３．Development of Earthquake Countermeasures' Toolbox as a Method to Increase Public Awareness

（防災意識向上のための情報伝達手段に関する研究－地震防災対策ツールボックスの開発－）

和文要約

フィリピン・マリキナ市を対象として行った地震防災計画の策定過程には大きく、１）地震被害想定、２）想定結果に基づく戦略計画の２段階があり、その移行時には地震対策にはどのようなものがあるのかといった防災対策の全体像、体系に関する情報の提供が計画に関わるステークホルダーに必要であった。また、策定された防災計画を実行する際には、特に一般市民に対して地震リスクや対策に関する情報を開示することにより、市民の防災意識を高め、計画に対する理解と自主的な行動を含めた協力を得ることが地域防災力の向上に結びつく。このような観点から、情報を欲するステークホルダーに対する総合的な情報コンテンツの開発とその伝達機構の構築は、防災対策を推進する上で重要な課題の一つであると考える。

本研究は、情報伝達の一手段として展示会に着目し、2003年７月28日にマリキナ市において開催された防災対策に関する展示会の１）コンテンツと配置計画を紹介するとともに、２）展示会の効果について考察を行う。

その結果、この展示会を通してステークホルダーに防災対策の４要素、防災の10分野を含む総合的な情報が提供され、防災計画策定に役立ったことが確認された。また、展示会には高校生を中心として約1000人が訪れ、その参加者へ配布した質問紙の回答から、参加者は地震リスクが低減可能なことを学び、展示会が何らかの防災行動を起こす契機になり得るといった効果があったことや、防災に対してより興味が深まったためにさらに新たな情報を欲していることが明らかにされた。

なお、本研究の一部は、科学技術振興調整費「アジア・太平洋地域に適した地震・津波災害軽減化技術の開発とその体系化に関する研究（研究代表者：亀田弘行　地震防災フロンティア研究センター長)」、および、科学研究費補助金「災害情報の「情報到達度」向上のための戦略の開発（研究代表者：立木茂雄　関西学院大学教授)」によるものである。

Development of Earthquake Countermeasures' Toolbox as a Method to Increase Public Awareness

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ABSTRACT: It is essential to provide information that aids in understanding earthquake risk and countermeasures in making process of an effective earthquake disaster reduction planning. Moreover, such information should be available not only to local planning practitioners, but also to those seeking to increase public awareness of disasters. Therefore, it is important to develop a systematic mechanism to disseminate comprehensive information. This paper describes a methodology to propagate such information. An exhibition on disaster reduction is an effective means of information dissemination. Such an exhibition was held as part of earthquake disaster reduction planning at Marikina City, Philippines. To present comprehensive information, contents of the exhibition were adopted using the Planning Concept Matrix, which consists of a matrix of ten fields and four phases of a disaster management cycle. The visitors of this exhibition learned about earthquake risks and how they can deal with such risks. According to the results of questionnaires filled out by participants, the exhibition was successful. Outcomes obtained from the exhibition will be distributed as a Toolbox, both through the Internet and a catalog, as a set of techniques that can be used by local practitioners when they develop disaster management strategies.

KEYWORDS: earthquake disaster reduction planning; information dissemination; exhibition; Marikina City; Digital City

1. INTRODUCTION

Earthquake disaster reduction planning at Marikina City, Philippines, has been established through five workshops with stakeholder participation in collaboration with Japanese experts (Maki *et al*., 2004). There were two major stages in the process of making an effective earthquake disaster reduction plan: 1) risk assessment and 2) strategic planning of countermeasures against risk. In the first stage, seismic damage risk focused on important structures, which stakeholders such as Marikina City administrators wished to protect in case of earthquake disaster at the first workshop "Problem Identification Workshop" held on January 29, 2003, were assessed by experts from the authors' research group (Hasegawa *et al*., 2004). When the risk assessment result was presented to the stakeholders at the second workshop, "Risk assessment and Goal Setting Workshop" conducted on May 7, 2003, many questions were asked. Participants had strong interests in disaster reduction, necessitating more information which could be divided into three categories:

1) General information on earthquake disaster such as damage imaging and technical terms.
2) Information on risk assessment such as hazard analysis, vulnerability evaluation, and risk assessment method.
3) Information on earthquake countermeasures such as improved methods of construction, seismic retrofitting, and countermeasures against liquefaction.

