English translation prepared as a reference only.

2nd Forum on Preparation for a Nankai Trough Earthquake
－Society 5.0 and Application of Advanced Disaster Prevention Technologies

Introduction

AIG Institute’s second forum focused on preparing for the Nankai Trough earthquake following up from last year. Last year, expert panels discussed pre-disaster prevention considering the financial losses caused by catastrophic natural disasters. At this year’s forum, an overview of cutting-edge disaster response and forecast technologies was introduced, along with how these technologies can be utilized.

First item is the real-time earthquake damage estimation keynote speech about the use of disaster prevention technology which is part of the government’s initiative to "strengthen functions for resilient disaster prevention and mitigation". This effort established a centralized framework to share collected information with relevant government agencies contributing to the more effective decision making at disaster sites. It has been used at disaster sites and contributed greatly to the prompt response of government agencies after disasters.

In the private sector, utilization of real time disaster information is progressing. Systems are developed and implemented to estimate damages to business partners and customers within 10 minutes after an earthquake occurs. Other efforts include predicting the river water levels a few hours immediately after rainfall. This functionality is being developed and tested at more than ten selected river sites to better manage evacuation orders to neighboring residents.

Then, as a disaster prevention technology in disaster prediction, the understanding and utilization of hazard maps were covered using examples of the heavy rainfall in western Japan. The simulation technology for visualizing disasters enables more realistic disaster prediction and is being rolled out to the field of education for disaster prediction. As a case study of using disaster evacuation simulation, the effectiveness of evacuation by walking or other transportation was introduced. Also, it was demonstrated that detailed simulations of earthquake motions allowed predicting the building damages to the main structural area as well as building contents, which is effective for companies’ BCP initiatives.

As ways to potentially leverage disaster prevention technologies for the insurance industry, incorporation of real-time disaster information, disaster prevention to parametric insurance and resilience bonds in the context of the Sustainable Development Goals (SDGs) was discovered to be areas to focus on further.

Through the discussions in the forum, we found that various disaster prevention technologies had been implemented or would be soon implemented and connecting such technologies would expand new possibilities for problem solving. Forum discussions are summarized in this report and we hope the information sharing will contribute to effective disaster prevention and mitigation in the society.

“Research results of SIP Phase 1 focusing on Real-time Earthquake Damage Estimation"

Mr. Hiroyuki Fujiwara
Head, Multi-hazard Risk Assessment Research Division,
National Research Institute for Earth Science and Disaster Resilience

After experiencing at the Graduate School of Science, Kyoto University in 1989, the Director of the Social Disaster Prevention Systems Research Division at the Institute of Science and Technology for Disaster Prevention in 2008, and the Director of the Resilient Disaster Prevention and Mitigation Research Promotion Center, his current position is the Director of the Multi-Hazard Risk Assessment Research Division. He was the head of research on Issue 5 of the government's strategic innovation creation program, "Strengthening Resilient Disaster Prevention and Mitigation Functions," and was awarded the Prime Minister's Commendation for Disaster Risk Reduction Merit in 2017. He is a doctor of science.

※You can download the materials for his speech at the web site (link).

I am Fujiwara from the National Research Institute for Earth Science and Disaster Resilience. Today, I will talk about the Real-time Earthquake Damage Estimation that I was in charge of and worked on in the Strategic Innovation Creation Program (SIP) conducted by the Cabinet Office. First, let me introduce the SIP. The SIP was led by The Cabinet Office's Council for Science, Technology and Innovation and disaster prevention science and technology was selected as one theme. As explained on page 4 of the material, we worked on seven projects in the three areas of forecasting, prevention, and response under the theme of "Strengthening Resilient Disaster Prevention and Mitigation Functions." The Phase 1 of the five-year research program was ended in March, 2019. The research was about to keep obtaining damage estimation over time immediately after earthquakes and plot the data on a map. Looking back at the history, after the Great Hanshin-Awaji Earthquake in 1995, the network of sites to observe earthquakes has been constructed for the past twenty years. Recent ICT technology has been overlaid on this observation network, and it is now possible to understand the statuses of damage in real-time.

In order to promote these programs, we established the Resilient Disaster Prevention and Mitigation Research Promotion Center within the National Research Institute for Earth Science and Disaster Resilience and have pursued the programs for the past five years. As the director of the center, I have been playing various roles for promoting many research and development initiatives. It is now possible to provide a mechanism to estimate the high-level distribution of damage within ten to fifteen minutes after an earthquake, covering the entire national land with a total of 6 million meshes that divided into approximate 250-meter meshes. This system has been completed with the cooperation of many stakeholders and organizations. After the Great Hanshin-Awaji Earthquake, the maintained network of seismic observations and the database for damage estimation were all integrated, and now the information is shared real-time in cooperation with ministries and agencies. This system is expected to be utilized not only by the government and local governments but also by the private sector in future, and currently the experiment is conducted jointly.

One type of the underlying information is the observation network of earthquakes and tsunamis. The National Research Institute for Earth Science and Disaster Resilience maintains and manages the network of approximately 1,800 observation sites. The seismic intensity information network of the Japan Meteorological Agency and local governments nationwide are combined together with the observation network, approximately 5,000 seismic observation points are in operation in Japan. These data sets are gathered at the National Research Institute for Earth Science and Disaster Resilience in Tsukuba City in almost real-time and automatically processed to estimate the damage after an earthquake.

Five thousand earthquake observation points are individually located at every ten kilometers square all over Japan; by overlaying the records at those observation points and the ground information and indicators of vulnerability to ground motion which were accumulated for past twenty years; it becomes possible to estimate level and location of earthquakes immediately. In addition, the degree of damage varies because the periodic band varies depending on the structure of the building. The system that processes the observation data also processes not only the data of the vibration meter but also the waveform individually. Even if an earthquake occurs in various parts of the country, damage estimation can be issued in ten to fifteen minutes.

With this technology as a key foundation, the damage to the building and the number of injuries are estimated, and the result of estimation is overlaid as data. The technologies to process large amounts of data in real-time and the technology to automatically share the result of processing with many organizations for effective utilization are being seamlessly connected. Twenty-four years ago, even after the Great Hanshin-Awaji Earthquake, there were so many requests to obtain estimation of damage, but at that time, there was no observation network, and it took time to estimate various things based on data, and it was difficult to share with the parties concerned. A quarter of a century has passed since then, and we are entering an era in which such data can be distributed to smartphones, for example, at the individual level.

For the earthquake experienced for the past three years, analysis can be completed in five to ten minutes, and damage can be estimated in about ten to fifteen minutes. As you see on page 11, you need to make a solid building model first. With the cooperation of companies and local governments that develop maps, we have completed a database of 250-meter meshes for approximately fifty-six million buildings nationwide. For the estimate of the injured, to identify the number of people in every 250-meter mesh, in addition to their daily movement, their behaviors on Saturdays and Sundays were considered to create a population model.

Even if there are five thousand earthquakes observation sites connected as a network, six million 250-meter meshes will be required to cover the entire land of Japan. Each mesh has very specific ground condition. Ground information (e.g. characteristics, vulnerability to ground motion) is required to complement observation data to identify the vulnerability to ground motion. Data accumulated even before engagement in the SIP project through creation of hazard maps and other activities was very useful. Also, in Kanto or Tokai regions, by adding more detailed data of ground conditions, it became possible to obtain more accurate estimation of vulnerability to ground motion in a more connected way.

Page 14 is about the Kumamoto Earthquake occurred in the third year of the five-year project. Since the core part of the real-time damage estimation system was already in operation, we were able to apply 250-meter meshes and look at an area intensively damaged in about ten minutes after the earthquake. Members of the National Research Institute for Earth Science and Disaster Resilience visited the site the next day. While providing the data obtained here to Kumamoto Prefecture, they supported responses to the disaster.

Page 15 helps you understand how earthquake data is collected in real-time and analyzed to create a map. Data collected from all over Japan is integrated with data directly managed by the National Research Institute for Earth Science and Disaster Resilience, as well as seismic intensity observation information of the Japan Meteorological Agency and seismic intensity information network owned by local governments.

Page 16 shows a comparison of the estimation result and the field survey result about damage found a few months later. According to this, although the damage caused to the west side of Kumamoto City were relatively overestimated, the levels of damage are aligned at a certain degree between the estimation and the actual damage, both of which show that most of the damage had occurred around the city hall in Mashiki-cho which was the most severely damaged. The Kumamoto earthquake occurred at night. Ten minutes after the disaster, we were able to spatially capture the status of the damage with this accuracy; it was evaluated as a great reference for the initial response.

Page 17 explains an advanced research using data of actual damage. The fragility formed based on data of the Great Hanshin-Awaji Earthquake was still in use, but database was constructed for improvement. We are also reviewing technologies to capture actual damage based on data of aerial photographs. More than one hundred engineers spent a few days to create about 400,000 data. The same type of exercise was executed in this project as well.

