this reason, I went so far as to create an assignment-free team. You need a team that spends the whole time playing around if you wish to have an innovative development.

Obinata: That sounds very encouraging to me. At ULVAC, we have come up with eight development themes for the employees to work on. This is a 3-year project, but I feel like we need more. Mr. Saito here and I have been discussing launching something like a future business project and a development team with a 10-year goal. The team would be free to come up with development themes and details with a 10-year vision.

Sakai: That sounds good. The important thing is who to choose. From my experience, I prefer someone who does not blend in to the organization much. Someone who thinks outside the box or wishes to win big money is good (laugh).

Someone who says "I don't want to do normal stuff" is a good candidate. Managers need to be able to identify these employees. You do not need to supervise them but need to check on them without pressuring them. It would be a disaster if you set them completely free. In any case, no one knows the future, so just wait and see what they do.

Obinata: I will keep that in mind.

A Policy of Not Saying "No" and Fast Responses Expanded the Module Business

Saito: According to the data in a magazine that I read, your smartphone parts have high market shares; 60% for Wi-Fi modules, 35% for multilayer ceramic capacitors, and 40% for SAW filters. Other products also have very high shares. What is the secret?

Sakai: The secret is to get a hold of good materials before competitors. We had a high quality dielectric material called barium titanate ($BaTiO_3$) for multilayer capacitors and lead zirconate titanate (PZT) for piezoelectric materials. We supplied them constantly, stably, and rapidly.

The same secret does not however apply to modules. Let me explain a little.

The first secret is never say "No" to the customers. This policy met a lot of internal resistance. Not saying "No" may be dangerous—there is a risk of us becoming the customer's slave. There is a fine line between becoming a slave and not. Another secret is speed. As I mentioned earlier, modules were not used much in mobile phones.

When smartphones became multifunctional and highly functional, discrete components could no longer meet the requirements. When the customers asked us for a solution, we immediately introduced our modules. We met our customer needs quickly and repeatedly, and this I believe led to the expansion of our module business. In the end, it may have been our speed.

Authorizing Employees to Make Decisions is the Key to Fast Responses

Obinata: How did you get that speed?

Sakai: One of the reasons, I think, is our corporate culture that allows the employees to make decisions. An assistant manager or a team leader, instead of a general manager or manager, occasionally makes important decisions while meeting with the customers.

For example, we sent our best engineer to meet with a major mobile phone manufacturer in Northern Europe. You would think someone higher up like an executive officer or general manager would go, but in our case, an engineer who was not much of an English speaker went.

This made the engineers of the mobile phone company very happy. They respect the capabilities of the person instead of formality. They would say "You flew half way around the world all alone to meet us!? Let's have a tech talk!"

Regardless of how big a company is or how important the project is, we send people who understand the product inside out. Important decisions are made without the presence of their bosses. This is where the speed comes from. Yet at the same time their bosses never say "I haven't heard about it. No one reported." I think we are good at communicating.

Obinata: English skills are definitely good to have, but successful communication with engineers relies on the level of technical knowledge. The engineers actively talk to the person with knowledge because they do not want to waste the opportunity to understand.

Sakai: At Murata, individual employees, irrespective of the organizational hierarchy, fully engage with the customers. This could be dangerous because important decisions are made without the knowledge of their bosses. But when you think about it, a manager with insufficient technical knowledge cannot make decisions on the spot until he/she talks to someone who understands. This is not efficient.

Obinata: I also believe authorizing employees to make decisions energizes a company. I want to build a corporate culture like yours quickly, but I do not have the guts you do.

Work Environment with Open Communication and No Buck-Passing

Saito: Whether or not you can authorize the employees to make decisions depends on their skill levels. How do you educate them?

Sakai: Different types of customers appear in different business situations. They may be engineers, sales engineers, or cost managers. The level of staff communication determines if we can deal with them.

In my office, persons in charge of different divisions work on the same floor and talk to each other freely. We have chosen not to be tucked away in an office, but we don't schedule meetings either. Our thinking is that if you want to know or confirm something, you should do so on the spot. I believe that things go faster regardless of job titles if the staff members share necessary information. I would also like to emphasize that you should never blame someone else. Trying to locate the person ultimately responsible for a mistake intimidates the employees, prohibiting the company from improving. Managers must be most careful about any such accusations.

Obinata: Is this about your company? Or, is it only about your division?

Sakai: This is about my division. If this were a company-wide practice, our company would be a 10 trillion yen company by now (laugh).

Unique Production Technology for Handling Large-Volume Orders

Saito: Recognizing the needs of major accounts early on is the key to increasing the market share. What is your approach?

