the japan times forum on disaster prevention

Experts: Panelists at The Japan Times forum at the Grand Hyatt Tokyo on May 15 are (from left) Yoshimitsu Okada of the National Research Institute for Earth Sciences and Disaster Prevention, moderator Yuzo Suwa of Kyodo News, Hideo Watanabe of IBM Research and Shota Hattori of Kozo Keikaku Engineering. YOSHIAKI MIURA

Lessons learned from the Great East Japan Earthquake

The Japan Times held a forum recently to discuss the lessons learned by industry experts in light of the March 11 Great East Japan Earthquake, tsunami and nuclear accident. Joining the discussion were Yoshimitsu Okada, president of the National Research Institute for Earth Science and Disaster Prevention, Shota Hattori, CEO of Kozo Keikaku Engineering, and Hideo Watanabe, manager of resilience engineering at IBM Research. Yuzo Suwa, an editorial writer at Kyodo News, served as moderator of the discussions held this month in Tokyo. Excerpts of their discussions follow.

Lessons from the earthquake

Moderator: A year has passed since the Great East Japan Earthquake, when close to 20,000 people became victims. In the beginning, the magnitude of the earthquake, the accident at the Fukushima No. 1 nuclear power plant and so forth was all expressed as unexpected and unprecedented events, but since then many things have been subsequently verified. Big lessons, such as on "How the government and residents prepare for an earthquake disaster," "What companies' business continuity plans (BCP) should be," were obtained through these events.

With this as a theme, please provide an outline of your business and tell us what lessons were learned from the earthquake.

Yoshimitsu Okada: The disaster prevention department deals with earthquakes, volcanoes and other natural disasters, such as storms and floods. It is based in Tsukuba, Ibaraki. In Miki, Hyogo Prefecture, we have the Hyogo Earthquake Engineering Research Center, which can conduct experiments on the destructive process, while in Nagaoka, Niigata Prefecture, is the Snow and Ice Research Center, which has a branch in Shinjo, Yamagata Prefecture. After the March 11 disaster, we have been strengthening the tsunami research field.

I was truly surprised by this earthquake even with my background in seismology. It was said that there was a 99 percent chance that an earthquake would occur off of Miyagi Prefecture and the prediction was right. However, it was not imagined that the earthquake center would spread to the offing of Ibaraki, with a magnitude of 9. This is because there was no data that this kind of earthquake occurred in the past. It is very difficult to predict phenomenon not having experienced it. In principle, it had to be thought that the focal region naturally grows rapidly and enlarges. It is very regrettable that the thought did not arise there.

In 1993, the Hokkaido earthquake generated a destructive tsunami that hit the island of Okushiri, drawing attention to the rise of a tsunami from an earthquake in an oceanic trench. However, after the Great Hanshin Earthquake in 1995, people worried more about active faults, and the investigation and research of these faults were preferred instead. Simi-

lar measures were made with nuclear power plants and the resistance to earthquakes was given priority while measurements regarding tsunamis were postponed.

After the Great East Japan Earthquake, in addition to the seismic movement, a prediction map for tsunamis was created and the production of a network of seismic stations in the seabed off Japan was also started at our lab. By getting data sent straight from the ocean, I think that it can contribute to disaster prevention or progress in earth science.

Shota Hattori: Kozo Keikaku Engineering Inc. started as a structural design office in 1959. For example, we have been involved in the design for the Grand Hyatt, where we are having our discussion today, Roppongi Hills next door, the Shanghai World Financial Center. As for the structural design, it is mainly focused on buildings not being destroyed by earthquakes. Besides that, there are also design issues that focus on damage from other natural disasters, such as wind and flood damage, or typhoon damage. The interaction between a building and a natural phenomenon are then considered and providing that information to the private sector is what I think is our line of duty.

