June_18_407_003

Digital Twin Paradigm for Disaster Resilience

I'm Shinichi Koshimura from Tohoku University. So why we are having hosting this session is that digital twin. So as you know, the digital twin technology, we are utilizing the digital twin technology in diverse industries, including the urban planning, or architecture, civil engineering, also in our science researchers, even aerospace engineering.

What is good for utilizing digital twin is we have many data from the census, various centers, and then put it in the copy as a copy in a cyber road that is a computer. And then running lots of simulations, machine learning models, to get the insight for our society.

So even you have the Apple Watch or any other watches that are measuring your body's conditions and measuring the heart rates, and then give you some insights. You need more sleep, or you need more steps, you need more work, or something like that.

So I think that is the point of the digital twin. So what we are doing here is to expand that digital twin paradigm to disaster resilience. So actually, we have two speakers. So we have plenty of time to discuss lots of things.

I hope you enjoy this session. Thank you. And then let me invite the keynote speaker. Dr. Kusunoki Koji is a professor at the Earthquake Research Institute at the University of Tokyo. In 1997, he completed his PhD program at the University of Tokyo, and then he became a member of the University of Tokyo Earthquake Research Institute since 2014, and has become a professor at the University of Tokyo Earthquake Research Institute since 2018.

So his major research topics include health monitoring of structures, experimental research on structural performance of reinforced concrete structures, and damage investigation in earthquake -damaged areas.

Why we invite him is that he is the program director of the Cross -Ministerial Strategic Innovation Promotion Program, which is called SIP. That is one of the Japan's flagship research and development project.

So he's going to talk about the outline of a project called SIP for the disaster resilience.

So good afternoon, everybody. Thank you, Professor Koshimura, for your kind introduction. Again, my name is Koichi Tsunoki from the RK Research Institute of the University of Tokyo. So at this occasion, I would like to introduce the SAP program for disaster mitigation.

So this is somehow the selected items, the topics for SAP. SAP is a five -year project, and then not every year, we just apply for the SAP. But since once we start SAP, for five years, no new items could be added.

So first term was started in 2014. Then at that time, here, the 11 topics are selected for SAP. Then the second term just finished in 2022. Then this time, 12 topics are selected for the SAP program.

Then here, you can see that for the first time, the social resilience, which is for the disaster mitigation and the management, was selected. And for the second term, again, national resilience, the name was a little bit changed.

But again, the selected, because you may know that Japan has too many kinds of natural disasters. So for SAP, the disaster means not only the earthquake, but also the flood, typhoon, and some other natural disasters.

Then 2022, just to finish the second term, then from 2010 to 2020, I think you can see a lot of the devastating natural disasters occurred in Japan, including the 2011 Pacific Coast of Tohoku earthquake, 2016 Komamoto earthquake, not only the earthquakes, but also you can see a lot of typhoons and floods hit the palm, maybe because of the global warning issue.

Then we are facing such a devastating disaster that so many people were killed due to the disasters. So that's why the government always elected the disaster mitigation issue for the SAP program. Then unfortunately, this year, just on the New Year Day, the earthquake never cared what day it is.

Even the New Year Day, the earthquake hit the somehow central part of Japan, which occurred in the Noto Peninsula. This is the peninsula. It's quite unique shape. It made the disaster management difficult.

Then so far, I think the latest number is 243. Compared to other countries, probably the number of the casualties is rather small, but still, 243 people were killed due to earthquake. Then thanks for the sensors deployed all over Japan due to the Kobe earthquake, our government decided to increase the number of sensors all over Japan.

Now we have a lot of sensors. Then we can get the seismic intensity right after the earthquake. About three minutes after the earthquake, we can get the seismic intensity like this. And the Ministry of Education has a National Institute to deploy other sensors all over Japan to get the waveform of earthquake.

Here, they have about 10 stations in this prefecture. Then you see the maximum ground acceleration exceeded about 2G. It's incredible. Then how can buildings can survive such a strong shaking? Then here you can see the comparison between the major acceleration and the code requirement.

