DISCUSSION

Round Table Talk on Metrology in the Twenty-first Century and Technology Tie-ups

Taking Japanese swords as an example, American metallography scientist C. S. Smith once said, "If the Japanese people had devoted all their energies to science and the Europeans had been outstanding engineers, the history of metallography would have been quite different."

At the draw of a new century, in the midst of a period of accelerated globalization, Dr. Hidehito OBAYASHI of Hitachi, Ltd., and Dr. Kozo ISHIDA of Horiba, Ltd. have discussed on the perspectives of measurement businesses and technology alliances.

Dr. Kozo Ishida

Dr. Hidehito Obayashi

Mr. Koichi Matsumoto [Chairperson]

Photo taken at Hitachi's Naka facility, December 7, 2000.

Metrology in the Twenty-first Century

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Synergies Resulting from the Development of SEMEDX

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Seeing What Can't be Seen, Measuring What Can't be Measured - Nature and Metrology

Ishida I think the role of measuring instrument makers in the new century is to help us see the natural world more as it really is-thus revealing its true beauty.

Hidehito Obayashi, Ph.D.

Administrative Officer
General Manager,
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Metrology in the Twenty-first Century

Chairperson(CP) Chairperson: The twenty-first century has arrived at last. What are your opinions on how the measuring instruments business will look in the new century?

Obayashi The twenty-first century will turn out to be, I think, the century of biotechnology and IT. These past five years or so have been a period of preparation as far as biotechnology is concerned, what with the decoding of the genome map. In the new century, the task will be to put all that knowledge to good use. There is a huge amount of complex data involved, too, so it will be imperative to combine biotechnology and IT.
But other hard science areas, like semiconductors, will remain important. The semiconductor industry, after all, supports the IT sector, and the semiconductor industry, in turn, is based on the materials industry. Between all major industries there is a network of industry integration. I think it is important, therefore, that executives and young engineers alike should take an overall viewpoint and try to see their own work from that wider perspective.

Ishida When thinking about the measuring business in the twenty-first century, it's important for us to be able to decide which products and technologies will be really useful to mankind and to our planet. Our business should always have that outlook.
In fact, I feel that measuring is my vocation in life. Measuring things to gain a more thorough understanding of them is, after all's said and done, an activity that paves the way for big advances in fields such as biotechnology, IT and semiconductors. So, in a way, measuring equals new business, and that's something about my work I never tire of.
At the end of 2000, Horiba set up two new businesses. One is Bio Applied Systems, Inc. The aim of the new corporation is to combine biotechnology, semiconductors, and sensor technology to try to develop new products and technologies capable of measuring ultra-minute traces of substances like environmental hormone disrupters. The other new company, X Precision, Inc., will develop and manufacture measuring instruments that make use of X-ray technology.
What both of these new venture businesses have in common is that they were created through alliances of Kyoto citizens, private industry, local government, and academia, with the aim of answering the prayers of scientists who want to be able to measure more accurately things that have always been difficult to measure.

Obayashi Dioxins, and other toxic substances, will certainly continue to be a big problem. These types of substances, which appear in very small amounts and behave in complex ways, can barely be observed under laboratory conditions, but taking accurate measurements of them where they occur in the natural environment is still next to impossible. Recently, we started marketing measuring instruments using a mass spectrometer that can measure precursors in the air to provide continuous monitoring of dioxins inside flues. This product is an example of converting a general-purpose analyzer for use as a specialized instrument-something we hope to do more of in the future.

The Loop Linking Special-Purpose And General-Purpose Instruments

Kozo Ishida, Dr. Eng.

Senior Managing Director
Horiba, Ltd.

CP I think that moving from general-purpose to specialized instruments will surely continue to be one of the key trends in the twenty-first century. A classic example of a new device successfully opening up a new market can be seen in Hitachi's CD-SEMs, electron microscopes for the semiconductor manufacturing industry. By the way, I hear that it was born of a change in the way scientists think. Can you explain that?

Obayashi Before Hitachi CD-SEMs for the semiconductor industry were developed, electron microscopes were instruments that could only be found in the laboratories of universities and research institutes. In order to develop a product that could be used in the semiconductor manufacturing process, several obstacles had to be overcome. Foremost, was the fact that semiconductors themselves are very susceptible to static charges, and can easily be damaged by electron beams, so it was essential for us to keep the acceleration voltage as low as possible. Faced with that problem, we made the most of Hitachi's long history of R&D work and looked at FE-SEM (field emission - scanning electron microscope) technology, which can produce high resolution at low acceleration voltages. So at that time, when there was a big demand for the product we were trying to develop, we found that the ideal technology had already been developed and was waiting for us to come along and apply it. Until that time, FE-SEM technology had no specific applications of its own and hadn't been used much, so the Hitachi CD-SEMs we successfully developed changed that state of affairs.

Ishida It's certainly true that if you sell nothing but general-purpose instruments, then your business won't grow much, and I have the feeling that a company should try to find out what kind of products its customers would be most pleased to have. General-purpose analyzers have been around for a long time, and in the past it was common to build specialized instruments based on them. However, more recently there has been a turnaround, and it has become common for features found in specialized machines, developed for one particular application, to be applied to more general-purpose devices in a kind of feedback loop, so that new markets can be created. I think this kind of circular arrangement will become extremely important in the analysis field from now on.

