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ANALYSIS OF 10 YEARS RESTORATION PROCESS AFTER A BIG DISASTER, STORY OF 1995 HANSHIN-AWAJI EARTHQUAKE, KOBE, JAPAN

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ABSTRACT

In Japan, frequently, large scale earthquakes with magnitude about 8.0 have occurred at subduction zone along the Pacific coast. Also many big inland earthquakes with magnitude about 7.0 have occurred just under the highly urbanized areas. In future seismic activity in Japan is going to be more as explained by the national council of disaster mitigation. In local governments of big cities like Tokyo, Osaka, Nagoya, the restoration/reconstruction processes after suffering serious seismic damage will face big problems based on the experiences after the 1995 Kobe earthquake. This earthquake surfaced the facts that the general reconstruction processes are resultant of many smaller scale processes that are closely and interactively related to local societies and their economic activity. In other words, the life and sufferings of each individual household are related to restoration/reconstruction process mutually and is affected interactively. In this paper, a follow-up survey is provided to show the complexity of the reconstruction and restoration works and then summarized the time history of damage restoration transition during ten years after the 1995 Hanshin-Awaji great seismic disaster in order to pick-up the main factors needed for future seismic disaster mitigation plans. Considering the future seismic disaster mitigation, very important research is to follow-up and pick-up the main factors in which strongly influenced the big seismic disasters in the past earthquakes and to study the timely transitions in social responses.

Introduction

Post-disaster restoration and reconstruction is a major concern for governors of large cities such as Tokyo, Yokohama, Osaka, Nagoya and so on. It is obvious that the extent of damage, which would be caused to a large city by a major earthquake, will be determined scientifically by the characteristics of the earthquake itself and socially by the characteristics of communities in disaster area in which are essentially different for each mega city and seismic region. Furthermore the restoration and reconstruction (R&R) processes are also diverse and complex for each city

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based on different economical, technological and social situations. Considering the R&R process as an interrelated implementation of a series of micro-rehabilitation processes (for example; the daily lives of individual households affected) to a macro-rehabilitation process (for example; local social and economic activities) the emphasis must be given to both micro and macro processes.

In this study a database is created for the 1995 Great Hanshin-Awaji (Kobe) Earthquake using the records and articles of local newspapers about the lives, households and population, in the earthquake affected areas. In this database the accumulated articles arranged by time of issue and by type in order to analyze the effect of restoration and reconstruction process on daily lives of the local communities and affected households.

As like as previous earthquake reconstructions, after the Great Hanshin-Awaji Earthquake, efforts were made to utilize urban planning projects, such as town re-demarcation projects, to rehabilitate the most badly affected areas. At the same time, "council-style" "reconstruction town planning" was pursued as a means of urban development with promoting citizen participation, which raised many issues and lessons to be learned. The reconstruction process after the 1995 Great Hanshin-Awaji Earthquake could be taken as an example. As a results of such lessons Tokyo Metropolitan Government's urban reconstruction manual, took steps in formulation of advance reconstruction plans recently are oriented toward "reconstruction town planning" using "urban planning projects" and "council-style" (Nakai, 2003) participations, to determine the actual state of reconstruction town planning in disaster areas.

In this study, we focused on the complexity and the temporal transition of damage aspects due to the 1995 Hanshin-Awaji Great seismic disaster during ten years in order to pick-up main factors from a database summarizing reports and many documents during a long term period.

Newspaper Article Database

The Hanshin edition of the Yomiuri newspaper between 17 January 1995 and 6 April 2000 have been collected and the articles on the Great Hanshin-Awaji Earthquake was extracted into a database stored in Microsoft™ Excel™ application. The input data included the date, morning or evening edition and headline. A database already been created (Murakami, 1997) for the year from January 1995 to January 1996, therefore we appended our data to expand this database. Since Murakami's database had been only for the first year after the earthquake, the headlines focused mainly on the damage. We therefore had to rearrange the categories afresh and create categories which could take the restoration and reconstruction process into consideration. Fig. 1 shows the total number of articles in current database by month and the cumulative total. The newspaper articles show the fluctuations in social phenomena relating to the earthquake, and the earthquake restoration and reconstruction process is seen as inherent in them.

Classification of articles

The articles categories were re-arranged based on keywords applied in the Kobe Earthquake Restoration Summary and Inspection Report together with the keywords used for classification by Murakami 1977, making a total of 270 keywords. Table 2 shows the results together with the total number of articles over five years. Fig. 2 shows the temporal fluctuations in the number of newspaper articles by category. It shows how the number of articles varied in each category, based on the total number of articles until April 2000. Categories with few articles, therefore, show great variation, but time-series fluctuations differ depending on the

content of the article and, as described above, are thought to show fluctuations related to the earthquake restoration and reconstruction process.