For long, for wide period range, the major acceleration exceeded the code requirement. So we can say that too strong to the Japanese buildings. Then this is the shape of the peninsula with showing the locations of the road.

You see the number of roads are quite limited. Then due to the shaking, they were severely damaged. Then we lost the way to get to the affected area. It took time to know where the earthquake occurred and where the most affected people are living.

Where we should send the materials and the tools and so on, we couldn't know because of the damage of the roads. Then this earthquake was somehow unique from the structural engineering viewpoint. My major is a reinforced concrete structure.

Now I was dispatched to the affected area right after the earthquake. Then you see this is one of the damaged buildings due to shaking, but it's quite limited. This is the private medical clinic. And the round bar, which is the smoothed bar, was used for this building.

That means that this building was designed according to the previous building code, but not strengthened yet. Unfortunately, the earthquake came faster than the Little Pity. Then this photo was one of the most famous damage occurred during this earthquake.

Seven story, reinforced concrete structure totally overturned. Of course, during some other earthquakes, buildings overturned. But this is the first time when the building overturning killed one family.

Then there used to be two story, I'm sorry, three story timber house right here. Then New Year Day, the family gathered together in that house, then they were killed. So that's why the government dispatched us.

Then many buildings inclined a lot, but only one building overturned, then killed one family. This is the school building. Then it was a Little Pity already because our government was promoting the Little Pity after the Kobe earthquake.

Now 30 years has passed after the Kobe earthquake. Then about 99 .8% of the school buildings are all Little Pity. Then this building was also Little Pity. Then you see it didn't collapse. So we can say we succeeded by Little Pity in the building, but they inclined a lot.

But even if it's not New Year Day, even if the students were inside the building, we can save the lives of the students. So we should say we succeeded. Then the timber houses, so many damages, and roads like that, we couldn't go through that kind of serious damage on the road.

And it's devastating. We don't need to look for the damaged building everywhere. So we found once the earthquake happened, disaster is already there. So many buildings collapsed. They're widely affected, just in a second.

Then the problem is we cannot find out the locations and the area where the most affected. Then the government, of course, before this earthquake happened, the government decided to start the third time of SIP program.

Then here you can see the, I think, 14 items, the topics which were selected for SIP. You see the widely distributed topics, like post -COVID -19, health care, community food chain, and so on. Robotics there.

Then the third time, this topic, the disaster mitigation is only the topic which had been selected for all terms. The third time, again, the development of a smart network for disaster mitigation was selected.

Then I was also assigned as a PI for this program. Then the budget size is about $24 million per year for five years. It's huge. Then this time, the other topic which is development of a smart infrastructure management system is also selected.

This is for the daily maintenance. Then our topic is for the disaster. But the topic is quite similar. We are dealing with the infrastructures, buildings, houses, hospitals, and so on. So we are collaborating together, especially for developing the digital twin.

If we can develop a digital twin of the cities, we can use for both of them, disaster management and also the daily infrastructure management. That's why we are collaborating. So then SAP should be the multi or multi -ministerial project.

If the issue is only for one single ministry, it should be done by the ministerial budget, not SAP. So that's why for the disaster mitigation, you can imagine easily, it's not only for the Ministry of Construction, but also for many, many different ministries and agencies, such as the National Police Agency and the Ministry of Self -Defense and also Ministry of Construction and so on.

So many, many ministries are involved in this project. Then this is the view of our project. The current situation, we have a lot of difficulties to tackle with natural disasters. One of them is, as I told you, we want to know what's going on right after the natural disaster, but it's quite difficult.

And also, on the other hand, for the aspect, we should know the affected area. But on the other hand, for the heavy rain, the situation is totally different. Thanks for the second time and the first time, we have developed some new technology to predict the typhoon, heavy rain, and so on.

So we can predict one day or two days before it happened. Even if we announce to the people the heavy rain is coming, you should go evacuate, but people do not evacuate. Sometimes they just come to the river to see, is it true, flat?