Obayashi With general-purpose instruments, only the basic needs of the market are met. There is a great demand for specialized devices, and when these can be successfully developed, then the market itself can be transformed. Hitachi's electron microscopes for the semiconductor industry are certainly such devices.
Another point is that successful new products will not appear unless designers themselves visit, in person, the customers who use the instruments they have developed and then observe exactly how they are used and how they perform under real working conditions.

Ishida Recently, comments by Shintaro Ishihara, the Governor of Tokyo, have focused public attention on the measuring of particulates in the exhaust gas of diesel automobile engines. Now, that's a very difficult task. At Horiba, we took a flame ionization detector (FID) and started trying to analyze diesel exhaust gas. Eventually, we managed to take continuous readings of the soot and SOF (soluble organic fraction) levels in the particulate matter.
As you know, the FID was originally developed as a general-purpose instrument for gas chromatography. We started using it to analyze hydrocarbons in exhaust gas, and worked hard both to market it as a special-purpose instrument and to enhance the technology even further. Then came the current chance to use it as a particulate analyzer. While clearly a product of advances made in technology, it is also the product of a process of repeated trial and error. There are many, many areas in which, together with clients, we need to work to try and measure things that can't be measured.

Synergies Resulting from the Development of SEMEDEX

CP The market is becoming ever more diverse, while on the other hand specialization is also becoming more common. As manufacturers, for whom being able to respond speedily to market needs can be a matter of life and death, alliances are of vital importance. However, there are alliances and there are alliances, and there are many problems that need to be overcome if an alliance is going to lead to success.

Ishida Well, our three-way alliance, Hitachi, UK-based Oxford Instruments, plc., and Horiba, has resulted in the successful development of SEMEDX, a device that combines a scanning electron microscope (SEM) and an energy-dispersive X-ray spectrometer (EDX). Oxford Instruments had always been a competitor of ours and at the start of our tie-up there was a certain amount of fear and suspicion, but now we produce each other's products. What you give, you gain in return. We've learned a lot; primarily that successful alliances are based on mutual trust and communication.

Obayashi It's impossible to have one hundred percent trust in a business partner right from the beginning. In many cases it takes a long time to develop a completely open mind. However, as soon as there's one example of success, however even small, it acts as a trigger and the impact spreads like wildfire.
There are many ways to sum up what an alliance is, but in the end one of the main aims has to be to give a boost to the business and spur growth. It has to be a case of not one plus one equals two, but of one plus one equaling three or four.

CP That's called synergy, isn't it?

Obayashi Exactly, synergy. By forming an alliance, companies with different histories and cultures come together to try to stimulate even bigger business. It's important that they find a way of benefiting through synergies. When two different cultures collide, engineers and managers find that "genomes" that have been dormant inside them suddenly become active. And that type of stimulation is the core of the alliance.

Ishida Alliances, unlike the one we're talking about here, have existed for a long time, usually with the aim of introducing new technologies. However, in the present era, alliances have become something quite different. Now, the participants have to work hard at it on a daily basis, making use of resources and links outside their own companies in order to try and create the desired product using the existing technological base.
Back in 1997, Horiba purchased Jobin Yvon S.A. (JY), at that time the world's leading company as far as spectroscopy is concerned. We began by focusing mainly on material analyzers, trying to expand both the market and the uses of the new technologies we had acquired. We planned to expand the market for our products in both Japan and Asia as a whole. As for the technology, we intended to try to expand the scope of our business to include ultraviolet and visible spectrum devices, which we had never handled before.
When we actually got down to the task of sitting down and working together, it became clear that the differences in our organizations were not just limited to the wavelengths at which we had expertise-Horiba with infrared and X-rays, JY with ultraviolet and the visible spectrum-but that there were also big differences in the ways we developed and manufactured products. We realized that they were stronger than us in basic technologies, while we were better at making things-particularly with regard to product quality. So we made the most of our respective strengths to make up for each other's shortcomings, and that was a great help when we began developing our next generation of products.

Obayashi That's right. In the old days, alliances between Japanese companies and firms in Europe and America were always tainted by a kind of "developing country-developed country" relationship, in which we were the "developing" partner. Now, however, alliances typically begin with both firms on an equal footing. As to what the purpose of an alliance is, I would say it is speed, in that an alliance helps us to develop products that satisfy our customers' needs more speedily.

Technology Archives

CP Recently, there have been young engineers who have asked worriedly, "If we don't develop our own technologies by ourselves within the company, then what will become of in-house technological creativeness?" What are your opinions on that technology development issue-alliances versus in-house research?

Obayashi That's a really tough question. As a basic strategy, it's important to develop new business based on the core technologies that you've been successful in developing on your own, your area of so-called "core competence." As for expanding that core competence in new directions, you need to take decisions based on careful marketing and by listening to what your customers tell you. And there's no chance of being successful in doing that if the whole team isn't aware of what you're trying to do. With positive thinking, there are lots of fresh opportunities to be found in change. What's most important is that the team as a whole, not just certain individuals, should be sensitive to what's happening. Having just one "ace" is not enough; of utmost importance is that the whole organization is moved to action.
The only other thing is to make sure that youngsters get plenty of opportunities to make, and learn from, mistakes.

