R&D Spirits

Creating Environmental Businesses Using a New Product Commercialization Method

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The Environmental Assessment Systems Group at NTT Energy and Environment Systems Laboratories is introducing a new R&D management method to get research results out into the world in a form that meets market needs. The first product to be developed by this method is creating quite a sensation in the USA and large-volume sales began there in July. What is this product that so impressed the US Environmental Protection Agency? And where did the idea for it come from? We put these questions to senior research engineer, senior manager Tatsuya Kunioka, who, as team leader, has been the driving force behind this product.

Introducing a new R&D management method and expanding product development according to needs

—Mr. Kunioka, please outline your current work for us.

My job is to refine and market the results of R&D from NTT Energy and Environment Systems Laboratories as products that can be useful to society while also generating a profit for NTT. Of course, this is not something that can be done by just one person, so, for any one product, a team of specialists from various fields must be formed. My role here is to organize separate entities into a unified project.

At present, the project receiving the most attention in the Environmental Assessment Systems Group, to which I belong, is the commercialization of an ozone sampler. Based on decolorizing reactions caused by exposure to ozone, this product makes continuous measurements of ozone concentration in the immediate environment. It features a sensor with a special dye immersed into a filter paper having a large effective surface area. This product has already been commercialized under the name of “M’s Ozone Discovery,” and large-volume sales have been under way since July in the USA, a country with an advanced environmental-business field. Moreover, in April, an NTT liaison office called the Energy and Environment Office (E&E) was opened in Wisconsin in the USA. As one of the principals concerned, I visit that office every two months to attend meetings and gather information.

—How can M’s Ozone Discovery be of use to society?

M’s Ozone Discovery is considered to be very effective in highlighting and enabling the prevention of the ill effects of ozone, which has become an issue of concern in recent years. Although ozone was originally thought to be harmless except in high concentrations, research conducted by the US Environmental Protection Agency (EPA) has revealed that, even at low concentrations, ozone may cause irreversible damage to the lungs. Since ozone has strong sterilizing and deodorizing properties, it has come to be frequently used as a substitute for chlorine in the daily operations of hotels, hospitals, and other establishments and in fields like the distribution of perishable foods. The use of ozone in such activities is not, in itself, a problem. However, if the exposure region extends beyond the target items and affects workers,

that is a serious problem. In the USA, the EPA and the Occupational Safety & Health Administration have been establishing safety standards and promoting greater awareness and countermeasures. But despite the establishment of safety standards, no high-performance and inexpensive measurement devices were available for use in such countermeasures. That is what led us to develop M's Ozone Discovery.

—How did the project itself begin?

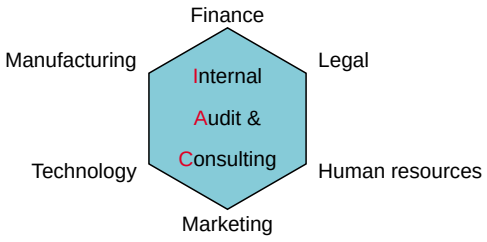
The Environmental Assessment Systems Group has been conducting research on a variety of substances in the atmosphere for some time. Research on ozone began in 2002, before I arrived at the Energy and Environment Systems Laboratories. The technology for detecting ozone using a special dye was developed by senior research engineer Dr. Yasuko Yamada Maruo, who, with great foresight, began research in this field at these laboratories. At that time, however, no good means of developing this technology for the market could be seen. It was for this reason that I was chosen to turn this technology into a viable product using my experience in new environmental businesses [1].

—What are some of the outstanding features of this product development?

Technically speaking, the greatest feature is the development through basic research of a special chemical substance whose color fades when exposed to ozone. Another important feature is the formation of a product by immersing that substance in filter paper instead of a porous glass in the commercialization stage. Actually, the ozone active sensor that we developed before this project is completely different from today's product. It was electronically driven and about one third the size of a standard box of tissues. The change from this configuration to today's badge format resulted from the introduction of the Internal Audit and Consulting (IAC) management method into NTT Energy and Environment Systems Laboratories. I believe that this is another very important feature of this product development.

