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Urban Information Infrastructure
– One Year After Great Hanshin and Awaji Earthquake –

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From the Editor

The Great Hanshin and Awaji Earthquake struck at 5:46 on the morning of January 17, 1995. It was the first large-scale earthquake to hit a major city since the Great Kanto Earthquake of 1923, and caused major damage as is typical of earthquakes occurring directly beneath a city. According to figures released by Kobe City, 4,567 people were killed, 1 person unaccounted for, and 14,679 people were injured. Approximately 58% of all deaths were of the elderly (over 60 years old), and deaths due to the collapse of buildings accounted for approximately 73% of all those killed. In all, 67,421 buildings or structures were totally destroyed, with 55,145 partially destroyed (as at Dec. 12, 1995), of these 6,965 buildings or structures were completely destroyed by fire, with 80 semi-destroyed, and 270 partially burned (data as of Feb. 1, 1996). A total area of 81.9 ha was destroyed by fire, and there were 175 incidents of fire (59 occurring at about the same time as the earthquake hit).

As for the degree of damage to information-communications networks, eight exchanges were affected due to long-term power outages and damage to generating equipment, paralyzing as many as 285,000 telephones. The fiber-optic cables of interexchange lines were severed due to the collapse of the Hanshin Expressway and the JR facilities along which they were laid. Telephone lines were badly damaged by fire and the collapse of buildings, and approximately 193,000 telephone lines and 4,000 private lines suffered damage.

Amidst all the wreckage, however, a large amount of information-processing equipment escaped harm, and because many of the machines that were overturned retained their information function, they were able to play an important role in transmitting information at the time of the disaster and also during the recovery afterwards. Companies that did not suffer damage to their information-processing equipment are considered to comply with the "Standards for Computer Safety Measures" planned by the Ministry of International Trade and Industry (MITI). The disaster was

used as an opportunity by MITI to completely overhaul the relevant standards in line with recent developments in data transmission technology. The new standards were recently released as the "Standards for Information System Safety Measures." Cellular phones played a major role as substitutes for fixed telephone lines, and following the earthquake, the surrounding Kansai area had the highest rate of cellular phone use in the country.

Computerization in cities, including that by administrative bodies and private enterprises, is continuing to advance at a rapid pace, and should a city's information base suffer major damage, the effects would be extremely serious. It is vital that disaster information-transmission systems be provided that the disaster-resistance of information systems be improved in order to cope with future urban disasters. For example, 0.2% of underground cables suffered damage in the Great Hanshin earthquake, while the figure was 0.6% for overhead cables, demonstrating the superiority of underground cabling. Unfortunately, progress in burying cables is being made in only a few areas in Japan, even in major cities. While speedy progress ought to be made from both an aesthetic and disaster-prevention standpoint, it is a fact that there has been little progress due to high costs and a lack of cooperation of administrative bodies. Apart from the provision of infrastructure for these networks, there are numerous problems that remain have to be solved, such as the establishment of effective disaster-proof information systems, standardization, and deregulation.

In this issue, the Great Hanshin and Awaji Earthquake is used as an example what can happen to information security during an urban disaster. We hope our readers will find this discussion useful.

Yuji Yamadori
Director
Research & International Affairs

I. Urban Information Infrastructure

—— One Years After Great Hanshin and Awaji Earthquake ——

Michihisa Matsumoto, CRC Research Institute Inc.

Introduction

The Great Hanshin and Awaji Earthquake which occurred in January of last year claimed over 5000 lives, and was the biggest disaster since the end of the World War II. This major earthquake sounded alarm bells against the ways of building various technology and systems in Japan in recent times, and also taught many lessons.

Over the past decades, and especially during the past few years, with the progress in information technology, various kinds of social activities have come to depend on information systems. The earthquake was the first major disaster to be experienced since the beginning of social systems supported by such information systems, and it made apparent the problems and tasks facing the handling of a crisis situation by the unplanned present social system and the information systems used within it.

In this report, the relationship is reassessed between "urban systems", the social systems in urban areas, with particular attention to systems formed by private economic activity, and information, or "information system" measures for handling that information. An attempt is made to analyze from an informational viewpoint the events which occurred following the Great Hanshin and Awaji Earthquake, and the positioning of information in urban areas, as well as the relationship with risk management are investigated.

1. Information as an urban infrastructure

1.1 What is meant by "information" in "urban areas"?

Various definitions of "urban areas" have been put forward up until now from political and sociological viewpoints, and the most important are given below.

• Requisites for "cities" described under the Regional Autonomy Law

(1) A population over 50,000.

(2) More than 60% of homes lie within the area formed by the central urban district.

(3) More than 60% of the population are involved with urban businesses such as commerce and industry etc.

• Requisites for the population concentrated areas or "Zonal units for statistics revealing the special characteristics of urban areas" in state-of-the-nation research[1]

The national research zones are generally set at having populations exceeding 5,000, with a population density over 4,000 per square km. However, there are cases where area which do not satisfy the population conditions but which have community and business facilities are included in the population concentrated areas.

• The understanding of "urban areas" as a research theme in urban sociology

According to Yoshimi's reorganization[2], in urban sociology "space" in urban areas is exceedingly artificial and cultural, and quoting the words of R. E. Park, only when this space is "linked to the individual or community, or at the limits, does the initially existing part of the urban area become a valuable item, and also becomes an unexpected device".

From these definitions of "urban areas", it is thought not unreasonable to conclude that up until now urban areas were understood to be locations where "people" and "property" were concentrated. In the reorganization of these definitions, let us first define urban areas as places where the subject of activities, "people", and the object of the activities, "property", are concentrated to a high degree.

However, no one can deny that in recent years the activities in urban areas have become highly developed due to advances in information technology such as telecommunications, broadcasting and computers. The various activities of current society are deeply immersed in information technology, and we have become an "information society" supported by this technology. With this in mind, the accumulation of the new activity component "information" could also be added to the next definition of

urban areas in addition to the vital elements of "people" and "property" put forward as making up urban areas.

Here, "information" may be considered to include both that with a time lag (or where time is not important) between accumulation and use, such as statistical data, organizational or procedural instructions (methodology, know-how), lists describing conditions (lists of names, registers etc.), and information having a dynamic nature, such as "directions" or "messages" etc. where there is mostly no time lag between occurrence and use. The former type will hereon be referred to as "accumulated information", and the latter as "dynamic information".

[1] "1995 State of the Nation Report", Management and Coordination Agency Statistics Office (1996)
[2] Toshiya Yoshimi: "Observations on Space", Urban Frontier 1 - Organization, space, methods. Susumu Kurasawa et al. pp.111-139, Japan Hyouronsha (1992)

1.2 The information infrastructure for urban areas

If the "urban infrastructure" is to be thought of as the static elements of urban activities through "people, property, information", in the case of information, "accumulated information" stated above covers both the accumulated information itself and the information systems for handling it, while "dynamic information" covers the information systems supporting the creation and transmission of the information. These exist continuously, supporting urban activities, and it is appropriate to refer to these as the "urban information infrastructure or "information infrastructure".

Table 1 shows the urban infrastructure with "organization and system" from a "people" viewpoint, and location, with the urban infrastructure rearranged from an information viewpoint to handle the main information systems in the present society.

However, this table does not necessarily include currently existing organizations and information systems since it is an intuitive reassessment. In this table, it is also necessary to note the big differences in the state of progress of computerization for each organization and system in public and private computerization and information systems.

Table 1: Urban foundation and the supporting information systems

(Part 1) Public

Urban infrastructure			Representative information system
Administration	Administration services	Notification, procedures etc.	Residents basic registry management system
	Safety	Police	Police network system
		Fire service	Fire service prevention system
	Health	Hospitals	Medical service information system
	Health and sanitation	Health centers	Combined health and medical system
		Rubbish management	Waste management system
	Welfare	Senior citizens, disabled, juveniles, mother & child	Combined welfare information system
		Social welfare council	Regional welfare information system
	Education	Compulsory education	School administration system
		Higher education	School administration system
		Lifelong study	Lifelong study information system
	Leisure	Cultural amenities	Amenity management system
		Sports amenities	Amenity management system
	Labor	Employment centers	Job vacancy information search system
	Business management	Small and medium sized businesses	Business diagnostic system
	Housing		Housing management system
	Transportation	Roads	VICS
		Railways	Operation control system
		Ports	Ports management system
		Airports	Airport control system
	Vital public utilities	Water supply	Water rates system
		Sewage service	Sewage map management system

	Mail	Post office	Postal savings system, insurance system
	Legal Affairs Bureaus		Land register information management system
	Social insurance		Social insurance system
	Tax	Tax offices	Tax information/collection system
Legislation			Assembly data integrated application system
Justice	Law courts		Case searching system

(Continued on next page)

(Part 2) Private

Urban infrastructure			Representative information system
Primary industry			Greenhouse cultivation management system
Secondary industry	Construction industry		Works management system
	Manufacturing industry	Basic materials class	Production management system
		Processing and assembly class	CALS
		Daily life class	EOS
	Other secondary industries		Production management system
Tertiary industry	Distribution	Food distribution	POS system
		Daily necessities distribution	POS system
		Oil distribution	POS system
		Other distribution	POS system
	Services	Individual-oriented services	Customer management system
		Business-oriented services	Customer management system
	Financial insurance	Banks	Bank accounts system
		Life insurance, non-life insurance	Insurance policy management system
	Electricity		Electric power network control system
	Gas		Gas main mapping system
	Communications	Telephones	Telephone exchange system
		Broadcasting	Broadcasting information system
		Cable TV	Broadcasting information system
		Electronic mail, internet	WWW, FTP, SMTP
	Other tertiary industries		Sales control system

While there are also urban infrastructures where the information systems are fixed among the functions, and the information systems themselves are aging, their appearance is not uniform with urban infrastructures where the concept of information systems supporting functions has only just been set up and instances of actually working systems are few, or urban infrastructures at even earlier stages. There are also differences in the development of computerization due to the awareness and matching of timing of individual administrative bodies and private businesses, and so the situation is not uniform even within a single urban infrastructure.

Even within the same organization or system, ideas differ according to individual subjects on computerization and systemization, and the extent of work involved with a single information system differs. Recently in particular, the integration in direction is increasing in both private and public sectors. In the private sector, systems for accounts, financial affairs, sales, and stock control etc. which have up until now been operating separately, are now being made to cooperate mutually allowing the building of an integrated business system. There are also examples in the public sector where local governments are constructing integrated management systems as "urban information systems" from map data. However, the integration of such systems is proceeding according to policies reflecting the differences in organizational and business configurations of enterprises and local governments, and this makes it difficult to define a general configuration.

In the private sector, cooperation of systems between businesses via networks is progressing through business groups, fellow businesses, regions, and distribution systems. It is estimated that in the same way that business activities have increased dependability on information systems, cooperation like this will create large scale and wide area information systems supporting socio-economic activities (1.

(1 With the present handling of EC, EDI, CALS etc. through their cooperation, it is possible to cover the development from "single business information systems" to "systems for economic activities on a social scale".

2. Information systems in disasters

2.1. Business operations in earthquakes

If urban areas are defined as the space for activities based on "people, property, information", businesses possess parts of the "people, property, information", and form activity locations closely related to other "people, property, information". They can be understood as one "urban subsystem".

So, in the aftermath of a disaster damaging the entire urban area, the kind of activities which are essential for these urban subsystem businesses can be broadly grouped in the following three classifications.

- Preventing damage from spreading
- Assessing damage status
- Restoring functionality

"Preventing damage from spreading" involves measures to prevent major damage to facilities from secondary disaster, particularly in the case of businesses handling highly inflammable or noxious substances. In the Great Hanshin and Awaji Earthquake, measures by related businesses supposing damage beforehand and afterwards were effective, and no large scale secondary disaster was triggered. For example, Kansai Denryoku (Kansai Electricity) made arrangements for TV and radio announcements (the necessary tapes had already been distributed to broadcasting studios) asking people to switch off main circuit-breakers when away from home to prevent fires, and even when restoring services, power was not provided to unoccupied homes[3]. Similarly with cooking oil manufacturing businesses, utmost priority was given to restoring safety of inflammable and explosive materials [4]. The relief of company employees and the citizens in the neighborhood of company facilities is also included in this category, but there was various information in this area with differing individual degrees, and such activities were conducted over a very wide area.