Sakai: Identifying what the customer wants as fast as possible is the only strategy. Customers may not think too much about the price if you can successfully deliver what they want promptly. Being slow never works. Regardless of how great your products are, customer will not pay attention to them if you are slow. Generations change quickly particularly in the field of modules, and dual or triple sourcing occurs frequently. Therefore, you must always be the fastest one.

Saito: You are saying that you select who to send to customers based on their technical knowledge instead of job title to identify their needs as quickly as possible.

Sakai: That's right.

When mobile phones were first released, they were

Hisaharu Obinata, President and CEO, ULVAC, Inc.

Company Overview (as of March 31, 2015)

Murata Manufacturing Co., Ltd.

Trade Name: Murata Manufacturing Co., Ltd.
Location of Head Office: 10-1, Higashikotari 1-chome, Nagaokakyo-shi, Kyoto
Date of Incorporation: December 23, 1950
Common Stock: ¥69,377 million
President Statutory Representative Director: Tsuneo Murata
Murata Locations: Americas: 15, Europe: 14, Greater China and East Asia: 30,
　　　　　　　　　Japan: 31 (except Murata Manufacturing Co., Ltd.),
　　　　　　　　　Southeast Asia and South Asia: 15
Number of Employees: 51,794 (consolidated basis)
Function: Research, Production and Sales of Electronic Devices made from fine ceramics
Products: Monolithic Ceramic Capacitors, SAW Filters, Ceramic Resonators, Piezoelectric Sensors, Ceramic Filters, Piezoelectric Buzzers, Short-range Wireless Communication Modules (including Bluetooth® Modules), Multilayer Ceramic Devices, Connectors, Isolators, Power Supplies, Circuit Modules, EMI Suppression Filters, Inductor (coils), Sensors

manufactured by Motorola, and then manufacturers like Sony, Nokia, Samsung joined the competition along with several more Japanese manufacturers. Typically, production of a new product is dominated by one manufacturer at the beginning and later joined by others as the market expands. Accordingly, the order volume from each manufacturer decreases, allowing parts manufacturers to handle it without requiring a high production capacity. In the case of mobile phones, however, only a few manufacturers continued to dominate production despite the steady market expansion. It was the complete opposite of the typical pattern.

What happened was that the volume of a purchase order from a single manufacturer exceeded the capacity of parts manufacturers. Meanwhile, we had the manufacturing capability and production technology that met the manufacturers' needs. We also had reserves and were therefore able to start using production equipment that could handle the order volume. I believe that was an excellent decision our management made.

Obinata: So you were able to release the products at the right time, before anyone else, and provide a stable supply as a main supplier.

Sakai: We may not have grown this much if many parts manufacturers were involved and the purchase orders were smaller. I think we were able to demonstrate our potential because of the market dominance. The employees ourselves, including me, were surprised with what we were really capable of (laugh).

Strict Standardization to Carry On High-Mix Low-Volume Production

Obinata: How long is the life cycle of a smartphone module?
Sakai: It's usually 18 months.
Obinata: Do you change the manufacturing equipment accordingly?
Sakai: We standardize the products to avoid equipment changes as much as possible. We do not change wafer processing equipment but make changes to the packaging equipment in order to meet customers' specifications.

Saito: You used the word "standardize." We at ULVAC often customize the products to meet customers' specifications but are not good at standardization. Would you tell us about your approach?
Sakai: It may sound like boasting, but I give lectures on standardization to the employees.

When I first joined the module business, I actually had a negative view of standardization. At one point, my boss scolded my group saying "Every time you develop a new technology, you cause confusion and lower productivity at the plant. Productivity would improve if you just didn't do anything." It is a bit strange that I am now an advocate for standardization.
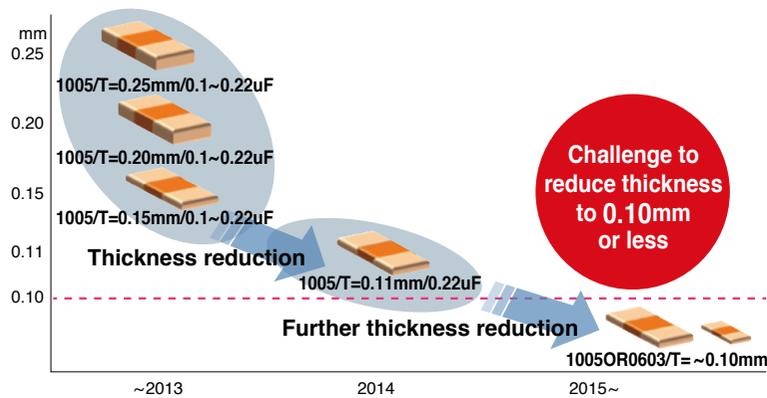
The reason why I changed was a big mistake that I made. Modules vary in size, and we used to produce them on a high-mix low-volume basis. When a few manufacturers dominated the mobile phone production, we received a large purchase order from one of the major manufacturers. You know, mass production gives production engineers a sense of achievement.

