# Global Disaster Prevention

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First of all, let me introduce myself. After leaving my position as director of the Disaster Prevention Research Laboratory at the Research and Development Center of JR East Group in December of 2012, I took on the role of project professor in the Department of Civil Engineering at the University of Tokyo. There, I teach a course endowed by JR East on risk management for transportation infrastructure against large-scale disaster damage, running from May 2013 to March 2016. This article will cover an overview of the endowed course while explaining the goals of activities in the course.

Provisions against large-scale disasters for social systems have been under review since the 2011 Great East Japan Earthquake. Re-inspection and assessment of safety and reliability of those systems have come to be demanded more than ever before, as have appropriate improvements for the future. This endowed course was set up in light of that demand to develop risk analysis methods that will form the basis for effectively improving the reliability of transportation infrastructure such as railways, highways, seaports, and airports against a variety of disasters. Research in the course is being done to overcome that issue of making improvements.

For example, consider line sections along mountain slopes where landslides often occur. People in charge of disaster prevention deal with issues such as whether digging a tunnel for a separate line would be more cost effective in the long run, enhancing protective equipment for the current line would be better, or installing landslide warning devices would be sufficient. It would be so convenient if there were software that could output the appropriate decision-making instructions automatically if the necessary data was input. Of course, everyone involved in actual work in this field knows that is merely a fantasy.

When John von Neumann, the father of the computer, was told that a machine could not deal with the human mind, he replied that the issue was a problem with the field of psychology where the mind is not properly defined; as long as it is defined, a machine can calculate it. The concept of risk management is, at least among experts, widely accepted. Even so, important decision-making involving risk is often done haphazardly in an intuitive manner. Opportunities for decision-making by accumulating explicit and logical information processing are few and far between. The reason for that, however, is not the difficulty of defining the problem, as is seen in computer simulation of the brain. Even though we can note the logic structure of risk assessment in a form that computers can process, it is generally presumed that such an assessment method could actually be applied only in cases where all the detailed and accurate data used in assessment could be acquired. Apparently, that often impedes utilization of logical and quantitative risk assessment methods. Putting together such data would involve too much cost

## Profile

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| 1954 | Born in Osaka |
| 1978 | Graduated from the Department of Forest Science, Faculty of Agriculture, the University of Tokyo<br>Joined Japanese National Railways |
| 1991 | Chief Researcher, Safety Research Laboratory, JR East |
| 2006 | Director, Disaster Prevention Research Laboratory, Research and Development Center of JR East Group |
| 2008 | Earned doctorate degree (engineering) from the University of Tokyo<br>Thesis topic: Improving methods of train operation control in rain, wind, and earthquakes |
| 2013 | Current position |

and effort, making implementation impossible in most cases.

Conversely, if the issue of data to input were solved, risk assessment by computer would become possible. So, the idea itself could be worthy of being pursued as an area of research.

A risk assessment system where all required items must be accurately entered to proceed, like with online shopping, would be nonsensical. That is because it goes against the basic understanding in modern risk management of uncertainty itself being the essence of risk.

The conditions that need to be provided in a practical disaster risk assessment method can be summarized by the dual meanings of the keyword "global." First of all, such a method is supported by geoscientific knowledge. In other words, it is "global" in the sense that it is a method backed by scientific knowledge related to the earth (globe).

In general, standard risk assessment is conducted by the steps of considering…

1. What can happen?
2. What is the possiblity of that happening?
3. What will result from that happening?

Risk is calcluated in the end by putting the answers to those together. Of those three steps, the first—listing without omission the assumed scenarios to be assessed for risk—is undoubtably the most important.

Although modern science and technology have unfortunately been unsuccessful in putting into practical use a method of predicting with pinpoint accuracy what disasters will occur when and where, "potential prediction" of what kind of disaster could occur at an arbitrary point on the globe is possible at a practical level of accuracy with geoscientific knowledge accumulated up to now. In other words, we are in a position where we can give an answer with certainty to the question of "What can happen?" asked in the most important consideration step, at least in terms of natural disasters. We should be grateful in this for the results accomplished by scientists in the past.

The word "unanticipated" came to be excessively used in the aftermath of the Great East Japan Earthquake. But we should recall with humility that most natural disasters, including the giant tsunami, are simply normal phenomena. They regularly repeat according to their mechanisms and schedules when observed in a geoscientific time and space scale.

In potential prediction of natural disasters, topographical knowledge and use of topographical charts should be emphasized in particular. This is significant in ways more than just that the tendency for a disaster to occur differs due to terrain. In other words, we can determine that almost all natural disasters are "harm to life and property due to abrupt changes in terrain (or state of artificial structures such as civil engineering structures and buildings) in locations with human activity due to forces that are repeatedly generated in geosceientific scales of time and space." At the same time, current terrain expressed on topographical charts is a form of database expressing the accumulation of historical information on past forces generated at that point. So, we are led to the assertion that the type of disaster that can occur at a certain point can be predicted by topographical chart data.

Another meaning of the condition for being "global" is that something is "comprehensive." This condition is related to the essence of risk management as "optimizing decision-making in situations of uncertainty." Breaking that down, we see that the following are particularly important.

1. Pursing balance of individual parts in the overall picture and in whole instead of with partial detail or accuracy.
2. Assessment work being possible without being affected by the quality or quantity of usable input data.
3. Expressions in assessment results being understandable to persons making decisions who have money and authority instead of the people doing the actual assessment work.

Development of a risk assessment system that can fulfill those conditions is the ultimate goal of the endowed course. Efforts have just gotten underway, but a hint can be gained in the slope grading charts jointly developed in the 1970s by civil engineers and scientists of the former Japanese National Railways (JNR). Those charts were used for more than 30 years by JNR and JR companies as materials for deciding priority in planning and execution of constructions to prevent rainfall disasters. While there is not enough space here to cover them in detail, they used data already available at the worksite to calculate how much rainfall a slope along a railway line can withstand. That made them great problem-solving tools, allowing quantitative expression of how much improvement can be expected in resistance to rainfall when constructing countermeasures.

The accuracy of the grading charts in assessment results of individual slopes was actually quite questionable, but their widespread use did facilitate communication of people in charge of disaster prevention with officials at the head office and Railway Operating Division and with those in charge of budgeting. It is an undeniable truth that, as a result, the number of disasters due to rainfall visibly declined at JNR. In other words, the second condition for being "global" was satisfied.

In contrast, improvement proposals for the grading charts later that were attempted to alleviate their impreciseness did not catch on at all. While they were more refined technically, they involved costly and time-consuming additional investigations and required expert knowledge to interpret.

We are now working to develop a disaster risk assessment method that can be used by actual worksites, taking into account the wisdom of our predecessors as well as the latest scientific knowledge. And we ask for your support and encouragement in our endeavors.