Supporting Life Recovery Process with the Management System Based on the Victims Master Database - A study of Crisis Management Following Tokyo Metropolitan Near Field Earthquake Disaster-

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SUMMARY:
The research team developed a GeoWrap Method that joins tables from different databases using spatial location relationships instead of primary keys. This technique made building master database possible in order to support disaster victims, which was consisted of the data retrieved from the several sets of administrative database of the daily work and combined them into Victims Master Database. Tokyo Metropolitan government accepted the importance of previous arrangement for going through those procedures.

Keywords: GeoWrap; integrated database; Victims Master Database

1. INTRODUCTION

The Tohoku Earthquake was a magnitude 9.0 (Mw) undersea megathrust earthquake off the east coast of Japan that occurred at 14:46 JST on Friday, March 11th, 2011. This strong earthquake caused huge and destructive tsunami waves that reached heights of up to 40.5 meters (133 feet) in Miyako in the Iwate Prefecture and travelled up to 10 km (6 miles) inland in the city of Sendai. Approximately 15,200 people lost their lives and over 8,600 people were reported missing. The number of houses that were partially or totally destroyed in the disaster was about 160,000. The tsunami caused a number of nuclear accidents, primarily the on going level 7 meltdowns at three reactors in the Fukushima I Nuclear Power Plant complex. The resulting evacuation zones affected hundreds of thousands of residents that resided in the afflicted areas including 10 prefectures and 241 cities, wards, "cho" districts, and villages. Because of experience from past disasters, Japan has a variety of well-organized support services to help the victims to rebuild their lives. However, standardization of the workflow in order to effectively offer these support services and build support tools are not sufficient. The amount of work required is extremely large since the areas of disaster are widespread and a large number of people need to receive support services. Therefore, it necessitates the establishment of a workflow and support tools. Herein, we describe the generation of a Victims Master Database in order to effectively provide support for victims.

2. OVERVIEW OF LIFE REBUILDING SUPPORT SERVICES

In Japan, many of the life rebuilding support services are designed based on a degree of damage to the victim’s principal residence or the victimized household where their life was centered. These

services were provided by the municipality of their city, "cho" district, or village where the victim or the household were registered. The following summarizes the flow of life rebuilding support services to a victim. (1) Building inspection. The degree of damage to a building in an afflicted area is assessed based on a set of standards prescribed by the national government. (2) Preparation of a certified victim survey database. The survey results are converted into a database for each building location. (3) Issuing a disaster victim certificate. The result of a building damage certification survey is conveyed to a victim in the form of a disaster victim certificate. (4) Providing life rebuilding support services. Two types of services are provided: financial support service that is based on the victim's application and an exemption service through administrative procedures within a municipality (See Figure 1). The Victims Master Database discussed in this paper is a tool used to provide items (2) and (3), and also serves as the foundation on which to base the service provision in item (4).

