

The Role of Top Management Is to Generate a Perturbation without People Being Aware of It



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Abstract

NTT's laboratories are engaged in a wide range of research and development from basic research to applications, and divided into four laboratory groups. As one of those laboratory groups, NTT Science and Core Technology Laboratory Group carries out research and development with three missions in mind: "Conduct research and development on cutting-edge technologies to expand NTT's business domains," "Create new principles and concepts that will revolutionize society," and "Research and develop technologies that are friendly to the global environment and people." We asked Akira Okada, senior vice president of R&D, head of NTT Science and Core Technology Laboratory Group, about the technology strategy of the laboratory group and his mindset as a top manager.

Keywords: basic research, human resources development, R&D management

Cutting-edge research and development with an eye on society in 2050

—Please tell us about NTT Science and Core Technology Laboratory Group.

NTT Science and Core Technology Laboratory Group is engaged in cutting-edge research with the vision of "Creating a society toward 2050 by connecting everything, nurturing the Earth, and building a world where people can live vibrantly."

The laboratory group is composed of four laboratories. To create innovative network systems, NTT Network Innovation Laboratories researches and develops technologies for diverse frequency bands

and transmission media to pioneer a new communication paradigm. NTT Device Technology Laboratories conducts research and development (R&D) of devices and materials that create new value through the convergence of photonics and electronics by using its clean rooms to realize next-generation communications, information-processing infrastructure, and technologies that are sustainable and enrich people's lives. NTT Communication Science Laboratories researches media, information processing, and human science to construct fundamental theories that address the essence of humans and information, develop media and information processing technologies that break down communication barriers, and bring about changes in society. NTT Basic



Research Laboratories researches materials science, physical science, and quantum science to create new principles and concepts that overcome the limitations of current technologies and explores technology seeds that will become future core technologies.

By expanding their knowledge of science and technology and thinking outside the box, researchers at these laboratories are striving to create the world's first and best technologies or technologies that amaze everyone.

—NTT Science and Core Technology Laboratory Group is engaged in a wide range of basic research. Would you introduce some of the research topics that are currently attracting attention?

In the information-processing field, we are focusing on photonics-electronics convergence technology, which is the backbone of the All-Photonics Network (APN). The APN is one of the three elements of the Innovative Optical and Wireless Network (IOWN) and uses optical signal processing in an end-to-end manner in contrast to conventional networks in which signals are transmitted by repeating conversion between electrical and optical signals. In fact, the results of our laboratory group's research on photonics-electronics convergence technology were the starting point for envisioning the IOWN concept, goals of which include a hundred-fold increase in power efficiency by introducing this tech-

nology. The development of an optical-electrical-optical converter (optical transistor) reported in Nature Photonics in 2019 is a stepping stone in this research field.

Artificial photosynthesis is also attracting attention as a sustainable technology. As its name suggests, artificial photosynthesis is a technology that artificially recreates the natural photosynthesis mechanism that uses sunlight to generate energy from carbon dioxide (CO₂). We believe that artificial photosynthesis can contribute to the creation of a carbon-recycling society. In 2023, we developed an artificial photosynthesis device achieving the world longest continuous carbon fixation for 350 hours. The cumulative amount of carbon fixed by the CO₂ conversion reached 420 g/m², which surpasses the annual amount of carbon per unit area fixed by a tree (Japanese cedar). We are currently striving to improve the performance of our artificial photosynthesis device by increasing both the efficiency of the reaction and the longevity of its electrodes. We are also attempting to establish this device as one of the technologies for reducing CO₂ emissions using solar energy through outdoor tests.

Setting a new research problem by identifying a problem and boldly tackling a challenging problem

—I think that because basic research is so pioneering, it is sometimes difficult to convey its importance, isn't it?

Basic research serves as the foundation for the development of new technologies, products, and systems through the discovery and elucidation of mechanisms of theories, phenomena, natural laws, and the like in a manner that approaches the essence and existence of things. Therefore, since we cannot directly “see” basic research in our daily lives, it is difficult to convey its importance to people. Everyone can understand that research that wins a Nobel Prize in physics is amazing research; however, it is often difficult for the general public to understand how the results of such research are implemented in and useful to society. To widely convey the importance of basic research to the general public, I believe that researchers need to have the ability to convey their research to non-experts in easy-to-understand and



simple language.