Analysis of the Restoration and Reconstruction Process

The total number of articles by factor and by time on a graph and the results are shown in Fig. 2. There are over 500 articles, the categories with the highest number of articles are: temporary housing and evacuation shelters (U), permanent housing (V), disaster prevention (R), vulnerable groups (S), mental health (W), economy (E) and government (G). It can be seen from the results that, although there are a few jumps, like the changes in the cumulative total number of articles in Fig. 1, most of the curves tend to change into gentle inclinations with the passage of time.
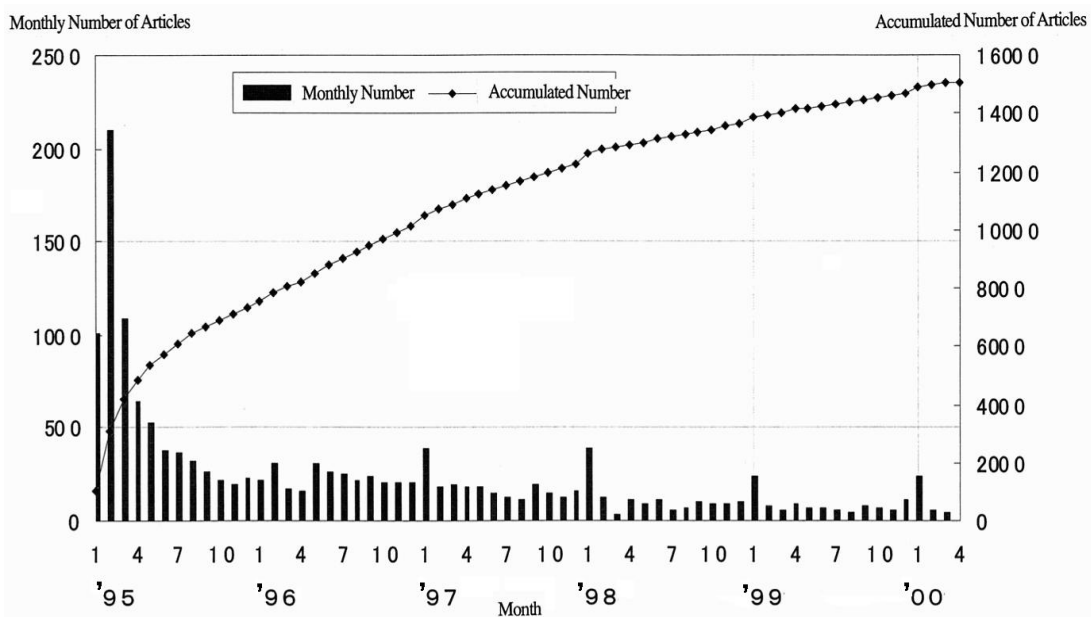

Figure 1. Number of articles by month and cumulative total

As shown in Fig. 3a The time-series fluctuations are characterized by the fact that lifelines (M) and medical care (O) rise in 1995, the first year after the earthquake, and then level off, conforming with the early end of the response in infrastructure development, emergency aid and medical care, the foundations of civic life, in the initial stages of the R&R process. Items on which there were many articles, such as temporary housing and evacuation shelters (U), permanent housing (V), disaster prevention (R), community (H) and vulnerable groups(S), shifted over a long period, showing very minor fluctuations Fig. 3b. Items such as urban planning (F), urban development(N), economy (E), reconstruction (J) and government (G) show similar tendencies, displaying fluctuations midway between the former and the latter, Fig. 3c. In other words, the response in these areas began quite soon after the early response in infrastructure development, but after that, a long-term response became unavoidable. This process is evident in the results. Another feature is the significant rise in mental health (W) in January every year showing the high concern among people in the disaster area even after five