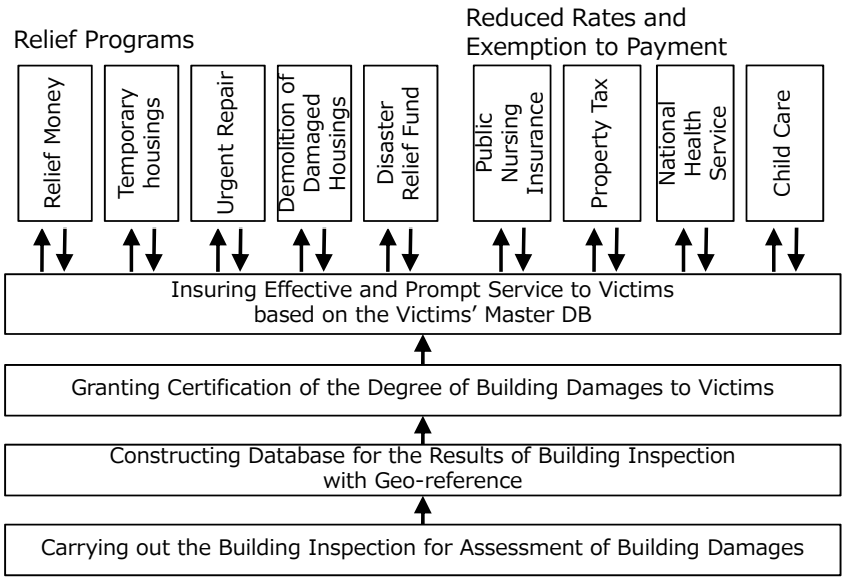

Figure 1. Work Flow of Administrative Support

3. OVERVIEW OF THE SYSTEM

3.1. Development of a Database to issue Disaster Victim Certificates using the GeoWrap Method

Requirements for issuing a Disaster Victim Certificate on the basis of a victim's application are: To identify an individual or a household on the Basic Resident Register (*Juumin kihon daichou*), to identify which house is their primary residence where their life is centered, and to find out the results of a building damage certification survey. To gather these required pieces of information, it is necessary to extract and collate the applicable data from the (1) Basic Resident Register, (2) Property Taxation Database, and (3) Building Damage Certification Survey. Items (1) and (2) are databases for a normal time, and item (3) is a database built after a disaster occurs. There are a plethora of issues listed below that affect the ability to connect items (1), (2), and (3) together.

3.1.1. (1) and (2) do not share a common primary key

The primary key of the Basic Resident Register is an individual number or a household number to designate a resident. On the other hand, the primary key of the Property Taxation Database is a house number used to set tax on a building. The Property Taxation Database may also contain an individual number in some municipalities if the tax payer is a resident of that jurisdiction. However, this is not standard procedure. Therefore, these two databases cannot immediately be combined.

3.1.2. The only primary key of (3) is location

The Building Damage Certification Survey is organized according to locations used to conduct a

survey at disaster afflicted areas. Therefore, information on the residents and houses is not known, and as such, (1), (2), and (3) cannot immediately be combined.

3.2. Proposition of Novel Technology to Combine Databases with Different Primary Keys

Our research and development team developed a GeoWrap Method that connects data from different databases using spatial location relationships instead of primary keys. The GeoWrap Method employs the Geographic Information System (GIS) to position information from each database in a space, and the spatial distance between pieces of information is designated affinity. This affinity assigns weight between the pieces of information and provides rank order among the pieces of information. Therefore, the information from each database is converted into spatial information. The spatial information was then taken into the GIS to calculate affinity based on spatial distances among the pieces of information. This was an automated process for generating flexibly connected pieces of information (See Figure 2).

When a resident applies for a Disaster Victim Certificate, a simple search of the "resulting data that are flexibly connected together in a space" makes a resident identify their primary residence based on the information provided. By presenting a Building Damage Certification Survey result, we can let the resident complete the entry of the Victims Database. A major feature of this system is that it effectively combines automation as an optimum solution and a real solution provided by humans.

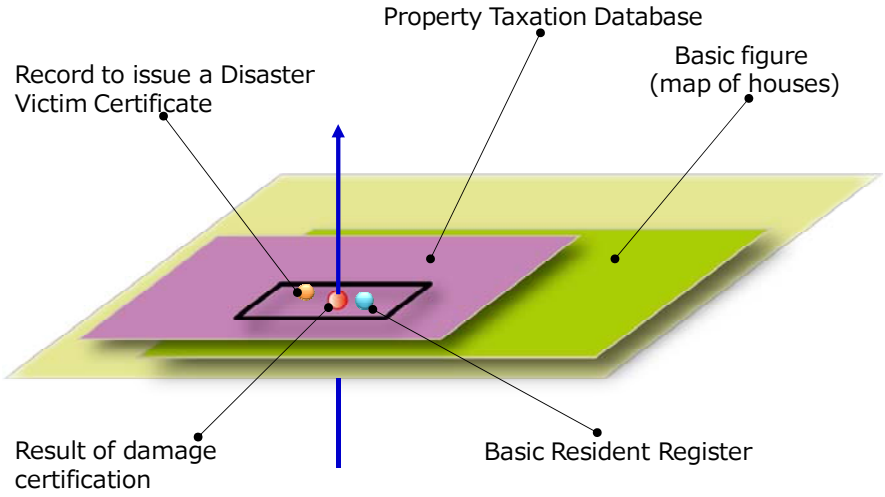

Figure 2. "Flexible" join made by the GeoWrap Method

3.3. Development of a System to Apply and Issue the Disaster Victim Certificate

3.3.1. Workflow Using the New System

a) An applicant submits an application containing basic information.