In the lessons learned from the Great East Japan Earthquake, because of the Great Hanshin Earthquake and new earthquake-resistant criteria being reinforced in 1981, there were no seismic adequacy problems with the buildings. Other varied elements, such as the nuclear power plant disaster, instead caused this tragedy. Although 500,000 people suffered a great deal from the damage, 480,000 people were saved, and having this structural design mechanism is one way to indicate its value. Japan needs further disaster prevention technology and think what it was that went wrong.

Hideo Watanabe: IBM, with the vi-

Interior movement: A computer image shows living room furniture after an earthquake occurs, based on data from the 2007 earthquake off the coast of Niigata. KKE

sion called "Smarter Planet," has already developed various solutions and computer systems. Not only in a company but the cities and a country as a whole, we are advancing the social system altogether. Lessons have been learned not only from the Great East Japan Earthquake, but also from China's Sichuan earthquake, Haiti, the New Zealand earthquake. Among these, using the information and communications technology (ICT), principally by a section in IBM, we are considering what kinds of solutions and services can be developed.

We came up with a futuristic technology outlook, proposing the "resilience business and services." We had in mind a company system, a city and a country, making a society as a whole more resilient. Proposing from an ICT viewpoint and making a faster recovery, returning everything to its original state.

For example, in the economic field, a system that can be used only at the time of a disaster is difficult for the continuity of investment. In order for a company to build a resilient system, it is required that it can be helpful and used daily, also at the same time having a standpoint where it can be simultaneously used for an emergency. In addition, from a city or a business continuity standpoint, actively assimilating the information already acquired by a simulation or a sensing of the weather, for example, brings it to the desired direction with little damage as possible. If it occurs, research has begun for calculating the fastest recovery plan.

On the other hand, as a person who is part of ICT, I think there were many cases where ICT wasn't being used as expected. One reason for this being the control of information. For example, depending on the shelter, relief supplies either weren't enough or were too plentiful. From the reports given by the United Nations, the importance of using social media and its information was pointed out. Compared to 10 or 20 years ago, the exchange of information has completely changed, changing from "one to many" to "many to many." In a nutshell, people are now able to exchange information with various people on a personal level. Yet it also has a negative effect, such as false information. So the U.N. said, "Although information is very important, it must be reliable and accurate." Information control must run more smoothly next time.

Usage of simulation technology

Moderator: While still focusing on the problems we faced during the Great East Japan Earthquake, in light of the worries over the Nankai trough and an inland earthquake in the Tokyo metropolis, how can we use simulation technology, and respond to these issue with it? And what are Japan's capabilities in this field?

Okada: There are many levels to simulation, too. A scientific earthquake simulation can have many difficult fields to it. There is a big difference depending on what kinds of ideas are innovated to the program. This is because there's hardly any information on the underground construction and movement. Although, we are currently re-creating earthquakes from the past as models, we will see if the model is correct only when an earthquake occurs. Since the cycle in which a big earthquake occurs is very long, therefore, progress is very slow. Basically, it is very difficult to have a model we can fully rely on.

On the other hand, we have been able to simulate precisely the engineering with the wave motion of an earthquake, the propagation of tsunamis and the shaking of a building. I believe Japan's technology is progressing.

Moderator: This earthquake caused seismic movement to skyscrapers for a long period, isolating some residents. How do you think earthquake resistance and evacuation can be improved through simulation in the near future?

Hattori: The seismic movement of the skyscrapers influenced the research on not only the building, but also the furniture installed and how it shakes. After simulating, I think the damage can be decreased by fixing furniture and working on other security measures.

Regarding evacuation, Minoru Mori, the former president of Mori Building Co. who passed away this March, suggested the idea of evacuations using elevators. Due to the fire service law, Roppongi Hills cannot evacuate with elevators, but predicted how 20,000 people could evacuate the fastest in the daytime. The way of evacuation is different depending on if it is a Sunday, when there are many elderly people and young children, or on weekdays, when there are more office workers. It is important to simulate it carefully and also to support it efficiently.