Regarding "assessing damage status", the identification of damage to facilities and equipment including those unstaffed at the time of the earthquake was carried out relatively quickly (1. However there were numerous cases of problems in assessing injuries to employees and customers due to effects of

disrupted transportation and communications.

The effect of suspended transportation and communications is large and so more than assessing damage status, "restoring functionality" requires the most time. First of all at a "people" level, many businesses restructured using staff limited to those already on duty or those who were fortunately able to get to work. After carrying out steps for "preventing damage from spreading" and "assessing damage status" as described above, they restored the functions as much as possible of damaged equipment, and reopened for business using limited resources. Many cases were observed where working procedures different from those prior to the earthquake had to be used for reopening businesses due to the suspension of information system functioning. For example, at one distributor, the customer ordering system was down due to damage to the computer, and so the crisis was endured by classifying sorting labels by a "card game method" and introducing an order-book system as a substitute. Similarly, at one hospital, ordering for medical supplies etc. and medical accounts were switched to paper-based systems, and data to be recorded was entered into the system after restoration.

However, business functionality is not necessarily restored just by restoring the guarantee of the company's individual resources and work arrangements. Business functionality is reliant on economic activity of the entire population of the region, and the restoration of functionality of consumers and customer businesses is necessary for the true restoration of business functionality. It should be noted that in the Hanshin and Awaji Great Earthquake, not just in the meaning of "services to the region", there was active supply and stocking of goods beyond prior business relations and aid to citizens in the disaster area.

At the end of the day, it must not be forgotten that the recipients of such actions were human beings, and in (many cases) disaster victims. Supply and transportation of food and daily necessities in the area was extremely difficult, even for oil distribution businesses and vital services able to assemble the manpower necessary for wide area support. Under conditions like these, the importance also of maintaining staff morale and accurate decision-making was indicated for businesses hit by the disaster.

(1 However, there were many cases where only simple external assessments were made, and while initially buildings were judged safe to use, they were later deemed as structurally dangerous following the results of inspections by experts.

2.2. Information systems in the Great Hanshin and Awaji Earthquake

In addition to physical damage such as the collapse of buildings and toppling of hardware caused by the earthquake to information systems, functional damage due to suspension of communications and vital services (although there were no problems with the hardware itself, it could not be operated) was indicated as a blind spot in hardware disaster countermeasures up until then. From previously, MITI's "Information Systems Safety Countermeasure Standards", and "System Inspection Standards" were set out. In the Great Hanshin and Awaji Earthquake, these standards were shown to be adequate for protecting against damage sustained by facilities housing hardware, but at the same time it was shown that forecasts were not necessarily adequate in situations like this major earthquake where almost the entire was hit by the disaster and vital services were cut for long periods of time.

There was mostly no damage to the safety of buildings and to hardware located within them conforming to these standards, and hardware which sustained damage were those which did not adequately conform (1. In the survey, it was proved that there was machinery which could be operated normally even among the hardware knocked down or overturned by the earthquake. However, such cases should be considered as being fortunate, and there cannot be overconfidence placed in the strength of hardware. Furthermore, because the Great Hanshin and Awaji Earthquake occurred early in the morning, there were no great problems caused by people being close to hardware. However, the toppling and scattering of hardware is a cause of personal injury, and so it is necessary to tackle these measures thoroughly.

As reported in the news, of the damage to vital services caused by the earthquake, power was quickly restored, but water and gas supplies took time. As far as power, under which information systems operate, was concerned, measures were relatively advanced with on-site generation etc., but the measures

against interruptions to the indirectly related water and gas supplies were certainly highlighted as weak points. The majority of air-conditioning systems for cooling mainframe computers are water-cooled, and some facilities employ air-conditioning equipment using natural gas, so the interruption of water and gas causes great problems with the cooling of mainframe computers. Fortunately, being winter, temperatures were low, and many cases were observed where operation was possible by protecting computers from heating up by using large cooling fans. However, if the earthquake had occurred in the summer, operation would not have been possible without air-conditioning, and this can only be called good fortune.

Apart from problems like these from the usage and facility equipment, there were hindrances resulting from usage of the information systems themselves. In particular, many examples of lost data due to fires etc. were seen because of insufficient awareness on backing-up data. Even in cases where backups were made, this was more of a measure to overcome problems with the system, and not much consideration was given to restoring the system through decentralized arrangements or periodic collection of backups. Countermeasures for the back-up of information systems themselves were poor, and there were numerous cases where reliance had to be placed on support from the manufacturer.

With the recent increase in dependence of business on information systems, large amounts of vital information are managed as magnetic data, and so the effect on business operations of loss of data or interruptions to information systems has become substantial. In the Great Hanshin and Awaji Earthquake, many cases were seen where time was needed to restore past customer records or problems were encountered in restarting business because of customer data lost through actual losses of data. Similarly, there were many cases where even when data hadn't been lost, it could not be used for rebuilding work as the contents could not be extracted due to the system being suspended. The effects of interruptions to information systems are not just on accumulation, but are the same on promoting business. The steps for managing information collected by the replacement "card game system" and order book systems of the distributor mentioned previously were

not sufficient, and it was simply a case of waiting for the restoration of information systems to enable the smooth promotion of business.

(1 In the survey, cases were reported where machinery fitted with castors predicted to move on the floor during an earthquake and prevent toppling were not able to withstand the vertical earthquake movement and overturned. In the "Information system safety standards" machinery is to be fixed to the floor.

3. Improving the disaster resistance of information systems

3.1. Lessons from the Great Hanshin and Awaji Earthquake

(Main human and organizational points)

When disaster occurs, those responsible for enacting from the "prevention of damage spreading" to the "restoration of functionality" are after all "people". In the situation of a major disaster with non-existent transportation and communications, there are expected to be people who have difficulties in getting to work or returning home. In reality, in the Hanshin and Awaji earthquake due to traffic paralysis for many days immediately after the disaster, many examples were seen of trouble getting to work and of obstacles in work to build the system for countermeasures. And not just because of transportation and communication problems, staff members on whom the countermeasures are reliant may also themselves be disaster victims. The Great Hanshin and Awaji Earthquake taught various lessons concerning proceeding with disaster countermeasures using the staff limited to those able to be assembled under the conditions.

Frequently heard during the research was the necessity for a "key people" to supervise the countermeasures. They would be leaders to shake of the pervading feeling of despair and bring about change by carrying out decisions, and specialists familiar with business able to make accurate judgments on the actions and methods required on those fronts. With these key people as pivots, how swiftly structures could be established for countermeasures was indicated as the important point.

(Management of information resources and use of information systems in disasters)

There is not expected to be any change

in the importance of leaders, but the importance of specialists is expected to further increase in the future. Even up until now, the business related knowledge accumulated within the heads of specialists has provided support, but this is because of the trend of increasing difference in knowledge of business "supervisors" and business "specialists" due to expansion and progress of business as well as the accompanying spread of information systems.

Information systems not only contribute to the business efficiency and handling ability of industry, but also bring about effects to enable advanced application of information, and to alleviate the burden of training by simplifying part-time work. That is, by accumulating specialists' knowledge in systems, the burden of business managers to acquire knowledge has been alleviated. With such systems, the situation is now that knowledge necessary for the original business is treated as a "black box", and knowledge of the system beyond that of operation is not required of business managers. A situation like this brings about the difference between business managers and business specialists. With the increase in information system users and the spread of knowledge treated as a "black box", the increase in the numerical disparity between managers and specialists will also be one reason for the greater importance of specialists.

To make good this disparity, the situation is necessary for specialists' past knowledge to be documented and be able to be accessed by managers in times of disaster in order for business managers to truly have the ability to support the specialists. In disasters, there is a limit to how business can be reconstructed to normality, but without an understanding of the business organization in a normal situation, the restoration of business will be impossible within the restrictions. This business related understanding reveals business functions which must be spread immediately, data which must be restored with high priority, and records which must be kept, and makes possible the swift resumption of business.

Even in the Hanshin and Awaji earthquake, some companies had prepared "disaster manuals" or similar documents, but these manuals were not necessarily of use for actual disaster countermeasures. The details of the manuals were not always widely known, but the real

problems were that expectations in the drawing up of disaster prevention manuals were not sufficient, and also there were too many areas where the expertise of certain individuals was relied upon for the actual restoration of operations. Disaster countermeasures have been reviewed in various organizations following the earthquake, but following these lessons, the following three points can be put forward as items for constructing disaster countermeasure plans which will form an accurate guide during times of disaster.

a. Construct an enterprise model revealing overall how the business has been run up till now.

b. Investigate what substitutes can be made if resources (people, equipment) supporting the business are lost, and what can be prepared now as substitutes.

c. Reassess what things have essentially a small effect on business even if lost, and what things have a major effect if lost.

The enterprise model in a. does not just outline a summary, but should describe the details of each individual business, namely as far as specialist knowledge, reveal the information, property and equipment necessary for undertaking business, and analyze the relationships between the intermediary business. With an analysis like this, a comprehensive analysis of the entire business activity is made possible, and it is possible to clarify the black-box organization of the business and the whereabouts of equipment and information within the company. This facilitates the construction of an action manual for times of disaster and the investigations in b. and c., and allows more exhaustive investigation.

While in the investigations in b. and c. it is necessary to consider policies for safeguarding within the limits permitted by costs resources for which there are no substitutes, for items like information systems for which substitutes and dispersed locations are simple, it is safer and more cost effective to decentralize them at a range so that they are not simultaneously damaged rather than upgrading the individual physical safety.

With information systems, even in the worst case as long as the data and program backups remain, it is possible to

restore the data and processing. If it is just data and programs, the decentralization of backups is simple, and with this alone it is possible to increase the degree of safety. Even for backing up the entire system, services are available for leasing part of an extremely disaster-proof computer center or outsourcing services using these facilities. In most cases, combining these steps is more effective and cost efficient than devising measures for improving the original disaster resistance of resources kept centralized.

With this process, from the description of an enterprise model to the construction of a disaster action manual and investigation of cost etc. of disaster countermeasures, a resemblance is apparent with systems analysis process of the information system structure. With systems analysis up until now, as business analysis, through interviewing etc., the property and flow of information of the business being examined are absorbed from business specialists (referred to as "domain specialists" in the systems analysis field), and systematic analysis and reassessment work is being carried out. Construction of a new business system is being carried out assuming adoption of a new information system based on this, and an analysis on the cost front of the transition between the new and old systems is generally being conducted.

For example, when considering the disaster handling of all companies, and the normal risk management, the business analysis methods used in systems analysis can be used as they are by altering the viewpoint somewhat. Also, even in the examination of the business model during a disaster, systems analysis methods are believed to be effective as methods for reassessing the results. Naturally an examination with expert knowledge is required for the various assumptions at the occurrence of disasters and the business and operations peculiar to disaster situations, but it is believed that consideration be given from business system analysis and reassessment point of view to the participation of information technologists in the drawing up of the disaster countermeasure guide.

3.2. Viewpoints on improving the disaster resistance of a highly computerized economy

Measures to improve the disaster resistance of a networked economy

Disaster resistance of transaction data

The speed and efficiency of inter-industry communications are currently being improved with electronic transactions such as CALS (Continuous Acquisition & Life-cycle Support), EDI (Electronic Data Interchange) and EC (Electronic Commerce) etc. being pushed on all aspects as the single goal.

Computerization and networking of communications is progressing through the promotion of computerization at each company, and despite the efforts to increase speed and reduce paper, paper still streams between companies. With the current mainstream configuration, the conversion to the computerized company internal distribution protocol (essentially paper data is input into the information system) is a burden on both time and labor.

As one of the characteristics of the practical configuration of the process towards such electronic transactions, the replacement of the up till now paper-based information exchange between companies with electronic data exchange via networks will progress.

