京 都 大 学 防 災 研 究 所 年 報　第48号 C　平成17年4月
Annuals of Disas. Prev. Res. Inst., Kyoto Univ., No. 48 C, 2005

# Integrated Disaster Risk Management: Research on Methodology of Urban Diagnosis

Norio OKADA, Hirokazu TATANO, Yoshiyuki SUZUKI, Yoshimi HAGIHARA, Yasuhiro HAYASHI*, and Michinori HATAYAMA

* Graduate School of Engineering, Kyoto University

**Synopsis**

This paper gives an overview of ongoing research activities under the 21st Century COE Research Project, primarily carried out in the Division of Integrated Management for Disaster Risk, DPRI, Kyoto University, for the fiscal year 2004. Illustrations are made to introduce several research efforts which are intended to promote the methodological development of urban diagnosis. Further research needs are also addressed to further improve the methodology of urban diagnosis.

**Keywords:** urban risk diagnosis, spatial-temporal risk, integrated disaster risk management, risk communication, participatory approach

## 1. Introduction

COE research efforts have been performed by Division of Integrated Management for Disaster Risk, DPRI, Kyoto University, with a view to developing the methodology of urban (regional) risk diagnosis for planning and management of safe and secured cities and regions. This paper presents an outline of its related research work and illustrates how applicable this methodology is to integrated disaster risk management.

## 2. Urban (regional) risk diagnosis for integrated disaster management

The methodology of urban (regional) risk diagnosis is intended to make overall assessment of risks inherent to common space for people living there. Such spatial risks are considered to change over time. Therefore urban (regional) diagnosis starts with assessing the current status (status-quo) of common spatial risks, and then continuously monitors their changes over time.

By definition this methodology includes what is called the method of "seismic diagnosis" of houses, buildings and facilities. However it is important to note that the methodology is used to make an overall assessment of the collection of houses, buildings and facilities located on common space, in stead of independently assessing each of them.

(i) Characteristically it should produce information with "policy-linkage label." Here "policy" means "a bundle of diagnosis and prescriptions (countermeasures) to collectively achieve the goal of a safer and secured life under disaster risks." For instance seismic diagnosis needs to be combined with diagnosis and prescriptions for enhancing quality of safety and security in a common living space, such as a neighborhood community.

(ii) Urban (regional) diagnosis underlines identification of the status quo, instead of immediately starting planning.

(iii) This means that the PDCA cycle should be reinterpreted to emphasize the phase of "to check" as a starting point of the cycle, rather than to highlight the phase of "to plan" as commonly interpreted to be appropriate (see

Fig.1). Let us call this reinterpreted PDCA cycle "CAPD cycle."

(iv) We assume that cities and regions as common space entailing diverse types of inherent spatial risks tend to change over time. Urban (regional) spatial risks need to be viewed also as temporal risks. Therefore urban (regional) diagnosis requires continuous monitoring and continuous updating.

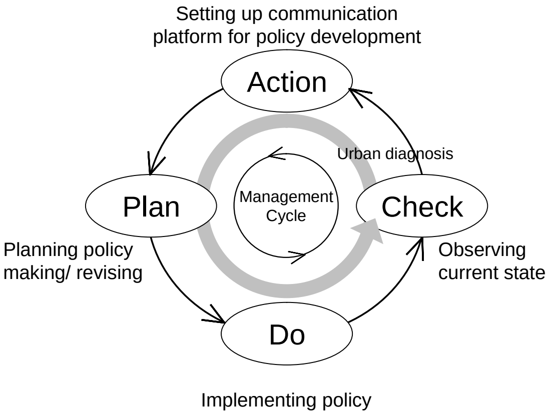


Fig. 1 Urban diagnostic risk management as PDCA (CAPD) cycle

(v) This diagnostic methodology becomes even more important when specialists and practitioners usually tend to be limited in information and knowledge and are only aware of segmental scopes of their professional and jurisdictional areas. They are likely to be not so much integrated and thus the methodology serves for this integration purpose.

(vi) To put it otherwise, this methodology can also support "risk communication" among different stakeholders whose views, perceptions and information are limited and not so much mutually compatible. For instance, stakeholders are government people, consultants and engineering experts, researchers, NGOs and citizens. Participatory approach may be effectively introduced to set up a common communication platform for risk communication among diverse stakeholders.

(vii) This diagnostic methodology can be utilized for vertically integrating multiple strata of a city (region) viewed as a vital common spatial/temporal system. As shown in Fig. 2, Okada et al has proposed a five-storied pagoda model for this view.