Then the river is sometimes killed. So we need to change their mind. So that's a very, very big challenge for this SLP project. that we are trying to do. Then, first of all, how are we gonna grasp the situation or condition right after the disaster?

We need to use the IT technology, satellite sensing, and so on to detect the situation automatically. If we can do so from the beginning of the disaster management, every information, all information will be digitized.

Then, with that information, we can develop the digital twin in cyberspace, like what Koshumura Sensei introduced. Once we got the digital twin, we can do almost everything. We can conduct a numerical simulation to predict the two hours later situation, how the typhoon will go.

Then, we can predict the subsequent damages and so on. We will do that, but we need a very, very powerful computer power. But anyway, we will do that. This figure showed some schematic idea. Of course, the disaster happened in the real space, in reality.

But as I told you, we are trying to correct the data. In digital format, with sensors, satellite, and so on. So, for the second term of the SAP program, we developed a system to use a satellite. So, automatically, the system will detect what satellite should take the photos of the damaged area.

Then, automatically, the image will be sent to the Ministry of Education. Then, the damage detection system will start to detect the affected area. So, for the third term, we are going to use the commercial small satellites as well.

They will be involved in the project. Then, as I told you, the gathered collected information will be transferred to the digital twin in the cyberspace, then conduct a numerical simulation. Then, oh, it's counting down.

So, five minutes, five minutes left, okay. Then, we're gonna conduct the numerical simulation and to predict the coming situation after the disaster. Then, comes back to the real space to give some advice, support to the digital makers.

Like the mayors, governance, and so on. So, this is the structure of our project. We have the five sub -topics. The first one, subgroup A, is to detect the information, such as using the satellite system and IoT techniques, IoT sensors are now everywhere in the air conditioning system, TB, then washing machine and so on.

They can speak, actually. They are talking too much, so I don't like that, but they talk a lot. So, they can give us the information after the disasters. They can tell you, you should evacuate. To where?

To the nearest evacuation center. It's depending on your health condition. If you are too old to climb up the slope, the evacuation center, where you can go on the flat road, will be announced, something like that.

Then, group B, subgroup B, is a challenging. They are going to change their mind, the people's mind, to evacuate. They are now developing some system, especially for each of you. According to your health condition, according to your characteristics and your lifestyle, they will provide the information just for you when you need to evacuate and where you should go.

Then, group C is another quite challenging group. They are trying to make the collaboration among the police department, fire department, and the Ministry of Defense. Basically, they don't want to collaborate.

You may easily imagine. But we are trying to change their mind. Actually, so far, we succeeded. They are developing the standardized data sharing system among the Department of Police, Fire, and Ministry of Defense.

The group D is for the only flat. They are developing the dam management system. To manage the dam, it's quite easy. If the heavy rain is coming, just release the water. That's quite easy. But the water is used for the agriculture as well.

They don't want to reduce the amount of water. So we need to balance. The Ministry of Construction and the Ministry of Agriculture. So we are trying to find out the better solution to manage the dam system.

Then group E is developing the best technique for digital tuning. So we are collaborating with another SIP program, as I told you, the Smart Infrastructure Management. They are going to develop the digital tuning of the cities.

We are going to develop the application for the disaster management. Then this is the structure, the people who are involved in the project. I'm a PD program director. Then Koshimura sensei is right here.

He is the player side. He is developing the digital tuning technique for the tsunami disaster management, which will be introduced in a minute. I should finish within 20 seconds. So I should skip several slides.

Then after this one, I talked with World Bank in this morning. Then they told me all slides will be open on their homepage, as far as I know. I'd hope so. Then from this slide, some slides are introducing what will be done by each subgroups.

A is to detect the damage by satellite and so on, like the heavy rain and the water level sensors and so on. Then they are going to use the building sensors and sensors in the home applicants and so on.

Then group B is how to change the people's mind. This is also very, very challenging. Then group C is to develop the new data sharing system for the Department of Police, Fire, and the Ministry of Defense.