In the case of the Nankai Trough earthquake and the earthquake centered directly under the capital, the magnitude of disaster would be tens of times bigger. Researches about technologies that process image data through machine learning to improve performance or that increase accuracy based on more accumulated data over time are being executed. The mechanisms of such technologies have been reviewed and advanced through the experience of earthquakes.

Page 21 is about the earthquake in northern Osaka Prefecture. Ground motion above seismic intensity 6 was immediately estimated, with the epicenter in the northern part of Osaka Prefecture. At first, we got an impression that only a limited area had been damaged, but it was suggested that damage could have been caused in areas exposed to greater ground motion. However, it has not yet been possible to estimate damaged sites in a pinpoint manner. When observing using various methods with multiple parameters specified, it was discovered that one approach estimated zero building, while another approach estimated over one thousand buildings. As a result, we are reviewing not only the evaluation of absolute values, but also how to relatively show where damage has occurred.

Page 25 is about the earthquake in Iburi region of Hokkaido. Seismic intensity 7 was observed in Atsuma-cho, and compared to the northern Osaka earthquake; extremely strong seismic motion was measured. Within about ten minutes, we were able to estimate the distributions of damage and seismic motions.

Page 27 shows technology development that uses more detailed data in a pinpoint manner to overlay individual key facilities one by one above wide-area estimate information. We are reviewing what can be done if individual building data is in place in certain areas, as well as what kind of information is needed to improve accuracy. We know that it is very important to obtain data of a whole building as much as possible and to understand the magnitude of the seismic motion per building.

Page 28 shows an initiative led by RIKEN to capture attributes of each building as a physical model. If earthquake sensors are installed on each building, and analysis is done using this physical model, the possibility of completing in-depth damage estimation is increased, which is not a mere statistical analysis. When this can be performed in real-time, the accuracy of damage estimation will be greatly improved.

This is one of expectations raised.

We are also engaged in another initiative to create a mechanism to integrate and update damage estimation data immediately after a disaster with actual damage data. In order to figure out the damage of each building or the damage of important structures, it is necessary to understand the input seismic motion and ground motion of each building. Probably needless to say, but in addition to the basic seismic observation network; we have been developing technologies that allow us to observe earthquakes at the individual building level for about ten years. We are considering a method to combine the cloud technology with the IoT sensing technology to embrace a town by spreading meticulous sensing points.

When the Great East Japan Earthquake occurred eight years ago, a simple sensor was installed at the home of a member of this project. At that time, iPhones and iPads were used as simple sensors. Page 31 shows them, and an iPhone seismometer installed in my apartment near Tsukuba Station detected ground motion with a seismic intensity of less than six. This is the actual ground motion, and you can see that it is at 200 to 300 gal. According to analysis of the running spectrum when the ground motion reached its peak in the first S-wave after it had continued for around three minutes, the cycles were misaligned. I was on my business trip and not at home, so, according to the residents of my apartment, they had heard a loud noise. This event made me think that even the data of a very simple seismometer could enable analysis in the same way as the normal seismic analysis and triggered the initiative that is currently led by the Ministry of Education, Culture, Sports, Science and Technology.

Page 34 shows an example of applying an algorithm to estimate damage in real time to the previous assumption of damage. For hundreds of active faults, a surface distribution and a damage distribution of seismic intensity are mechanically created, and their data can be used for drills. Such information can be delivered by various mechanisms such as API. This is becoming used in experiments involving private companies. We have started concrete activities with thirty companies in order to distribute information to private companies through the information sharing system called SIP4D in cooperation with governments and agencies.

Page 36 is about data used by Kajima Corporation for the northern Osaka earthquake, indicating that it can be used for BCP. Reviews and discussions have started for the specific usage of data. In the future, we would like to work on real-time analysis that can be extended only to earthquakes but also to damage caused by tsunamis, heavy rains, and tornadoes.

Page 39 is about a mechanism to share such information. It would be critical to be able to connect everything in real-time after information required by individual parties is delivered. Mr. Usuda of the

National Research Institute for Earth Science and Disaster Resilience is now dedicated to the development of such a system.

This is the last page, one of the second phase SIPs led by the Cabinet Office, a team of science and technology laboratories for disaster prevention has joined to create a mechanism that can evaluate economic damage estimation in addition to direct damage estimation.

I could not spend more time for the last part of my presentation but I would like to close it now. Thank you very much.

"How to prepare for the Nankai Trough earthquake"

Mr. Norio Maki

Professor, Disaster Prevention Research Institute, Kyoto University

He is specialized in disaster prevention plan, disaster recovery plan, and crisis management system. Graduated from the Department of Architecture, Faculty of Engineering, Kyoto University, and received a Ph.D. in Engineering. In addition to engagement in the formulation of disaster prevention strategies and regional disaster prevention plans of numerous local governments, he has been involved in local government support activities in disaster-affected areas, such as formulating and verifying the reconstruction plan of Ojiya City after the Niigata Chuetsu Earthquake in 2004, and providing information processing support for disaster response at the Iwate Prefecture Disaster Response Headquarters during the Great East Japan Earthquake in 2011. He is also conducting surveys on the post-disaster reconstruction process and housing reconstruction in Japan and abroad.

※You can download the materials for his speech at the web site (link).

I am Maki from the Disaster Prevention Research Institute in Kyoto University. I would like to talk about how to use risk-related information, which was also featured in the keynote speech. Let's move to is the first slide. The Nankai Trough earthquake is a very big issue for the Kansai region, and the Hyogo Earthquake Memorial 21st Century Research Institute is working on a policy research project to prepare for the Nankai earthquake. Dr. Makoto Iokibe, who chaired the Reconstruction Design Council in response to the Great East Japan Earthquake, is the head of the project, while I am the project leader. For this type of policy research, it is critical to understand disaster risks to initiate discussions about what kind of damage should be considered.

In March, this year, the Cabinet Office released guidelines for emergency information on the Nankai Trough earthquake. This phenomenon is called "Hanware" or semi-cracking, and refers to a situation in which an earthquake of M8 occurs in the assumed areas and affects other regions, and the possibility of a large earthquake is increased. How to prepare for this is a huge challenge.

Next, I would like to talk about how we can apply hazard simulation to actual plans and countermeasures. As you all know, "Establishing the Context" in the ISO risk management process is an important point for risk management. Before risk assessment, it is important to well consider the purpose of using damage assumption. It is also important to think about how to assume hazards that we think are appropriate for that purpose. Hazard assumptions and risk assessments are current themes for research in the fields of science and engineering. People tend to think that it is better to increase accuracy of assumption and assessment. In the keynote speech, the number of completely destroyed buildings in the northern Osaka earthquake was estimated to be between 0 and 1,000. Researchers want to bring their damage assumptions closer to the actual damage, but things do not work that way. I understand that debates are going around about whether estimation is more accurate or less accurate, but I think it is important for us as users to think about whether such debate itself is correct.

We need to have a lot of discussions with experts for tsunami to think about what kind of simulation we need to do, and with reference to the ISO risk management process I mentioned first, it is natural that the method of assessing risks to protect lives and, for example, risk assessment methods for insurance, are different. It is important to firmly consider that hazard assessment should be appropriately selected according to individual purposes to use it. For example, some people say that the figures are different between Osaka Prefecture's damage estimate and the government's damage estimate of damage, which is a problem. This is not a rare case. The objective of the government's damage assumption is to examine in a unified manner where bigger damage may be caused. On the other hand, Osaka Prefecture implements damage assumption to identify necessary measures to be taken. It is important to recognize the difference in their approaches.

Now I will touch on the multiplex presentation system for information about damage by tsunami. There are many types of approaches to simulate tsunami. This material shows the result of simulation conducted for around four thousand times as a frequency distribution. After the simulation is executed for four thousand times, the levels of disasters consist of five hundred times, eight hundred times, or one thousand times. If someone asks me which is correct, then, I would answer that any of them would be possible. This type of understanding is important when you access information.

As the material shows, we told the residents to decide hazards they need to consider for a reconstruction plan for their town by themselves. Importantly, because this hazard simulation is differently applied according to purposes, for example, it is necessary to differentiate the simulation to plan a post-disaster reconstruction from simulation that protects people’s lives. In the past, calculation for simulation required lots of time and resource, and not many data could be shared. I feel that all possible patterns should be shared for this type of hazard simulation in the future.

We are working on the same initiative for earthquakes. For earthquakes, there are various opinions among researchers, as you heard in the keynote speech. It was decided to combine all the elements including location of earthquake, model of earthquake occurrence, influence to the engineering base surface, and influence of surface ground. It is important to consider that damage assumption by a local government is one of the tens of thousands of combinations, and what it really means.