Therefore, it was necessary to provide local planning practitioners with comprehensive information including general information, risk assessment, and countermeasures in order to move from the risk assessment stage to the strategic planning stage in earthquake disaster reduction planning. Such information

should also reach people in the community as well as local planning practitioners to enhance public awareness and promote community-based earthquake disaster reduction capacity. As an effective way to disseminate the information to the community, an exhibition was made.
This paper introduces a systematic method to disseminate information on disaster reduction, including how to plan and arrange an exhibition through an actual exhibit case.

2. WHAT KINDS OF INFORMATION SHOULD BE DISSEMINATED?

It was found that stakeholders needed three kinds of information for earthquake disaster reduction planning: 1) general information on earthquake disaster, 2) risk assessment, and 3) earthquake countermeasures.

2.1 General Information on Earthquake Disaster

General information provides basic knowledge on earthquake disaster. This information is important for those who do not have expertise and includes earthquake mechanism, seismic intensity, earthquake damage type, and a historical earthquake disaster case.

2.2 Information on Risk Assessment

It is important to know not only the results of risk assessment, but also the means by which the assessment is conducted. This information is also necessary to plan countermeasures. To conduct seismic damage risk assessment, two types of data and assessment tools are typically used: hazard and vulnerability data. Hazard data includes the fault system, soil conditions, and shaking intensity data, which are obtained from hazard analysis. Vulnerability data consists of indicators of structural vulnerability such as structure type and construction age. As a typical structural damage assessment tool, both a fragility function method and damage estimation method based on a structure' scollapse mechanism are used.

2.3 Information on Earthquake Countermeasures

A scheme for collecting comprehensive information on earthquake countermeasures, applying the Planning Concept Matrix, is proposed here. The Planning Concept Matrix is a useful tool that fulfills all the elements of disaster reduction, as shown in **Figure 1** (Kondo *et al*., 2004). It consists of a matrix of ten disaster reduction fields and four phases of a disaster management cycle. Ten fields were defined as follows: 1) Critical Facilities, 2) New Buildings, 3) Existing Buildings, 4) Education, 5) Research & Technology, 6) Public Information, 7) Land Use Planning, 8) Institutional Initiatives, 9) Economic Development, and 10) Sources of Finance. Each field has its own experts for disaster reduction. Those fields are also summarized into three categories of countermeasures: physical, informational, and strategic countermeasures. The disaster management cycle illustrates the process of disaster management, as shown in **Figure 2**. There are four phases: Mitigation, Preparedness, Response, and Recovery. This Matrix enables one to extract comprehensive earthquake countermeasures information in each of ten disaster reduction fields, taking into account each of the disaster management phases.

OBJECTIVES	Mitigation	Preparedness	Response	Recovery
1 Critical Facilities				
2 New Buildings				
3 Existing Buildings				
4 Education				
5 Research and Technology				
6 Public Information				
7 Land Use Planning				
8 Institutional Initiatives				
9 Economic Development				
10 Sources of Finance				

Figure 1. Planning Concept Matrix

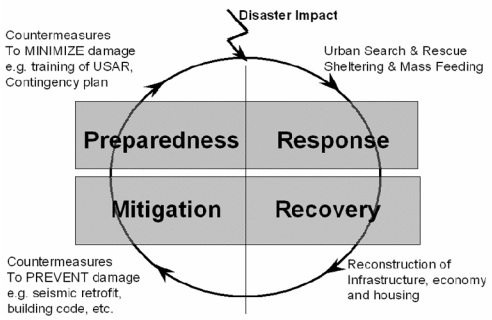


Figure 2. Disaster Management Cycle

3. MARIKINA EXHIBITION ON EARTHQUAKE DISASTER REDUCTION

3.1 Purpose of Marikina Exhibition

An exhibition is an effective tool for providing knowledge and techniques on disaster reduction to the community. The exhibition method also allows attendees to obtain information interactively from experts in disaster reduction. It also facilitates understanding by providing vivid displays. An exhibition on disaster reduction for information dissemination, entitled “Preserving Marikina's Future through Earthquake Disaster Reduction", was held at City Hall in Marikina City, Philippines, on July 28, 2003 at the third workshop, the “Planning Workshop”. This exhibition was held as part of earthquake disaster reduction planning in Marikina City. Almost one thousand people visited the exhibition to learn about earthquake disaster risks in Marikina City and techniques and tools to reduce those risks in four hours from 1:00pm to 5:00pm.