In the progression of current transactions, each company inputs information like this into their information systems, and the fixed period will exist where it is replaced with magnetic data. For this reason, if by chance damage occurs to the magnetic data, back-up is possible from the original paper-based documentation. However, with electronic transactions, no original paper records exist, and so the meaning of magnetic back-ups becomes even more important. How to raise the awareness on guaranteeing the safety of data owned by the company is thought to be a problem for every company.

Tackling network and system troubles in disasters

Replacing the business performed by information systems with manual operations involves tremendous difficulties. In the case of electronic transactions also, where transactions via networks are the norm, introducing transactions via paper and telephone as now will intermix differing transaction protocols, and end up causing a reduction in labor and financial transaction efficiency. If there are no advantages for the transaction partner corresponding to this drop in efficiency, it is predicted that a trans-

action configuration like this will be difficult to accept.

If a large number of companies cannot participate in electronic transactions due to damage to networks or systems in a major disaster, the formation of consensus with companies involved in electronic transactions and agreement between the parties concerned regarding the personnel and financial burden of transactions with such companies may be problematic. Also, the maintenance of reliability of settlement methods (settlement administration bodies and their systems) on the network in the period of chaos immediately following the disaster may be problematic. On the problems relating to faith in transactions, because there are many cases where smaller businesses and individuals are in a position of disadvantage, care is required in examining these so as not to put smaller businesses and individuals at a disadvantage.

As tasks for the improvement of disaster resistance of private sector information systems in the future, considering these trends also,

1) In order to maintain economic order following the occurrence of a disaster, measures are needed which do not harm the functioning even when the information system of the financial organization supporting the faith sanctioned system and the information system controlling the credit and debt data of every company have been hit by the disaster.

2) In order to progress smoothly with the restoration of regional economic functioning (particularly distribution functions) following the occurrence of a disaster, redundancy allowing the maintenance of the system's entire functioning and flexibility allowing the demonstration of these functions even in emergencies are needed even when part of the information system supporting distribution and material flows has been damaged in the disaster.

3) Thorough examination is needed into priority rankings and methods of the restoring information systems, reopening work, and guaranteeing essential staff, in order to progress smoothly with the resumption of business following the occurrence of a disaster.

4) The expediting of mutual holding of information by information system

managers, and the establishment of co-operative relationships with information system operators in emergencies including the maintenance of replacement information system equipment are needed in order to progress smoothly with the restoration of information systems hit by the disaster.

II. Results of Survey into Information Security (Extracts)

In order to ascertain the status of our nation's measures to deal with the security of information systems, the Japan Information Processing Development Center has conducted a "Survey into Information Security" every alternate year. Here we present the results of a survey conducted in January 1996, one year after the Great Hanshin and Awaji Earthquake, into countermeasures to deal with disaster and unforeseen problems.

Survey into Information Security

(1) Survey Objectives

This survey was conducted on the information systems divisions of business enterprises and similar organizations and investigates the current status of information security in this country, as well as the prevailing consciousness vis-à-vis this issue. The aims of the survey have been not only to ascertain the present status and problematic issues surrounding this question, but also to help to advance information security in the future.

(2) Survey Subjects

Forming the subject of this survey were the 4,743 business concerns comprising the population of the biennial "Survey into Information Security" conducted by the Japan Information Processing Development Center.

(3) Survey Period

Survey forms dispatched January 30, 1996
Collection deadline February 20, 1996

(4) Collection Data

Number dispatched	4,743
Number collected	1,391
Retrieval rate	29.3%

(5) Average number of employees of responding concerns

Average number of employees:

2,230

(6) Items surveyed

(1) Information system assets (5 items)
(2) Implementation of the Ministry of International Trade and Industry's safety countermeasures (6 items)
(3) Past results in dealing with trouble etc. (4 items)
(4) Information security control (14 items)
(5) Countermeasures to deal with disaster and unforeseen problems (9 items)
(6) Back-up countermeasures (7 items)
(7) Measures to combat illegal accessing (10 items)

(7) Business Categories of Survey Subjects

The businesses engaged in by survey subjects have been classified into 40 categories. However, for the purposes of this report, they have been reclassified in the manner below and displayed as "business category groups."

Business category group	Business category	Number collected
Food, paper, pulp, textiles, printing	Food manufacturers	52
	Textile industries	26
	Paper, pulp, processed paper manufacturing industries	13
	Printing and related industries	5
Petroleum, chemicals, iron & steel, non-ferrous metals, metals	Chemical industries	63
	Petroleum product manufacturing industries	8
	Iron & steel industries	26
	Non-ferrous metal manufacturing industries, metal product manufacturing industries	53
Electric machinery, general machinery, transportation-related machinery	General equipment & machinery manufacturers	41
	Electric machinery & equipment manufacturers	77
	Transportation machinery and equipment manufacturers	51
	Precision machinery and equipment manufacturers	17
Other manufacturing industries	Ceramic industry, clay & stone product manufacturers	17
	Other manufacturing industries	73
Commerce	Wholesale industries, trading concerns	131
	Retail industries	49
Financial & insurance industries	Banking business	160
	Securities brokers, commodity brokers	4
	Life insurance concerns	14
	Non-life insurance concerns	7
Information processing services	Information processing industries, software industries	113
Other business-oriented services	Agriculture-, forestry-, game-, and aquaculture-related industries	1
	Mining industries	2
	Construction industries	68
	Newspaper & publishing industries	9
	Real estate concerns	9
	Transport-, communications-, and warehousing-related businesses	50
	Electric power and gas industries	14
	Broadcasting industries	12
	Advertising, research, and information services	6
	Other service industries	37
Subtotal		1208

Public services	Medical industries	10
	Religious corporations	0
	High schools	9
	Universities	31
	Other educational institutions	14
	Organs of scientific & academic research	5
	Bodies corporate, agricultural cooperatives	33
Government, local public bodies	Government	7
	Local public bodies	74
Subtotal		183
Grand total		1391

3. Detailed Survey Results

3-1 The Status of Information System Assets

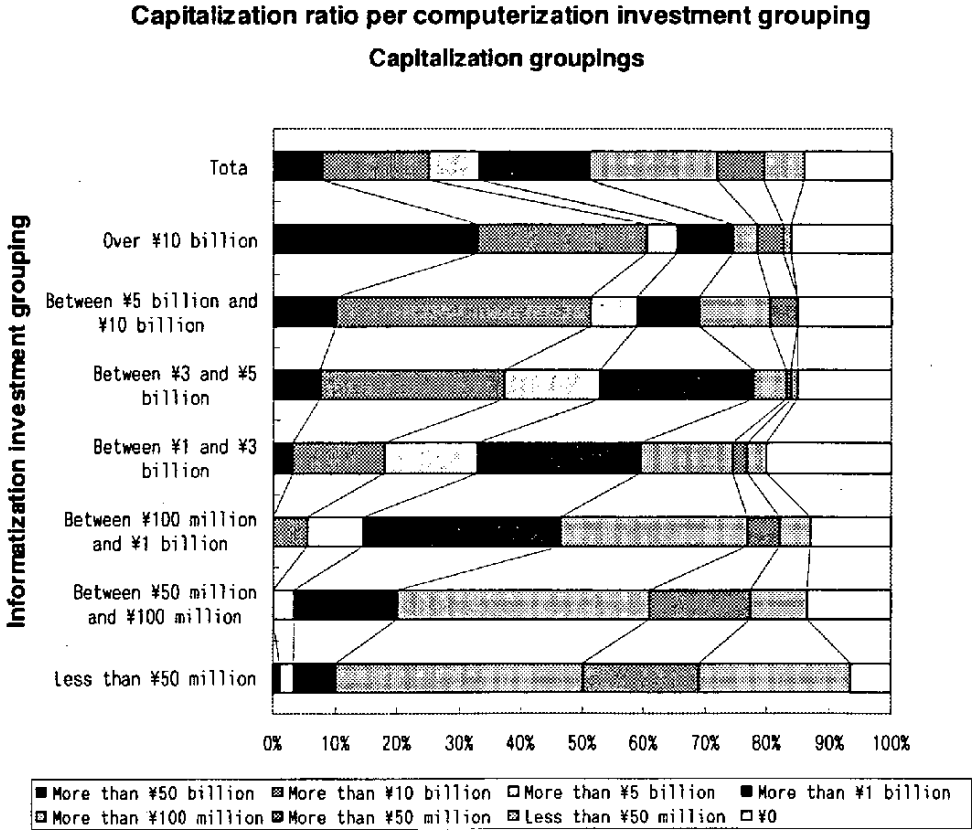
Q1: Please give a rough estimate of the overall amount that you have invested in your entire computer systems currently in operation, including hardware, software, and data. Please also put down what percentage of this figure is accounted for by your total PC investment.

No great change was evident in the amounts invested when compared with the figures in the previous survey; if anything, figures for the present survey were somewhat more restrained. The trend toward economic recovery is not reflected in the sums invested in information systems.

Facility investment	1993		1996	
Over ¥10 billion	132 cases	8.3 %	126 cases	9.1 %
Between ¥5 billion and ¥10 billion	98	6.2	70	5.0
Between ¥3 and ¥5 billion	77	4.9	79	5.7
Between ¥1 and ¥3 billion	278	17.6	237	17.0
Between ¥100 million and ¥1 billion	673	42.5	550	39.5
Between ¥50 million and ¥100 million	142	9.0	139	10.0
Less than ¥50 million	94	5.9	93	6.7
No answer	90	5.7	97	7.0
Total	1,584	——	1,391	——

Although a per-capital breakdown of enterprises naturally shows a tendency for concerns with smaller capitalization to have made smaller investments, this does not necessarily mean, however, that the amount invested is proportionate to the capitalization, but rather that businesses with a smaller capitalization also apparently need to make investments of uniform proportions.

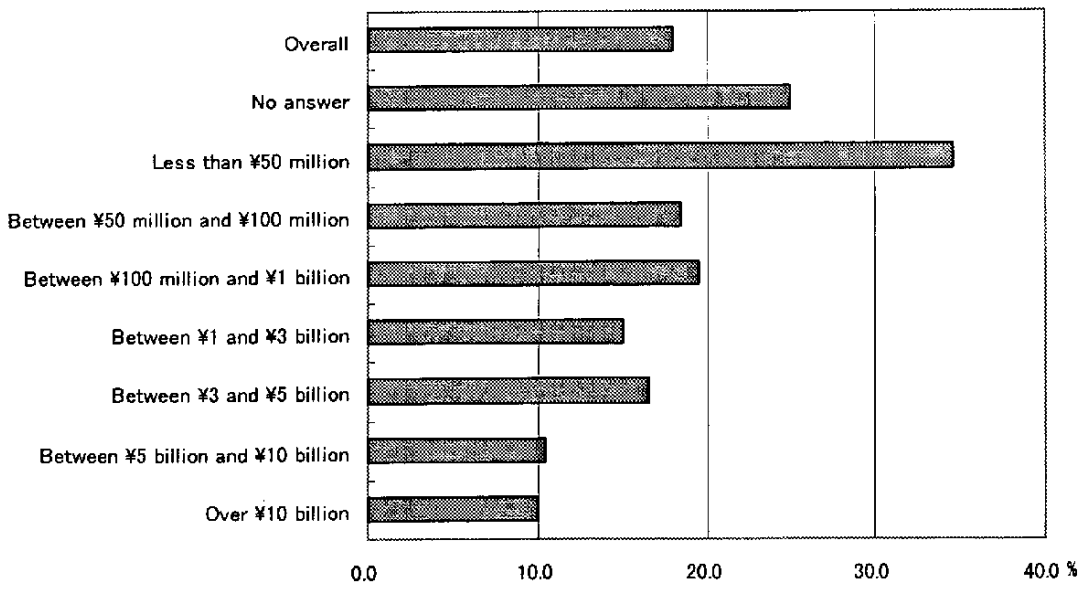
Capitalization ratio per computerization investment grouping



Although enterprises were once again asked in this survey to give information as to what proportion of their total investment in information systems was occupied by investment in PCs, the percentage here was relatively small, with the mean figure for the enterprises as a whole standing at 18.1%.