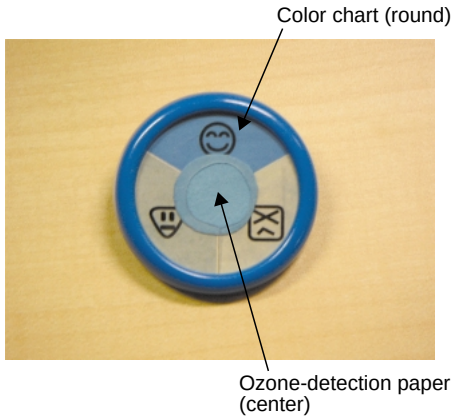
IAC is a management method proposed by Francis Kohno, an expert in business administration [2]. As shown in **Fig. 1**, it has three main elements: 1) a "cross-functional system" in which specialists from the six fields—technology, manufacturing, marketing, finance, legal, and human resources—share their knowledge; 2) "repetition" in which the cross-functional team develops an idea by discussing and researching it and deriving and verifying a hypothesis and then repeating this process as many times as needed; and 3) "recommendation" in which the results are delivered directly to the highest management layer.

We ourselves are well equipped in the fields of technology and human resources, but we sorely lack specialists in fields like manufacturing and marketing. Accordingly, in introducing the IAC method, I sought the cooperation of various entities and formed a team that came to include NTT Advanced Technol-



(a) Cross-functional system of the 'IAC' (© Francis Kohno)

(b) Brainstorming by IAC cross-functional team



(c) Ozone passive sampler born in the IAC (mock up)

Fig. 1. Management methodology 'IAC'.

ogy and Mr. Kohno himself (**Fig. 2**). NTT Advanced Technology, by the way, is the company that works to turn research results into products within the NTT Group.

During the course of the project, we came to realize that ozone was receiving a lot of attention in the USA. We therefore discussed how to market the ozone sampler in the USA. These discussions gave birth to the hypothesis that a simple, non-electronic sampler in a badge-like format might be the best way to go. From this idea, we eventually arrived at the form of today's product. If we had not made use of the IAC management method, this excellent research achievement of detecting ozone by using a special dye might still be stuck in the laboratory.

—How do you see this technology developing three and five years down the road?

First, with regard to M's Ozone Discovery, the fact that it's a product well matched to American needs leads us to forecast widespread penetration within a few years. We also envision a larger lineup of ozone samplers customized for individual users and applications. For example, ozone samplers could be aimed at various ozone-detection levels, or they could be made to conform to waterproof specifications for use by water departments or made to withstand the effects of ultraviolet rays for outdoor use. We also might expand the target of detection beyond ozone. For the future, moreover, we plan to apply this IAC-based product commercialization method to other research items within NTT Energy and Environment Systems Laboratories. We therefore expect to become increasingly adept at this method as the number of application examples grows. Of course, our eventual goal is to write up our know-how in a manual. We expect to reach the first stage toward that end in about three years.

Using the high praise received in the USA as a step toward a world standard

—Please tell us about R&D trends in the world similar to the ozone sampler and the part that NTT is playing.

We are now seeing much research throughout the world on the measurement of toxic substances. Competition is therefore strong, but I think we can say that NTT is quite advanced. NTT's ozone-targeting product, in particular, is world class. Similar products do exist in the USA, but there are three major differences between them and M's Ozone Discovery. The first is accuracy. While existing products have an accuracy of ±30–50%, our product achieves an accuracy of ±10%. The second difference is safety. We use indigo, a vegetable dye, as the main component in M's Ozone Discovery, and all the other components are substances that are allowed to be used in food additives. The third difference is ease of use. The shelf life of existing products with unbroken seals is three months in cold storage while that of M's Ozone Discovery is guaranteed to be six months at room tem-