b) Municipality staff inputs the information from the applicant into the Disaster Victim Certificate application and issuing system, to search the database for 'most likely' data such as people, house, and damage.

c) The system uses the GeoWrap Method to give a rank order to other data in the Database based on the information identified in step "b" above.

d) The employee requests correct information from the applicant based on rank-ordered pieces of information, and updates this in the system.

e) Print and issue the results from step "d" as a certificate.

f) The system records connections among the confirmed pieces of information in the database.

Among the six steps above, steps "b" and "d" require human intervention. Improved efficiency and integrity are highly desired.

3.3.2. Requirement 1: Installing a graphical interface using a map

Visualization of rank ordered information in each database on a map would facilitate an applicant identifying their primary residence based on his or her actual place of residence.

3.3.3. Requirement 2: Coordination between list information and map

List information would be color-coded for each database and displayed on a map. Rank order information would be made into a list for each database and displayed at the bottom of a map. An applicant would compare the map and the list to make the following selections (Figure 3): (a) does the displayed address information for the applicant match the actual information?; (b) does property taxation information displayed as the primary residence match the actual information?; (c) in the applicant's opinion, does the displayed results of the building damage certification survey accurately reflect the damage due to the earthquake?; and (d) in the applicant's opinion, does the displayed results of the building damage certification survey reflect the damage due to a fire?

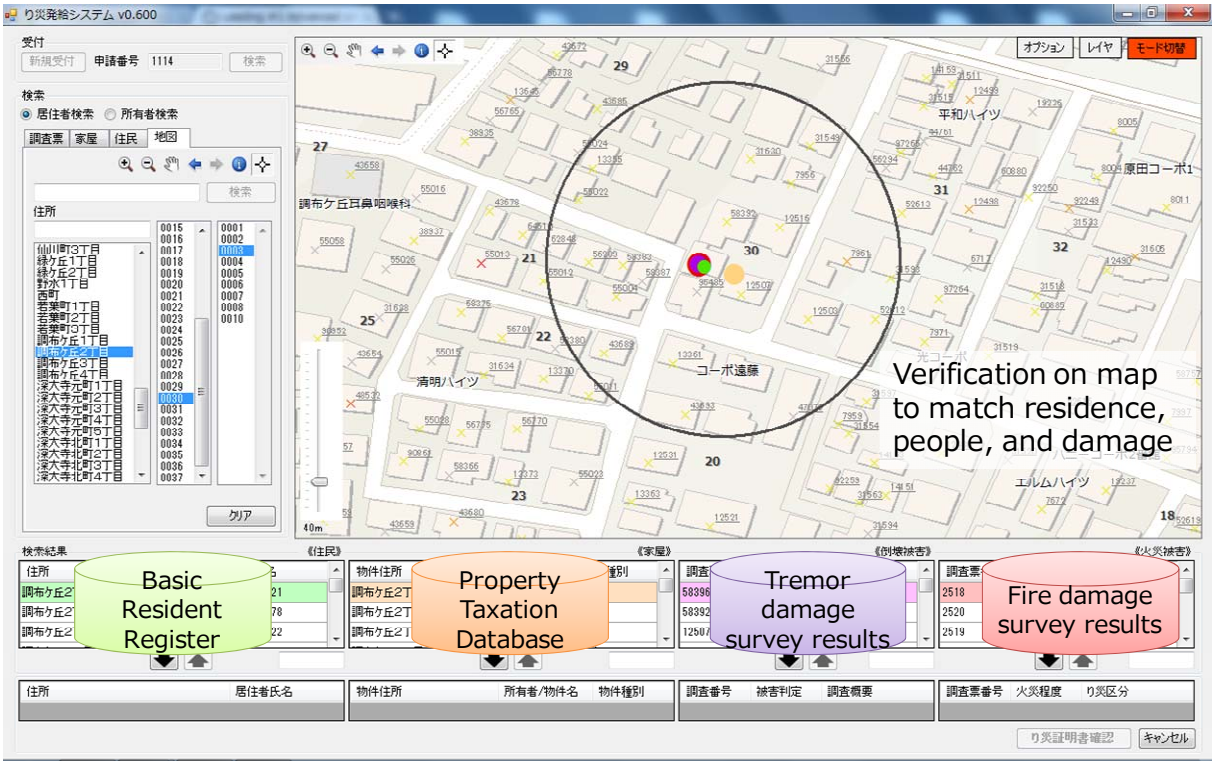

Figure 3. System to Apply and Issue Disaster Victim Certificate
(Interactive information search system between an applicant and a municipality clerk)