There were two purposes of this exhibition:

1) To provide information on earthquake countermeasures for local planning practitioners to promote earthquake disaster reduction planning in Marikina City.
2) To disseminate information on earthquake disaster reduction to the community, allowing attendees to understand earthquake risk and countermeasures in order to increase public awareness.

To achieve the above purposes, both exhaustive displays on earthquake countermeasures and displays encouraging better understanding were planned.

3.2 Zoning and Moving Flow Plan for Exhibition

The exhibition was held in part of the common space at Marikina City Hall, as shown in **Figure 3**. This space was generally used as a waiting area, enabling free access for citizens. City officials could also visit the exhibition. The exhibition area was about 216 m^2. Clear zoning and a moving flow plan for the exhibition were designed. The zoning plan is shown in **Figure 4**. The main moving flow was planned clockwise to avoid viewers crossing each other. The exhibition area was divided into three main zones, in accordance with the contents of the exhibition: risk assessment, general information, and earthquake countermeasures. The risk assessment zone was arranged as the first zone at a conspicuous place next to the entrance. This arrangement was expected to attract people to view the remainder of the exhibition because the information in this zone, which presented seismic damage risk assessment applied to Marikina City, was of special concern to the community. In the general information zone, participants leaned about basic knowledge on earthquake disaster. Next, they entered the earthquake countermeasure zone, which was further classified into three groups: four phases of countermeasures, physical countermeasures, and informational countermeasures. The contents in the earthquake countermeasures zone were collected from

Japanese researchers using the collection scheme “Planning Concept Matrix” to provide comprehensive information on earthquake countermeasures for local planning practitioners. The strategic countermeasures, however, could not be collected in the Marikina exhibition. Because this theme is a relatively new research field, sufficient materials have not yet been prepared.

3.3 Contents Layout and List

The contents layout of the Marikina exhibition is shown in **Figure 5,** and aspects of the exhibition are shown in **Photo 1**. Photos providing locations and directions are also shown in **Figure 5**. The contents were provided through 42 posters, 5 video programs, and 4 demonstrations. In addition, information on earthquake disaster in Philippines was also presented by the Philippine Institute of Volcanology & Seismology (PHIVOLCS). These displays were expected to arouse interest, and thus were located in front of the entrance. A signboard listing the contents, as shown in **Figure 6,** was also placed in the entrance, and a box for collecting questionnaires regarding visitors’ opinions was placed behind the signboard. The contents of each zone are summarized as follows:

1) Risk assessment
The list of displays in the risk assessment zone is shown in **Table 1**. The locations of all displays in list are also shown in **Figure 5**. The process and results of interactive seismic damage risk assessment, which was applied to Marikina City, were presented in this zone. Since the risk was assessed using digitalized data on the geographic information system (GIS), the technologies of GIS were also introduced in this zone.

2) General information
The displays list is shown in **Table 2**. In addition to basic knowledge such as technical terms, earthquake mechanism, and distribution of historical earthquakes, the 1995 Kobe earthquake case was shown on video. Visitors learned the lessons of what actually happens in a disaster situation.

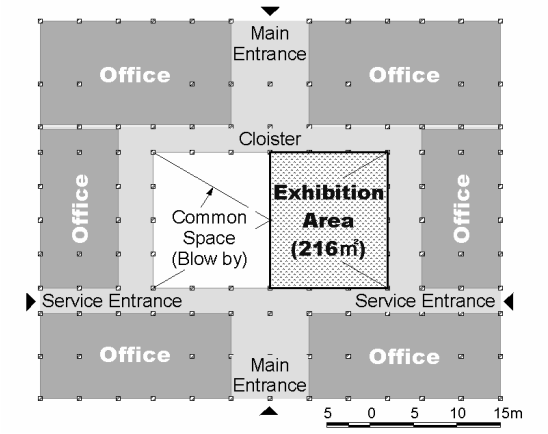


Figure 3. Exhibition Area (First Floor in Marikina City Hall)