Okada: In a high-rise office building, copy machines on wheels drastically change into killing machines. With that in mind, if the computing ability of a computer increases, not only the structure but also the non-structural component, such as the furniture within, and all the details are put together in the same frame simulation, it can quickly be brought into a realistic simulation. This I believe is one way.

Also, in order to link this to education and individual measures, it is important to visualize the end result. For example, rather than showing a map of how much flooding a tsunami will cause, instead, showing a picture of a tsunami coming has much more impact. Or asking every person the structure of their house and seeing on a computer how it will actually shake. If we can show "This is how much it will shake" or "This is how much it will collapse," then they will think, "We need to strengthen it more." It is important to develop the visual effects and spread them to the world, not just doing calculations.

Watanabe: I think the ultimate goal of disaster response simulation is to be able to bring it to the state of evacuation instructions. In the current state, it may be hard to actually support it, but having the information of where each individual is and having the real-time data on how the tsunamis and tornados are approaching, having a grasp on what the traffic situation in the city is, if the overall simulation can be performed, it should be able to give directions like "Please escape now in this direction." I think such things are what we should be aiming for as the ultimate goal.

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> HIDEO WATANABE, IBM RESEARCH

Hattori: Also, I think, professionals should always be diligent toward simulations. Even if it is entering data, I would like them to be conscious and know that just trusting the result without looking at the data can be very dangerous.

Moderator: With the great earthquakes, many times the power supply was lost, and neither the Internet nor mobile phones could connect, leaving areas isolated one after another. It is the same for the media information that is being shared and there are still many problems that need to be solved. I would like to point out that tools for information, such as mobile phones and the Internet, need to be able to connect during emergencies and not be an easily crippled system.

Business continuity plans (BCP)

Moderator: In response to the great earthquake, a lot of attention is being brought to the business continuity plans of companies. In order to build an effective BCP, how should the Internet, information technology, etc., be used?

Watanabe: Regarding BCP, the awareness of it has changed a lot. In the Tohoku area, the component makers for cars suffered a great deal of damage, affecting not only the domestic but also the global economy. From a viewpoint of the supply chain being disassociated, not only carmakers in Japan, but also the companies that are active worldwide have and share the same view. Therefore, by looking at the weak points of the supply chain and then analyzing and recognizing it, if it does not work, then think about the next option. Making plans for such points that may be foreseen will definitely be important in the future. Companies that work with the supply chain on a worldwide scale should recognize how the efficiency can be increased and how the company can be made stronger. It is a management problem that should be recognized.

Also from the IT point of view, the recent trends show an increase in the use of the "cloud." I think it was quite difficult for each company until now to manage the data independently and with extensive backup. We can now deposit our data in the cloud, which is being developed worldwide, so on a world level the data can be dispersed and the safety can be improved. By using the cloud, it is easier to create BCP compared to 10 years ago.

IBM has developed and used a weather system called Deep Thunder for a long time in the Smart City simulation. This can predict the weather, i.e. rain, wind direction, wind force, in a 2-km mesh. For example, power lines go out due to storms, tornados and strong wind. You have to dispatch a maintenance staff immediately for restoration. With an electric company for a wide area, people are stationed beforehand for all bases. If the prediction is used for it, the dispatch of people can be performed efficiently. Some large cities are currently doing this.

Hattori: Before, a company's way of preparing for natural disasters was just to wait for instructions from the government, but during seminars held after the Great East Japan Earthquake, companies directly attended and have become very conscious. Furthermore, companies are purchasing the tsunami simulator and other software and are studying it. It is necessary to work hard and to have high danger awareness like this.

Okada: The role companies have to play is in the part of mutual aid, which is being brought closer together. It is because we feel that we can no longer be depending on the city office. It is not only in companies but it is important that we use the connection with our neighborhood association and school.