This information can be shared on the screen only since it is still being calculated and not included in the material handed out. For example, if simulation with the seismic intensity of seven is carried out 10,000 times for Kochi Prefecture, you can tell that compared to Uemachi-daichi, other areas would go through ground motion twice as big. I do not really want to take a look at the possibility for Osaka. Speaking of damage to buildings, you can tell which buildings are more or less vulnerable to ground motion. Rather than probability, I believe that people would feel more realistic fear if they are told that a building will be destroyed for 2,500 times in 10,000-time simulation. This type of representation is also important, and as Mr. Fujiwara of the National Research Institute for Earth Science and Disaster Resilience said, since the Great Hanshin-Awaji Earthquake, various researches have been conducted, and I feel that it is important how to share and use their results. In a nutshell, I believe that changes have to be made in such a way that hazard simulation or risk assessment will be selected depending on their applications. This is all my presentation.

"Political Issues of Parametric Disaster Insurance"

Mr. Shingo Nagamatsu

Professor, Faculty of Social Safety Sciences, Kansai University

Manger & Research Fellow, Disaster Resilience Research Division, National Research Institute for Earth Science and Disaster Resilience

Specialty: Public policy (disaster prevention, mitigation, crisis management), regional economic reconstruction. Graduated from the Department of Political Science, Faculty of Law, Chuo University, and received a Ph.D. in International Public Policy from Osaka University. After working as a researcher at the Center for the Future of Human and Disaster Prevention and a Research Fellow at the Institute of Science and Technology for Disaster Prevention, he assumed his current position. In 2015, he was a visiting researcher at the Price School of Public Policy at the University of Southern California, where he was engaged in research on disaster recovery. His major works are "Introduction to Disaster Reduction Policy Theory." In 2009, he received the Japan Society of Public Policy Award.

※You can download the materials for his speech at the web site (link).

Hello everyone, I am Nagamatsu. I was introduced as a faculty member of Kansai University, and after I received a request to be one of the presenters at this forum, I decided to serve as the head of the Disaster Process Research Division of the National Research Institute for Earth Science and Disaster Resilience and Science and Technology, as well as a faculty member of the university. It's still a new department, so I don't have anything to share as an accomplishment at the moment, so today I would like to talk to you as a faculty member of Kansai University.

I have prepared a presentation on parametric disaster insurance, and I would like to talk about what parametric disaster insurance is, share some supplemental information.

As I mentioned in the previous forum, you already know about the current situation, that is, Japan is facing significant catastrophic risks, including the Nankai Trough Earthquake.

For this situation, a term, "protection gap", is used. That is, the protection gap refers to the difference between how much damage is insured and expected damage. In fact, a recent study has revealed that Japan has the third largest protection gap in the world in terms of the ratios of the GDP. By the way, the Philippines is in the first place is, Taiwan is in the second place, and Japan is in the third place, followed by Chile and Indonesia. Looking at this, Japan is in a place that she does not deserve at all as a developed nation. Another problem in this situation is that the government's financial responsibility in the event of a disaster is increasing rapidly.

For example, there is a program called "Financial Aid for Reconstructing Livelihoods of Disaster Victims" which was not available at the time of the Great Hanshin-Awaji Earthquake. There had never been a system called group subsidy to support private companies, and it was launched after the Great East Japan Earthquake in 2011. In addition, more of earthquake insurance is owned by the government who now takes more disaster risks.

However, no special fund has been allocated for this, and it can be said that the government issues more government bonds and raises funds after disasters have happened.

This will cause a lot of problems. One of them is political interventions that happen around funds collected after disasters, which is often addressed. In addition, such fund is not always used for efficient reconstruction. For example, although a community was relocated to a hill, there are few residents, or the most land is vacant, which is often seen in areas damaged by disasters. It is also often suggested that such a case hinders private incentives such as advanced measures for disaster prevention. Therefore, I raised the issue at the last forum that there were great questions about the sustainability of Japan's disaster risk financing system.

It is important to transfer the risk of disaster utilizing insurance. In the recent years, various studies have shown that there is a function can be leveraged to reduce risk, increase resilience, and promote a society that can recover quickly by better using this disaster insurance in the world.

Dr. Saminsky of London School of Economics has also published a research on the spread of risk maps created for insurance purposes in Germany, resulting in fewer houses built in high-risk areas. He also points out that insurance is not always sufficiently functional and has a damage mitigation effect, and there is still room for improvement.

Much more interestingly, business interruption insurance is available. This is also called BI insurance to compensate for business losses and loss of sales due to disasters, and in New Zealand, there are studies that the more companies that have BI insurance policies, the more productive they are in the reconstruction. It has been also suggested that their profit structures tend to improve.

Although it is not written in the document, the research paper also points out that the earlier claim payment is completed, the more effective improvement will be. This suggests that the prompt payment of insurance claims is also a very important factor in order to increase resilience.

It is a traditional way of insurance to appraise individual damage one by one and pay insurance claims according to loss levels, while in parametric insurance, for example, for a particular location, claims will be automatically paid for earthquakes with a certain seismic intensity or for a certain amount of rain. This is a way to decide claim payment based on some external conditions. As Mr. Hattori of AIG already mentioned in his report last year, traditional insurance has several problems. One of the most known problems is moral hazard. After buying insurance products, people feel safe and will not take measures to reduce damage. Or what is called adverse selection is a problem where people with higher risks are more likely to buy insurance to cover their risks. In the case of corporate insurance products in particular, there are some traditional problems such as higher cost because their coverages are individually designed in negotiated transactions.

Parametric insurance is expected to solve such insurance problems up to a significant degree. For example, there is no way for the moral hazard to occur because claims are paid upon a certain external force. Since there is no need to assess losses, it is expected that claims can be paid quickly. In particular, the decline in transaction costs is highly expected as a method of reducing poverty in developing countries. On the other hand, even if damage occurred, and a trigger does not meet predefined conditions, claims will not be paid, or vice versa. This is called basis risk, which is a big challenge. Also, there are technical challenges in setting triggers for events such as the Nankai Trough Mega Earthquake.

There are discussions that this can be used in developed countries though it is used and evolving developing countries. As Mr. Fujiwara said in his keynote speech, Japan has information and technologies related to various disasters, so this may reduce basis risk. Political benefits include BI insurance, which can expand the market by developing cheaper insurance products, eliminate moral hazards, or compensate for business losses. There is also a debate that parametric insurance is effective because BI insurance is difficult to assess actual damage in the first place.

Lastly, when a researcher compared the demand for real-life traditional insurance that covers actual loss and parametric insurance for flood insurance in Germany, it was found that the demand for parametric insurance was actually quite small. It can be said that this is a discussion point about the problem of parametric disaster insurance in Japan. This is due to the problem of the basis risk. In other words, it is pointed out that people try to stay away from such problems or a case that their claims are not paid regardless of their insurance policies.

Although it is not limited to parametric insurance, there are studies that show various government reconstruction initiatives reducing insurance demand. Another important thing is that parametric insurance is widespread in developing countries, while there are various alternative financing mechanisms in Japan. In such a situation, it is necessary to think calmly about how far parametric insurance meets people's needs.

Because of time constraints, I'd like to finish my presentation. Thank you for your attention.

"Utilization of disaster simulation technology"

Mr. Takeshi Sato

Manager, Public Project Design & Marketing Department, KOZO KEIKAKU ENGINIEERING Inc.

He graduated from the Department of Precision Engineering, Faculty of Engineering, Kyoto University, and the Department of Architecture, Faculty of Engineering, Tokyo Metropolitan University, and joined the Structural Planning Research Institute in 1999. From 2000 to 2004, he was engaged in research on the improvement of seismic resistance of bridges as a research student at the University of Tsukuba's Shoji research seminar. After working for structural analysis, data analysis, and as a simulation engineer, he led the public marketing department with a focus on disaster prevention since 2015.

※You can download the materials for his speech at the web site (link).

I am Sato from KOZO KEIKAKU ENGINIEERING Inc. Mr. Fujiwara and Prof. Maki talked about disaster simulation technology, and I would like to focus on how private companies use such technology.

First of all, I would like to introduce my company. Its name is KOZO KEIKAKU ENGINIEERING, the Structural Planning Institute in English, but it is a corporation. The company is headquartered in Nakano, Tokyo, with a total of less than 600 employees, with sales of approximately twelve billion yen. This year, it is sixty years anniversary since it was established. Our business is to simulate engineering knowledge on a computer, analyze data, and use it for forecasting. We have been working on disaster prevention for a long time. Today, I would like to focus on simulation of disaster prevention and introduce some examples.

First of all, as Prof. Maki addressed, disaster simulation is a large-scale disaster experiment conducted on a computer. Because it is not possible to actually experiment with disasters, we simulate them on computers and think about what need to be done. As Prof. Maki said that the result of simulation might or might not come true, if some preconditions are changed, the results may change significantly. I think it is necessary to consider such factors to conduct simulations.