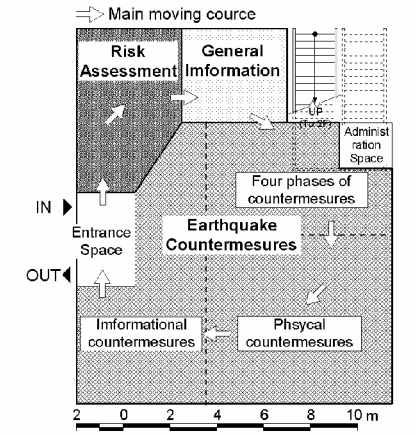


Figure 4. Zoning and Flow Plan

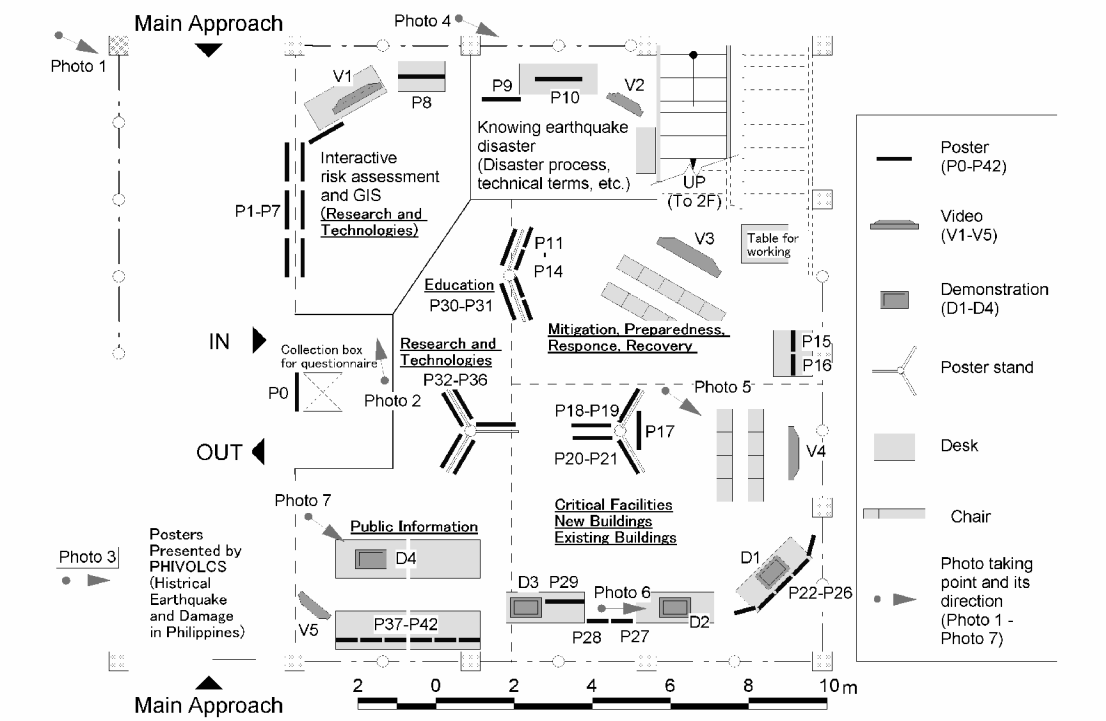


Figure 5. Layout of Marikina Exhibition

Photo 1. Cover Shot of Marikina Exhibition.
Almost one thousand people visited the Exhibition.