Using the K supercomputer

Moderator: Simulations and models are important in the process of acquiring data to decide how society as a whole needs to be supported, and for decisions regarding natural disasters to be made. Currently, the Japanese supercomputer K has an computational speed and capacity that is the best in the world. If utilized, forecasts and estimations of hurricanes and thunderstorms will be done more swiftly and can be applied for disaster prevention and evacuations.

Okada: If a high-capability calculating machine is created, the mesh division of space as well as the interval of time would be smaller than ever, and will lead to the ability to perform detailed simulations. There is the merit of being able to come up with a forecast for the future in a certain amount of time. There is also the ability of re-creating whole cities in computers and re-enacting an earthquake, instead of doing so with individual buildings. It gives hope to

the future of disaster prevention.

It is true that for disasters that change rapidly, such as hurricanes and "guerilla" rain, meteorological models will suffice, but to predict what will happen to events that are occurring at that time, observed data is always needed. This is what is lacking the most. For example, the radar used by the Japan Meteorological Agency does not register observation records. Unless new radar technology is used to collect data, accurate forecasts cannot be made even if computers are used. Therefore, collecting data needs to be processed through sensing in order to simulate. Simulations will capture what parts of the data are inaccurate so that they can be re-observed, and in that way, sensing and simulations are closely connected with each other, and both need to work closely together.

There is also a problem in software. In the development of software, there are still many areas in ideology that are missing. A major example is in the use of supercomputers for weather change, where the atmosphere, the ocean, ice, forests and human activity are included into the calculations. This is still insufficient. How other aspects, such as solar activity and volcanic activity, are going to be included need to be thought of, for example.

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SHOTA HATTORI, KOZO KEIKAKU ENGINEERING

Hattori: Supercomputers such as K should be utilized more, but the country should show its support to promote this use or it would be a good thing gone to waste. Natural disaster simulators using computers such as K are high-level machines that can be introduced to the world.

Watanabe: Having simulations for numerous scenarios for entire cities will help in averting disasters. High-performance computers will become very important, and the use of super-computers such as K and our Blue Gene will become essential.

In the Rio de Janeiro city command center, weather forecasting to predict rain and flood disaster prevention is under way. Security cameras and traffic cameras were incorporated for this weather forecast, and the traffic operation of the whole city is managed at the center as well.

There are over dozens of huge screens in the center where the entire city is monitored, and people from each department gather there. Until now, decisions were made individually, but now all departments look at the same data and decisions are made together. This is the important point. There are a lot of thoughts on vertical hierarchy, but a system is needed where everyone can come together to one place and make decisions as a whole in cases of emergencies. When a decision-making structure applying the ICT is built, supercomputers will be put to good use.

Bringing technology to the world

Moderator: In what ways do Japanese simulators exceed international ones?

Hattori: For example, a base isolation building is being built applying the simulations. We have been dealing with many different types of natural disasters, and we should contribute to the rest of the world by sharing our technology.

Moderator: Is there anything being done to internationally expand Japan's processes and technologies regarding natural disasters?

