R&D SYMPOSIUM ROUNDTABLE

COOPERATION WITH MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Joseph M. Sussman (video message)
JR East Professor,
Department of Civil and Environmental Engineering and Engineering Systems, MIT

Areas of Specialization
Transportation systems and institutions; regional strategic transportation planning; intercity freight and passenger rail; intelligent transportation systems; simulation and risk assessment methods; complex systems; large-scale, interconnected, open sociotechnical (CLIOS) systems

Career
1995-2001 ITS America (Board of Directors)
1995-Chairman, Executive Committee, Transportation Research Board
1991- present --- JR East Professor at MIT
1986-1991 Director of Center for Transportation Study at MIT
1980-1985 Head of the Department of Civil Engineering at MIT
1967, Ph.D. MIT
1967- present, Member of MIT faculty

Makoto Shimamura
Director, Disaster Prevention Research Laboratory,
Research and Development Center of JR East Group

1 MIT and JR East

MIT is one of the top universities in the USA. It has turned out many Nobel Prize laureates and been playing a core role in the Boston region that is a center of advanced technologies on par with Silicon Valley.

One of the management members of the Office of Corporate Relations' Industrial Liaison Program of MIT told us that MIT has long history of cooperation with industries. Unlike other universities, MIT had clearly declared "valuable science for industry" as an objective as far back as the time of its establishment in 1861. One of the major characters of MIT from the beginnings is its emphasis on the relationship to society and the importance not only to obtaining knowledge but also to applying knowledge.

In April 1991, JR East started a sponsored chair at MIT under the leadership of then-president Yamashita and has continued industry-academia cooperation for around 15 years. It was the first time that JR East endowed a chair in a university overseas and also that MIT accepted a program sponsored by a foreign railway company. The endeavor was a landmark event at the time.

One of the pillars of the endowed chair that we have dealt with is joint research. Since the opening of the course, we have accumulated experience in technical exchange in such collaboration. We have decided to base our relationship on the long-term perspective of selecting meaningful themes to build fruitful partnership between MIT and JR East—two organizations different in nationality, role and character—rather than to go after research results that can be easily put into practical use.

The second pillar of the endowed chair is dispatch of JR East employees to CAES (Center for Advanced Educational Services), an adult education course of MIT. The course at CAES is different from usual overseas study programs to obtain degrees. Instead, it is to make use of MIT's excellent research environment by independently studying under the guidance of professors and by freely selecting and attending related lectures to deepen job themes in the company without suspending them. The CAES carefully considers the needs of researchers and engineers in companies, and we have dispatched 16 members in total so far. And, as a program paired to that, we have carried out internship programs for MIT students at JR East.

Today, we have Prof. Joseph M. Sussman, JR East professor since the chaired professorship was established. here in a video message. Professor Sussman will introduce the origin of the endowed chair as a topic about the diversified activities of our relationship.

2 Video Message by Prof. Sussman

The Great Dome of MIT

Let me introduce myself. I am Joseph Sussman, the JR East Professor at MIT and a professor of CEE and Engineering Systems. You have just seen some views of MIT including the Great Dome, the global symbol of MIT. I am speaking to you from my office, room 1-163, where I have had the opportunity to meet with many of you over the years. It is a privilege to have this opportunity to speak to this JR East Research and Development Symposium. This is an important event for JR East, both in the content that you will discuss, and also in the important symbolism of your outreach to the academic and research community. This has been a hallmark of JR East for many years, and I am pleased to see it highlighted in this symposium. Although I am videotaping these remarks here at MIT, I can assure you I am with you in spirit at your meeting.

Before I begin my formal remarks, I would like to show you some photographs I think you will enjoy. Then, I will have some comments about the relationship between JR East and MIT and lessons we have learned in the 15 years since the JR East professorship at MIT was established.

Seeing these photographs, I am sure you will recognize the close relationship between MIT and JR East. I would love to show you all the photos I have; but due to time restraints I will just introduce some of them here.

This is a photograph of when then-president Yamashita attended the World Economic Forum held at MIT in 1993. It shows Mr. Yamashita presenting a gift to Charles Vest, who was MIT president at the time.

President Charles Marstiller Vest, Prof. Sussman (MIT), President Yamashita (JR East)

The story of JR East and MIT begins with Mr. Yamashita and Mr. Yamanouchi who visited here in 1990 to discuss the possibility of JR East endowing an academic chair here at MIT.