The advantages of simulation are that; it can be tried many times and based on various conditions. Therefore, rather than the result becoming true or not, I believe that the purpose of simulation is to understand, for example, fatal events and average events, and to effectively examine countermeasures for those events.

Disaster simulation is integration of various technologies. As described on Page 6, there are three components of the simulation. The first is a simulation of the natural phenomenon itself. It is about how earthquake or tsunami occurs analyzed in the physical simulation. The next target of simulation is artificial structures. This means that simulation is conducted to understand how structures would be physically affected and mechanically broken. Lastly, people and their society need to be in the scope of simulation. It is also necessary to simulate how human consciousness is affected and how their behavior is affected. I think that it is very important to consider the entire disaster simulation by combining simulations with different technologies and theories to monitor their interactions.

Actual application of the simulation can be categorized into three groups as page 7 shows. Looking at each case, the first is the study of disaster prevention plans. It can be the most orthodox one. If you actually look at the simulation, you can put seismic waves in the building and compare before and after seismic implementation. On the screen, the seismic wave of Kobe is entered, and the building before earthquake resistance implementation shakes like this and collapses. Then, where to reinforce the building is considered so that it will not collapse. The video on the right shows reinforcement with a damper; and it can be calculated on the computer and demonstrate that the building will not collapse if the vibration damper is installed in a certain way. Let's take a look at the case where people's decisions are also put into this. Page 9 is about a simulation of tsunami damage in a certain area. A tsunami comes and hits and goes over a breakwater, and people evacuate. The points turning red are people who have been attacked. Then, how to escape and how the damage will change are simulated. The previous simulation is only for evacuation by walk, and the next simulation is about evacuation by car. You can see that there is a traffic jam and cars are being damaged while they are stuck in a traffic jam. Now, if you add evacuation by bicycle, you'll see that there's no traffic jam and less damage.

Next, I want to show you simulation for education and awareness. If you actually look at the simulation I showed you to visualize the situation, you will understand more and feel the seriousness of the matter. Here are some examples. This is ground motion from an earthquake of long frequency. There is a big earthquake in the distance, and while its wave is propagating, only the seismic wave of a long frequency remains and normal buildings are not much affected, but the upper floors of the structural buildings continue to shake greatly. Even if you understand it as knowledge, I think that it is difficult to image. This simulation shows the state of the upper floor a high-rise building when ground motion of long frequency is added. We actually put in a physical model and enter the coefficient of friction of chairs and desks. At first, it a bit shakes, and then resonates, and eventually the fixtures in the building are smashed and likely to crush people. Giving this kind of fear is one of the functions that simulation can provide to make observers understand that they could be directly involved in disasters.

When I showed this simulation to Prof. Tatano, he suggested that it can be done with AR (augmented reality). So, we demonstrated a pulse wave of a long frequency using AR in NHK Special. I don't have much time today, so I'll omit it, but these technologies are also developed.

The third point is a simulation using real-time information that was also featured in today's keynote speech. This is an idea to simulate in real time, to understand the situation, and to predict the consequence. Simulation is done based on the actual information that have been sensed and collected at the time of the disaster, so please think that the accuracy will be increasing over time. Based on the results of seismic waves measured using seismic intensity meters spread throughout the country, seismic intensity distribution is clarified. There is a case that we have implemented with the cooperation of the National Research Institute for Earth Science and Disaster Resilience. This is explained in the case on page 14. This is a case of a company that started simulation with our support. They are a major manufacturing company, and they manage their domestic supply chain with approximately seven thousand companies as up to the fifth suppliers in a database. In the event of the Great East Japan Earthquake, it took a month for them to understand the damage caused to the seven thousand companies. After they had called all of the suppliers, they requested us to develop a new way to understand damage. All the addresses of the seven thousand companies are available, and if an earthquake occurs, the seismic intensity distribution is received, internal calculations are performed, and the estimated damage for each location is calculated. The companies can be listed in the order of levels of estimated damage. They then largely improved the speed to confirm damage. It was also used for the Kumamoto Earthquake and the Eastern Iburi Earthquake in Hokkaido. It was reported that they had completely confirmed the damage within one or two days.

I predict that more private companies will conduct simulation in such a format in the future. In addition, the supply chain also needs information on the statuses of damaged roads connecting business-to-business logistics. This is page 15. Page 16 is a case in which the traffic results are provided based on the probe data from Toyota, and the data on traversability has been published.

Page 17 is about real-time flood information. This is a river water level estimation using AI, and the water level six hours later is predicted using real data. On the graphic, the red line shows the water level forecast. I believe that it will be important to use this kind of real data to implement disaster countermeasures in the future.

As a wrap-up of what I have shared with you so far, various simulations are now available, and as Prof. Maki mentioned, rather than looking at the results of the simulation as it is, how to judge the results according to the purpose should be well understood because that is most important. It is now time for me to finish my part. Thank you very much.

Panel Discussion

※You can download the materials for his speech at the web site (link).

AIG INSTITUTE: Now we will hold a panel discussion for the next hour. Let me use a PowerPoint presentation. The first slide is the summary of the speeches and presentations so far and identifies points for the panel discussion. The top of the slide illustrates the risk management process, and the bottom of the slide shows the corresponding disaster prevention technologies. I believe that it is a challenge of how the insurance industry will utilize the risk prediction, such as the hazard map before disaster, and the real-time damage estimation after the disaster. Based on this challenge, I would like to develop our panel discussion.

The first theme was the financial risk that Prof. Nagamatsu touched on. This was the theme of last year's AIG Institute Forum. The possibility of causing financial risks was mentioned because the damage assumptions of the Nankai Trough earthquake are so large. In 2018, it became clear that financial risks could be caused in disasters closer to the society.

This is shown on page 3. On the left is the assumption of damage from the Arakawa River flood. The area of the Arakawa basin is about 3,000 k ㎡, and the estimated rainfall causing the flood is 632 mm in seventy-two hours. On the right is rainfall record in the heavy rain in western Japan, and there are twelve points in the country that exceeded the expected rainfall of the Arakawa River floods, and this document showed that it rained extensively. On the other hand, the Arakawa basin is 50 k ㎡ square, and you can see that it fits perfectly into the rainy area in the heavy rain in western Japan. If the amount of the heavy rain in western Japan were caused in Saitama, there is a possibility of triggering the Arakawa River flood. The economic damage caused by the Arakawa River flood is estimated as sixty-two trillion yen, according to a report published last year by the Japan Society of Civil Engineers.

This is a scenario of a catastrophe that could directly affect our society, and it would be helpful if Prof. Maki and Prof. Nagamatsu could comment on last year's disaster. Prof. Maki, what do you think?

Prof. Maki: Yes. In terms of last year's major disasters in Kansai region, there were three disasters: the northern Osaka earthquake, the summer heavy rain disaster, and Typhoon No. 21. First of all, in the northern Osaka earthquake, the problem of people being stuck in elevators gave a huge impact as often said. Another thing I can say about the insurance industry is that the amount of claim payments was very large.

Kansai Airport was damaged by Typhoon No. 21. It's not well known, but there's a problem of disconnected communication in the airport because of the Internet outage. Tsunami needs to be additional consideration for preparation for the Nankai Trough earthquake; therefore, I believe that we need to think about measures against flood damage and ground motion by earthquake.

Another point is that, Kansai Airport did not function, and foreign visitors went to Narita Airport by a Shinkansen. In the case of the Nankai Trough earthquake, you will not be able to take a Shinkansen to Narita Airport. I think this kind of problem is very serious.

AIG INSTITUTE: Thank you very much. Prof. Nagamatsu, what about you?

Prof. Nagamatsu: :As Prof. Maki has said, the water level of the Yodogawa River rose considerably during Typhoon No. 21. As many of you know, the embankment of the Yodogawa River is cut off at the intersection of National Route 2, but since the water level came to a height beyond the bridge, the floodgates were closed to prevent flooding. The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) took the planned measures promptly. On the other hand, no alerts or instructions for evacuation were provided, which makes me wonder if appropriate actions had been really taken. In case if the floodgates had not been closed or it had taken too much time to close it, I think that it was a disaster that would have turned Osaka city completely flooded.

AIG INSTITUTE: Thank you, Prof. Nagamatsu. On the hazard map of Edogawa-ku, a slogan, "You can't stay here", is highlighted, getting attentions, and the next slide is about the comparison between the hazard map and the actual damage. The MLIT quotes a material to look back on last year's disasters. According to their material, the flood damage in Kibi-cho, Okayama Prefecture, is almost the same as the actual flooding range of the hazard map. The same is true for sediment disasters, and according to the review by the MLIT, the disaster actually occurred in the place where it had been predicted to occur. On the other hand, a survey released by the University of Yamanashi last October shows that the population and number of households included in the hazard maps have increased over the past twenty years. The purpose of hazard maps is to warn that we should not live in dangerous areas as suggested by advanced science, but the actual situation does not follow. I would like to ask the speakers about scientific approaches to disasters. So, Mr. Fujiwara, what do you think about such a regrettable case?