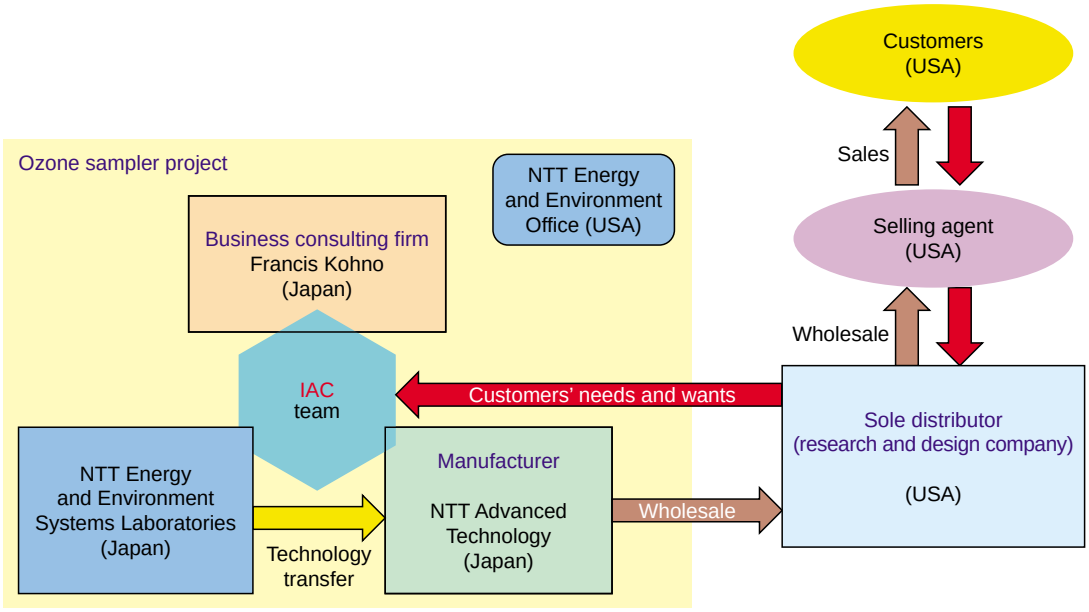


Fig. 2. Business formation for the ozone sampler project.

perature with enhancements for extending this to 12 months now in the works. To date, there has been no other product as advanced as M's Ozone Discovery (**Fig. 3**).

—How have these achievements been received outside NTT?

In addition to describing M's Ozone Discovery as an amazing product, the EPA has offered to collaborate with us in our research. They also mentioned that they wished to distribute M's Ozone Discovery to elementary schools for trial environmental education and we were happy to provide several hundred samples free of charge for that purpose. Receiving offers such as these from specialists in the USA, the most environmentally conscious country in the world, is very gratifying for us. We have also been receiving many inquiries from exclusive agencies in the USA. They fall into three groups. The first group uses ozone in business operations and includes distribution companies. The second group produces ozone as a byproduct of business operations and includes power plants and factories that perform arc welding. And the third group, while not directly related to ozone, is involved in environmental activities as a form of corporate social responsibility (CSR). So each of these groups has its own objectives and stance with regard to ozone, which demonstrates to us the possibility of diverse business models. Our objective is to meet all kinds of needs as far as possible.

—Are you involved in joint research with any research institutions in Japan or abroad?

Well, as we have already made our passive ozone sampler into a product, we are not involved in any joint research in this area. But for other research items, we are moving forward on collaboration in various forms. For example, we are working on academic and personnel exchanges with the University of Wisconsin-Platteville, where our E&E office is located. In February of this year, we began to offer its students research fellowships at our laboratories, and in the future, we would like to expand this exchange program to include researchers as well. Finally, within Japan, we are exploring collaborative research with the National Institute for Environmental Studies and other institutions.

—What about standardization and other international activities?

Right now, we're not involved in any special activities in academic societies, committees, or the like, but in terms of standardization, we would like to make M's Ozone Discovery a world-wide de facto standard based on its designation as an EPA authorized product. EPA approval in the USA is widely regarded as being equivalent to an official guarantee in many countries around the world. For this reason, we look forward to collaborating with the EPA, as I mentioned earlier.