With that importance in mind, we are conducting educational activities to communicate our technology in an easy-to-understand manner. NTT is unique in being one of the few Japanese corporate research institutes that conduct basic research. Since this uniqueness is one of NTT's strengths, NTT laboratories are engaged in activities that firmly emphasize the cutting-edge nature of our technologies by bringing our researchers to the forefront.

Specifically, we use metaphors to communicate our research to the general public in a way that is easy to understand even for those without specialized knowledge, and we are increasing exposure of our research via various media, including news releases, to make it easier for our message to reach as many people as possible. We are also presenting our research results and progress at conferences and symposiums while actively participating in lectures at general venues.

It has been discussed that Japan's research capabilities are declining. Technology in the basic-research field cannot be developed after two or three years of research. Although we are conducting research with an eye on 2050, we also set milestones for 2030, 2035, and 2040 indicating—as concretely as possible—the technology we are aiming for and the value it will create. Considering the nature of basic research, we try to create an environment in which researchers can tackle challenging themes from a long-term perspective and proactively propose what they want to research.

I constantly advise researchers to avoid using the word “difficult” when they are pursuing their research. I say that because the moment we say the word “difficult,” we sometimes stop thinking. From a different perspective, what is “difficult” is something has not been done before or something no one has been able to achieve, and that situation provides an opportunity for us to take on a challenge. We can overcome a challenging problem by taking approaches from a variety of angles and mobilizing our knowledge and out-of-the-box thinking and means. I believe that adopting this stance can create a new paradigm and lead to the improvement of our research capabilities.

—You are encouraging the creation of research seeds and drawing out the potential of researchers. What do you consider important in R&D management?

Solving problems is not the only way to develop research capability. I believe that, setting a new



research problem by identifying a problem and valuing the attitude of boldly tackling a challenging problem will lead to developing true research capability. Taking this approach may require patience, but it is a significant undertaking of NTT Science and Core Technology Laboratory Group. I would like us to continue taking this approach.

Applied research and its practical implementation, which are the next steps following basic research, are also important processes, so from a management standpoint, I want to ensure that basic and applied research are running as two wheels on one axel. We should not only engage in basic research because we are responsible for it but also do our part to ensure that we do not become ignorant of the real world and be isolated from society. That is, we should play our roles while taking a bird's-eye view and learning about applied research and the operations necessary for its practical implementation.

From a management standpoint, we must also consider the value we create and its return. At risk of being too frank, I have to emphasize how important it is that we understand and communicate the value that our research provides. How the value of research is determined depends on the party determining it; however, it is important for researchers themselves to first identify the value of their research and believe in it. Since research does not tend to produce results in a planned or smooth manner, it is important for

researchers to determine to some extent the pinnacle they are aiming for and pursue it.

Take initiative and be passionate while respecting others

—In light of your past experience, tell us what you value most.

I joined NTT laboratories in 1993 after completing my doctoral course. When I was a student, I studied creating devices by exploiting the properties of materials. After joining NTT labs, I was involved in researching new optical functional devices useful for optical communications and fabricating such devices in the clean room at the Musashino R&D Center, which gave me valuable experience. In 1997, to broaden my horizons, I spent a year as a visiting scholar at Stanford University, where I studied optical communications and transmission. That experience made me realize the importance of taking a bird's eye view of things.

At the time, a major movement toward optical communications began emerging, such as the establishment of the Optical Internetworking Forum, the global industry forum regarding optical networking. Since Stanford University is located in Silicon Valley, I was able to observe this movement firsthand and felt my horizons expanding. After returning to Japan, I

worked on a research project to propose a network system from a device perspective, and I had the opportunity to learn the importance of investigating devices from the network system. Through these activities, I acquired a wide range of research skills and knowledge as well as human connections.