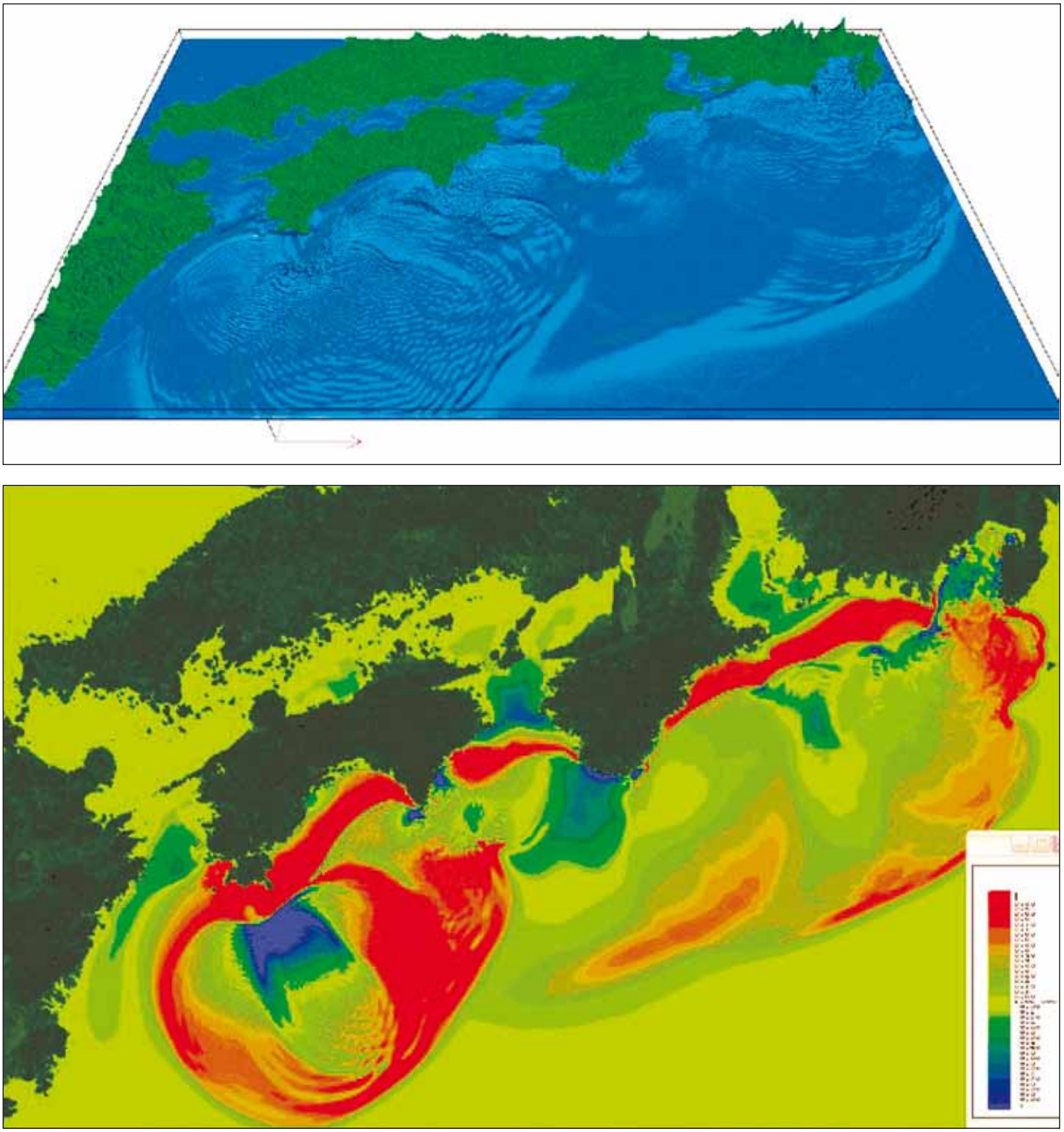
Okada: In developing countries such as Southeast Asia, despite using simulations, the observation records are inaccurate. To bring Japan's technology as is to these locations will be very difficult. Deciding on methods that will be useful in these locations and working with the local researchers and citizens on how to utilize them is important. There is work being done to create a database of low-cost disaster prevention measures such as planting mangroves along the coast for protection from tsunamis.

Watanabe: Regarding Japan's contribution, there is risk appraisal for land that is done for property insurance. Our company is also participating. Insurance companies are working on creating a global model of risk assessments for tsunami called Global Flood Model (GFM). Also, a model for risk assessments for natural disasters and a Global Earthquake Model (GEM) are being worked on.