Figure 6. Signboard (P0)

Table 1. Displays List of Risk Assessment

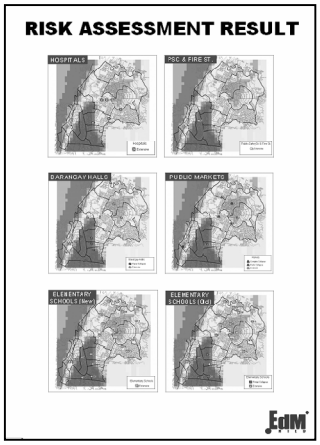
#	Title	Outline	Sample image
P1	Surveyed Facilities	Process and result of interactive seismic damage risk assessment applied in Marikina city using the method of the Global Earthquake Safety Initiatives, which is developed by the United Nations Centre of Region Development in collaboration with the GeoHazards International. Hazard data was horizontal peak ground acceleration, which was calculated by PHIVOLCS. Vulnerability data was acquired from field survey, which was conducted to important structures that Mariina city administrators wished to protect from earthquake.	 P7: Risk Assessment Result
P2	Survey Results		
P3	Risk Assessment Result on IKONOS Image		
P4	Seismic Hazard Map		
P5	How to Assess Buildings		
P6	Building Damage Map		
P7	Risk Assessment Result		
P8	Risk-Adaptive Regional Management Information System (RARMIS)	GIS based disaster information system	
V1	GIS Technology	Risk assessment method using GIS	

Table 2. Displays List of General Information on Earthquake Disaster

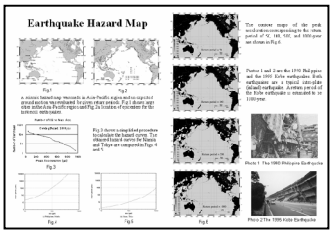
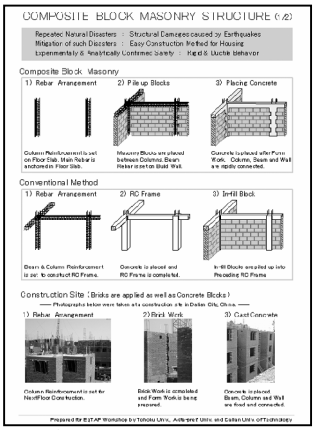
#	Title	Outline	Sample image
P9	Earthquake FAQ	Earthquake mechanism, fault system, shaking intensity, damage image on past-earthquake	 P10: Earthquake Hazard Map
P10	Earthquake Hazard Map	A seismic hazard map made in Asia-Pacific region (location of large city, location of epicenters for the historical earthquakes, evaluated ground motion)	
V2	Disaster process in the 1995 Kobe Earthquake Case	Records through disaster occurrence to recovery	

Table 3. Displays List of Earthquake Countermeasures

(a) Four phases of countermeasures

#	Title	Outline	Sample image
P11	RADIUS (Risk Assessment tools for Diagnosis of Urban areas against Seismic disasters)	For Preparedness. This tool is used to prepare risk management plan.	 P13: PNY
P12	GESI (Global Earthquake Safety Initiatives)	For Preparedness. This method is a useful tool for providing training to city managers.	
P13	PNY (Patanka Navjivan Yojina: Patanka New life Plan)	For Recovery. This project aims to establish a model of holistic rehabilitation.	
P14	CBDM (Community Based Disaster Management)	For Preparedness and Recovery. This project aims to empower community.	
P15	California Earthquake Loss Reduction Plan	For Preparedness. The plan matrix is introduced	
P16	Structural Countermeasures for Earthquake	For Mitigation. New retrofitting idea for residential houses.	
V3	Big Rescue, and 10 Suggestions of Earthquake Disaster Reduction	For Preparedness and Response. Lessons from the1995 Kobe earthquake	

(b) Physical countermeasures

#	Title	Outline	Sample image
P17	Drawings of the Structural Details for A RC house	How to draw a structural detail for better construction practice.	 P20: Composite Block Masonry Structure
P18	Evaluation and Assessment of Structural Performance of School Buildings (1), (2)	Introduction of evaluation method of seismic performance of buildings.	
P19			
P20	Composite Block Masonry Structure (1), (2)	Improved construction method to raise safety for housings.	
P21			
P22	Portable Digital Seismometer – AcCo – (1), (2), (3), (4),(5)	Introduction of seismometer function. This seismometer has a digital display of maximum acceleration and seismic intensity scale at real-time.	
P23			
P24			
P25			
P26			
P27	What is Liquefaction?	Liquefaction mechanism	
P28	Countermeasures for liquefaction	Damage due to liquefaction and countermeasures techniques.	
P29	Shaking Behavior of Building	Explanation of building shaking experiment using shaking table.	
V4	Advanced technology for Hi-Raised building.	Introduction of base-isolation system and vibration control system	 D3: Shaking Table Demonstration
D1	Ground Shaking Measurement	Demonstration to understand ground shaking using “AcCo”	
D2	Liquefaction Demonstration	Experiment of liquefaction	
D3	Shaking Table Demonstration	Building shaking experiment	