years (Fig.3d). From the above, it can be seen that the fluctuations level off from about January 2000, five years after the earthquake, showing a trend towards slowdown in R&R.
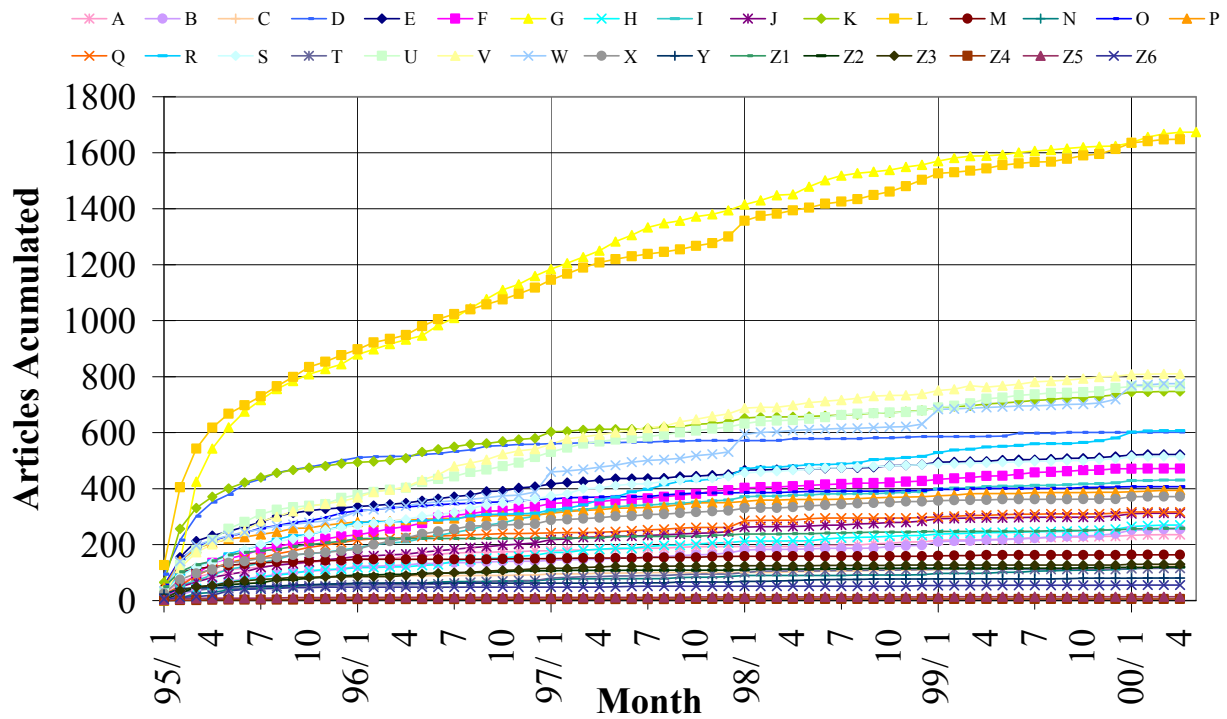