Mr. Fujiwara: I have been involved in making hazard maps for the country for nearly twenty years. Hazard maps are created using hazard prediction techniques to reflect disasters that have occurred repeatedly in the past. While accuracy is definitely improving, the uncertainty of technology to predict the likelihood of unexpected disasters that have not been experienced is still very high. I feel we need to discuss how to handle and use epistemological uncertainty.

AIG INSTITUTE: Prof. Maki and Mr. Sato said that the purpose of the simulation should be clarified, and I have a question for you, Prof. Maki. Private companies feel that they are not making full use of simulation. Can you tell us if you have any tips or ideas for private companies how to use?

Prof. Maki: For example, during large-scale development, you may be asked if fifty centimeters as flood depth is enough. In this case, the resolution should be increased according to the purpose. For example, it is necessary to simulate in detail after deciding the level of protecting buildings, how to protect buildings from any levels of floods, or acceptance of minor floods. Hazard maps created by the government assume the worst scenarios to protect people's lives, so I think it is important to know how much private companies will increase the granularity of their assumptions.

I could give you an analogy. According to the result of your medical check-up, it is written that even if your life is highly risked due to high blood pressure, and you have to go through a detailed inspection. It would be necessary to look at the hazard map from the administration first, and then carry out a detailed inspection. I also feel that it is necessary to request various detailed simulations to the KOZO KEIKAKU ENGINIEERING Inc., for example. Hazard maps are general information, and if companies are going to plan measures by themselves, it is effective to thoroughly simulate scenarios according to the levels of such measures.

AIG INSTITUTE: Thank you very much. Next, I would like to ask Prof. Nagamatsu about how evacuation should be planned. There was a discussion about the disaster in 2018, and it would be helpful if you could comment on this.

Prof. Nagamatsu: ： For example, evacuation from large-scale floods should be prepared for quite some time in advance, and I think we need to think about it differently. In this context, it is rather important to talk about evacuation which quickly protects lives, while land use has a different context, therefore, I believe that and a hazard map for promoting evacuation should be differently considered from restricting residence. The long-term probability for residential areas is important, and in my presentation today, the risk map was referred to for decisions on residences, and in Germany and the United Kingdom, by utilizing that risk map for insurance, there have been some cases of success in reducing the population of people living in hazardous areas. I think that if the risk map is linked to insurance, and the insurance premiums change, people's perspectives will change. It would be better to think about how it would be used as a system and in the structure of society, rather than relying on people's awareness.

AIG INSTITUTE: Thank you very much. Next, Mr. Sato, in your presentation, you showed a water level prediction. I feel that we can use that water level prediction for evacuation. How do you think?

Mr. Sato: With regard to the water level prediction technology, it has improved considerably over the past few years. The problem is that the water level is not measured in many locations yet. Large Class-A rivers such as the Arakawa River are measured by the MLIT. The rivers which have caused great damage in recent years are Class B rivers in regions with small populations in the mountainous area. A challenge is that there is no water level meter in such rivers, while their situations still have to be captured. Last year, the MLIT launched an initiative to install crisis management-type water level gauges at 5,000 locations, and I think that the number will gradually increase in the future. Measurement should be done first, and the next step is to use the result of measurement for prediction.

AIG INSTITUTE: So, your company is proving water level prediction?

Mr. Sato: Yes, it is being proved in about fifteen places. Quite a few local governments introduced it in the first half of 2018, and certain results have been achieved by local governments that used it in various occasions during heavy rains.

AIG INSTITUTE: So far, the discussions were about risk assessment and hazard assessment, and now I would like to talk a little about finance, which is our role as an insurance company. This document explains the background of a theme from SDGs perspective. Specific actions were announced in June, last year regarding the SDGs' goal 11 (building a city where people can continue to live). This is a joint effort presented by the United Nations, the insurance industry, and the ICLEI, a community of 1,500 cities around the world. About twenty cities in Japan, as well as Tokyo, Aichi, and Kyoto Prefectures, participate in ICLEI. These three parties have their action goals from 1 to 10, including parametric insurance, presented by Prof. Nagamatsu, and will contribute to the realization of a sustainable society through the development of innovative insurance. Another finance I would like to cover today is resilience bond. As Prof. Nagamatsu mentioned at last year's forum, it combines the function of risk transfer with financial resources for disaster prevention infrastructure. Firstly, I would like to talk about parametric insurance. Page 6 is a reference to this insurance compared to traditional insurance. For example, in the case of an earthquake, the first step is to decide that ten million yen will be paid for a claim for the seismic intensity of 7 at a specific point. The amount of claim is determined according to the degree of seismic intensity at a particular point. Therefore, loss assessment is not required in principle. Loss assessment usually takes a

long period of time, but it is possible to pay insurance claims quickly.
On the other hand, the disadvantage is basis risk. Prof. Nagamatsu also mentioned that parametric insurance allows payment of a predetermined amount, and there would be a gap between the paid amount and the actual loss. Minimizing this gap is a major challenge in developing parametric insurance. In developed countries, there are many types of data that are candidates for parameters, so I think we could some solutions.

I would like to ask for your opinions. First, it's about technology. Mr. Fujiwara, for housing and data, the housing performance indication system has begun and a lot of data has been collected. Major house manufacturers have detailed information such as ground and structural calculations. In addition, in the E-Defense, which the National Institute of Science and Technology for Disaster Prevention has, buildings are created and earthquake sensors are installed for experiments to prove how damage to buildings can be estimated. There will be a very large amount of data, and I think that if you use it, you can apply the concept of risk subdivision in earthquake insurance. Mr. Fujiwara, what is your view about this?

Mr. Fujiwara: First of all, I think that sensing technology is making great progress, and in the near future, sensors will be installed in individual buildings, and the degree of damage based on them can be objectively and quantitatively evaluated. Technically, it has been accumulated quite a lot. For nearly a decade at the National Research Institute for Earth Science and Disaster Resilience, house manufacturers and E-Defense teams have been working on establishing these technologies. The results are becoming available. Ground information and hazard information are more accumulated over time, and I feel that it is becoming possible to provide very finely differentiated insurance. But, as localization of hazards, In other words, the uncertainty about places with and without very high risks is not so high, therefore, investigation will make the levels of such high risks visible; there may be situations where the insurance system does not work. I feel that things are not so simple.

I have a lot of information, so I have a hard time making a decision. Sometimes it is difficult to collaborate with a certain initiative. For example, you can tell if a certain person is vulnerable to a type of disease by examining this person’s gene, and more than that, you can gain almost 100% certainties because people have been too ignorant about natural phenomena. With this in mind, I am very interested in how to incorporate this into new insurance.

AIG INSTITUTE: Thank you very much. Let me ask Prof. Nagamatsu. Parametric insurance has been mentioned as having a very large room to adopt disaster prevention technology, and it was pointed out that it is necessary to verify whether there is a demand for this insurance. On the other hand, it was pointed out that Japan has a low penetration rate of insurance and a large protection gap. Is there a way to use parametric insurance to reduce such gap?

Prof. Nagamatsu: : I've got two pretty big questions. Before answering them, I would like to tell you that Mr. Fujiwara's story was very interesting. It is certain that each house has its own risk, which makes insurance dysfunctional. On the other hand, if risks are indicated in insurance and reflected in specific premium amounts, then, building a house on a safer location could be a reasonable choice for many people. I felt that insurance was not just about protecting people's lives, but also as a potential tool for inducing people's rational behavior. While I was listening to his presentation, I thought that such insurance would have a great potential for disaster prevention in the future.

Now I would like to answer the questions I received from AIG Institute. Regarding the possibility for parametric insurance to be used as earthquake insurance, I feel that the benefit of parametric insurance is mostly to reduce transaction costs. For example, in developing countries, when designing a small amount of micro insurance, even if it is a small amount of insurance that cannot be achieved because the transaction cost is high in the case of conventional insurance; I think that there is a room for parametric insurance to be applied. The premium for an earthquake insurance policy should be less than a half of that for a fire insurance policy. For example, an insurance policy whose premium is around one-tenth to allow living for a certain period of time should be parametric insurance to ensure profitability. I think that this is valid application. On the other hand, if you try to apply parametric insurance as an expensive insurance, there is a problem of basis risk. So, it is difficult to figure out how much parametric insurance would be demanded.

Another question about the use of parametric insurance to close the protection gap could be answered like this. I don't know if it should be called a protection gap, but reputational damage always occurs after a major disaster. It is said that the basis risk of parametric insurance is a disadvantage, but I feel that parametric insurance can be applied when it is difficult to measure the presence or absence of reputational damage and such reputational damage cannot be covered by conventional insurance. The actual situation is difficult to know, and it's hard to catch media reports that trigger reputational damage.