(c) Informational Countermeasures

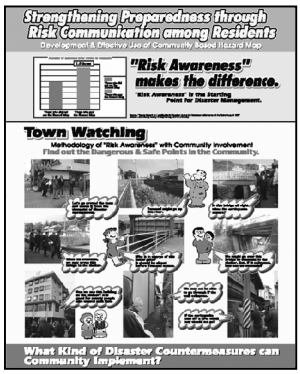
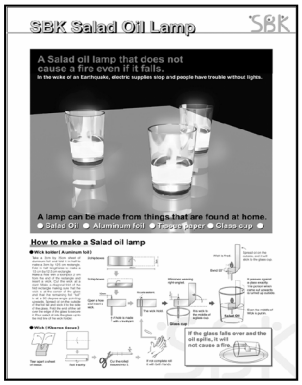
#	Title	Outline	Sample image
P30	Strengthening Preparedness through Risk Communication among Residents (1), (2)	Introduction of community based hazard map to enhance risk awereness and its effective use.	 P30: Strengthening Preparedness
P31			
P32	Quantification of Earthquake Risk	Software for natural hazard risk assessment	
P33	Earthquake Risk Management	Risk management framework to provide most cost-effective programs	
P34	Business Interruption Network Model Analysis	Loss estimation method considering business network	
P35	Risk Management Plan for Production Facilities	Risk management strategies to fulfill responsibility to supply products	
P36	Decision Making in Risk Management Program	Decision making support system based on Analytic Hierarchy Process (AHP)	
P37	The Contents of SBK Activity	Public Information and education. Activities of Simin Bosai Kenkyuusyo (SBK, Community Disaster preparedness Research Institute) was Introduced. As the activities, SBK established study group for citizens and disaster response practitioners to enhance public awareness. The survival kit was also developed and distributed through demonstration, publication and so on.	 P42: SBK Salad Oil Lamp
P38	About the Founders		
P39	SBK Protective Hood		
P40	SBK Water Pack		
P41	SBK Salad Oil Stove		
P42	SBK Salad Oil Lamp		
V5	SBK Video	SBK Activities, how to make and use SBK Survival kit.	
D4	SBK Demonstration	How to make SBK Salad Oil Stove & Lamp	

Photo 2. Risk assessment zone.
Process and result of risk assessment in Marikina City were presented.

Photo 3. Displays by PHIVOLCS.
Historical earthquakes and damage by the earthquakes in Philippines were shown.

Photo 4. General information zone. Many people were learned why earthquakes occur and what happen in disaster case.

Photo 5. Earthquake countermeasures zone. Information was communicated effectively by Video.

Photo 6. Difficult things such as a mechanism of liquefaction were explained through an experiment.

Photo 7. Scene of practice by visitors.
Such kinds of demonstration were most attractive for the participants.

3) Earthquake Countermeasures

(a) Four phases of countermeasures (Mitigation, Preparedness, Response, and Recovery)

The list of displays is shown in **Table 3(a)**. In advance of displays on individual techniques of countermeasures, a holistic approach on disaster reduction practiced in other countries by the United Nations, the United States, and Japan was introduced. Those concrete projects on disaster reduction promoted better understanding of the four phases of countermeasures.

(b) Physical countermeasures (Critical Facilities, New Buildings, Existing Buildings)

The list of displays is shown in **Table 3(b)**. Visitors learned how buildings respond to ground shaking, liquefaction mechanisms, engineering techniques to make earthquake resistant structures for residential buildings, and engineered buildings through multi-media.