Then we already developed some prototype. It was used after the earthquake happened on the New Year day. Then group D is developing the new dam management system for both Ministry of Construction and the Ministry of Agriculture.

Then for the group E, we are developing the digital training technique for disaster management and infrastructure management. Then like this, then we can somehow conduct the numerical simulation of whole city, looking at each individual building.

You see, the red marked buildings are evaluated to be collapsed. Then in the center, we are also developing the very, very accurate, very precise numerical model in the digital team for the important structures, like city hall, the central government buildings, and the nuclear power plants, like this.

Then this one is digital training for tsunami. Then the consumer sense is here. I don't need to talk about this one. She will talk later. But you see, his system can predict the tsunami within a few minutes.

Then his system can estimate what area will be under the water. Then where and who should evacuate immediately. with using the digital training system. So as I told you, we are collaborating with the Smart Infrastructure Project.

So as a conclusion, this is the last slide I believed in. We are tackling with natural disasters for more than 2 ,000 years in Japan. Then before we got the computer, of course. So that's why we had not been believing the electricity right after the disasters.

So our disaster management system was developed based on the papers and the pencils. But everything has changed. We have the cell phones. We have a computer. Then all systems in the cities are based on the computer system.

So we change our mind. We can believe the electricity and the computers. We should digitize the disaster management. We are not running in front in terms of the digital techniques. We are following the other groups.

But we can do many things with computer systems, like what Koshima Sensei is going to introduce right after me, my presentation. So five years later, I believe that Japan will be somehow stronger than what it is today.

But still, Japan is very safe. Even if the strong earthquake happened right now, don't worry, it's safe. That's all. Yeah, that's all for my presentation.

Thank you for broad picture, to show the broad picture of the SAP program. So I'd like to move on to my presentation, but after this, I'd like to take some questions. As Professor Kusunoku mentioned, there's a program which is underway in Japan, a we are taking a role, one of these, called Tsunami Digital Twin.

So I guess that some of you are joined in the morning that are hosted by Ron Eguchi. Can you, okay, okay, that's, so I guess that I'm a little bit same with that. What the, what the Digital Twin? So that is kind of, this is the definition of myself about the Digital Twin.

That is a fusion of computing and sensing, monitoring, and visualization AI running between the physical world and the cyber world. So let's take a look at the, from the physical world. What we have as a technology, as a technology, we have the technology of sensing, monitoring, and even the practice, our efforts.

The practice is also the critical technology in the physical world. And then what we have in the cyber world, it's, we have the capability of modeling or forecasting, and then inference, and then policy design, or what we call hexagon concept of the Digital Twin.

So with that, we are having the loop, feeder group between the physical world and cyber world get the insights. What we do in the physical world is a support of the disaster response. And also what is good in doing the Disaster Digital Twin in the cyber world is run the diverse simulations with many scenarios, potential scenarios in the future, like an aging community, civil rights, and the future urban configurations.

That makes it possible to run every simulation to get the consequences of the running policy and then with the potential adaptation strategies to use that insights for the physical world. So that is the concept of the Digital Twin, Disaster Digital Twin.

So the core technologies are operational GNSS -based, it's not an additional focus system. That runs very rapidly in the aftermath of the event occurs, like that one. That's the result of the very behind Tohoku event.

So on the right -hand side, that is so -called the sensing technology in the physical world, to get the information, crustal movement in the real time, that will be copied into the cyber world to run the simulation on the left -hand side, like that, to get the consequences of tsunami inland penetration.

So the advantage of running this is the supercomputer in Tohoku University, which makes it possible to run this simulation anytime once the tsunamis occurred. And also this is no longer a research project.

We established the Tohoku University -based startup, RDCAST, and then starting the focus services with the product as a tsunami cast. So that is the one we had, we are

proud of this. The performance of that tsunami cast using the high performance computing infrastructure, on the right -hand side, let me show some examples of performance.