Figure 2. Fluctuations in number of published articles by category

Table 1 Categories and number of articles collected

| Notation	Classification of Articles	Number of Articles	Notation	Classification of Articles	Number of Articles
A	Buildings	236	Q	Experience	317
B	Reconstruction	255	R	Disaster Prevention	607
C	Fire Spreding	123	S	Weak People	515
D	Transportation / Logistics	602	T	Evacuation	116
E	Economic Situation	522	U	Temporary Housing / Refuge	766
F	Urban Planning	472	V	Residential House	810
G	Government	1,674	W	Mental Treatment	775
H	Community	270	X	Information	372
I	Opinions	430	Y	Emergency Response	81
J	Recovery	312	Z1	Earthquake	258
K	Company	747	Z2	Crime	120
L	Assistance / Support	1,648	Z3	Port of Kobe	130
M	Life Line	164	Z4	Development / Invention	6
N	Town Planning	118	Z5	Analysis	14
O	Medical Facility	407	Z6	In-direct Damage	56
P	Education	394			
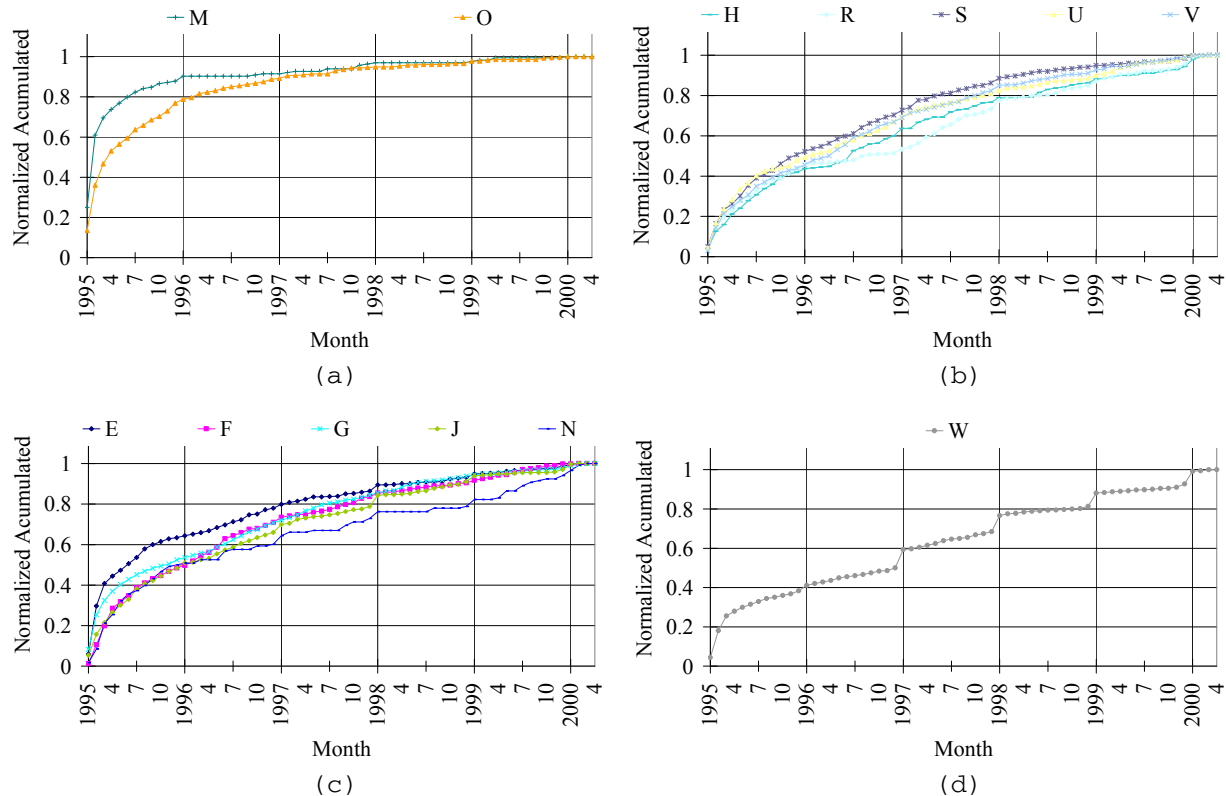
Figure 3. Normalized Fluctuations in number of articles for some categories with different patterns

Restoration/Reconstruction (R&R) Process

Until now, authors tried to analyze the various social phenomena appeared in the damaged urban areas of Kobe during the R&R process based on the frequency of the appearances in newspaper articles. And also, we investigated the R&R process based on the statistical change of residential population of political districts which were settled to selectively accentuated reconstruction zones limited by Kobe City's reconstruction urban planning during 10 years. Just after 5 and 10 years from Kobe Great Earthquake Disaster, Kobe City Government (2000, 2005) published official reports on summary and investigation of earthquake disaster in Kobe City. Finally, as a local government's scope, the R&R process due to the Hanshin-Awaji Great Earthquake Disaster was almost finished and officially was going to be made public the closing of the reconstruction and recovery activities of the disaster and its social influence. Therefore, we investigated many response actions based on the above mentioned two reports.

Restoration/Reconstruction (R&R) Process in Kobe City

Five years after the 1995 Hanshin-Awaji Great Earthquake Disaster, Kobe City municipality published a report of a very complex investigation on R&R situation and process with the title: "The report on summary and investigation of earthquake disaster in Kobe City". This report was summarized verity of detail phenomena about social and residential life

activities during R&R process. In this report the time line of investigations was divided into 5 stages as shown in Fig. 4, starting from the occurrence of earthquake disaster, as named from A to E, and then they summarized the characteristics of each time stage by picking up several representative keywords that appeared to be important. According to Fig. 4, the first three years was heavily influenced by direct damages of infrastructures. Furthermore many indirect phenomena appeared under the influence of direct damages in suffered urbanized areas. And it was obviously recognized that the scope of R&R had been changed with advancing the projects and restoration of damaged infrastructures in the city.