(c) Informational Countermeasures (Education, Research & Technology, Public Information)

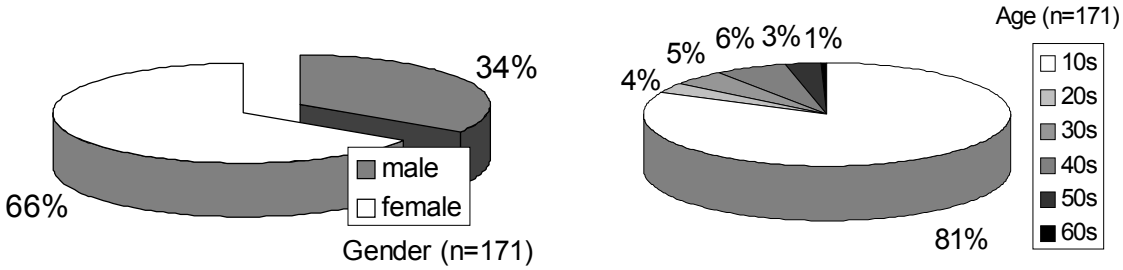
The list of displays in the informational countermeasures zone is shown in **Table 3(c)**. In this zone, visitors studied how to reduce the risk concerning to life, business, community, and the economy. Their risk awareness was also enhanced by a presentation on survival practices.

The displays in each zone are shown in **Photo 2 to Photo 7**.

4. EFFECTIVENESS OF THE MARIKINA EXHIBITION

4.1 Characteristics of the Participants

The effectiveness of the exhibition was evaluated through questionnaires filled out by participants. The questionnaires were collected from 171 persons of participants. 66% of responders were females, as shown in **Figure 7(a)**. 81 % of responders were teen-agers, as shown in **Figure 7(b).** The reason why many younger people participated was that brochures, as shown in **Figure 6,** were distributed in advance to schools in Marikina City.



(a) Gender　　b) Age

Figure 7. Characteristics of Responders to Questionnaire

4.2 Analysis of questionnaire

The following five questions were asked in the questionnaire:

1) Q1: Did you know that Marikina was under earthquake threat before you came to the exhibition?
2) Q2: Do you think you can reduce earthquake damage if you take proper action?
3) Q3: What would you like to do after seeing today's exhibits?
4) Q4: What would you like to know more about?
5) Q5: Which additional exhibitions do you think would be useful?

From the results of Q1, 77% of responders knew of the existence of the West Valley Fault, which lies to the north and south at the western part of Marikina City. From the results of Q2, the exhibition was determined to make citizens aware that they could reduce earthquake damage, as shown in **Figure 8**. The exhibition also motivated them to take initiatives to implement earthquake reduction measures, as shown in **Figure 9**. According to the results of the questionnaires, one of the purposes of the exhibition, which was to enhance public awareness, was therefore achieved. Furthermore, all information on disaster reduction, provided to stakeholders at the Risk Assessment and Goal Setting Workshop were explained in the exhibition. Moreover, earthquake disaster reduction planning in Marikina City was established after the exhibition. Therefore, the other purposes were also accomplished.