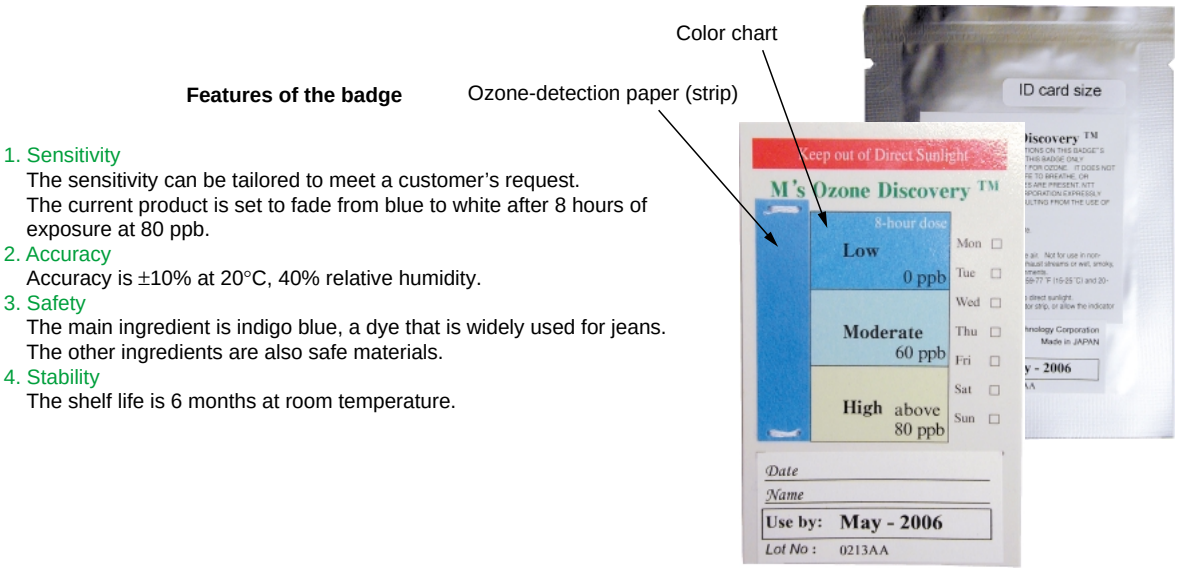


Fig. 3. NTT's ozone passive sampler "M's Ozone Discovery".

Three years of experience on the business side becomes a personal turning point in an R&D career

—Mr. Kunioka, what was your major at university? What was your motivation for entering NTT?

My university major was electrical engineering, and I researched fuzzy-control applications. For example, I researched ways of representing on a computer the know-how of experienced operators of hot-blast stoves in iron works and container cranes in port facilities, and ways of automating that know-how. This research provided me with the opportunity of collaborating with the corporate world, and the software that I developed actually came to be used at a steel manufacturing plant in Taiwan. As for entering NTT, I wanted to pursue basic research at the origin of control engineering. Most people associate the word "control" with machines like robots and airplanes, but in actuality, the foundations of control engineering were laid by Bell Laboratories in their original speech-waveform correction technology for long-distance calling. For myself, as a student of control engineering, the research laboratories of a telecommunication carrier feel like home.

—What R&D themes have you been involved with up to now?

Although I entered NTT with the idea of doing basic research, I was first assigned to NTT LSI Laboratories. At that time, there was a scarcity of engineers in the field of ultraprecise machines for LSI manufacturing, and I was originally involved in the development of electron-beam drawing equipment. I also got hands-on experience with vacuum-compatible, non-magnetic, precision XY stages, vacuum-compatible transport equipment, and vacuum-compatible exhaust systems. With regard to precision XY stages, we developed a large-scale, vacuum-compatible, completely non-magnetic precision-stage system based on an ultrasonic linear motor drive and transferred this technology to a manufacturer. This manufacturer, by the way, received the Nikkan Kogyo Shimbun's Best Ten New Products Prize in January 2000 for this system. Then, as NTT decided to wind up its LSI research projects, my research into LSI manufacturing equipment likewise came to an end. It was now time to select a new research theme, and I decided that I would like to be transferred to NTT East as deputy general manager of the Environmental Protection Office. Here, under the direction of Shunzo Morishita, the foremost authority on the environment in the NTT Group and now the president of NTT West, I drafted environmental measures and environmental reports and worked on acquiring ISO 14001 certification for a period of three years. I also served in company-wide management positions and headed the founding of the first comprehensive environmental consulting firm in the NTT Group called NTT GP-ECO. These activities taught me how to see things from a broad perspective, and it was also during this time that I encountered the IAC management method for the first time.

In 2004, I returned to NTT Laboratories, and though I was in a position to return to LSI-related research to establish some continuity with my prior research, my interesting encounters with environmental themes in my work at NTT East persuaded me to choose the Energy and Environment Systems Laboratories as a new stage in my career. Here, I was placed in charge of R&D for a 3D atmospheric environment simulator and the assembling of an IAC team to promote the creation of businesses dealing with environmental sensors. Since the summer of last year, I have been working exclusively on IAC-related matters.

—What issues are you dealing with now?

That would be the establishment of a product commercialization method appropriate for NTT Laboratories and the training of personnel in that method. Having a person working full time in a role like mine is a first at NTT Energy and Environment Systems Laboratories. And in contrast to research laboratories at manufacturing companies, we tend to be undermanned in terms of people that can handle manufacturing and sales functions. Under these circumstances, human resources become very important in setting up a cross functional system. For this reason, I would like to become actively involved in procuring marketing specialists from outside NTT Laboratories and in cultivating talented people for management roles based on IAC.