A breakdown of total investment showed concerns in the "less than ¥50 million investment" grouping to lead the field with the highest investment ratio of 34.6%. The same figures for enterprises with invested amounts of over ¥50 million indicate a tendency for the ratio of PC investment to fall in inverse proportion to the overall amount invested. However, this trend is not marked.

PC investment ratio
(average figures per computerization investment)

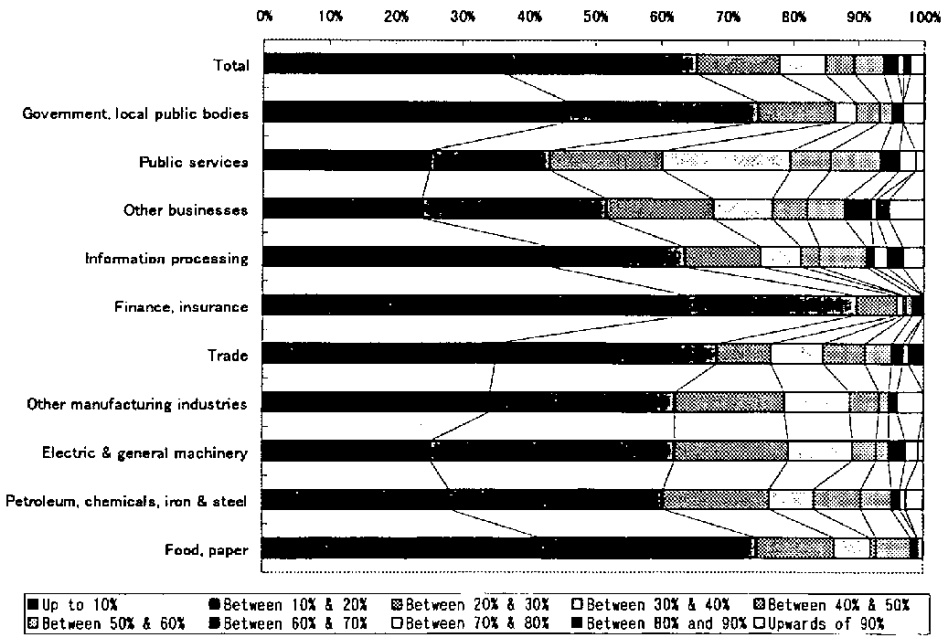


In terms of business categories, PC investment is lowest for the "financial & insurance industries," whereas the highest ratio is to be found for the "other business-oriented services" and "public services." In the case of the former, this is probably because accounting-type systems that employ conventional mainframe host computers still account for the greater part of investment in information systems.

A closer look at the latter business category reveals a high level of investment on the part of educational institutions such as high schools, universities, and the like. This is conceivably due to the fact that educational institutions have been active in introducing PCs as educational tools.

The proportion of money invested in PC information systems in terms of overall investment is relatively small; one possible effect here could well be the low price of the PCs themselves.

PC investment ratio (by business category)

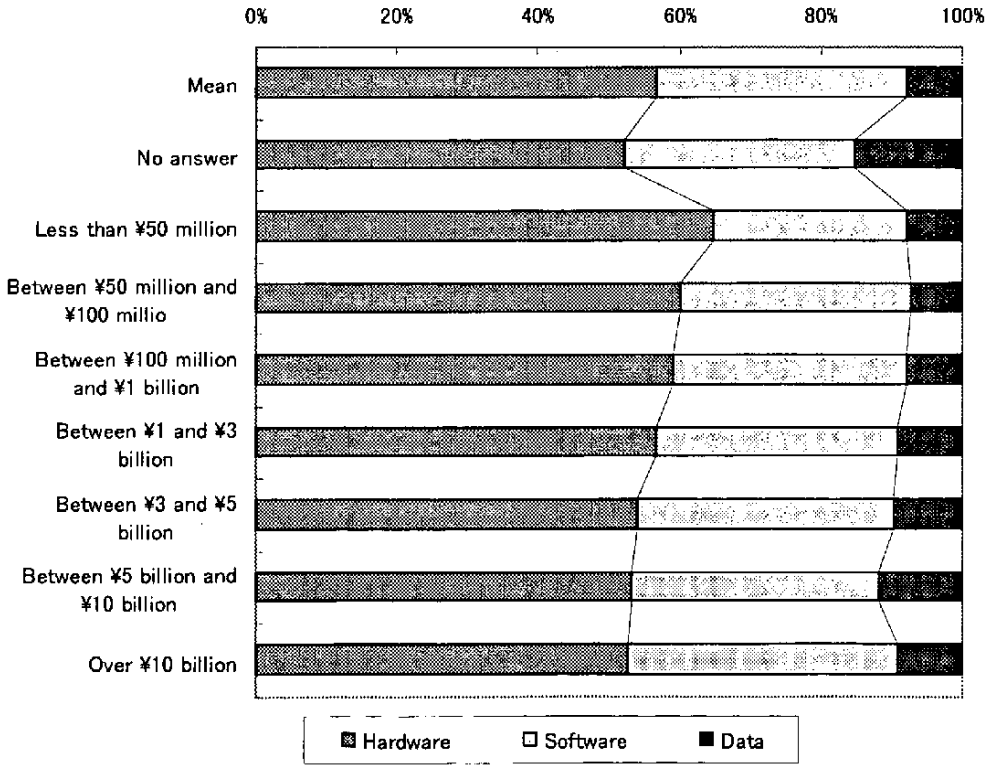


Q2: What percentage of your overall investment (see above) in your entire computer systems do hardware, software, and data account for?

Hardware, software, and data accounted for 59.0%, 32.9%, and 8.1% respectively of the overall amount invested in computer systems. This represented no great change over our previous survey.

A breakdown of capitalization, numbers of employees, and amounts of investment does not reveal a significant change either. However, if anything, the tendency to emerge is that the smaller the company, the greater the ratio of hardware investment and the smaller the ratio of investment in software and data.

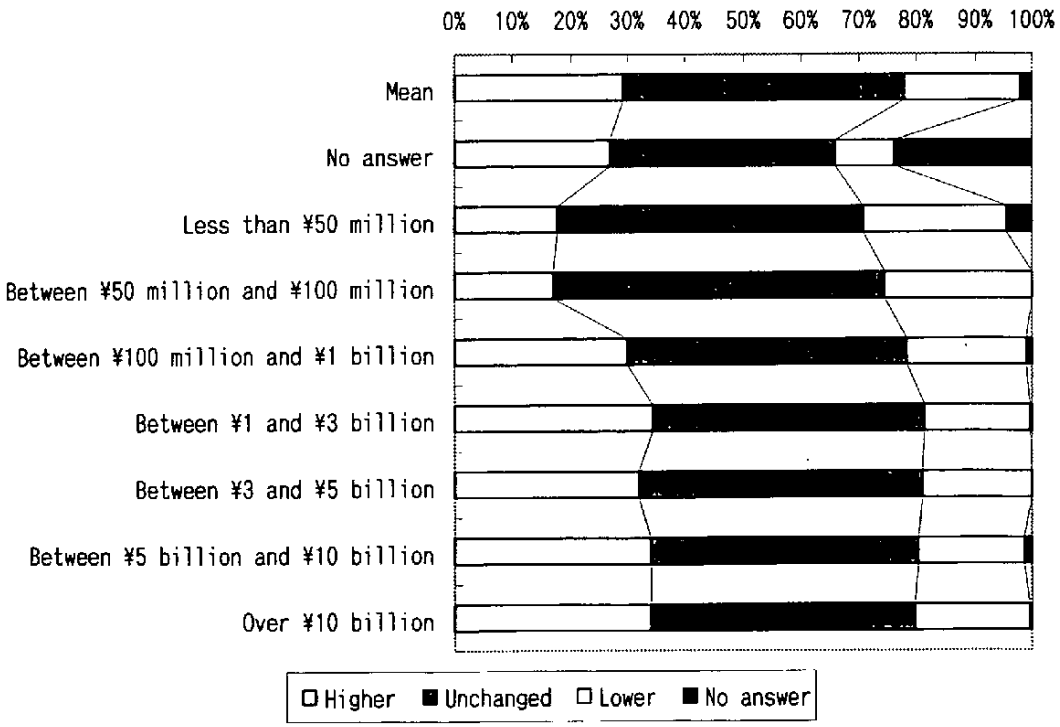
Percentage of hardware, software, and data investment per overall investment



Q3: What trends does your overall investment in your entire computer systems show?

The majority of replies, 48%, indicated unchanged investment levels, while next came "tendency to greater investment" followed by "tendency to lower investment," which showed similar trends to those revealed in the previous 1993 survey. However, the present survey gave a lower percentage for "tendency to greater investment" and higher percentage for "tendency to lower investment" than the previous survey, with figures of 29.8% and 19.8% respectively. In terms of capitalization and number of employees, replies indicated a "tendency to lower investment" the smaller the scale of the enterprise, which suggests that smaller enterprises are curbing their investment in information systems.

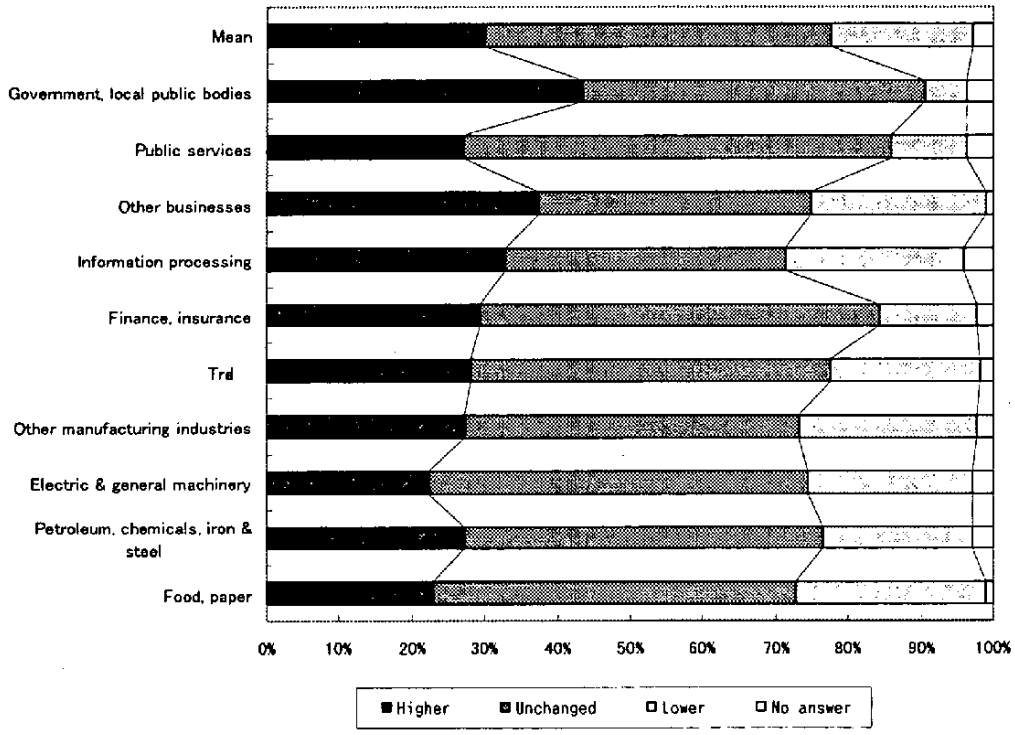
Investment trends in computer systems (per overall investment)



In terms of business category, the grouping "Government, local public bodies" shows a marked "tendency to greater investment." This is thought to be due to the government's economic countermeasures. The response for "other business-oriented services" also revealed a "tendency to greater investment" with the large figure of 37.5%, although the high response of 50% on the part of broadcasting industries affects the undoubtedly high average proportion of responses indicating a "tendency to higher investment" for each category of the service industries. This high figure would seem to point to the prevailing eagerness of broadcasting industries to invest in information systems as a means of launching themselves into the so-called "multimedia society" of the future.