So this is a relationship of the computation time and how many cores we're going to use. To complete the six -hour forecast within the 10 -meter grid. So with the special resolutions of 10 -meter grid, it's very precise high resolution tsunami inundations forecasting.

So you can see that the red plot, our new generation supercomputer in Tohoku University, which is called SXORA, that gives us, makes us possible to complete the very precise forecast, tsunami inundation forecast within a couple of minutes.

So we already did that in the social implementation, starting the focus services surrounding Japan. So you know where we are? That's a, we are an image, we don't have a laser. Okay, so it's a because we are in a set or in Nancy that we suppose that that's not coming so that but We are covering the whole part of the coast and nationwide.

So we doing the services focus services to the government Organizations and in private sectors So and Also, what's important is The to see the consequences with tsunami inland minute transition penetration.

That is make a spot I believe this is called tsunami fragility curve that makes a spot possible to Estimate the structure damage competitively. So this is a relationship of Damage probability of the houses as a function of the in a niche It's not mean in addition that according to the building types wouldn't house this or others like a still are living folks hungry on the data we have In every event data.

Well now it will be would be utilized this kind of statistical models And then how we use that This is one typical example of the how there's are with the what their their response row So on the left hand side, you see the picture Of their operation room to use the forecasting for me Or there are search and rescue operations and the medical services and the role and the supplies that makes them possible because we Look for in about tsunami in addition that Building damage and expose populations.

So those are Us responders so All the product so you see the very precise numbing focus result Can add many information like like a red paint you're looking at that is Designated like things shelters for vertical To know Or something Thank you.

It's working? Okay. So, one more thing. This is very, this is very interesting. So, call exposure. Should I click the button? Ah, yes, yes, OK. This is the moment of the earthquake, or the January 1st, in Northern.

So what you're looking at is the population estimates using the cell phone data. So you see, the time situation on the light blue square, that is one of them. What a good digital technology. Anyway, anyway, I'm joking, sorry.

So what is the remarkable thing is that you see the time of season, and then suddenly you have the drop. That is the drop of the population at the 4 PM. That is the time of earthquake occurred. What this means, what this means, we had a sudden population drop.

That means the people of this movement, that many of them tried to evacuate at a higher place. So that is the reason why we had a sudden drop at the coastal area. So it's good to know, I think it's good to know in real time how people responded.

So this is one example at the Noto Peninsula earthquake that you see, take a look at the right up, right top, this is the city center. What you're looking at is the blue is decreasing, and then red is increasing.

Every five hundred meters. So what you read, in the coastal area, blue, and then higher place, red. That means many of the people tried to evacuate to the higher ground right after the earthquake. So that is good thing to know.

So this is one example how the digital twin will work in real time, in the aftermath of disaster. So in the future, what if we have the real time positioning individuals like that? And then what if we have the very quick focus of the tsunami inundation?

And then that makes it possible to find out where people are suffering. And then how we save them, or even before that tsunami comes, we can tell or we can disseminate that information to the people as an individual focused product where they go, how to survive.

So that is what we are trying to achieve in the SIP program. And also, I hope we have started more. One use case is of using the digital twin is not only the real time. For example, the reconstruction planning.

So this is the Sendai City's reconstruction plan we had after the 2011 event. So we have the concept of multiple defense lines. First line is the civil. And behind that, we designed the coastal road raised from two to six meters in the plan.

But the question is how high we should raise the road. So I think that is a good functionality of using the digital twin to get the answers like that. So working with the Sendai City planners, we run many simulations in the cyber world with the potential urban plan scenarios, or land use, or design of the elevated road like that.

So the question is how high we should elevate the road. So as a consequence of the simulations and discussions, we decided to elevate the six meter above the ground. And then now, the picture on the left -hand side, that is what we have in the real world.

Right -hand side, the cyber world. So I think that is one good use case is use the digital twin in the planning phase. And then, last one, this is like a Nintendo game. That what we do, what these guys are doing is the medical response.