Ishida I think it's also important for the organization itself to be allowed to make mistakes, too. But, from the viewpoint of a company, not too many, perhaps? There was once a big thing about "the Japanese who can say 'no,'" but when it comes to developing new technologies and products, what we need is scientists who can say "yes." Unfortunately, whenever a theme is put forward, I feel in many cases the first thing people do is worry and say to themselves, "can we really do this?" It's important to start tackling the problem and learn from mistakes as you go because that's how new discoveries are made.
However, in order to be able to say "yes" there has to be something to back you up. I heard from a manufacturer of customized IC chips how that company managed to move ahead of its competitors by using the experience it had built up in the past. First there's a core, and around that there are other opportunities. By building a company culture in which experience is cherished and recycled, then it's even possible to take part in a really fast-changing, dynamic market, such as that for mobile phones.
Make lots of mistakes, concentrate on core technologies, and store all the data you come up with in a way that can be accessed and used by anyone within the organization. It's important to have that type of technology archive system in place. Until now, in the measuring instruments industry, we may have been a little too lax in that respect.

Obayashi Using those kinds of intellectual assets as a basis, everyone has to get involved in debating how to use them. If they do, then something useful will surely come of it. Just by discussing things with other people, the thought process often becomes clearer. By speaking out loud, through conversation, one can hear an echo of one's own ideas as well as receive another person's real-time reaction and ideas can thereby be altered on the spot. I believe talking to be the basis for everything.

C P That's conventional communication, isn't it? Don't you think people involved in technology have come to be lacking in that area to some extent?

Obayashi The other day one of our designers, who was having problems with some software, posted a message at some kind of online forum. The message said, in Japanese, something like "I want to use this software but it won't run properly. Somebody please help!" And do you know what happened? In a single day there were about a hundred responses, from all around the world, from people explaining what to do. And as I said the original message was written in Japanese! That kind of amazing thing can happen with the Internet. That's the age we're living in. The more I think about it, the more impressed I become, and I think it'd be good if there were more and more cases like that.

Ishida From now on, what's required of engineers is knowledge and skill they can share with others. Doing that creates new opportunities and also shortens the time needed to solve problems. And that in turn means that customers will get what they want faster. We have to create organizations with that type of circular chain. The more advanced and complex technology becomes, the more imperative will be the need to do so.

Seeing What Can't be Seen, Measuring What Can't be Measured - Nature and Metrology

Mr. Koichi Matsumoto

General Manager

Analytical Equipment & Systems Division

Horiba, Ltd.

CP The twenty-first century is being hailed as the era of knowledge, so finally I'd like to ask your opinions on knowledge and its relationship to measuring.

Ishida I think that now, at the start of a new century, there should be a little more debate about what the purpose of science should be. There's one aspect of the sciences, and natural sciences, which originally satisfies the intellectual curiosity of the people. If we look closely at measuring technology itself and take every part of the subject separately, then it's a pretty interesting field. From that viewpoint, we can gain satisfaction by seeing that measuring is right at the center of science itself, and feel that ours is, after all, an exciting business to be involved in.

Obayashi At Hitachi we use the catchphrases "Seeing what can't be seen" and "Measuring what can't be measured" and I guess that they really sum up what measuring technology, or metrology, is all about. Also, because passing on knowledge in a scientific and easy-to-understand way is now so important, measuring is going to be one of the key technologies for the new century.
At our company home-page we display a gallery of images captured by electron microscopes, and they're made easier to view and more beautiful because false (artificial) colors are added, pixel by pixel, using image processing technology. Recently, image processing has really advanced a great deal and, although it's still important that we continue to work to improve the performance of the electron microscope itself, by using appropriate image processing, we can almost see a new version of reality.
It is often said that IT is merely a means, without an objective of its own. But it's also certainly true that without IT there would be no science or biotechnology as we know them today. Measuring will be a key twenty-first century science in that respect, too.

Ishida There's a similar example at Horiba. We measured pH distribution on the surface of metals and plants with a light scanning chemical microscope (SCHEM™). But trying to display a chemical quantity like pH visually meant a vast increase in the volume of data necessary. It is a good example that suggests how metrology will be used in the twenty-first century to measure things that people can't see.
Wherever you look-into space, at atoms, or at individual organic cells-what you see is always beautiful and moves you in some way. Likewise, superior design makes one feel that there is an inevitable logic at work.
The role of measuring instruments in the new century will be, I believe, to show us the truth and the beauty of nature.

CP Well that's certainly an alliance between nature and measuring, isn't it? Our discussion has covered a wide range of different topics-from business to science and nature-and I suppose that breadth signifies a bright future for the measuring business in the twenty-first century. And at the same time, you've made me realize afresh that the market is infinite and that alliances will be increasingly necessary for conducting successful business from now on.
Thank you both for coming today and for allowing us to listen to what you have to say.