(viii)

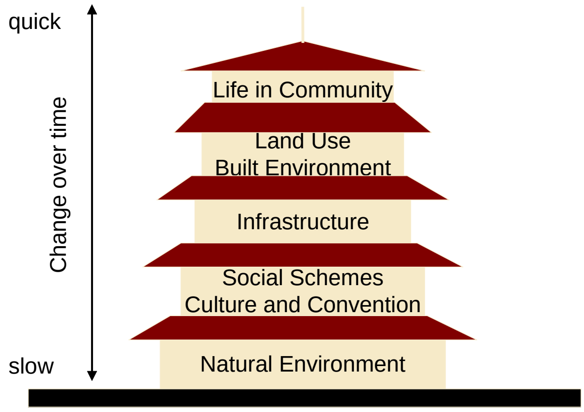


Fig. 2 Urban spatial system as five-storied vital model

## 3. Case studies

From the above viewpoints and perspectives, our group has been carrying out different types of application research and field works. Just to mention a few examples of this kind, illustrations are made just in short. They are Nagata Ward in Kobe, Nagoya-centered and Osaka-centered metropolitan regions, i.e., Chubu and Kinki Regions are selected for illustrations.

### 3.1 Urban diagnosis of disaster recovery process in Nagata Ward, Kobe City

Okada, Hatayama and others have been continuously monitoring the recovery process of some residential areas in the Nagata Ward, Kobe City which was severely damaged by the 1995 Hanshin-Awaji Earthquake. This continuous field works have been effectively supported by a special type of GIS, called DiMSIS that can handle temporal changes in geographical spaces. Figs. 3 and 4 illustrate two samples. Notably this special type of GIS is suited to accommodate relevant information by simply pasting on respective spot different kinds of data such as digital, qualitative/descriptive and visual (audio-video) ones. This work can be easily performed and repeated in a field, and thus information can be continuously updated as time passes.

We intend to repeat this field work and continuous monitoring by use of DiMSIS with a view to systematically accumulate and make urban diagnosis of the recovery process of this focused residential area.

Fig. 3 Display of disaster recovery process with DiMSIS (1)

Fig. 4 Display of disaster recovery process with DiMSIS (2)

### 3.2 Urban diagnosis in Nagoya and Osaka-Bay areas under Tokai, Tonankai and Nankai earthquake risk

One of our COE research strategies is to combine research resources and data with similar research projects and funds. This Dai-Dai-Toku (Tokai-Tonakai-Nankai Earthquake Disaster management) research project is one of those which have been carried out by Okada and others, in combination with the 21st century's COE research project. This combined research by Okada, Suzuki, Tatano and others aims at

(i) Proposing a new framework for disaster planning in Japan by incorporating the perspective and methodology of integrated disaster risk management, in which urban (regional) diagnosis constitutes an essential tool.

(ii) Making research contribution to the implementation of disaster mitigation countermeasures combined with increased regional/urban/community preparedness in Nagoya City and Nagoya-centered metropolitan region which are considered one of the most risky areas in anticipation of the Tokai-Tonankai- Nankai Earthquake Disaster.

(iii) Adaptive management approach is introduced to systematically support the case study areas in making a "social experiment" to set up and foster communication platform for participatory approach. The methodology of urban (regional) diagnosis is introduced to observe if it can be effectively implemented, given a specific context and actual field.

Table 1 lists up a set of major research outcomes expected from this project which is scheduled to be finalized in the year 2006.

Table 1 Expected Outcome

| | Regional level | Community level |
|---|---|---|
| Tool and system development | •Earthquake damage simulator<br>•Social/economic impact evaluation model | •Seismic Diagnosis on wooden houses (engineers/technicians)<br>•Community carte (residents)<br>•Community earthquake impact assessment model |
| Action Planning | •Performance index on regional transportation<br>•Prediction and policy for local governments' financial demand by Tokai-Tonankai Earthquake | •Reinforcement guidelines (government, technician, residents) |
| Research team and human network development | Researchers, (National/local) government officers, Transportation managers | Researchers, engineers, technicians (carpenters, designers, consultants), government officers, residents, NPO |

As a part of this research project the following field work at a school neighborhood level has been conducted.

The Higashiyama elementary school area is located in Nagoya, one of the Japanese mega cities with the highest potential to be damaged by an earthquake. Higashiyama Area is a typical residential neighborhood in an urban area. The elementary school area is traditionally the second smallest community unit that has about 7,000 households, divided into 24 smaller community units (residents' association).

Rescue Stockyard (RSY) is a nonprofit organization which has carried out disaster mitigation activities in this community for two years, such as workshops and furniture nailing campaigns. RSY and the authors' group (Disaster Prevention Research Institute, Kyoto University) had been collaborating for a year, and agreed to agree with carrying out survey in this area. One of the main purposes for RSY is to check its influence and the achievement provided by their past activities. The survey entitled "Community preparedness diagnostic sheet" was designed to meet RSY's needs and as implementation tool of urban diagnosis.

Whereas several social survey methods can be used for diagnosis, a questionnaire was selected for the study. Ever since RSY committed itself to community based activities, this was the first time it performed a social survey in the area. Therefore, a questionnaire seemed the most appropriate tool to hear citizens' opinions and attitudes towards disaster and their mitigation behavior. The survey sheet was distributed to all 6,646 households through the community organization in December 2004.

The survey questions consist of two parts. The self-evaluation part asks a respondent to state their self- and mutual- preparedness for an earthquake on a scale of 10. These two questions are used to measure citizens' self-evaluation of preparedness.