Representative Important Keywords in 5 Stages

The representative important keywords reported in the document "The report on summary and investigation of earthquake disaster in Kobe City" were indicated as follow:

A Occurrence ~ 3 Days
Rescue Activity, First Priority on Human Life Rescue
This period is related with rescue works, safety confirmation and fire fighting if required. Preparation of refuge places, restoring electricity, water, gas and telephone and starting the emergency managing works

B Occurrence ~ 2 Weeks
Start of Refuge Life, Actively Participation of Assistance Detachment
Distribution of relief goods, damage exploration

C Occurrence ~ 2.5 Months
Temporary Housing, Start on Rebuilding by Own Ability, Restoration Activity, Interest in Personal Property
Preparation of temporary housing, reconstruction and repairs. Restoration of life-line and transport facilities. Reconstruction plannings of houses and city

D-1 2.5 Months ~
Convergence of Problems, Bipolarization of Rebuilding by Self-support and Its Difficulty
Rebuilding the damages and solving its financial and social problems. Reconstruction of Public Housing

D-2 ~ 2 Years
Revision and Improvement, Problems on Employment and Economy, Normalization of Civic Life
Completion of restoration on infrastructure. Emphasis on disaster prevention measures. Regional activity on town planning. Reconstruction of local communities. Mental care. Problems on economy and employment. Management of medium and Small-size business

E 3 ~ 5 Years
New Trend, Reopen of Ordinary Measures, Influence Excepting Earthquake Disaster
Permanent housing. Return to ordinary life and social structure. Enhancement of Citizen's Consciousness. 80 % rate of reconstruction

F 5 Years ~
City Planning toward 21st Century
Summary and verification of reconstruction process. Lessons learned from earthquake disaster. Preparation of secure urban basis. Accumulation of industries

Structure of Restoration/Reconstruction (R&R) Process

After 1995 Disaster, the Kobe City Government reported annually about R&R process for ten years and finally in tenth anniversary the summary of 10 year R&R activities were published. In this summary, the important topics divided into 4 stages, 1st Stage; "Information Accumulation Period", 2nd Stage; "Restoration/Reconstruction Period", 3rd Stage; "Urban Reconstruction Period" and 4th Stage; "Lessons Learned From Earthquake Disaster Period". Fig.5 shows the temporal evolving of these stages respectively. Moreover the Fig.4 shows the outline of time historical pattern considering possible cyclic characteristics of earthquake disaster phenomena.

We summarized the representative items of topics in each stage during restoration/reconstruction process of Hanshin-Awaji Great Earthquake Disaster. Also, we analyzed and draw up the detailed structure of restoration/reconstruction process by using the selected topics as the detailed structure scheme of restoration/reconstruction process. Fig.6 shows the detailed structure scheme and Table 2 shows the representative selected topics.

According to Fig.6 and Table 2, it's possible to understand that what topics was appeared and related in each stage of R&R process during 10 years. Furthermore, we can recognized that many important topics related to the main activities on R&R process were concentrated in 2nd Stage (0.5 ~ 5 years) in which requires a very complex structural relations and interrelations between many topics.

Conclusions

In this study, we studied the restoration and reconstruction process made by the city municipality during 10 years after 1995 Hanshin Awaji earthquake on different topics. The engineering topics were investigated by following the Kobe municipal annual reports and summaries and as well as social topics by following the records in daily newspapers for 10 years long. Temporal fluctuations of topics and categories where studied and the ones which lasted the most where pointed out.

Restoration and reconstruction of affected households for ten years, as seen from the newspaper article data, progresses year by year and the curves are flattening out. Furthermore, it can be seen that, after five years, restoration and reconstruction in many elements of rebuilding the lives of the victims is showing a tendency to settle down.

In future, as well as continuing to create the database, it will be necessary to analyze the shifts in number of households and population changes due the disaster when analyzing the R&R process.

The R&R process have shown a very complex structural links between different topics and items specially in 2nd Stage (0.5 ~ 5 years) as shown and written in Fig. 6 and Table 2. However these complex structural links was related only to regional and national socio-economic relationships in rather wide aspects. In case of a large magnitude earthquake such as the expected magnitude 8 Kanto earthquake the R&R process and will demand a much wider socio-economic interactions in an international scale.

Earthquake occurrence

| 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |

A Occurrence ~ 3 days

B Occurrence ~ 2 weeks

C Occurrence ~ 2.5 months

2.5 months ~ 2 years D

3 ~ 5 years E

5 years ~ F

A

Occurrence ~
3 Days :
- - - - - - - - -
Rescue
Activity, First
Priority on
Human Life
Rescue

B

Occurrence ~
2 Weeks :
- - - - - - - - -
Start of Refuge
Life Activity
Participation
of Assistance
Detachment

C

Occurrence ~
2.5 Months:
- - - - - - - - -
Temporary
Housing, Start
on Rebuilding
by Own Ability,
Restoration
Activity, Interest
in Personal
Property

D

2.5 Months ~:
- - - - - - - - -
Convergence of
Problems,
Bipolarization of
Rebuilding by
Self-support and
Its Difficulty

~ 2Years:
- - - - - - - - -
Revision and
Improvement,
Problems on
Employment and
Economy,
Normalization of
Civic Life