Recognizing NTT for its environmental expertise—one engineer's ultimate dream

—What is the future direction for your current work?

My goal with respect to M's Ozone Discovery is to make it a hit product throughout the world. Once it becomes a success in the USA, we must expand it to European markets and even reverse-import it to Japan. That's the scenario that I have in mind. I'm also thinking of expanding the product lineup, and to that end, I am working on expanding our commer-

cialization and marketing capabilities. In this regard, a common pattern that can be found in product development at a research laboratory is to issue one model and then be done with it! Compare this with video-game manufacturers that are frequently issuing upgrades or coming out with hand-held versions of game devices. It is important that we continuously explore ways of applying and expanding the results of our research. I believe that creating such a product pipeline is one of my duties.

—What is the advantage of NTT Laboratories from a personal perspective?

NTT Laboratories is a place where researchers can devote their energies to something that is truly important to society even if their work may not bring forth results soon. To give some background, the trend in recent years has been to quickly curtail or discontinue research that encounters problems in commercialization. Even research related to the environment has come to be affected by this trend. Researchers, on the other hand, feel that there is merit in working on technology that may rescue the planet 10 years down the road even if it does not generate money right now. Of course, my colleagues and I also expect research results directly related to business, so we are no exception to this trend. Nevertheless, NTT researchers are given the freedom to pursue basic research in a relaxed and unrushed manner, and there is no other place like NTT Laboratories that exhibits this level of understanding.

—What is your ultimate dream as a researcher?

Actually, I have two. The first is to enhance the status of the Energy and Environment Systems Laboratories. I am often asked why NTT has laboratories devoted to the environment. The fact is, NTT is known first and foremost as a telecommunication carrier, and perhaps that cannot be helped. But as far as I'm concerned, I would like the name "NTT" to be associated with the environment more than with telephony. I would like the environmental expertise of NTT to be recognized by both academia and the general public.

My other dream is somewhat whimsical, but I am contemplating a business model that would enable researchers to become millionaires. In the USA, successful researchers can become millionaires as a matter of course. I believe that there are many superb researchers at NTT that have achieved results just as worthy as those of these millionaire researchers. Unfortunately, there are still no researchers here that have become millionaires. To provide even more motivation in research, wouldn't a business model that allows for millionaire creation be a good idea?

—Mr. Kunioka, please leave us with a message for young researchers.

Certainly. After taking on a management role, I've had more opportunities to talk with young researchers during meetings on research planning and the like. I would have to say that they are much more talented than my generation of researchers. However, when the time comes for me to set research assignments, there are many young researchers that don't know what they want to do. This is really unfortunate. So instead of simply agreeing to the research theme given to them at the location decided for them after they enter the company, I would like to see young researchers make clear what it is they themselves want to do and work aggressively toward convincing their superiors of their desires. Both management and the personnel department understand very well that it is best to allow a researcher to work on something that he or she really wants to do, so it is important to express one's will.

References

[1] Y. Y. Maruo and T. Kunioka, "Ozone Sensor and Sampler," NTT Technical Review, Vol. 4, No. 3, pp. 33-36, 2006.

[2] Francis Kohno, "Turn Over," Kodansha, 2005 (in Japanese).

Interviewee profile

■ Career highlights

He received the B.E. and M.E. degrees in electrical engineering from Waseda University, Tokyo, in 1985 and 1987, respectively. He joined NTT LSI Laboratories, Kanagawa, in 1987 and engaged in research on a precision mechanical system for an electron beam lithography system, spending most of the time in developing a precision non-magnetic XY-stage using an ultrasonic linear motor for use in a vacuum. He was transferred to the Environmental Protection Office, NTT East, Tokyo, in 2001 and was responsible for the entire environmental protection management in NTT East. In particular, he promoted the adoption of life cycle assessment (LCA) of the telecommunication network with NTT Energy and Environment Laboratories. He was also involved in setting up a new environmental consulting firm, NTT GP-ECO, and evaluating environmental business models. In 2004, he moved to NTT Energy and Environment Laboratories, Kanagawa, and is currently responsible for promoting business related to ozone sensing technology in North America.