For example, a hot spring town at the foot of a volcano may lose tourists more than necessary, if it erupts. I feel that there is a need for parametric insurance with eruption as a parameter from adjacent hot spring towns. This can be called application of loss of profit insurance. This type of insurance has a more space for development.

AIG INSTITUTE: I feel that business interruption insurance is rarely popular in Japan and is closely related to the challenges of the protection gap. Now I would like to ask a person who is involved in the practice for a comment. Mr. Hiraga, President of the Japan Insurance Brokers Association, who was not able to attend last year's forum, is here today. I would like to hear from Mr. Hiraga, who is familiar with the practice of insurance, about how to use this parametric insurance, focusing on business interruption insurance. Mr. Hiraga, please come over to the stage.

Mr. Hiraga:

Nice to meet you, everyone. I am Hiraga. I could not come to the forum last year because of the flu, and I would like to apologize. The stories of the speakers so far were very interesting. I'll share with you some of the things I've noticed. Insurance brokers will negotiate with insurance companies from the customer's standpoint, and I would like to briefly talk about the fact that parametric insurance is not spreading so much.

First of all, from the perspective of policyholders, parametric insurance is not yet well known and there is no deep understanding, either. As Professor Nagamatsu pointed out, I think companies have a fear of basis risk. I found that some companies had a fear of not being able to get their claims paid after their purchase. This means that they feel traditional insurance will be much safer. Parametric insurance is a better option in terms of immediate claim payments. Traditional insurance is generally to cover actual losses, so there are many cases where it takes lots of time to investigate losses.

Looking at the current situation from the standpoint of insurance companies, Japanese non-life insurance companies have already sold and provided insurance similar to parametric insurance. After a disaster, claims are paid as a provisional payment, and after loss investigation, the claims paid provisionally are adjusted. Although the name of parametric insurance is not known by policyholders, it is also true those insurance products that can be regarded as parametric insurance is actually in the Japanese market.

In addition, the word, parametric, is likely to give an impression that parametric insurance products are in the same group as derivative products such as CDS, swap, or derivative which used to be popular at the time of financial crisis, and that is why people stay away from it.

Also, when it comes to derivatives, it is not insurance, so it must be included in the business report, and there are cases where it is necessary to give explanations to shareholders and investors. Those who purchase insurance products have problems of awareness and recognition. In many companies, the General Affairs Department that manages fixed assets is in charge of insurance, and it seems that they are more likely to focus on properties. I think it's hard to think of it as a compensation for cash flow. It is not easy to appeal for risks during business interruptions across departments, i.e. lost profits and the need for their insurance (profit/business interruption insurance).

There is also a problem of awareness of disasters. I think that awareness of earthquake risk has been diminishing, especially in the Tokyo metropolitan area. Eight years have passed since the Great East Japan Earthquake in 2011. A number of measures are being carried out, such as seismic inspection of buildings and seismic retrofitting. People tend to think that because their buildings are now earthquake-resistant, they strongly feel that measures have been already made, which I would not call conceit or overconfidence.

Risk control and risk-finance are both sides of risk management, and if you don't turn both well at the same time, the car of risk management won't turn well. In addition to earthquake resistance, it is also necessary to finance residual risks.

As Mr. Fujiwara mentioned earlier, I can see that the environment in which parametric insurance forms is technically advancing, and I feel that it is possible to overcome the basis risk technically.

Although it is said that parametric insurance is not broadly available yet, I have experienced as an agency deals with billions of yen or more of parametric insurance. Demands for parametric insurance are surely emerging. I would like to tell you that it still has a more space for full growth. Thank you very much.

AIG INSTITUTE: Thank you, Mr. Hiraga. It may be called a problem of literacy, or the low spread of loss of profit insurance may be derived from insurance companies cannot properly communicate. We need to figure out how we could resolve this problem around parametric insurance. In September last year, a report of parametric insurance was uploaded on our website, so if you are interested, please take a look.

Next, I will talk about the financial resources of disaster prevention infrastructure. The resilience bond was mentioned in relation to the United Nations SDGs. This is a financing method for the financial resources of disaster prevention infrastructure. And reviewed by the financial industry, local cities, and specialized agencies that quantify risk mainly in the United States. Talking about financial sources of disaster prevention infrastructure in local governments, after a disaster, financial resources are contributed from the central government for recovery, but, there is no subsidy from the central government for reinforcement before disasters, and therefore, local governments must raise money on its own before disasters. This is the same situation in both Japan and the United States. However, the United States discusses quite actively with the intelligence of the private sector, which is different from Japan. In summary, the idea is to obtain financial resources from people who benefit from disaster prevention infrastructure. It is the government that provides public assistance after a disaster, public facilities, local businesses and residents, and insurance companies who receive benefit. It is being debated in the United States that infrastructure funds should be recovered from those who enjoy these benefits. There is an idea that the shift to renewable energy can lower electricity charges, and there is an argument that if we strengthen our disaster prevention infrastructure, we can apply it to lower insurance premiums.

We would like to ask the speakers. First of all, Prof. Maki, I understand that in Japan, the contribution of regional revitalization area management is similar to the initiatives in the United States. Please give us your opinion on how to use it.

Prof. Maki: Before I answer, I remembered while I was listening to Mr. Hiraga that I thought Kansai Airport would go into deficit, but, actually it went to surplus this year. I heard that it is covered by insurance. It is necessary to understand that such damage is covered by insurance. Next, I would like to answer your question. My answer is that, taking Grand Front Osaka building as an example, you may consider initiatives can be designed in town management to take measures to prevent disasters and the spread of damage.

As an effect, if the cost required for insurance falls, it will benefit everyone involved. In addition, as mentioned by AIG Institute, we are now able to leverage charges for area management in Japan. As a result, local governments have created mechanisms to prevent free riders to benefit from a particular area, and it is now possible to for stakeholders to gather funds and use them in those areas. This system is in line with the Business Improvement District (BID) in the United States. What we learned in urban planning is a system that increases the value of the community by implementing crime prevention measures and making it a safe town. If the same thing is considered for disaster prevention, a mechanism could be implemented to encourage people to actively invest since this area has implemented disaster prevention measures.

In addition, if there is a mechanism to lower the insurance premiums in the region, there would be an additional effect. For example, each of the underground shopping districts in Osaka is managed by different parties. There is no point in taking measures against flooding by only one company. It is very important to make a plan for an entire area. Instead of relying on the administration, the parties involved in the underground area should work together. If we can create a system that lowers insurance premiums by implementing disaster prevention measures, I think the framework of BID will function well.

AIG INSTITUTE: Thank you very much. Next, Prof. Nagamatsu, I would appreciate it if you could supplement the discussion about the United States on this point.

Prof. Nagamatsu: : First of all, I had never heard of Kansai airport's story. I thought that the cases in foreign countries were very interesting, but it might be an appropriate idea to directly implement them in Japan because the fiscal systems are completely different. Especially in the United States, such infrastructure has been much privatized; for example, according to the concession system, the operation of infrastructure is managed by private companies. In Japan, there is a plan to implement it for the water supply business in the future, but it will be managed by private companies. Financial services in the event of a disaster will also be planned by private companies. Insurance comes as an option, but in the case of public assets held by local governments, the idea of choosing insurance is hard to come up with. I think that's because it's cheaper to issue municipal bonds after the fact.

Most local governments in the United States are extremely demanding for financial balance of payments, which makes loan difficult for them. There seems to be a limit on the amount of local bonds issued. This is one of the factors driving insurance. As for how it could be spread in Japan, I think that the fiscal system of Japan which is relatively undisciplined will also be considered.

AIG INSTITUTE: Thank you very much. I am interested in this field, and I would like to actively investigate discussions in the United States and disseminate them in the future. We have limited time, so we will move on to the BCP as the next theme.

From the perspective of BCP, we need to think about what will happen to the supply chain; whether their employees are okay; how buildings and manufacturing facilities are affected; how infrastructure and lifelines that support them are; and how they are affected by the infrastructure and lifelines that support them? If you think from the bottom of your company business operation, I think this will be the order of thinking. As you can see on the slide, DHL has published a research report on the risks of cutting the supply chain. Among them, earthquake is regarded as the most impactful risk. The reason is presumed to be that the impact will broadly reach lifelines, infrastructure, etc. Mr. Sato of the KOZO KEIKAKU ENGINIEERING Inc. introduced the system that grasps the damage caused by the earthquake of 7,000 supply chain companies in real time. Can this system be used not only after a disaster, but also for pre-disaster assumptions? The intention is whether it can be used to formulate BCPs before a disaster.