Further, there were a large number of responses on the part of "financial, insurance industries" indicating a "tendency to greater investment," with only a 14.1% response rate showing a "tendency to lower investment." This reveals that financial institutions form part of a facilities and equipment industry whose information-dependent infrastructure makes it impossible for them to cut back their investment in information systems.

Investment trends in computer systems (per business category)



Q4: Have you ever assessed the value of your information system assets?

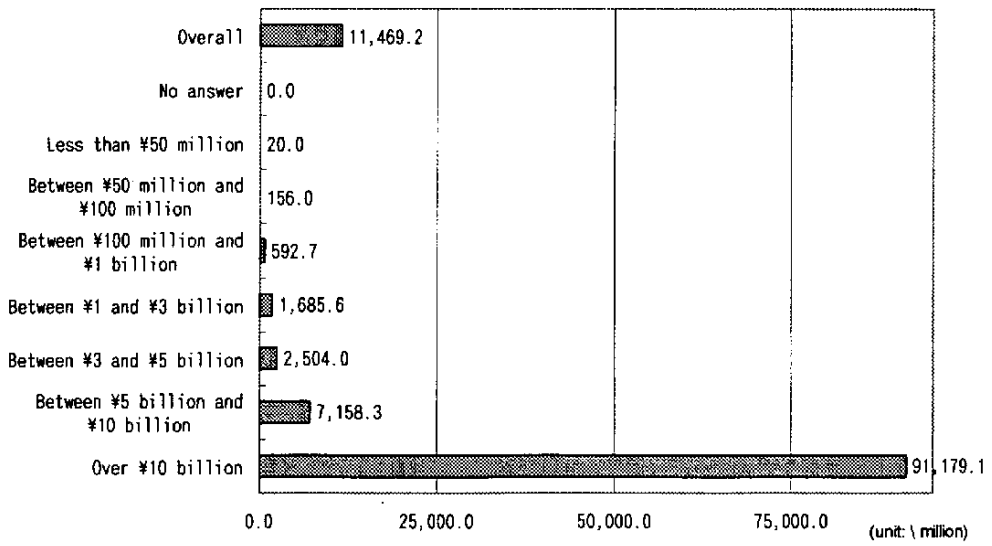
Some 91.3% of enterprises had not carried out an assessment of the asset value of their information systems.
Capitalization and business category breakdowns reveal this tendency to be uniform. It is not possible to judge whether this is because answers to the question of asset value present great difficulty or whether respondents actually evince little interest in the asset value of information systems.

Capital	Yes	No	No answer
More than ¥50 billion Between ¥10	11.5%	79.5%	9.0%
billion and ¥50 billion Between ¥5	3.0%	95.3%	1.8%
billion and ¥10 billion Between ¥1	9.9%	87.8%	2.3%
billion and ¥5 billion Between ¥100	5.8%	91.1%	3.1%
million and ¥1 billion Between ¥50	8.6%	90.2%	0.0%
million and ¥100 million Less than ¥50	9.1%	90.9%	0.0%
million No capitalization	4.0%	94.0%	2.0%
Mean	6.5%	91.3%	2.2%

Q5: At what sum would you estimate the current asset value of your information systems?

The mean asset value of information systems came to ¥11,469.2 million. However, since only 90 enterprises had made an assessment of asset value, this was insufficient to interpret any kind of trend.

Mean asset value of information systems (by amount invested)



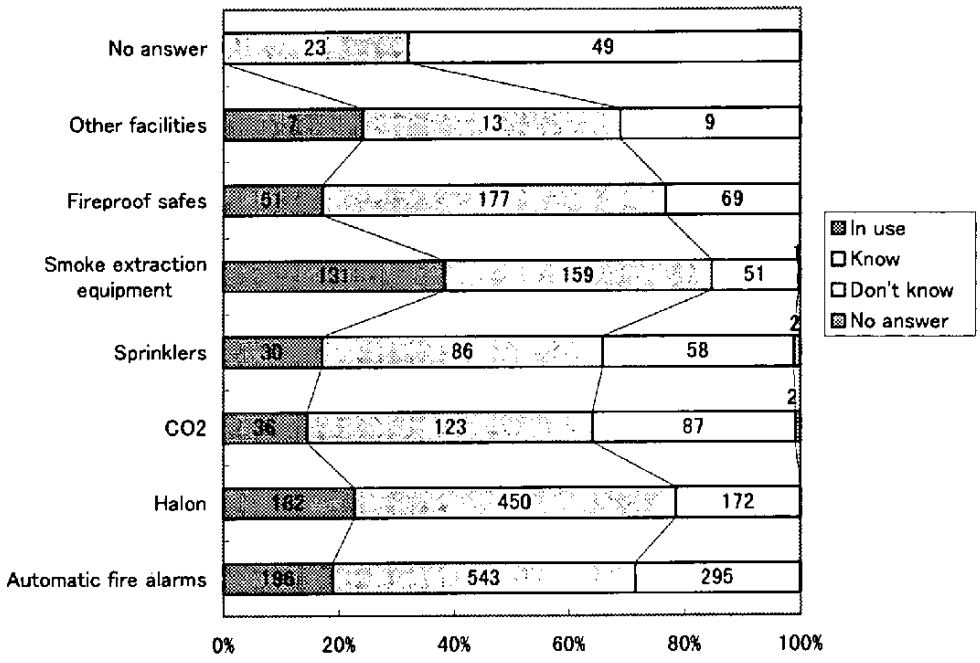
3-5 Status of Disaster & Problem Countermeasures

Q30: What kind of countermeasures have you taken to deal with fire hazard? (Multiple answer)

This was a countermeasure with a comparatively high rate of implementation. In terms of fire-fighting facilities, Halon fire extinguishers were the type in predominant use, leaving far behind other forms of fire-extinguishing measures such as carbon dioxide and sprinkler-type facilities.

A breakdown by business category showed "financial and insurance industries" and "information processing service industries" to have an extremely high implementation rate. In the case of the former grouping, the percentage in possession of automatic fire alarm equipment and Halon fire-extinguishing facilities was 91.4% and 82.7% respectively, while these figures stood at 81.4% and 81.4% for the latter grouping. Coming next to these was the "government, local public bodies" grouping, which showed figures of 74.1% and 79.0% respectively for the same facilities. (In either case, the ratio fell when it came to both to the computer rooms and data storage locations. However, the same tendency was evident for these places.). There was also a tendency for the rate of implementation to be greater the higher the capitalization and overall investment of the user. Higher rates of implementation were seen for users who were acquainted with and employed Information Systems Safety Countermeasure Standards. What conceivably accounts for the somewhat greater ratio of Halon fire-fighting facilities is that users are being guided by the standards.

Fire hazard countermeasures
(In recognition of computer room and infomation systems safely standards)

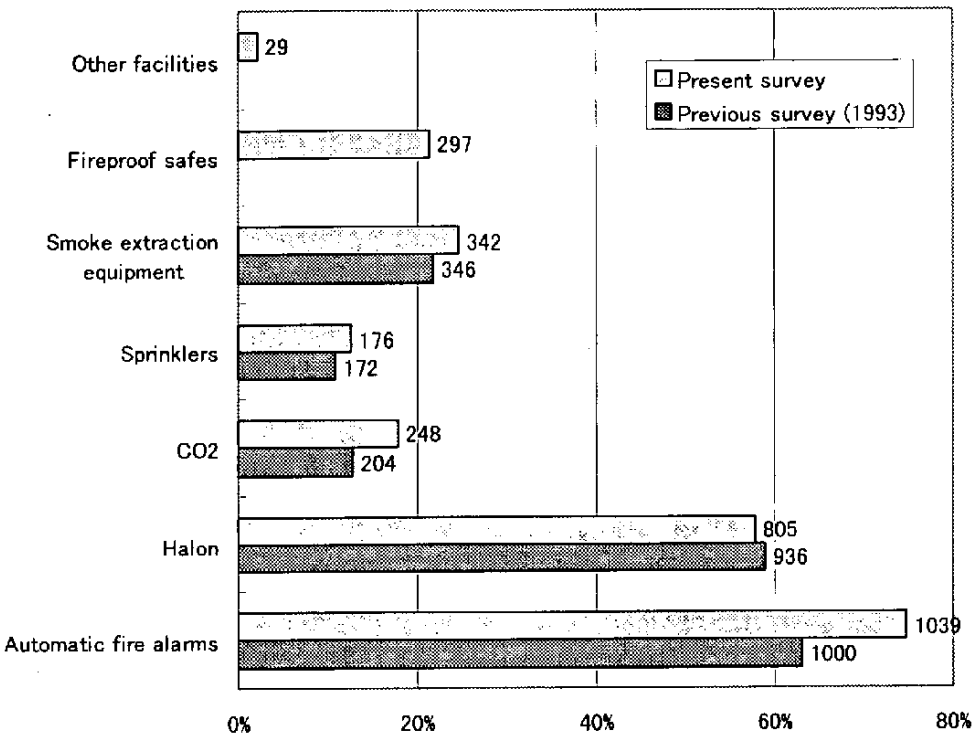


(1) Computer rooms

Approximately 88% had provided Halon fire-extinguishing equipment, carbon dioxide extinguishing facilities, or sprinklers.

Comparison with the previous survey showed a considerable increase in the use of automatic fire alarm equipment (previously 63.1%; currently 74.7%) and also growth in the use of carbon dioxide (previously 12.9%; currently 17.8%) and sprinkler equipment (previously 10.9%; currently 12.7%). The same comparison revealed a very slight drop in the use of Halon fire-extinguishing equipment (previously 59.1%; currently 57.9%). One possible reason for this drop in Halon fire-fighting equipment is that a degree of conversion is now under way, although this is not prescribed for by the regulations.

Fire hazard countermeasures (computer rooms)

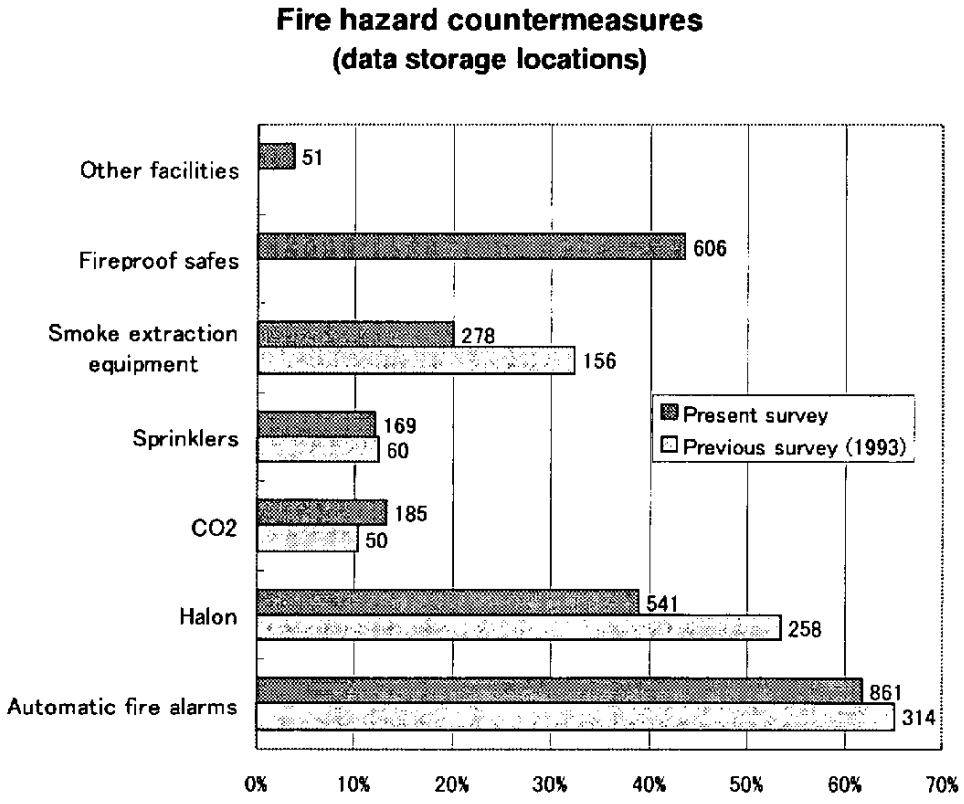


(2) Data storage locations

A substantial increase was seen in the number of responses gained in the present survey over the previous one. Responses for automatic fire alarm systems jumped from a previous figure of 314 to 861; for Halon fire-fighting equipment, from 258 to 541; for carbon dioxide fire-extinguishing facilities, from 50 to 185; and for sprinklers, from 60 to 169 cases. In percentage terms, however, there is no substantial difference of the kind that would cause any influence to be apparent in comparison; automatic fire alarm equipment went from a previous figure of 65.1% to a current figure of 61.9%; Halon fire-fighting equipment, from 53.5% to 38.9%; carbon dioxide equipment, from 10.4% to 13.3%; and sprinklers, from 12.4% to 12.1%. Conspicuous here is the drop in Halon fire-

fighting equipment, which has presumably been affected by the restrictions on the use of Halon fire extinguishers rather than by problems with the number of responses received.