Prof. Sussman and Vice President Yamanouchi (JR East), at that time

If I'm not mistaken this was the first academic chair that JR East would endow outside of Japan, having at that time only one chair housed at the University of Tokyo. Indeed it is a matter of great pride to us here at MIT that JR East selected MIT for this honor. But speaking frankly, JR East did not seek simply to honor MIT. They made it quite clear that what they wanted was a close working relationship with the Institute. And "relationship" is the key word—an ongoing partnership between two great organizations, one a transportation company, and the other an education and research institute, both arguably at the top of their respective fields.

The next important step in building the relationship was the six-month visit of Mr. Makoto Shimamura, then in the Safety Research Laboratory, and now the director of the newly formed Disaster Prevention Research Laboratory in the R&D Center of JR East. Mr. Shimamura came to MIT to see if we could establish a first research program on which we could cooperate. As a member of the Safety Research Laboratory, Mr. Shimamura was naturally very interested in safety-related research, but there was still the question of defining a program—a research project —that would have value for JR East, and would be an area in which MIT could contribute and advance its own intellectual agenda as well.

Mr. Shimamura came to MIT, met with a number of different faculty as facilitated by me in my role as JR East Professor, took several classes, and by the end of his six-month stay, we had the preliminary design of a research program in the area of global risk assessment for the JR East network.

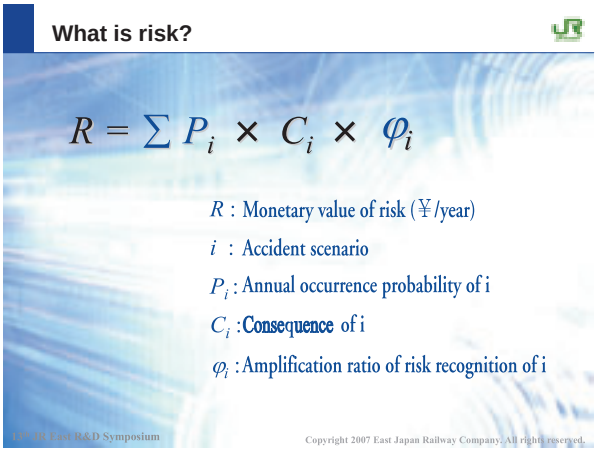
3 Risk Assessment for Railways

As Prof. Sussman mentioned, application of risk assessment to railways was chosen as the theme for the first joint research. This is because JR East's need to make scientific review of safety as its top management priority agreed with MIT's seeds of being one of the world's leading institutes for research in risk assessment methods applicable to advanced fields such as nuclear power technology and space technology. Now I will make a brief introduction of the circumstances and the themes of our joint research on risk assessment.

First of all, what is risk? The word "risk" has already rooted in our daily life and we often use this word in many contexts. As many people admit, it is basically a synonym for "uncertainty". That which is uncertain or unknowable in advance like the weather or exchange rate for tomorrow is called risk when the results of that affect our interest. The significance of the risk can be—again as recognized by many people—expressed as the combination of the probability that an event will occur and the consequence of the result of the event when it actually occurs.

The most basic of basics for keeping safe is to eliminate any risk in advance by thorough prevention. However, we cannot completely rule out the possibility of occurrence of an accident for the systems where it is difficult to ensure fail-safe operation as a nuclear reactor or a space shuttle. For these systems, we have to make risk assessment as the second best option to estimate the frequency and significance of an accident and to make total safety judgment based on quantitative risk.

Risks are often formulated as shown in the next slide.



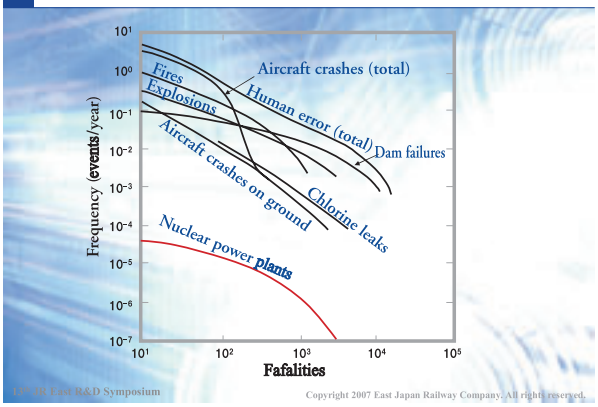
Such formulation itself has many uncertainties in calculation. For example;

- How can all scenarios be counted without omission?
- How can the probability of occurrence of an accident that has not ever occurred be figured out?
- How can risks with different attributes be assessed on a single standard?