E

3 ~ 5 Years:
- - - - - - - - -
New Trend,
Reopen of
Ordinary
Measures,
Influence
Excepting
Earthquake
Disaster

F

5 Years ~:
- - - - - - - - -
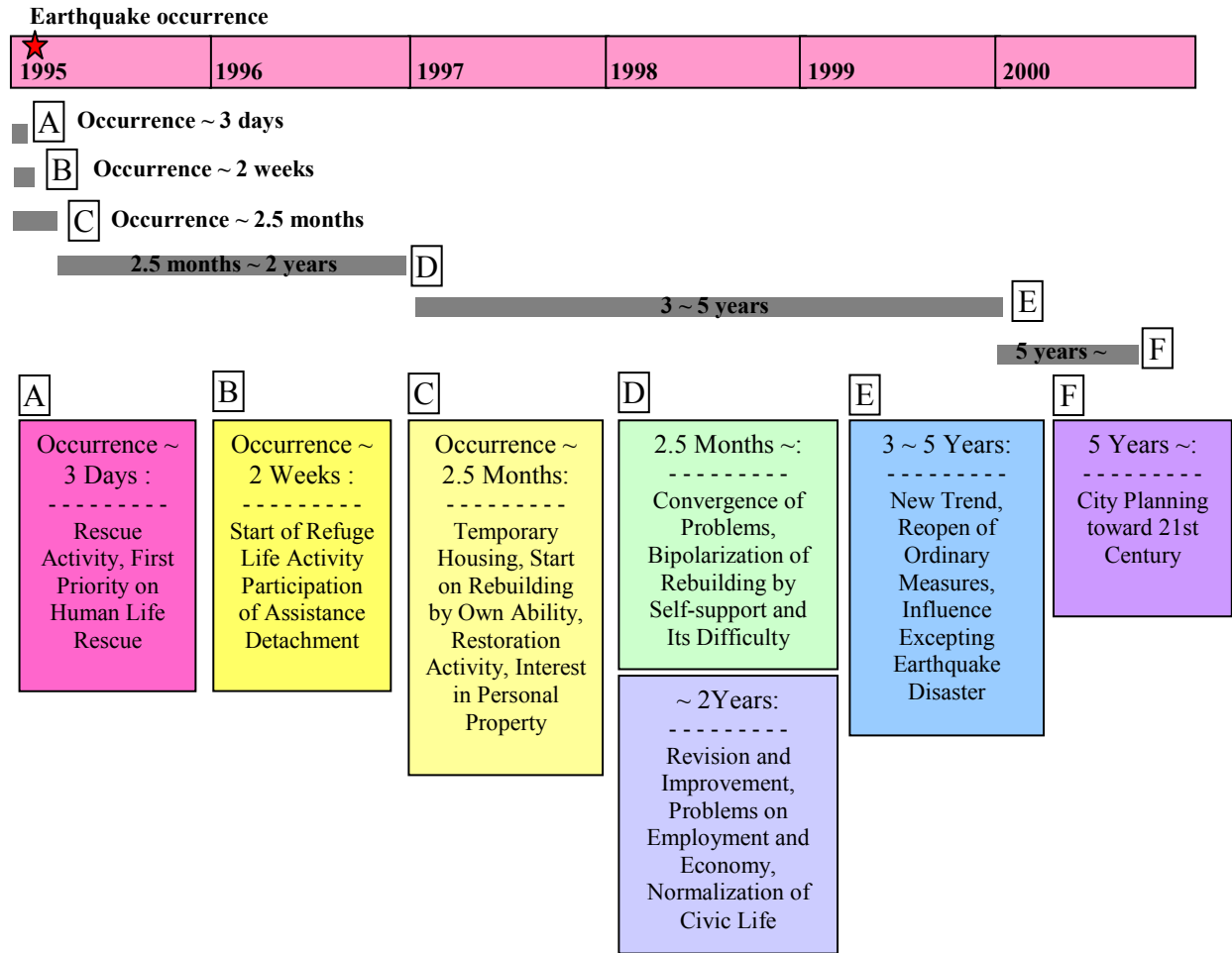City Planning
toward 21st
Century

Figure 4   Division of 5 stages in time historical view during restoration/Reconstruction Process
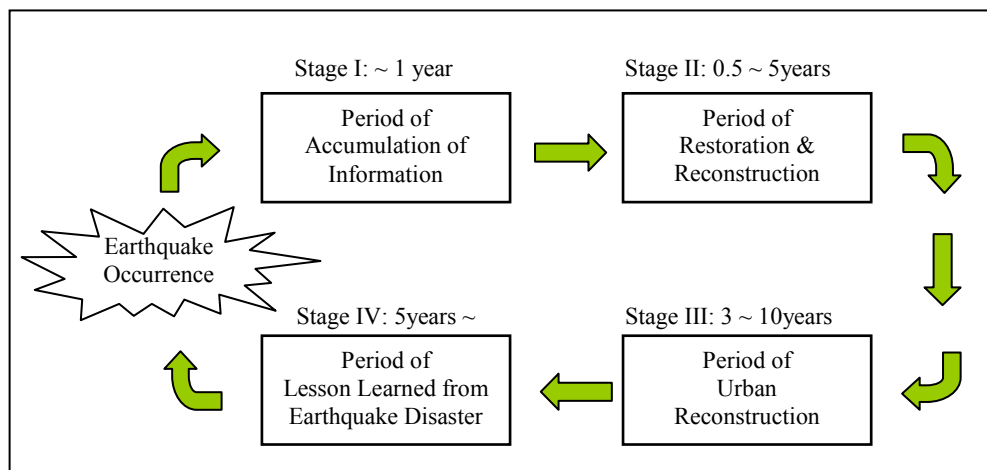Related to the 1995 Hanshin-Awaji Great Earthquake Disaster.

Earthquake
Occurrence

Stage I: ~ 1 year
Period of
Accumulation of
Information

Stage II: 0.5 ~ 5years
Period of
Restoration &
Reconstruction

Stage IV: 5years ~
Period of
Lesson Learned from
Earthquake Disaster

Stage III: 3 ~ 10years
Period of
Urban
Reconstruction

Figure 5.   Outline of Restoration/Reconstruction Process Divided to four Stages Concerned to
the 1995 Hanshin-Awaji Great Earthquake Disaster

Table 2 Explanation of Selected Representative Items and Topics Related to Fig. 5