So we have, in the cyber world, ourselves, even doctors, ambulances, any other mobilities can be represented by the agents in the cyber world, the agents in the computer. So in the cyber world, in disaster -affected areas, many agents are working like that to save people on the left -hand side.

Actually, on the left -hand side, you see the blue belt. That is that tsunami inundation zone. So medical people are trying to save people, transfer the patients. So this is like, yeah, this is like a Nintendo game.

But More data from the physical world can be copied to the cyber world in real time. I believe this could be more realistic, right? So what we're doing in the cyber world to run the agent simulation to find the optimal solutions, optimal configurations for medical people or mobilities to save people.

So that is the, I think is the one of the, the achievement we are trying to do. So I think it's time. So this is the, like some kind of conclusions as a pathways to overcome future catastrophe using the digital twin technologies.

So digital twin, that is the riveraging and also observation data product, products to create the comprehensive tsunami loss estimation and the search the best policy design. And then we want to make the co -creation of digital twin products with the many new partners.

And then the last thing is that what is important is the back casting from our inevitable future. So using the advances of new technologies and also growing concerns about that already. I believe that our future, the digital twin technology can help.

So thank you for your kind attention. So I think so our session started the 10 minute behind the schedule. So I think we have the right to do more 10 minutes. Okay. So I'd like to take questions from the audience's comments, whatever.

Yes, please. Can you bring the microphone or should we have?

I don't know if it is. So thank you, Amin, for the presentation. I'm Roberto Rudari from CIMA Research Foundation. Well, first let me acknowledge the tremendous work he's doing into the modeling part.

It's really impressive. However, my idea of Digital Twin, because I'm a modeler too, so always try to find ways to distinguish a very good modeling schema in the digital world from what we call a digital twin.

And I think, normally for me, I identify two things, just to be simple. One is the contact with the real -time information that is always absorbed by the model, which we normally do. Since before, the digital twin concept was there.

And the second one that is a little bit more complicated is the ability for us to interact easily with the model to evaluate what if scenarios. I mean, what if I'm doing something and how the thing responds.

So I'm not sure I capture this second part in what you were explaining. So maybe I would like to have a bit more insight to how you think this could be handled by decision makers, how this could be done in an easier way, I mean, really to interact with this type of modeling framework so that we can test what if scenarios and take the right decisions.

Let me go first. So I think I should, it's good to, ah, can you show my slides? Thank you. So, I think it's good to start with the digital twin framework. So the background is that, I think it's the background is that the quick acquisition or real -time acquisition with the sensor data, that is, I think it is a good start we had, especially we had more advanced technology after the 2011 event, including the Earth Organization data and also even the social sensing data.

So that is going to be, for example, in the tsunami cases, Earth Organization data, that will be utilized very good, very well to determine that tsunami source model like that. So what you're looking at the right -hand side is using the crustal movement data in real -time.

So that makes it possible to estimate the tsunami source model to run the simulations. So that is, I think, is the typical example using the sensing data or real -time acquisition data. And then also we have the real capability or real -time computing.

So real -time data and the real -time analysis, that is going to be input of the other models. I think it's also the input -output relationship or the loops are very good or very critical functionality with these results.

And then, you have two questions, right? What is the thing? I mean, it seems like if they have like an inch of clean up, we're likely to write it down. Right, right. So the good thing is it's not only the real -time focus.

In any phases of the data management, I think we can utilize the digital twin. For example, as I mentioned, in the planning phase, we want to do some what -if analysis. What if we do or what if we read this plan, what if we do have this policy?

It's good to, in the cyber world, it's good to see the consequences of that applying the policy or adaptation strategies in the cyber world. To do that, we need many models, for example, many agent models, many other AI to get the inferences of applying that policy.

But that's, I think, is that the key function area of the digital thing is not only about the real -time focus, but it's good to see the consequences of the potential policies. And then, I believe that we can find the very good solution, the best solution applying that many models and then what -if analysis, and then those solutions can be fed back to the real world, to the policy makers or practitioners.