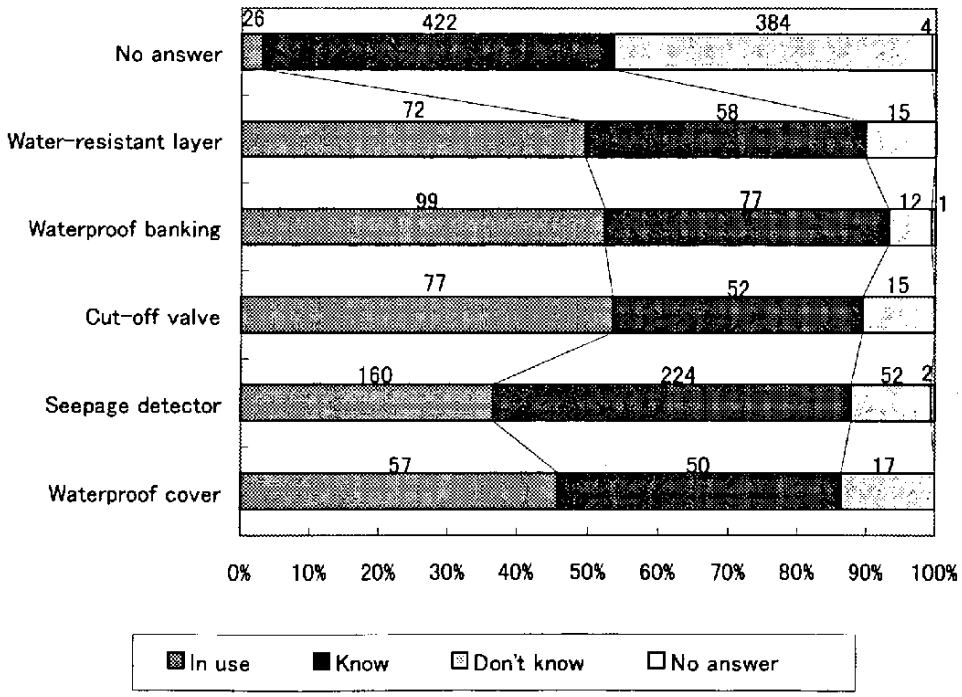
Approximately 64% of facility provisions was accounted for by Halon, carbon dioxide, and sprinkler fire-fighting facilities.



Q31 What measures have you taken against flood damage? (Multiple answer)

Results showed that measures in this direction had not been implemented to such a degree, although the implementation rate for computer rooms was slightly higher. The primary countermeasure adopted was water seepage detectors, whereas the implementation rate for what would seem to be the easier option of waterproof covers was surprisingly low. This leads one to wonder what countermeasures are available once the seepage detector has been activated; surely waterproof covers are better in that they afford an easier means of temporary protection, allowing time for countermeasures to be brought into effect. The possibilities of waterproof covers for this purpose need to be investigated further.

Flood damage
(in recognition of computer room and information systems safety standards)



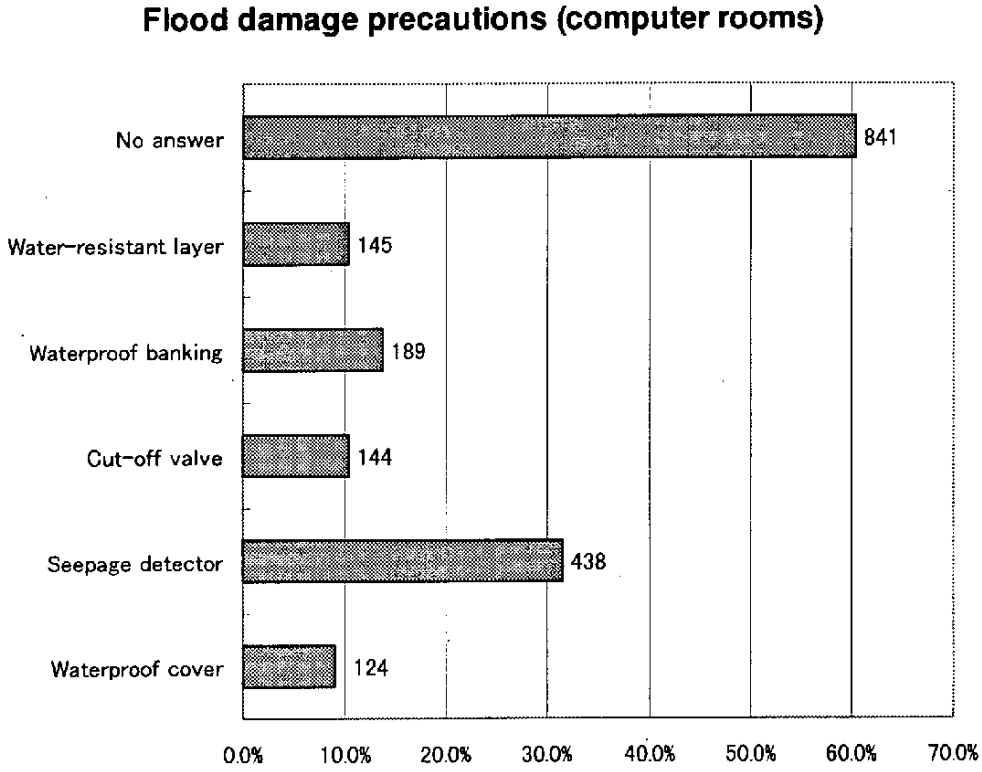
A breakdown by business category shows that the implementation rate is highest for "information processing services," and "financial & insurance industries". Next comes "government & local government bodies."

What presumably accounts for the high implementation rate of waterproof covers by the information processing service industries in particular is that these seek to acquire approval under the "system for the authorization of businesses instituting safety precautions." Further, the implementation rate increases according to the size of the user's capitalization and overall investment. The reason for the implementation rate being so high among users that are acquainted with and apply information systems safety standards can in part be attributed to the fact that they expect familiarity with the standards to lead to advances in preventative measures to deal with flood damage.

(1) Computer rooms

Although flood damage precautions were adopted to a degree (35%) in the form of seepage detectors, other forms of countermeasure were scant, covering a mere 10%. To some extent, these results lead to concern about what measures are to be taken to counter flooding once seepage detectors have been activated.

Nonetheless, despite scant countermeasure levels in this area, the results did point to the fact that information processing services and financial & insurance industries had taken greater precautions than the other business categories; the former had implemented waterproof covers to the extent of 31.9%, seepage detectors to the extent of 58.4%, cut-off valves 22.1%, waterproof banking/water pans 32.7%, and upper floor waterproofing 21.2%. The latter grouping had made the same provisions to the extent of 13.0% (waterproof covers), 52.4% (seepage detectors), 23.2% (cut-off valves), 33.5% (waterproof banking/water pans), and 25.4% (upper floor waterproofing).



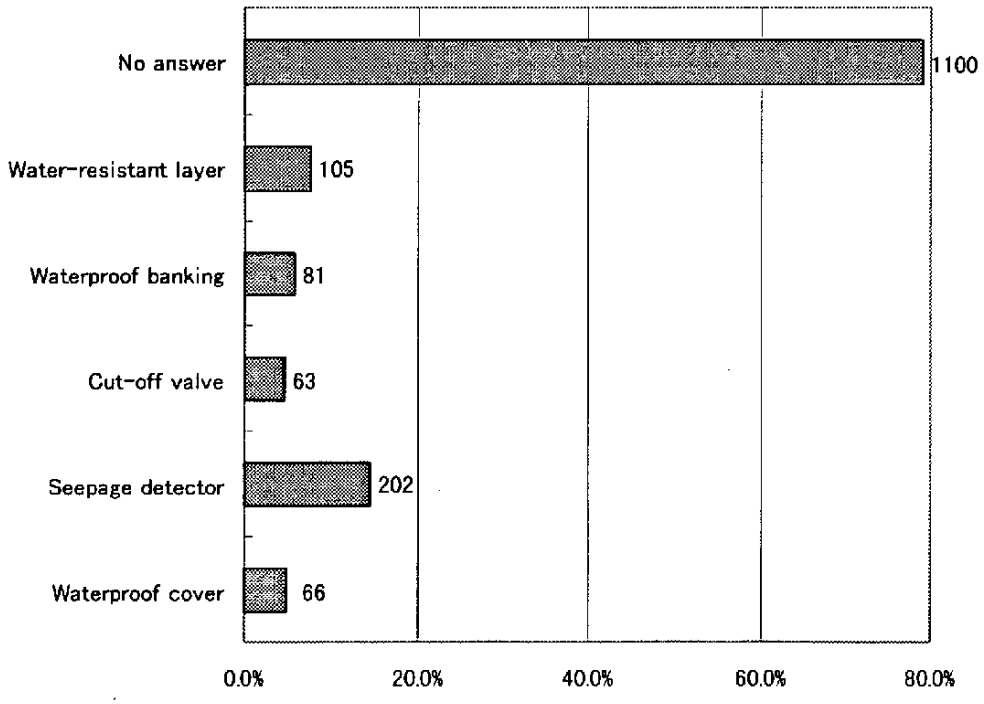
(2) Data storage locations

Although trends are much the same as those for computer rooms, with the exception of a figure of 14.5% for seepage detectors, the fact that other implementation figures barely reached the single-digit level points to a certain extent of problems, even given the nature of data storage.

Amid a low implementation rate, the results did point to the fact that information processing services and financial & insurance industries had taken greater precautions than the other business categories; the former had implemented waterproof covers to the extent of 19.5%, seepage detectors to the extent of 34.5%, cut-off valves 8.8%, waterproof banking/water pans 15.0%, and upper floor waterproofing 17.7%. The latter grouping had made the same provisions to the extent of 5.4% (waterproof covers), 23.8% (seepage detectors), 12.4% (cut-off valves), 16.2% (waterproof bank-

ing/water pans), and 17.8% (upper floor waterproofing). Nonetheless, it cannot be denied that the results as a whole revealed a low adoption level.

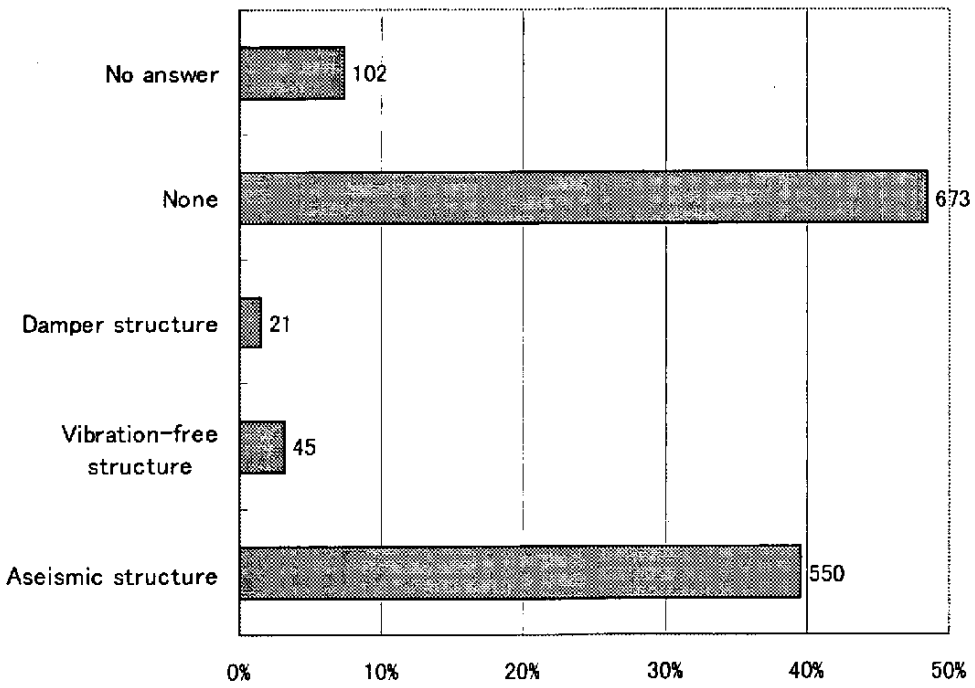
Flood damage precautions (data storage locations)



Q32: Which of the following earthquake countermeasures have you adopted for buildings?