MIT has carried out much pioneering research in risk assessment in light of these issues. The most well-known one is so-called the Rasmussen Report that the Nuclear Regulatory Commission has issued in 1972 about the first systematic probabilistic safety assessment of nuclear power stations under the guidance by Prof. Norman C. Rasmussen of MIT's Department of Nuclear Science and Engineering.

The next figure is from the Report. The calculation results of the risks caused by potential accidents of the 100 nuclear power stations in the USA are indicated with the significance of effect as the horizontal axis and on the frequency of the accidents with more significant effect as the vertical axis. Risks are compared to those caused by a variety of other human activities.

Risk Assessment of Nuclear Power Stations (the Rasmussen Report, 1972)



U.S. Nuclear Regulatory Commission, Reactor Safety Study : An Assessment of Accident Risks in *U.S. Commercial Nuclear Power Plants, WASH-1400 (NUREG-75/014), 1975.*

The next figure shows the interesting results of various research that studies the significance of risk recognized by people psychologically and accepted by society varies depending on the risk attributes, even when the physical size of the effect is the same.

Amplification Ratio of Risk Recognition per Damage Category

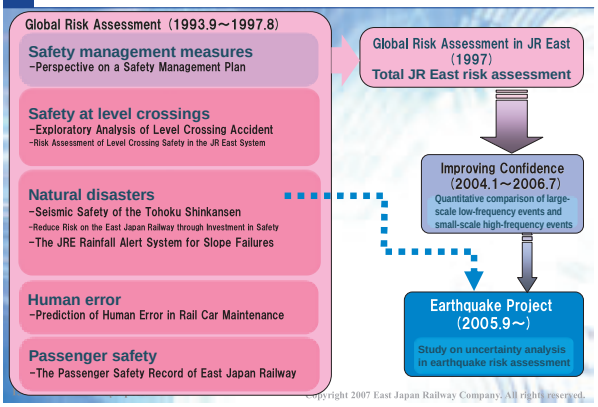
Comparison of category	Assessed value of risk amplification ratio				
	Litai, Rasmussen	Rowe	Starr	Kinchin	Otway & Cohen
Natural / Man-Made	20	10 (2)			
Ordinary / Catastrophic	30	50			
Voluntary / Involuntary	100	100 (10)	~1000		1-1000
Delayed / Immediate	30 (11)	20%/yr		30	
Controllable / Uncontrollable	5-10	100 (10)			
Old / New	10				
Necessary / Luxury	1 (7)				
Regular / Occasional	1				

For example, research also conducted under the guidance of Prof. Rasmussen indicates that people are conscious of the risk of human factor-related accidents 20 times higher than the risk of natural disasters, risks with lower frequency such as railway accidents or aircraft accidents 30 times higher than risks with higher frequency, and short-term or immediate risks such as traffic accidents 30 times higher than long-term or delayed risks such as health problems from smoking.

Reviewing railway business, we see that we cannot achieve fail-safe operation in all cases. Nor is there "perfect safety," even when there may be "utmost safety." Hence, we believe that we can make full use of risk assessment as a measure to assess safety more strictly and as a tool to promote safety measures more effectively. These were our motivations to start the joint research, as I mentioned earlier.

The overall flow of the joint research so far is shown in this figure. First, we looked at the risk assessment of each actual subject. Second, we integrated the assessment results into the risk assessment of JR East as a whole. Third JR East puts the research results to practical use and puts them in place internally after the completion of such research. Then, based on the information and problems found or obtained during actual application within the fixed period, we further carry out joint research to explore individual risk assessment measures. As you see, the flow is spiral.

Joint Research with MIT



That is our joint research on risk assessment with MIT.

4 Conclusion

Finally, I will end my speech with Prof. Sussman's message again. Thank you very much for your attention.

<Message by Prof. Sussman,>

It has been my special pleasure to tape these remarks for your symposium. I wish you every success, and look forward to seeing many of you, either here at MIT or in Japan in the future.

I thank you for your support—and your friendship—over the years. I appreciate your kind attention during my remarks—I hope you found them of some value. I wish you a good R&D symposium and again, thank you.