So that's what we want to achieve.

Oh, I would like to comment some things. Then the prediction is somehow easier for us, for academicians, just predict, just show the results. That's it. But disaster comes. Then we should know the real situation.

Then, as you said, you pointed out, the modeling can affect a lot. The results can be changed according to the modeling. But the disaster is here. The building collapsed. But some building didn't collapse.

The tsunami comes to this place, but not here. We know the situation. Then what I'm asking as a PI, as the name of PI, to Koshumura Sensei, is please update the model according to the measured disasters in front of us.

Then the aspects, we will have the aftershocks. Typhoons, it can move. The flood also can change. So we need to update the modeling according to the measured data. If not, once the disaster happened, we cannot use digital tuning anymore because it goes far away from the reality.

So that's why I'm always asking Koshumura Sensei to develop a technique to update the modeling.

I think that's a good point. So that's why I'm putting the circles and just I think it's not only one cycle, updating with the monitoring information. Thank you, Sunok Sese. Any other questions, comments?

Yes, please. Thank you.

Hi, my name is Wakita. Thank you for the presentation. My question is more about modeling small scales. So in order to run your simulations, I think you have to capture 3D models, 2D models of the terrain and stuff.

And maybe satellite imagery, you can do it at a higher level. But when you need smaller models, you need people on site using laser scanners and drones and stuff. And I think a lot of people are hesitant to use these new technologies.

How would you overcome this challenge? Good question.

Good questions. So that's the real that's why we are I'm on the last last slides I'm proposing you to cook co -creation of the digital time so why don't we share that data like to copy whole world as a computing platform to bit to use that to running the various diverse simulations to see the consequences our systems in the cyber world so I think

it's in that sense I think we we can share this picture this image work framework with the working with the many people and then industries practitioners so that's the part of the the thing you mentioned that about the data data is important

Thank you for the question. The developing the digital tree is somehow quite challenging. And the concept is OK. Everybody can understand how useful it is. But for the practice, who will develop the digital tree of the cities?

It takes time to modeling the whole structures, all bridges, all highways. It takes time. So the government has been promoting the development of digital tree into the local government. So now we are somehow digitizing the cities.

Then some cities already digitized. But there are several levels. The lowest level is just like a Google map. The highest model, we have almost all modeling. But it's quite limited. So under this project, we are going to develop somehow the new technique to develop the structure model from the 3D scanning.

And we have a bunch of the drawings. We scan the drawings, then automatically the model will be developed. That kind of the techniques must be developed to realize the digital tree world. Thank you.

Thank you for your presentation. So in the digital twin world, we have, let's say, multiple models, one for a flood, one for evacuation, and one for just anything else. How much work do you do in the interaction between these models?

For example, how the traffic model affects, when a flood comes, how this traffic model gets affected, versus the model you should have, monitoring, maybe using satellite, I mean, telephone information, the population, how the evacuation gets affected by, so like the cross, how models talk to each other.

I think there's no limits for integrating the models. I think it depends on what issue you are interested in. For example, evacuation, evacuation. So to do that, I think is that to evacuation, we want to establish the evacuation digital twin or something like that.

So to achieve that, what kind of information or data we need to copy from the physical world and then what we do in the cyber world. Something like that. I think through the discussion, thematic digital thing we call.

So what issue you are interested in or what problems do you want to solve? And then probably we can start working together, constructing and putting the data in the cyber world, putting the models in the cyber world to co -create the digital twin.

So that's a concept, that's the idea.

Thank you.

So just one comment, even if we got the digital twin, we don't necessarily need to conduct an American simulation. Just obtain the data, we just gather into the digital twin. Even that kind of digital twin, it's quite useful.

And also we are now trying to develop the digital twin to storage the data. In the digital twin world, you can go back to 20 years ago. Then what happened during the previous pretty strong earthquake to see the damage of the building in the cyber world?

That's what we are trying to develop. Thank you.