Mr. Sato: It can. It is included as a function. For example, it is used to which parties of the supply chain will be damaged at the same time; tell if an earthquake occurs as a scenario of the Nankai Trough. And if they are highly likely to be damaged at the same time, then, alternative measures can be reviewed.

AIG INSTITUTE: The supply chain will become more visible and it will be possible to develop alternatives in line with the scenario. Could you share your idea regarding the cost of building such a system?

Mr. Sato: If such a mechanism is demonstrated, many companies will be interested in it. However, there are many cases where their supplier information is not managed. The customers in today's case have very good ways to manage such information. They manage their suppliers up to the fifth suppliers by product in a tree form. It is easy to build a system with well managed information; but most companies capture information up to their primary suppliers; a half of them know about their second suppliers; none of them knows their third or later suppliers. For such companies, it is very difficult to measure the degree of its effect. Based on these factors, in the case where information is properly managed, a basic system could be constructed with ten through twenty-five million yen. The cost of the example introduced today cost double or three times bigger. However, I feel that the cost will be lowered by using the results of SIP as introduced in Mr. Fujiwara's keynote speech. This is because we basically designed the system before the SIP results were achieved.

AIG INSTITUTE: Thank you very much. I would like to ask Mr. Sato one more point. You explained the simulation of the shaking of long-period ground motions in high-rise buildings. Is it possible to apply that simulation to plants and reproduce the shaking caused by the earthquake? Or has it actually been reproduced?

Mr. Sato: Related to the previous statement by Mr. Hiraga, when thinking about BCP at a company, many people say that they will be fine because seismic reinforcement is carried out, but this is quite a big mistake. Seismic reinforcement and BCP measures are not equal. The reason is because the seismic reinforcement standard is a standard to show which people in the building should not die, buildings should not collapse and there should be no human damage. BCP is a standard that business continuity can be performed, so there is a big gap here. That's the first one.

Next, even if the buildings are functional, if the equipment is not available, the business cannot be continued. In addition, if employees are not able to commute to work, business cannot continue. Various factors are related to each other in a complex way, and if you cannot clear all of them, you will not be able to continue your business. I think it is very important to confirm whether buildings and facilities are comprehensively all right in such a situation. More companies have been requesting to check earthquake resistance including facilities in their buildings. They have finally become so conscious in the last few years. I hope that such companies will lead and influence other companies.

AIG INSTITUTE: Thank you very much. As the background of this topic, when a major electronics manufacturer was affected by the Kumamoto Earthquake, the facilities in their plants immediately after the disaster were completely damaged. I felt that it was very important to use these simulations to assume what would happen to plants first, not just buildings, but also how the production lines would be affected. Let me continue to talk about BCP. Now I would like to take up the visualization of the supply chain. I'd like to ask Mr. Fujiwara. As far as I understand, in the SIP stage 2, with Nagoya University and Kyoto University's Disaster Prevention Research Institute, visualization of the supply chain and capturing bottlenecks are making progress. After five years of the research, how much is it likely that this supply chain will be visualized?

Mr. Fujiwara: The SIP stage 2 has just begun, and we are working on very difficult issues such as estimating economic damage and eliminating bottlenecks, and I am keenly aware of how important it is to work together with the government and the private sectors to overcome economic damage. This is the first year since the project was launched, and the target disaster scenario is about the huge earthquake, the Nankai Trough. To be honest, we are still groping, including issues that are too difficult and almost impossible to solve. I believe that it will be a challenge for the next few years to have many people understands the importance of such research and to think about it, including the creation of a mechanism to support this.

AIG INSTITUTE: Thank you for your comment. This SIP stage 2 is now for an initiative in the Chubu region. I think it is important to consider and discuss in the Kansai area. Prof. Maki, what do you think?

Prof. Maki: The industrial structures are different between the Chubu region and Kansai, and I think that Kansai is more redundant. In other words, the Chubu region is more progressed, which means that the pyramid structure of the industry is solid, therefore, if something goes wrong, the rest could also go wrong all together. Kansai is not unified, and I feel that it is redundant because various people are doing various things. In the case of Kansai, I feel that each company should make great independent attempts and that each company will be stronger.

AIG INSTITUTE: Thank you very much. We are running out of time, so I will pick up a question raised by the audience. This question is to Mr. Fujiwara. You said that five thousand seismometers are not enough and what about the possibility of collaborating with private companies, such as using sensors from gas companies?

Mr. Fujiwara: In the project of the Ministry of Education, Culture, Sports, Science and Technology, it is true that they are reviewing a network of very high-density seismometers that Tokyo Gas has for the metropolitan area. However, private companies have their clear objectives and are operating specifically. To incorporate it into the network in a general way, there are many challenges, such as who will bear the cost and continue to deploy the service. Many seismometers may collect more information, and I feel that the challenge is how to build a way that allows continuous operation to generalize the sensors that the private sector has to fit public objectives.

AIG INSTITUTE: Thank you very much. We couldn't cover all discussion points we had planned, but we need to close this session. Today, we heard from people who are interested in various disaster-related issues. I would be happy if we could share with you tips, ideas, and suggestions on how to implement disaster prevention technology in society. Thank you very much.

AIG総研 English translation prepared as a reference only.

Summary

Mr. Hirokazu Tatano

Professor, Disaster Prevention Research Institute, Kyoto University

Specialty: Disaster prevention economics, planning theory, disaster risk governance. Graduated from the Department of Civil Engineering, Faculty of Engineering, Kyoto University, and received a Ph.D. in Engineering. He has been engaged in research on the method of weighing the effects of disasters on socio-economic systems, and engaged in research on methods and governance for proper planning and management of comprehensive damage mitigation measures. He is the general manager of the World Federation of Disaster Risk Reduction Research Institutes (GADRI), which is attended by 170 organizations

※You can download the materials for his speech at the web site (link).

I am Tatano from the Disaster Prevention Research Institute, Kyoto University. I think you're pretty tired. I'm going to start a general review.

I wanted to summarize what I had learned but I have found it so hard that I gave up before the end. I think that there was a lot of information in this forum. This slide shows some of it. First of all, Mr. Fujiwara and Mr. Sato explained the technical elements that are available now. This is about the real-time earthquake damage estimation, and earthquake should be actually observed to tell what kind of seismic motion was distributed. I think that it is possible to predict in real-time, but there may be differences if both are carried out at the same time. Why is it like that?

Mr. Fujiwara: Basically, we will give priority to the observed facts.

Prof. Tatano: That means you don't have to predict it in real-time, do you?

Mr. Fujiwara: So we use this prediction to fill the gap.

Prof. Tatano: Okay. That's right. First of all, there is an observation, and there is a forecast of the period, and if the forecast is not supported by the observation, the forecast could be wrong. If you make correction based on the result of the observation and run another forecast, then, accuracy will be increased. Look at this. There is also a different way such as downscaling, but statistics alone lack credibility. If you put physical data into it, the mechanism becomes solid and you can get to the level that is more convincing. In that sense, for the last five years, in SIP, more trusted discussions have been held. In the second phase of SIP, the economic impact is going to be discussed. Partially because of a wide-area ripple effect, as an extension, I think that the story of parametric insurance that was discussed earlier or the story of resilience bond, etc. will come out. In order to lead ourselves to such stories, I understood that it is necessary to maintain the same degree of trust and data assimilation technology, and, in short, observation. I think there are some things that we don't know until after the fact as we have already experienced. It is necessary to do a questionnaire survey to pick up the actual voice. I think it's a big challenge.

The important thing for industries is that cash should be secured, which is the same for companies and households. In the event of a disaster, some kind of cash should be secured, and business should continue, and daily living should be able to continue, to which the current technology may contribute. While I was listening to the presentations today, I really hoped that the technology could do more for business and people.

Also, I listened to Mr. Sato's story with excitement about the degree of evolution. I think the problem is that no solutions can be developed without knowing the frequency of the hazard itself. If the frequency is available, I think you can make good use of it. AI and monitoring were addressed today. Again, I think it's important to talk about the frequency. I think it's important to think about it in total, including the surveys that the government is conducting, and what's important for the industry is to make cash accessible, which is the same for companies and households.

Prof. Maki's talk was an interesting approach to how to make use of hazard simulation among a very wide range of policy studies to prepare for the Nankai Trough earthquake. What impressed me the most was that 100% accurate forecast would be impossible. I'd like you to remember this before you leave today.

I think it's important to know if the simulation is the right output for your purpose, not the one that is accurate or not. But this judgment is difficult. It is also true that people expect it accurate. From this perspective, the choice of models is hard and accompanied with many challenges.

Next, the issue of the demand for parametric insurance was raised by Prof. Nagamatsu, and it was shocking because I didn't know the ranking of Japan. The protection gap is the largest in the Philippines and the third largest is Japan. I would like to ask if Japan is a developed country. I understood the lack of earthquake insurance for companies through questionnaire surveys. With insurance, recovery will be certainly faster. With a smaller volume of data, it's not statistically significant, but it's clearly understandable to boost recovery.