Stage	Phenomena	Items		Topics
I Accumulation of Information	A Damage Distribution	a Casualties	II-A-a	1 Damage of Hospitals
		b Damage of Building		2 Social Welfare Facilities
		c Damage of Transportations	II-A-b	1 Damage of Agricultural Lands
		d Damage of Lifelines		2 Damage of Agricultural Use Facilities
		e Damage of Agriculture, Forestry and Marine Products Industries		3 Damage of Cooperated Facilities for Agriculture, Forestry and Marine Products Industries
		f Damage of Civil Engineering Facilities		4 Damage of Forestry Lands
II Restoration & Reconstruction	A Restoration of Damaged Structures	a Restoration of Damaged Medical and Social Welfare Facilities		5 Damage of Fishery Use Facilities
		b Restoration of Damaged Facilities for Agriculture, Forestry and Marine Products Industries		6 Damage of Structural Improvement Undertaking Facilities for Agriculture
		c Restoration of Damaged Facilities for Disaster Prevention		7 Damage of Fishing Port Facilities
	B Measures for Restoration and Reconstruction of Damaged Harbors	a Drawing up Reconstruction Plan of Kobe Harbor	II-A-c	1 Early Stage Restoration of Damaged Facilities Related with the Self-Defense Forces
		b Measures for Reconstruction Period		2 Early Stage Restoration of Damaged Fire Fighting Facilities
		c Measures Based on Long Term Views	II-D-a	1 Establishment of Head Office for Emergency Contact Related Small and Medium-Sized
	C Disposal Treatment of Waste	a Scrap Treatment of Waste Generated from Disaster Abolition		2 Establishment of Consultation System
		b Liaison Conference of Related Four Ministry and Agency for	II-D-b	1 Establishment of Committee for Economical Reconstruction of Kobe
		c Drawing up Draft of Management Plan for Municipalities		2 Promotion of Plenary Conference on Reconstruction from Hanshin-Awaji Great
		e Treatment of Asbestos		3 Establishment of Incorporated Foundation for Promotion System on Hanshin-Awaji Industrial Reconstruction
	D Reconstruction of Economy	a Support of Damaged Small and Medium-Sized Enterprises	II-D-c	1 Offer of Temporary Letting Out Factories
		b Propulsion of Economical Reconstruction		2 Real Reconstruction Countermeasures for Manufacturing Industries
		c Reconstruction of Small, Medium-Sized Enterprises and Local		3 Real Reconstruction of Fashion Industries