Aspects covered by the survey included the extent to which new anti-earthquake structures such as vibration-free structures and damping structures were available as earthquake countermeasures in buildings alongside the aseismic structures prescribed by the Building Standards Law. Also examined were the kind of changes that future surveys might reveal and the effects of the Great Hanshin and Awaji Earthquake.

Earthquake countermeasures precautions in buildings



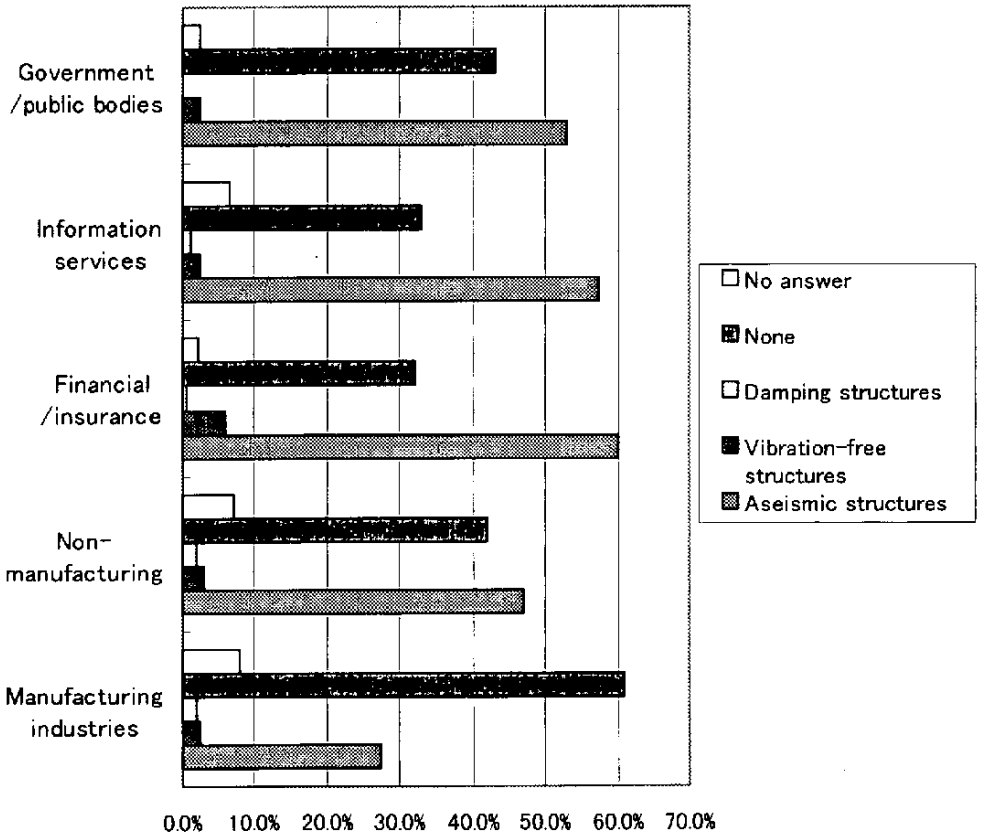
The results revealed surprising data, in that almost half (48.4%) replied "none," i.e. no provisions in the form of either aseismic structures, vibration-free structures, or damping structures. A considerable number of the buildings must, one supposes, have been built in accordance with the Building Standards Law, at the very least. One wonders whether the respondents interpreted this as meaning some special type of structure.

A breakdown by business classification shows even the "financial & insurance industries" and "information processing services" replied "none" to the extent of over 30%. The "construction industry" also shows a value of 35.3%. Here too, one cannot help wondering whether the respondents did not misinterpret the survey question. Since the Information System Safety Countermeasure Standards also recognize the acceptability of the aseismic structures laid down in the Building Standards Law, one cannot but feel that knowledge of these standards would be essential. In particular, of enterprises with a knowledge of the standards, more than twice the number replied "aseismic structure" than gave the answer "none."

The results showed a high proportion of replies for buildings with aseismic structures; the figure for "financial & insurance" was 60%, that for "information processing services," 57.5%, and that for "government & local public bodies," 53.1%.

Although the absolute value is low, it does indicate that enterprises housed in vibration-free structures and damping structures are beginning to emerge.

Earthquake countermeasures in buildings

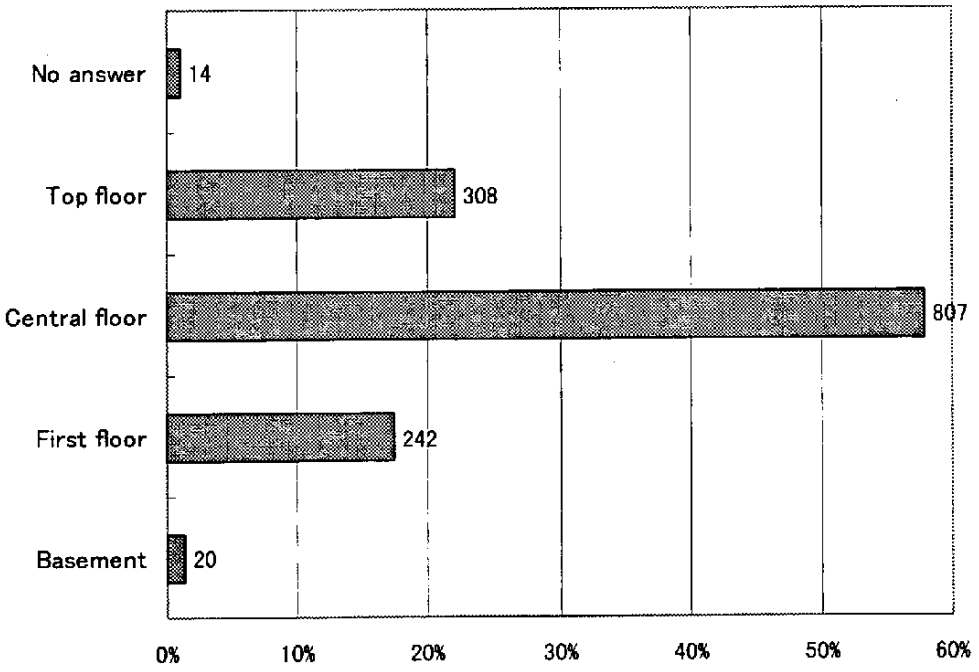


Q33: How many stories does the building housing your computer systems consist of? On what floor of this building are your main computer systems housed? (Multiple answer)

The following are regarded as undesirable as locations for computer systems: the first floor and similar locations (to prevent crime); the basement (to prevent flood damage); and the top floor (to safeguard against the effects of earthquakes, direct sunlight, etc.). Survey results showed that approximately 40% of computer systems provisions had been made in locations best avoided, i.e. 22.1% on top floors, 1.4% in basements, and 17.4% on first floors. However, 60% of top-floor locations comprised systems housed on the first or second floors, thus making the situation less problematic. The positioning of systems on the top floors of buildings of a wide-amplitude flexible structure is not advisable; here the survey results showed that no systems were located on top floors equivalent to floor 16 or higher.

Conversely, approximately 11% were shown to be the top floors of probable rigid-structure buildings of up to nine floors. Adequate consideration will have to be given to earthquake countermeasures in the case of systems in such locations.

Principal computer system locations in terms of floor

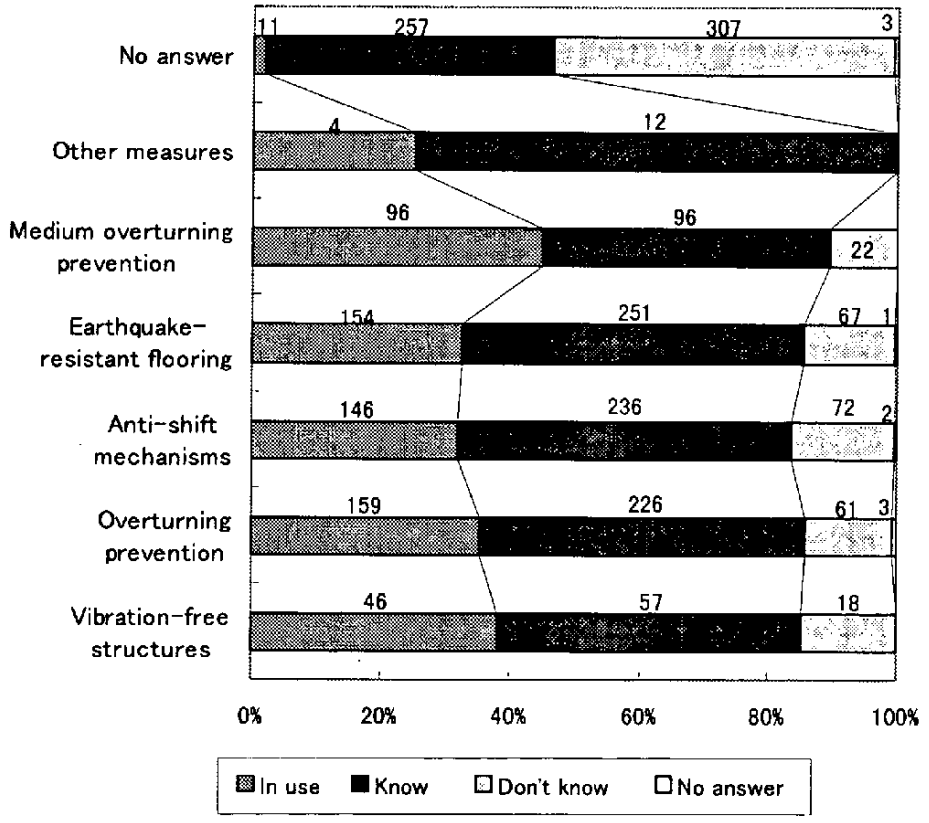


Q 34: What kind of earthquake countermeasures do you adopt? (Multiple answer)

Here, as a probable effect of the foregoing Great Hanshin and Awaji Earthquake, the results showed the countermeasure implementation rate to be comparatively high. In as much as the previous survey simply sought responses for earthquake countermeasures, these do not necessarily serve as an accurate means of comparison. However, the previous survey results showed an overall figure of 33.1%, which when broken down in terms of individual countermeasures revealed 8.7% for vibration-free structures, 32.3% for overturning prevention, and 34.0% for anti-shift mechanisms. Here too, notable among business categories with the high implementation rates were "financial & insurance" and "information processing

service industries." Further, with the exception of floor-related earthquake countermeasures, results showed the implementation rate to tend to increase according to overall investment. There was also a tendency for enterprises implementing such measures to be familiar with Information System Safety Countermeasure Standards.