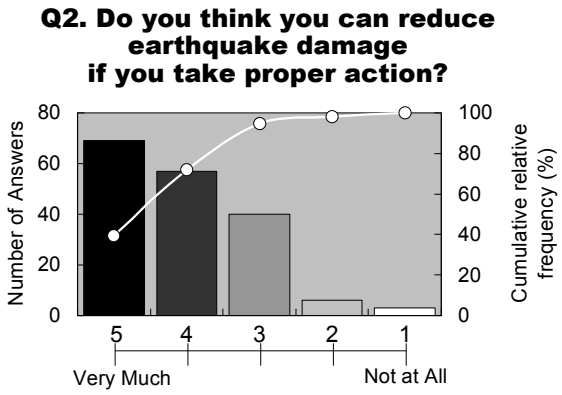


Figure 8. Result of Question 2

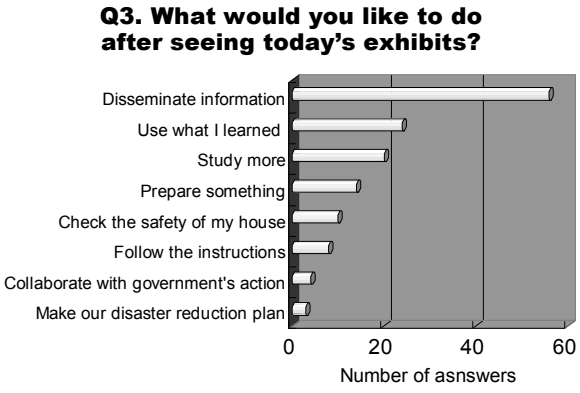


Figure 9. Result of Question 3

Figure 10 shows the additional information that the participants requested. The items that are not underlined in **Figure 10** represent information which was not provided in the exhibition. Thus, more sufficient information regarding these items should be prepared. The items that are underlined in **Figure 10** were provided in the exhibition. Thus, the contents of these items may have been too difficult to understand. According to the results of Q5, video displays and demonstrations were deemed to be most useful. Therefore, efficient multi-media tools should be developed. One shortcoming of the exhibition, however, was the limitations in time, space, and location. Thus, another dissemination mechanism needs to be established

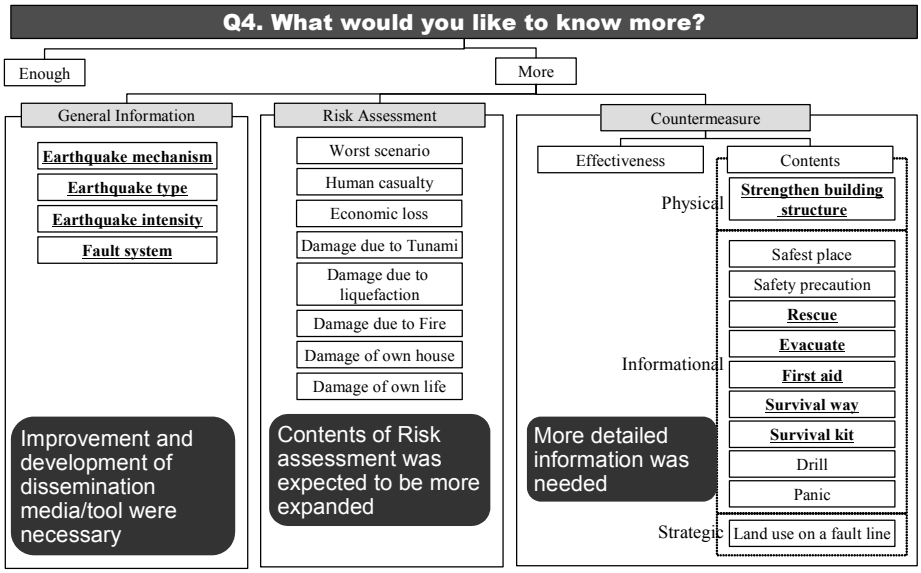


Figure 10. Results of Q4: Additional information requested by the participants

5. CONCLUDING REMARKS

This paper focused on the exhibition as a means of information dissemination and discussed effective planning and arrangement of the exhibition through an actual exhibit case, which was conducted in Marikina City. The exhibition was found to be a useful tool for providing information necessary for local practitioners to plan for earthquake disaster reduction. The exhibition was also an effective method for raising public awareness on disaster reduction in the community. On the other hand, the following three points required improvement:

1) More sufficient information for exhibition should be prepared.
2) Efficient dissemination tools such as displays using multi-media should be developed.
3) More detailed information should be provided.

To provide more detailed information, however, the extent of information dissemination is limited by time, space, and location. It is important to establish another dissemination mechanism, which enables us to address the shortcomings of the exhibition. Additionally, it is necessary to disseminate such information to various stakeholders including the national government and external organizations, in order to expand earthquake disaster reduction capacity. Therefore, a systematic mechanism, in combination with the exhibition, to reach from the community to world-wide level including other municipalities, regions and countries should be developed. As such an information dissemination method, the Digital City was developed using Internet technology. The Digital City is a portal site for information relevant to earthquake and tsunami disaster reduction. The purpose of developing the Digital City is to help local practitioners come up with a disaster reduction plan appropriate for the region of interest. The various countermeasures will then be assembled into a toolbox. The toolbox is a set of techniques that can be used by local practitioners when developing disaster management strategies. In the future, the displays and results of the exhibition will be distributed as a part of the information kit of the Digital City/Tool Box, both through the Internet and in a catalog of the exhibition.

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