December 16, 2016

Q&A at R&D Presentation

Date/Time: December 16, 2016 15:00-17:30 JST
Location: NEC Tamagawa Plant, Kanagawa
Presenters: Motoo Nishihara, Senior Vice President

Questioner A

Q. Could you please give us a rough estimate of the difference in remuneration between NEC researchers? If there is not a large difference at present, how will you incorporate the surging remuneration of AI researchers into your R&D expenses in the future? Also, I believe that NEC will face the risk of researchers being hired away by rivals in the future. With this in mind, how will you conduct performance reviews of researchers?

A. The remuneration of talented AI researchers is surging worldwide just as you describe. At present, remuneration between NEC's AI researchers at the initial level and top level differs by a factor of 10, and we therefore believe we have set an adequate difference in remuneration. A difference of ten times means that the remuneration of top-level researchers surpasses that of NEC's Directors. Remuneration based on international standards was originally provided at NEC Laboratories America, Inc. However, in certain cases, we have started to provide the same remuneration in Japan. We also provide this level of remuneration to certain young researchers. We cannot avoid the problem of researchers being hired away by rivals unless we strengthen two priorities. The first priority is to assign research projects that motivate and inspire our researchers. The second priority is to ensure that their abilities are put to good use, leading to the development of new businesses. We have no choice but to pursue steadfast management of these priorities. Given that AI and data science research relies on people to a considerable extent, our approach to performance reviews is to assess each individual's abilities. We rely on these personnel to achieve breakthroughs at our research laboratories.

Q. Isn't the average career span of these researchers very short? It is difficult to generalize because the career span will also vary with the lifetime of technologies, from long-lasting analog computers or devices with useful lives of 10 years to Internet-based technologies

with a life span of only two or three years. What is your approach to this issue?

A. NEC Laboratories America has a clear approach to temporary and permanent employment. Although NEC Laboratories America offers a high remuneration, employment contracts are regularly reviewed every one, three and five years. In Japan, we have just begun offering remuneration based on international standards. We have not yet set up a clear-cut structure like that of NEC Laboratories America. However, we intend to develop a structure based on the same fundamental principles. A high remuneration will not necessarily be guaranteed for five or ten years. We believe that it will be essential to review and dynamically transform remuneration at certain intervals.

Q. I believe it is critical for the Value Co-creation Center to assess technologies both within and outside the company. How will the new center be operated in terms of staff members and systems? I believe the researchers will oppose any excessively strict operation of the center. How will you make the center function effectively?

A. This unit was just established this year and still has only a short history. Basically, it will be an organization with an equivalent position to other research laboratories. Previously, these types of planning units were staffed by transferring researchers from the frontlines. Instead, we seek to staff the Value Co-creation Center with dedicated personnel. We are selecting personnel who have a good feel for the world outside the research laboratories, such as personnel with business experience, not only research experience. The priority we are currently pursuing is third-party benchmarking. It is important to determine how to reflect external expertise in our organization. Steering a course for the company in these respects is one of the most difficult tasks of management. Therefore, we have adopted an approach in which the Value Co-creation Center will not decide everything. Final decisions will be made by myself and general managers in consultation with the Value Co-creation Center.

Q. I believe the ideal candidate would be somebody with a strong track record in business and outstanding credentials as a researcher. However, it also seems somewhat wasteful to use such a person in this role. Have you chosen senior people who have a strong track record in past years?

A. We do not consider age to be a relevant factor in selecting personnel for this role. Aptitude also comes into play, as people tend to be either good at making these sorts of decisions, or not. Therefore, we are seeking people who possess different qualities than

those of researchers.

Questioner B

Q. I would like to confirm how you intend to monetize advanced technologies, or where you seek to generate earnings. I can understand your aspirations to be the world's No.1 in technology, but from the outside, it is hard to see the extent to which this will contribute to earnings. Could you please share some more insights into generating earnings in the future? For example, will the breakthrough technologies introduced in this presentation enable NEC to generate extremely large profits in fields where it has not made very large profits to date? Although this may lie beyond the field of expertise of the research laboratories, it would be helpful to be able to visualize how advanced technologies will lead to profits.

A. At the beginning, I noted that the research laboratories are responsible for developing technologies and creating new markets, and that its activities are not meaningful unless they contribute to NEC's businesses. I believe that this is indeed the crucial point. One research area that is currently producing results within NEC is predictive analytics automation technology, which we introduced in the presentation. There is also another technology called system invariant analysis technology (SIAT). For this area, the researchers, to whom the projects are entrusted, are very well known in the industry and have considerable business knowledge. The personnel involved in predictive analytics automation technology also have a sophisticated business mindset, and are working in North America as there are customers in North America who recognize the value of this technology. We are working based on the belief that it is the researchers themselves who will create new markets. Predictive analytics automation is a technology that can clearly create a new market. We believe it will certainly become a viable business next fiscal year, or the fiscal year after that. The same goes for secure computation, and it has been advanced through investment in startup companies. The startup companies made very rapid progress on research as they have an urgent need to generate profit. Although the result was made possible by combining their patents and NEC's technologies, the DNA of the startup companies has also played a significant role.