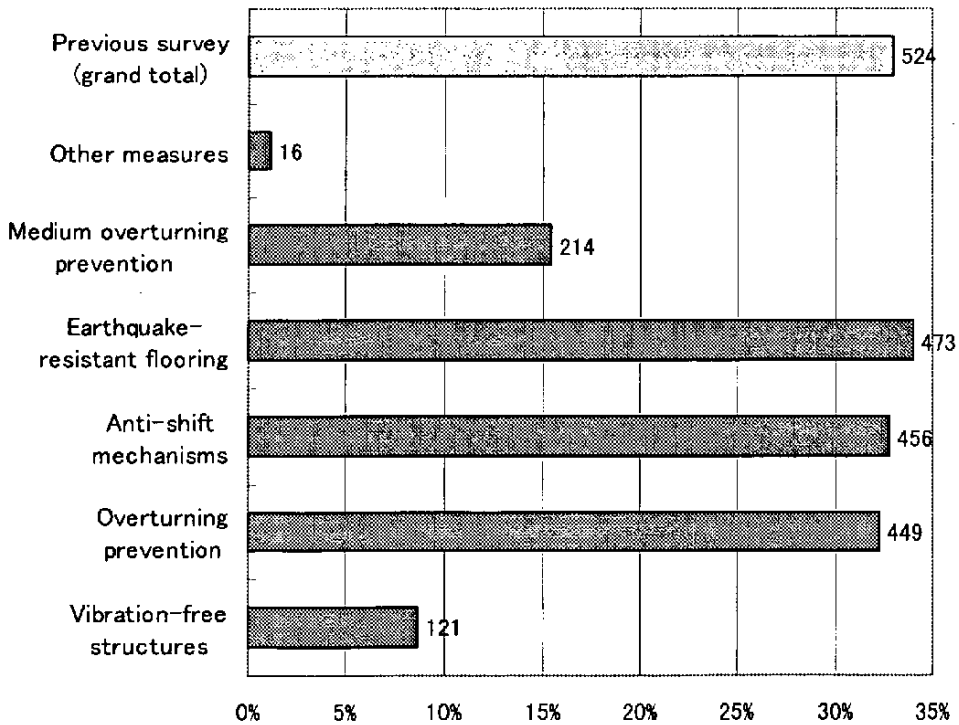
Anti-earthquake countermeasures
(in recognition of computer room and Information System Safety Countermeasure Standards)



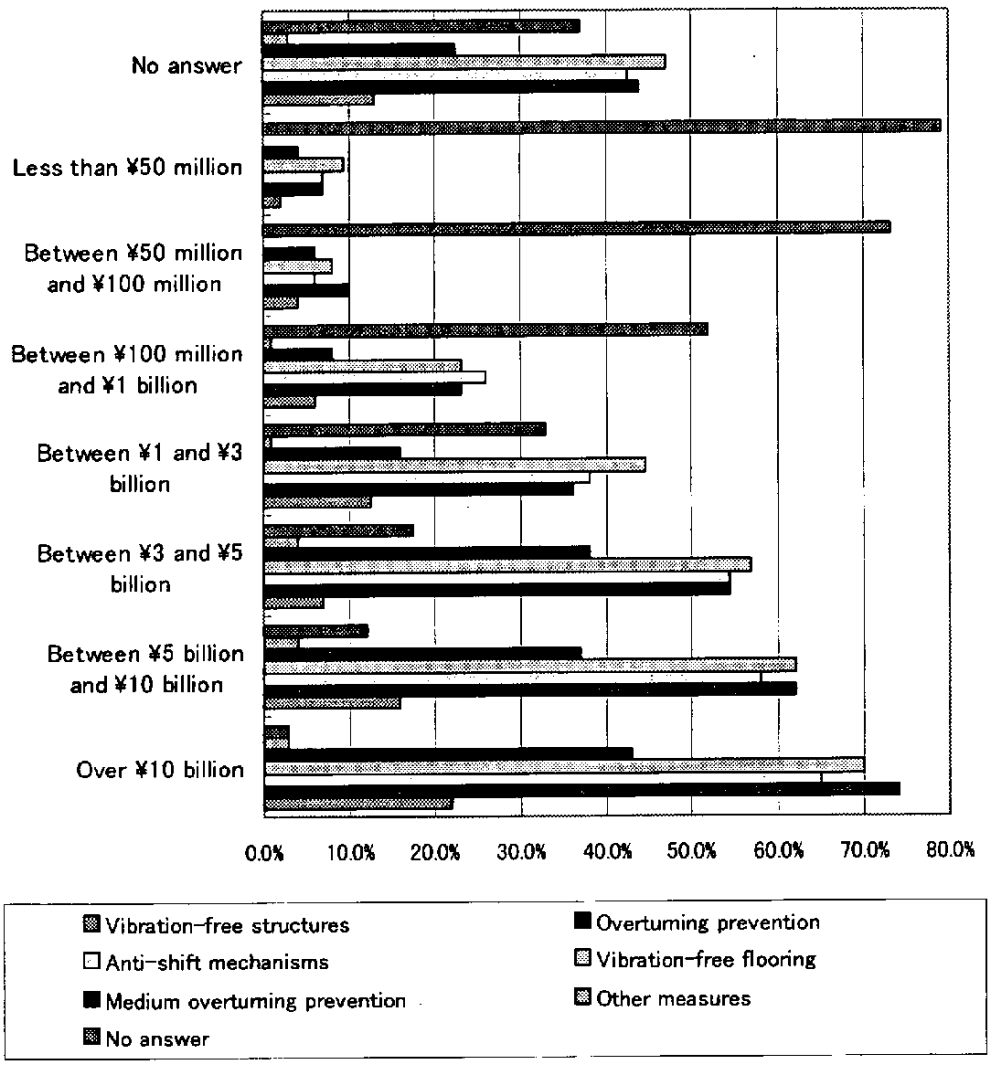
(1) Computer rooms

Survey results showed an apparently high level of implementation, with vibration-free structures constituting 8.7% and overturning prevention and anti-shift measures each standing at the 32% level. In terms of anti-vibration structures, "financial & insurance industries" showed a result of 18.9%, which was higher than any of the other business categories. The fact that concerns with high overall investments tend as a matter of course to predominate in this area no doubt results from the high costs involved. Nonetheless, even in cases where overall investment is not that high, it is advisable that adequate earthquake countermeasures be adopted not only for the protection of system assets, but also to ensure the safety of operators and other personnel working in the computer rooms.

Earthquake countermeasures (Computer rooms)

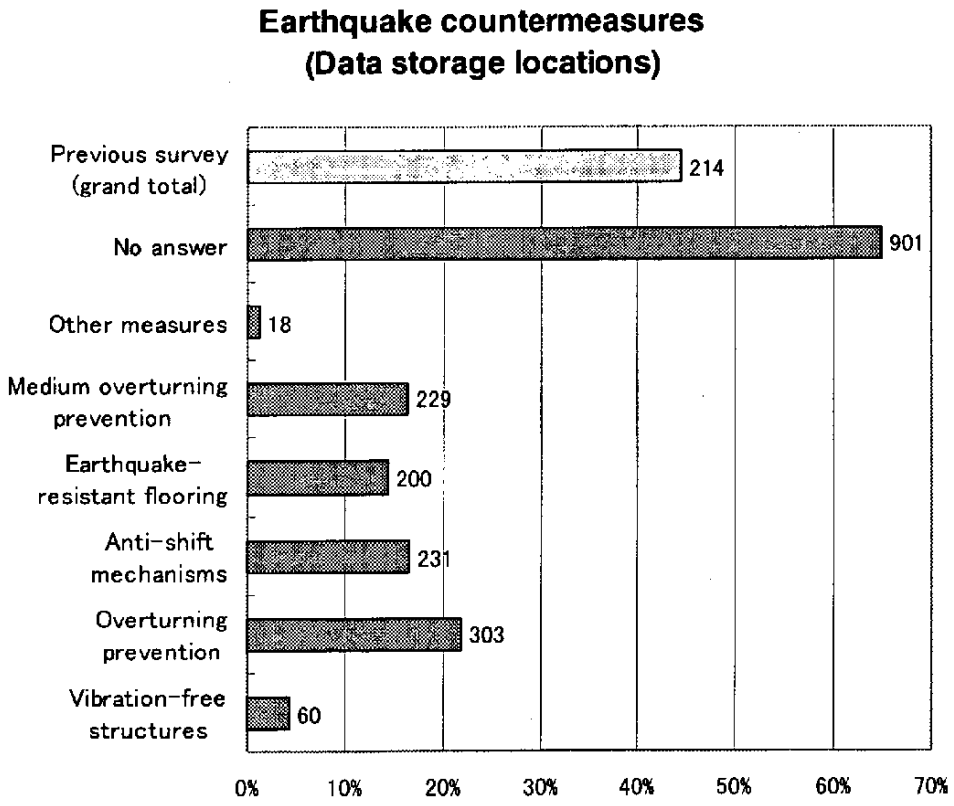


Earthquake countermeasures
(Computer rooms/overall invested amount)



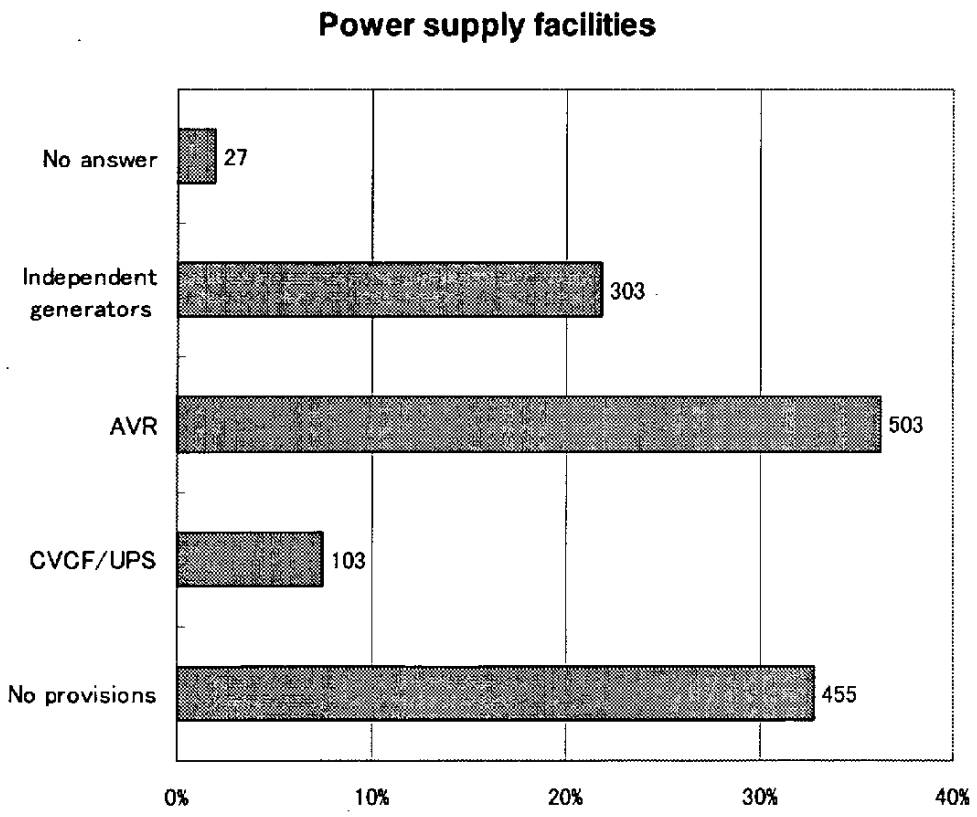
(2) Data storage locations

The ratio of implementation of overturning prevention and similar measures was somewhat low when it came to data storage locations. Further, a result of only 16.5% for the adoption of medium overturning prevention gives rise to concern when considered from the point of view of the functions served by data storage locations. The reason that certain concerns (i.e. 10.3% of enterprises with an overall investment of at least ¥10 billion/7.6% of financial & insurance enterprises) have gone so far as to adopt anti-vibration structures for their data storage locations can presumably be ascribed, among other things, to the vital nature of their systems.



Q35: Which of the following do you adopt as disaster countermeasures to safeguard power supply?

CVCF/UPS provisions had been made in 503 cases, i.e. 36.2%, while independent generating facilities accounted for 21.8%. Comparison with the results of the previous survey's figure of 45.9% for CVCF provisions reveals a drop in this area, whereas the previous survey result of 15.3% for independent generators suggests that such provisions are currently gaining ground.



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