After that, I suddenly found myself in charge of human-resources development at NTT Photonics Laboratories, which was a completely unknown field to me. As I often say over drinks, that time was the only time in my NTT life that I lost weight (although it was only for my first month). I was concerned about everything because I did not know what to do. Although I briefly returned to a research job as a group leader, until I assumed my current position, I also had the opportunity to interact with many people in NTT operating companies when I was with the general affairs department, where I endeavored to connect NTT laboratories and operating companies in terms of human resources. I have also learned various things at each milestone, including the globalization of NTT, such as the acquisition of Dimension Data (now NTT Ltd.), a global system integration company.

From these experiences, I realized the importance of being a little broader than the research I am currently involved in and take an interest into a variety of areas. I also think that it may be better not to think too much when asked to change. I have come to my current position through a process that I never expected to experience as a researcher. Maybe that is because others can judge me better than I can judge myself. I think we generally tend to avoid or resist change. In the case of researchers, they sometimes need to abandon or change their research themes for various reasons. This situation may be tough for some researchers; even so, we should see change as an opportunity to enrich ourselves as human beings, and by moving up the steps presented by that opportunity, we will become stronger people. Everything depends on our mindset, and there is no doubt that change makes people grow.

—Finally, what do you think is the role of top management? And would you give a message to researchers inside and outside the company?

I believe that the role of top management is to generate a perturbation without people being aware of it. As the world is changing, top management needs to make changes (i.e., generate perturbations) for their staff. I believe that at times of change, by communi-

cating with staff in a way that they do not notice the change (that is, by not making them aware of the perturbation), they can move forward without being aware of the change. Once people make progress, they will understand the change as they progress, realize that the change is interesting and fun, progress in their understanding, and develop a mindset of taking initiative in and having passion for their research.

A Nobel Prize laureate in physics Arthur Leonard Schawlow once said, “The most successful scientists are not the most talented. But they are the ones who are impelled by curiosity.” I quote these words every time I give a lecture to research staff at my laboratory group. Even if one’s knowledge and abilities are not sufficient, there is always room to improve, and taking initiative and having passion rooted in curiosity are the keys to success. However, you should not recklessly rush forward with only your own thoughts; listening to and accepting advice from others and respecting others are also key factors in improving your research capability.

The words of Goro Yoshida, the first director of the Electrical Communication Laboratory, “Do research by drawing from the fountain of knowledge and provide specific benefits to society through commercial development,” are the basic philosophy of NTT laboratories today. Keeping this philosophy in mind, we at NTT Science and Core Technology Laboratory Group strive to invent concepts that differ from past ones and constantly create something new that originates from us while collaborating with parties inside and outside NTT for creating things that cannot be done by us alone. We also want to become an organization that carves its own path to the future.

To our researchers. NTT’s laboratories are places where you can take on various challenges without fear of failure. The themes of cutting-edge and basic research may not be understood or communicated well at first, but top management and your seniors are patient and thorough in their efforts to unravel and understand them. Therefore, please take initiative in and be passionate about your research.

To our research partners. Our research is like a rough stone—although it may be unique and of great value, it may not seem attractive. When this rough stone is washed downstream and collides with other stones, its surface becomes smooth, shiny, and beautiful, sometimes shines like a diamond. If that happens, the stone’s value will be widely recognized by people and it will contribute to society. This process requires time-consuming polishing and processing. By combining our rough stones (i.e., cutting-edge

technologies) with your technologies, we want to contribute to creating a sustainable, safe, and secure society that embraces diversity, namely, the goal of the IOWN concept.

Interviewee profile

■ Career highlights

Akira Okada joined NTT in 1993. He became a senior researcher at NTT Photonics Laboratories in 2003, senior manager in charge of human-resources management and development at the General Affairs Department in 2009, senior manager in charge of research promotion at the Planning Department, NTT Science and Core Technology Laboratory Group in 2015, vice president, head of NTT Device Innovation Center in 2016, and vice president, head of NTT Device Technology Laboratories in 2017. He has served as head of NTT Science and Core Technology Laboratory Group since July 2022 and was appointed senior vice president of R&D in June 2023.