Blindly believing that we could mass produce mobile phone modules despite the general understanding that modules needed high-mix low-volume production, we built an exclusively designed mass production line. In a short while, however, the board shape and device changed as the mobile phone functions improved. The exclusive production line we built was no longer used. This bitter experience of wasting production equipment taught me that we must stick to high-mix low-volume production. That is how I started high-mix production with little changes to standardized equipment.
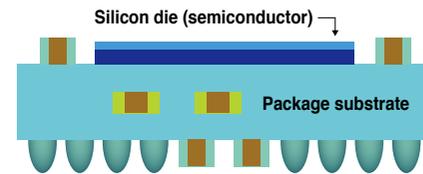
Obinata: You can implement far-sighted standardization because you are ahead of everyone else. If you were chasing after others and always trying to keep up with specification changes, you would naturally prioritize releasing products over standardization.
Sakai: I believe we should stick to high-mix low-volume production even when a small number of manufacturers dominate the market requiring mass production. We provide requested diversification and changes using peripheral

■ Figure 3. Miniaturization of embedded capacitors

mm
0.25 — 1005/T=0.25mm/0.1~0.22uF
0.20 — 1005/T=0.20mm/0.1~0.22uF
0.15 — 1005/T=0.15mm/0.1~0.22uF
0.11 — **Thickness reduction** — 1005/T=0.11mm/0.22uF
0.10 — **Further thickness reduction** — 1005OR0603/T=~0.10mm

Challenge to reduce thickness to 0.10mm or less

~2013   2014   2015~

Silicon die (semiconductor)

Package substrate

- Contribution to downsizing of devices and improvement of the IC characteristics
- Use in smartphones, various types of ICs, and wearable devices
- Promotion of collaboration with IC manufacturers

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technologies while keeping the core element standardized. We wait for 4 to 5 years before we make big changes to the equipment. We are patient until the time comes.

Modules may be Further Integrated and Unified

Obinata: I was looking at 0.1 mm and 0.2 mm chips earlier in the lobby. While I was impressed, I was also thinking that if I sneezed I'd easily blow them all away. They are that small.

Saito: How much smaller do you think they will get?

Sakai: Someone will give up someday, but we must believe that humans have unlimited intelligence. Well, it'll stop somewhere though.

Saito: In the past, semiconductors were made on a large substrate and cut in small pieces. Now they are even smaller, and it is predicted that high-density packaging, in which a device is directly mounted on a substrate, will advance further in the future. How will miniaturization influence your products?

Sakai: Chips have been rectangular so far. In the future, "bending" or "odd shapes" may become the keywords. In terms of modules, we may receive a wide variety of requests from users who want to place them on an angled surface or in every available nook and cranny. The point of consideration will be how big a module should be to put together a selected range of functions.

Obinata: Sounds like we will need only one vendor in the future. It'll give you more of an advantage.

Sakai: It is impossible to pack all necessary functions into a module. Roughly speaking, current smartphones have four parts: a CPU as a brain, an LCD for showing images, communication elements for interaction, and a battery to provide power. Some of these parts are analog and some are digital, so they cannot be completely integrated. Functions may be integrated within these four areas, however. This leads to a dramatic decrease in the number of modules while at the same time requiring further chip miniaturization.

Saito: Miniaturization is our strength. We will be happy to help you in many more areas in the future (laugh).

Speedy Responses to Promptly Meet Customer Needs

Obinata: Before finishing up, please let us know if you have any requests for us.

Sakai: That would be "speed." Only speed generates money. Our company grew because of it. We were able to demonstrate the value of speed, which is usually difficult to measure, by meeting our customers' requests. Speed makes a company better. Being fast is good.

Obinata: I completely agree. We must accelerate responses to customers as well as internal procedures.

Sakai: At Murata, requests for decisions are approved in as little as 2 to 3 days. This is a good result of delegating authority to make decisions to the employees.

It is like the company saying to the employees "Go ahead if you are in such a hurry!"

Obinata: One day I saw a document and was surprised with the number of seals of approvals. I made the employees halve the number of approvers. This tells me that we need a lot more improvement.

Sakai: Requests are checked more strictly when the economy is slow, of course. It is not that our employees are free to just do anything. I think it is that our executive officers doing a fine job of maintaining an exquisite balance between the two.

Obinata: We will use your stories as tips to accelerate our operations by giving employees more authority. We will continue learning from how Murata operates. Thank you for sharing these important stories and ideas.

Obinata & Saito: Thank you.

The photo shows (from right) ULVAC President Obinata, Fellow, Communication and Sensor Business Unit, Murata Manufacturing Co., Ltd. Sakai, and ULVAC Executive Officer Saito.