		d Reconstruction Situation of Trade and Distribution Businesses	II-D-d	1 Summaries of Reconstruction Situation of Shopping streets and markets
		e Reconstruction of Gathering Customers and Interchanging		2 Damaged Situation and Reconstruction Activity of Foreign Trades
		f Agriculture		3 Change of Action and Consciousness for Shopping
	E Infrastructure	a Life Line System	II-D-e	1 Damage and Reconstruction Situation of Tourist and Lodging Facilities
		b Transportation System		2 Recovery of Tourists
		c Rivers System	II-D-f	1 Influence of Earthquake Disaster on Agricultural Facilities
III Urban Reconstruction	A Creation of New Industries	a Enterprise Zone	II-E-a	1 Electricity System
		b NIRO	II-E-b	2 Gas System
	B Specified Undertakings for Reconstruction	a Shanghai-Yangtze River Trade Promotion Project		3 Water Supply System
		b Health Care Park Project		4 Information and Communication
		c New Industrial Structure Formation Project	II-E-c	1 Railway System
		d Hanshin-Awaji Great Earthquake Disaster Memorial Project		2 Road System
	C Policy Making for Reconstruction of Life and Residential Housing	a Law of Reconstruction Support of Life for Victims		
		b Support System for Dwelling Stabilization	II-E-b-2	i Town Gas System
IV Lessons Learned from Earthquake Disaster	A Revision of Fundamental Law for Measures to Deal With Natural	a Revision of Fundamental Law for Measures to Deal With Natural		ii Liquid Propane Gas
		b Revision of Special Measure Law for Anti-large scale earthquake	II-E-b-3	i Water Supply System
		c Specification of Special Measure Law for Earthquake Disaster Prevention		ii Sewer System
		d Reconsideration of Regional Disaster Prevention Plan	II-E-b-4	i Electricity and Communication System
		e Revision of Fundamental Law for Disaster Prevention		ii Broadcasting System
	B Preparation of Adaptation System Against Disaster	a Reinforcement of Disaster Information Accumulation and		iii Postal Service System
	C Phoenix Disaster Prevention System	a Sub-system		
	D Specialized Volunteer System for Disaster Relief	b Phoenix Disaster Relief Team		
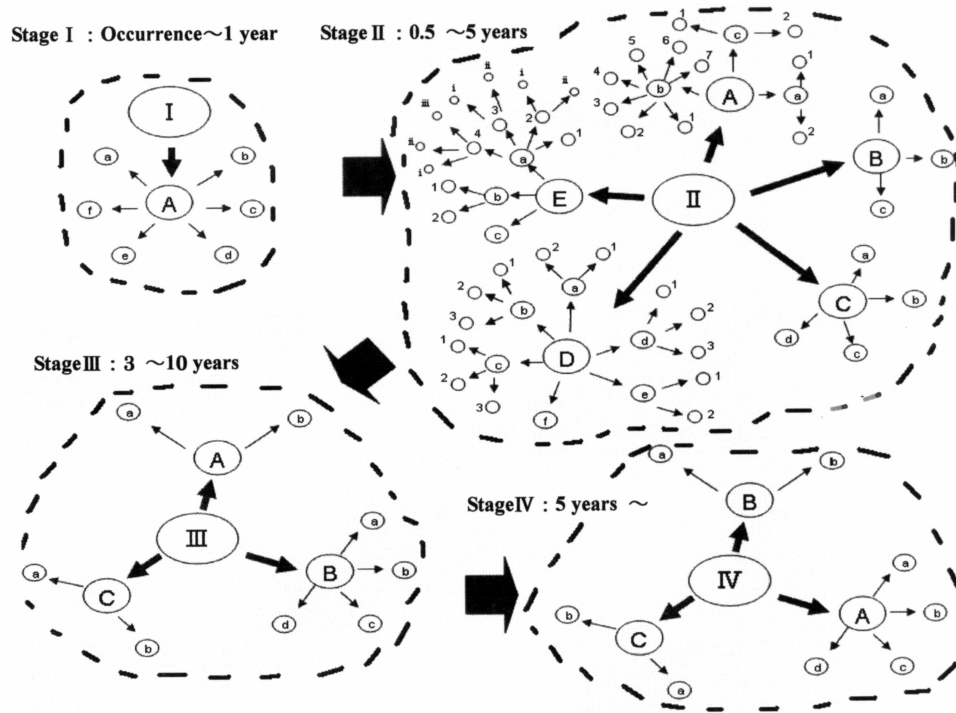
Figure 6.   Analyzed structure of Restoration/Reconstruction process using picked up
representative topics

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