Another survey found that liquidity is impaired after a disaster. Why is that type of insurance not so popular? Mr. Hiraga answered earlier that appropriate parties are not approached for sales, this was a blind spot to me. In short, the general affairs department that is a primary role to manage insurance is less interested. Securing the cash flow would not be well understood by other parties than the finance department, which really reflects the voice of the field. Mr. Hiraga also said that risk control and risk financing are two wheels, and I feel that this point has not been understood by companies.

As for infrastructure, if you reduce the risk, the residual risk will be reduced. We need risk financing one step further to deal with the residual risk, but we actually treat it as something we have forgotten, therefore we had a hard time after the disaster. I think it is important how to transfer the residual risk by using insurance.

In this forum, we found that there are a lot of tools available. I got better understanding about where such tools can be utilized. I often hear how they should be used in various places. Some people say that researchers close themselves in the domains they are interested in only, which is called silos, and because they are enclosed in the silos, their research is not useful in many cases. The same thing is said for collaboration to cope with disasters. For example, earthquake disaster risk assessment experts don't think that their role is to make contributions to the entire disaster process.

Projects such as climate change and the SDGs often use words such as Co-design, Co-planning, and Co-development. “Co-“represents researchers and users. This means that research should be designed, and output should be planned with users who use research results. That's the tendency. I think that's probably how SIP that Mr. Fujiwara explained today would work. I believe you've noticed a few things from you have heard today. You've come to think about how your work and products evolve using this. Researchers need your opinions because they want to reflect them to their researches. Therefore, utilizing opportunities like this forum could facilitate networking, and researchers could get better outputs.

In Mr. Fujiwara's speech, there was an explanation of SIP4D. I think that a lot of data will come in here and that it can be used for experimentation.

Many people will want to use it for their experiments, and I am one of them. It is expected that cooperation with the private sector will expand from these existing initiatives. I think this direction will continue to progress in the future.

This time, observations and surveys were discussed. In particular, advanced observational surveys such as seismometers, drones, and satellites were introduced. On the other hand, unexpected things could be detected when we assess damage after a disaster, listen to companies, and listen to the live voices of the people in the field. For example, in loss of profit insurance, it is not easy to prove lost profits. However, if you do not prove it, you will not get your claim paid. So can you prove all the cases of your planned sales? I don't think it's realistically possible. It may affect the foundation of business management.

On the other hand, the parametric insurance that Prof. Nagamatsu took up may not require proof of loss. I think it is also important to conduct on-site surveys to pick up the voices and needs of fields. Such a combination or a mechanism like a cooperative system is necessary.

The network and cooperation of various parties will become more and more important. Especially, today, we are at the Forum of AIG Institute. I would like to keep monitoring how AIG Institute will build such a system. Not only AIG Institute, but also today's participants thought about various combinations of disaster prevention technologies featured today. It's important to have this kind of opportunity. I don't think people at AIG Institute will not allow alliance among people have started in this room.

The future challenges of the organizer of today’s event include, as expressed on the slide at the beginning of the panel discussion, how to incorporate disaster prevention technology into risk finance. Also, it is important to find solutions to close the protection gap that Prof. Nagamatsu raised.

Changing the subject again, in the second phase of Mr. Fujiwara's SIP project, they are working on calculating the estimated economic damage in real-time. At the same time, there is also another research on the model of loss due to ground motion and business suspension. If such efforts so far are integrated, I think we have come to the point where we can achieve certain results. Technology is just around the corner. I feel strongly that even pilots can start to prove it.

And one more thing is that there are two cases of social psychology protection motivation theory: Outcome Expectancy and Self-Efficacy. The former is the significance of implementing measures and projects. The latter is a sense of self-efficacy about its realization. I would like to apply this to evacuation. If you have no option to evacuate, you can't evacuate. If you think this way, it means you lack self-efficacy. The other is about the senior who say that no one will be happy even if they evacuate. I heard about this in an evacuation case last year. This represents a situation where there is no Outcome Expectancy. To give a motivation, for example, through individual evacuation drills, if the elderly is told to evacuate with elementary school students, they will also evacuate. Self-Efficacy, in another sense, is related to the cost of evacuation. Or, it is related to the degree of effort to take actions. In case of cost, it is also related to insurance and disaster financing. Talking about Self-Efficacy, the latter Self-Efficacy is also applied to today's forums. Through today's forum, Self-Efficacy has increased, I believe.

I will stop talking about this not to getting further derailed. My conclusion is that I hope that today's forum will lead us to discussions about what we can start and what we can challenge ourselves for using risk financing. Good case studies were introduced. It would be possible to devise insurance products for households who want to pay small amounts of premium, reputation damage, business interruption loss, and so on. And resilience bond, I think, is also interesting. I think it would be great if we can make contribution for structuring the costs for area management more logically.

The supply chain was also discussed. Not only the building of own plants, but also the damage assumption of the manufacturing facility was addressed. This means that it is necessary to understand fundamental factors. I think the degrees of damage to assets owned by companies depend on the availability of such assets. I think that the degree of recovery of production capacity can also be assumed to be highly accurate If such simulations are carried out in advance, then, I think production recovery and damage can be more accurately assumed.

After all, I feel that discussions about how to take a new step forward are the next challenge or the start of discussions in the future. Thank you very much for your attention.

Remarks

Mr. Hideaki Shishido
Manager, Disaster Prevention Planning, Crisis Management, Osaka Prefectural Government

I am a public servant. Today, I have realized that many new things I discovered today are both same as and different from what the professors and the speakers discovered. One year has been passed since the earthquake in northern Osaka Prefecture on June 18 last year. Last year, I took my current post. Six people have passed away.

The simulation was addressed earlier. In the Northern Osaka Earthquake, eighteen houses were totally destroyed, but the problem that was often discussed by the administration was sixty-five thousand buildings were partially damaged. How to reconstruct the lives of the sufferers was debated. The partial damage of the sixty-five thousand buildings had not been assumed. I realized that the disaster prevention technology can be leveraged to solve such a problem.

In another disaster, Typhoon No. 21, eight people died. They went out despite the storm and fell over or were hit by scattered objects and lost their lives. Personally, and as a public servant, I found many new things. It made me wonder why they had gone out in the storm. In order to protect their lives, I think it would have been better if they had taken actions such as staying indoors until the typhoon passed. In today's forum, raising awareness was discussed. I feel that discussions should be held about how to use technology to pass on information to get as many people as possible to take appropriate actions.

Talking about administrative body, people who are involved in the disaster prevention department in municipalities are having a hard time. In some locations, only two people are assigned to such a role. While people constantly pay attentions to earthquake threats, they are engaged in operations for disaster prevention in an analog manner. It is also true that there are limited things we can do. I feel that if we don't improve the efficiency of these daily disaster prevention operations with technology, we will not be fully prepared for the coming risks.

Through today’s forum, I have been reassured of the importance of disaster prevention technology. I hope that this forum will lead to better disaster prevention activities for administrative bodies and everyone else in the future. I realized once again that we have to listen to various ideas, talk to various people, and collaborate with each other. To close my speech, I would like to express my gratitude for participating in today's forum. Thank you very much.

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Details

Date & Time	June 12, 2019, 14:00-17:00 (Door opens at 13:30)
Venue	Grand Front Osaka Tower B 10th Floor Room B01+B02
Support	Asia Pacific Institute of Research

Program

14:00-14:10	Opening Remark	Mr. Robert Noddin President and CEO, AIG Japan Holdings KK
14:10-14:45	Key Note Presentation: “Research results of SIP Phase 1 focusing on real-time earthquake damage estimation”	Mr. Hiroyuki Fujiwara Head, Multi-hazard Risk Assessment Research Division, NIED
14:45-15:15	Short Presentation	Mr. Norio Maki Professor, Disaster Prevention Research Institute, Kyoto University
		Mr. Shingo Nagamatsu Professor, Faculty of Social Safety Sciences, Kansai University
		Mr. Takeshi Sato Manager, Public Project Design & Marketing Department, KOZO KEIKAKU ENG Inc.
15:15-15:30	Break	
15:30-16:35	Panel Discussion: “Social implementation of disaster prevention technology – Examples and future of local governments and private companies”	
	- Panelists	Above 4 presenters
	- Moderator	Mr. Kazuya Hattori, Executive Fellow, AIG Institute
16:35-16:55	Summary	Mr. Hirokazu Tatano Professor, Disaster Prevention Research Institute, Kyoto University
16:55-17:00	Closing Remark	

Enquiries to AIG Institute

37F Tower B Grand Front Osaka, 3-1 Ofuka-cho, Kita-ku, Osaka 530-0011

Email: AIGInstitute@aig.co.jp