The other 43 questions are used to measure "Community Preparedness Index (CPI)". In these questions, a respondent is asked if they prepare for an earthquake in action or if they have enough consciousness of an earthquake, such as "Have you secured nailed down your furniture? (Yes, Considering, or No)", and "Do you discuss how to get in contact with your family in an emergency? (Often, Sometimes, Rare, or No)". Some questions ask about self-preparedness to help the individual or family to survive the disaster, and the others are regarding to mutual-preparedness to help neighbors in a community. This classification is not written on the survey sheet. The 43 questions are based about, RSY's experience people often raised as paint as anxiety in past workshops. These questions are divided into seven elements regarding community preparedness: Housing safety, Storage, Shelter, Special support (the elder, handicapped and infants), Community linkage, Fire and Emergency contact. Based on answers to these questions, the Community Preparedness Index is calculated as an average score over the whole sample of citizens on a scale of 1 to 10 to designate how well they are prepared. The detailed definition of the index is in the Appendix of the paper. A radar chart is used to visualize the result for the other two agents.

The following is a part of the results to show the classification of the population is attempted here depending on their self-evaluation,

Fig. 5 shows the distribution of individuals in Higashiyama community by their CPI and self-evaluated score for mutual-preparedness. A group of individuals located left above could be rather optimistic because their self-evaluation is relatively high compared to their low CPI. Contrary, those who are located right below could be comparatively pessimistic. Based on such criteria, the population is divided into optimistic (347 residents), pessimistic (376 residents) and neutral group (1,903 residents). 987 residents are did not respond.

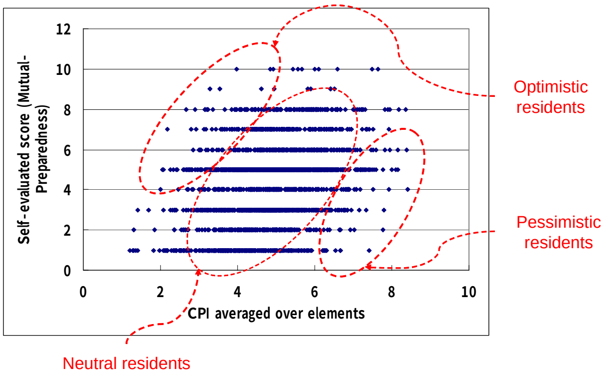


Fig. 5 Cognition gap between residents' self-diagnosis and experts' diagnosis

### 3.3 Collaborative modeling and application of option-taking support information system for flood risk mitigation

Okada, Tatano and others have been engaged in the CREST research project by closely linking it to the 21st Century's research project. Methodologically it is also combined with the NIED's research project commissioned to Okada's research group. This combined research activities have dealt with flood risk mitigation and increased preparedness at community level. What characterizes the approach adopted is its emphasis on interactive and collaborative work between modelers (researchers) and prospective users (residents). This mutual work of model building and development is called "collaborative modeling." Importantly collaborative modeling is also a process-oriented approach, in which reducing in size and functions could mean progress if and only if it contributes to the quality of risk communication on both ends, modelers on one hand, and residents on the other.

Just to mention an example of how modelers need to address more appropriately users' concerns, a PC device to develop a household-based risk curve for an expected bundle of disaster flood risks. Here again the information technology of the DiMSIS has been best made use of. This way we can better tailor the developed simulation technique to each user's essential concerns. It is also a part of our research challenge that such an elaborate simulation technology can be effectively utilized to make laymen (residents) virtually experience a possible set of disaster scenarios. We propose to refer to the capacity of highly-advanced simulation technique as "ima-simulator" since it enables people to develop virtual experiences of scenario disaster situations by way of activating the capacity of imagination on something awful and uncomfortable. Further research is intended to be carried out to overall assess the implementability of this simulation technique when we carry out disaster risk communication in a participatory process.

## 4. Conclusions

There are many other pieces of research work conducted by our research group. For want of space only a limited number of illustrations have been made.

## References


Disaster Prevention Research Institute (2004): Website of Dai-dai-toku Project, http://www.ddt33.dpri.kyoto-u.ac.jp/.

CREST (2004): R&D of Hydrological Modeling and Water Resources System, http://www.yae-mizu.jst.go.jp/yae-mizu/index.html

National Research Institute for Earth Science and Disaster Prevention (2004): Website of Research on societal systems resilient against natural disaster, http://www.bosai.go.jp/sougou/shakai/index.html


## 都市地域リスク診断技法開発としてみた総合防災研究


岡田憲夫・多々納裕一・鈴木祥之・萩原良巳・林康裕*・畑山満則

＊ 京都大学大学院工学研究科


### 要旨


本研究では、総合防災研究の観点から、災害リスクの下にある都市・地域空間の安全性を空間リスクとして捉えるとともに、専門家や住民が共同でその現状とその時間的変化を診断する方法論(**都市地域リスク診断技法**)の開発と適用を行う。21世紀COE研究の枠組みの中で、他の関連する研究プロジェクトとも有機的に連携させながら、これまでに実施されている個別研究事例について紹介した。併せて今後の研究の課題について言及している。



**キーワード**: 都市・地域リスク診断, 時空間リスク、総合防災、リスクコミュニケーション、参加型アプローチ