Okada: GEM is a project done by the Organization for Economic Cooperation and Development (OECD), which is trying to set a standard so global hazards and risks can be accurately compared. Japan is highly advanced in assessing earthquake hazards, but only insurance company organizations and individuals partake in the OECD project, and Japan does not officially participate as a country. Ministries and government offices that do not contribute to the funding is one of the problems. Even if we use our self-acclaimed advanced technology, there is a risk of it falling to the Galapagos effect, like Japanese cell phones. I would like to see the government become more understanding and supportive of the global contribution of Japan's technology.

Moderator: When you say Galapagos effect, you mean that Japan does not have the basic awareness to reach global standards?

Hattori: Electronics and automobiles



Graphical representations: Simulation results of the 1707 Hoei Earthquake, recognized as the largest earthquake in recorded Japanese history until the 2011 Great East Japan Earthquake surpassed it, show the moderate to severe damage caused throughout southwest Japan, including Shikoku and Kyushu, and the tsunami hit along the southwestern coast of Kochi Prefecture in Shikoku. KKE

are globally targeted, but there are many fields that are lacking a global viewpoint. Our company tries to hire foreigners who received their masters in engineering from Tokyo University or Tohoku University as much as possible. We would like them to return to Southeast Asia and Europe as superb leaders. The hiring of study abroad graduates will grow, and we would like the engineering field to evade the Galapagos effect.

Application of decision making

Moderator: Japan has a vertical hierarchy in government offices and during natural disasters, as well as the horizontal organization of the country and its local governments. Each is strong individually, but there is a weakness in making decisions as a whole, and I see the effect and reality of the vertical hierarchy sometimes.

Okada: For example, let's say we find something that we think may lead

to a certain natural disaster while analyzing our data. The research results can be put on the Natural Research Institute for Earth Science and Disaster Prevention website, but we cannot post warnings based on them. Based on meteorological service law, information on natural disasters can only be announced by the Japan Meteorological Agency. It is true that during natural disasters, information from numerous sources tend to confuse those who are on the receiving end. Therefore, the theory of one information source is understandable, but having too much of a strict restriction means that information found outside the JMA cannot be announced. Perhaps there is a better way to manage this.

Moderator: Even if the simulations perform well, if the society does not utilize them effectively, there is no meaning to it. There was an indication to the problem regarding fire laws in elevator evacuations, but how should simulations be applied in society's decision making?

Hattori: When it is said a number of times that a tsunami will come, people will not be able to evacuate when it really occurs. There is a need to train and educate in order to link simulation results to individual behaviors. For example, evacuation simulations can be organized in each region to provide information such as how evacuations in cars will lead to traffic or how people with children and the elderly should evacuate. This will be crucial in the future.

In occasions of natural disaster, governments and leaders must make decisions while being in control. This control system and simulations will be applied together in decision making. It is not only about simulation results being accurate or not, but planning on how to utilize them in political decision making and monetary policies.

Okada: In the relationship between decision making and simulations, I felt that the biggest problem during the incident at the nuclear plants was the usage of the System for Prediction of Environmental Emergency Dose Information (SPEEDI). Even if they did not know the absolute amount, the system showed high radiation in the northwest, which should have been applied in evacuation instructions. That those who decided on policies did not use these results is disappointing.

Watanabe: We feel that a lot of different types of simulations should be performed. For example, during a tsunami evacuation, the situation greatly changes on where the majority of people are. To inform this to the authorities and get them to utilize the information in decision making is necessary.

Moderator: Japanese politicians are used to not making decisions. They have almost no experience in making judgments in times of emergencies. There is a need to build a system for risk management or to train people solely for emergency decision making.

Okada: The director general for disaster management in the Cabinet Office changes every two or three years. This is not acceptable. There needs to be someone working full time on these matters for things to get done. Shizuoka Prefecture is an exception, but mostly the same. Unless there are specially trained groups or people, disaster prevention will not take root.

Moderator: The government indeed needs specialized people. Is there a way simulations can be created so that it can be easily used in decision making?

Hattori: Country authorities and local governments attend training sessions in the simulation room. It is important for them to individually think of actions to be taken during emergencies. Natural disasters differ depending on regions and need to be dealt with differently. If they all have different evacuation plans, aversions of regional disasters will increase.