Q. Could you please comment on any initiatives NEC is undertaking in the field of quantum computers?

A. NEC is participating in a project on quantum encryption. NEC's Tsukuba Research

Laboratories is currently working on platform technologies that could pave the way for quantum computers. Researchers in the field are members of Tsukuba Research Laboratories, so we have the component technologies. However, we are not directly involved in developing quantum computers.

Questioner C

Q. Heterogeneous mixture learning technology was introduced at a previous R&D information meeting. Why hasn't this business expanded? What is your assessment of the situation from the perspective of the research laboratories?

A. One major factor that is common to the entire AI and data science field, not just heterogeneous mixture learning, is that the market is still in an initial development phase. In addition, since customers cannot necessarily solve all of their issues with a single engine, it is difficult for a new technology to be introduced immediately simply because a new specific capability is available. With these reflections in mind, NEC has devised a platform called "NEC the WISE." Solutions that integrate several different AI technologies are provided as platform. The platform includes 20 to 30 different types of engines developed by the research laboratories. At present, we believe that by using this platform, we can provide higher value systems that combine various engines.

Q. My question concerns the technology roadmap. Deep learning and other techniques are being established as a result of advances in computers. If the research themes are already known, why is NEC planning to do things in 2019 that it could start doing now? Could you please explain why NEC must follow a step-by-step process? If more human resources are needed, wouldn't that mean that competitors could catch up with NEC by simply attracting personnel?

A. The roadmap is not final. We believe it must be revised regularly in real time. If the market changes, we believe it may also be necessary to drastically revise the roadmap. We do not use the future technology vision, for example, for three years once it has been set. It should be revised every year. The fields that can be dealt with by attracting large numbers of personnel are engineering themes, not research themes. Basically, the research laboratories do not select these fields as themes because our competitive edge would diminish over time. Meanwhile, there is a view that research can be accelerated by increasing personnel. In this regard, NEC will pursue research by combining approaches such as open innovation and utilization of external funds.

Q. If the importance of a research theme to the market changes, NEC has said that it would flexibly refocus its research based on those changes. If another company or research institution were to take notice of a theme before NEC, and pursue research for one or two years, wouldn't it be difficult for NEC to catch up?

A. Competition means that would be the case. With our previous approach, NEC found it difficult to make flexible changes in areas of focus. The Value Co-creation Center has been defined as a command center for both open innovation and our technology vision. It is a unit that was set up to ensure effective governance in both of these areas. It will also ensure that NEC is able to take more dynamic action in response to changes.

Questioner D

Q. The phrase "High value solutions" did not appear in last year's presentation materials. How do you define this phrase? Can I assume that a research theme that becomes a "high value solution" is a success as far as research is concerned?

A. Last year, we presented our approach of "value enhancement." This approach lies at the heart of "high value solutions." Under the value enhancement approach, NEC's businesses will not achieve progress unless a solution is able to create value for customers on a sustainable basis, not just temporarily. In the past few years, NEC has been working on various proof of concept (POC) trials with customers. As a result, we have found that it is crucial to narrow down research themes. Therefore, we are working to narrow down research themes to those that can spark disruptive change. We have defined high value solutions as those that can achieve value enhancement and spark disruptive change.

Q. You wrote that this year's main achievement was the development of more than 10 high value solutions. Could you please describe these solutions in detail?

A. This refers to the six solutions presented on page 36 of the presentation materials and the themes shown on page 37. There are individual differences between these solutions, which include both themes that are the focus of detailed business talks with customers, and those that are not. However, they are our themes for high value solutions. I cannot disclose any more information on what kinds of specific projects we have beyond what is shown in the presentation materials.

Q. Your No.1 technologies do not seem to have changed very much from last year to this year. Have there been any changes in your No.1 technologies?

A. Our No.1 technologies include predictive analytics automation technology, secure computation and video image face recognition. These areas are where NEC has always been strong, and the No.1 areas themselves do not change very easily. For example, NEC has a 30-year history of research into face recognition, speech recognition and cipher. For the past 20 years, we have been pursuing research into the machine learning used in predictive analytics automation technology. These No.1 areas depend on the accumulation of research and the number of researchers. We believe that it is important for new No.1 technologies to emerge from those areas. This year, we have actually been producing new research achievements in different fields through the use of open innovation and other additional approaches. That means we are pioneering areas in which we will continuously develop the next No.1 technologies.