Application to future cities

Moderator: In areas such as Tohoku, the buildup of a future environmental city will start, such as with ICT being applied to use natural sources to save energy. What is the potential in this?

Watanabe: In building cities, funds that can be used in systems solely for emergencies are limited. If the systems can be used regularly, that would be best. Even the command center in Rio was initially for flood prevention, but it is now used to operate traffic and for dispatching police cars and ambulances for accidents. It has been mentioned many times, but a system that can integrate component technology to make a decision is needed.

The main goal of simulation technology is to give evacuation instructions to each individual on the spot, but that is still something that needs to be worked on. What needs to be done right now is to actually have people see and experience the results of the output from simulations done through training. There will probably be a lot of developments for smartphones in the future, but using them in schools and companies in evacuation trainings will be necessary as well.

Okada: As Mr. Watanabe pointed out, systems that are regularly used should be used during emergencies as well. Systems that need to be turned on at times of emergencies will never work. It is mandatory that they can be used seamlessly, including simulations.

Also, not regarding natural disasters as a scientific, natural occurrence but to think widely about human behavior and policies is important as well.

Hattori: By using information technology, we now have the ability to plan ahead based on situations and in segments. For example, if an

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YOSHIMITSU OKADA, NATIONAL RESEARCH INSTITUTE FOR EARTH SCIENCE AND DISASTER PREVENTION

earthquake hits us directly, a detailed plan for students, young children, and the elderly needs to be created. It is essential that people acquire this knowledge through training for future cities.

With this earthquake, and thinking about the next step in engineering, looking at what we can send out from Japan is important as well. Do not listen to the perspectives such as "Japan has too many risks" or "Japan will sink," but use it to take the next step forward, socially and individually.

Moderator: To utilize supercomputers, the growth of society's systems and the development of the technology to acquire data are needed. I think we all confirmed that simulations will not solely resolve all the problems. Apply the observations in politics, education, and daily life. At the same time, it is also essential to build a strong city using the "Environmental Future City" as a model.

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Profiles of participants in The Japan Times forum

Shota Hattori: Hattori is the CEO of Kozo Keikaku Engineering Inc., based in Tokyo.

Born in Tokyo, Hattori obtained a master's degree in sociology from the University of Tokyo in 1982, and graduated from the graduate school program in political science at the Massachusetts Institute of Technology in 1985. He worked at the Boston Consulting Group in both Boston and Tokyo until 1987. He entered KKE in 1987 and has been the CEO since 2002.

Hideo Watanabe: Watanabe is a manager for resilience engineering at IBM Research in Tokyo.

Since joining IBM Research in 1986, Watanabe has been studying natural language processing such as machine translation. He has worked on a text mining project called Text Analytics and Knowledge Mining (TAKMI), which is a technology that can read and uncover trends from the avalanche of information in the natural language format.

Yoshimitsu Okada: Okada is the president of the National Research Institute for Earth Science and Disaster Prevention (NIED), an independent administrative institution based in Tsukuba, Ibaraki Prefecture.

He graduated from the University of Tokyo with a degree in geophysics in 1967 and obtained his Ph.D. from the University of Tokyo in 1980. After he worked at the National Research Center for Disaster Prevention (NRCDP) as a principal researcher, he entered NIED and researched several aspects regarding earthquakes before he assumed the position of president.

Yuzo Suwa (moderator): Suwa is a senior feature and editorial writer for Kyodo News.

Born in Hyogo Prefecture, he graduated from the Faculty of Foreign Studies of Sophia University in Tokyo in 1984. He then entered Kyodo News and has worked in its Hokkaido and Osaka branches. After he was back in the head office in Tokyo, he worked in the regional news section, and since 2011, he has been in his current position. He mostly writes about disaster prevention, public projects, the environment, reconstruction and local administration.