3.3.4. Development Environment

This system was implemented in an environment to coordinate DBMS (Database Management System) and GIS. For the DBMS, an SQL server was used as a server-client database system. The SQL server can be substituted with MS-Access (MDB) if only a client alone is used. A GIS server or GIS server runtime can be selected for the GIS function.

4. RESULTS OF EXPERIMENTS TO DEMONSTRATE SYSTEM EFFECTIVENESS

As a heightened risk is expected for an occurrence of a near-field earthquake in the Tokyo metropolitan area in the near future, we conducted a drill on issuing Disaster Victim Certificates using the proposed system in the Toshima Ward, Tokyo, and the City of Chofu (Figure 4). Prior to March 11th, 2011, it was predicted that there was a 70% chance that the Tokyo Metropolitan area and her vicinity would be jolted by a devastating earthquake within the next 30 years. Professor Naoshi Hirata of the Earthquake Research Institute at the University of Tokyo announced on January 23rd, 2012, "Tokyo Metropolitan Near Field Earthquake Disaster in Magnitude 7 class has a chance to occur 70%

for the next 4 years" as the result of the research taking into account the Tohoku Earthquake Occurrence.

Figure 4. Drill to issue Disaster Victim Certificates

4.1. Workflow to Issue Disaster Victim Certificates in the Shortest Time

The procedures were as follows (Table 1): (1) receive a new application, (2) search for the resident, (3) display a dialog for the applicant's residence, (4) confirm the resident's data, (5) display a dialog to confirm the residence information, (6) confirm residence information, (7) display a dialog to confirm totally destroyed residence, (8) confirm survey data for totally destroyed residence, (9) display a dialog to issue a Disaster Victim Certificate, (10) display a preview of a Disaster Victim Certificate, and (11) print a Disaster Victim Certificate.

Table 1. Basic procedures from receiving an application to issuing a certificate (11 steps)

	Certificate for total damage to a residence due to an earthquake	Certificate for damage to residence due to a fire
Receive application	1. New application	1. New application
Search	2. Search for a resident	2. Search for a survey form number
Confirmation of resident	3. Display a confirmation dialog for resident and household	3. Display a confirmation dialog for resident and household
	4. Confirmation of resident data	4. Confirmation of resident data
Confirmation of residence	5. Display a confirmation dialog for residence information	5. Display a confirmation dialog for residence information
	6. Confirmation of residence data	6. Confirmation of residence data
Confirmation of damage	7. Display a confirmation dialog for totally damaged residence survey form	7. Display a confirmation dialog for a fire damage residence survey form
	8. Confirmation of totally damaged residence data	8. Confirmation of fire damage survey data
Confirmation of certificate contents	9. Display a dialog for issuing a Disaster Victim Certificate	9. Display a dialog for issuing a Disaster Victim Certificate
	10. Display a preview of a Disaster Victim Certificate	10. Display a preview of a Disaster Victim Certificate
Print a certificate	11. End of printing and issuing a Disaster Victim Certificate	11. End of printing and issuing a Disaster Victim Certificate

※An average of 11.8 steps were required to issue one Disaster Victim Certificate during the drill, including operations such as canceling and deselecting.

4.2. Accuracy and Swiftness Were Proven in Issuing Disaster Victim Certificates

Disaster Victim Certificates were issued at a rate of about three minutes per certificate. Moreover, analyses of operators' log revealed that using the proposed system to accept applications and to issue Disaster Victim Certificates enabled a certificate to be issued to any applicant, including those that did not have a Building Damage Certification Survey Form, and those that were not registered in the Basic Resident Register (Figure 5).

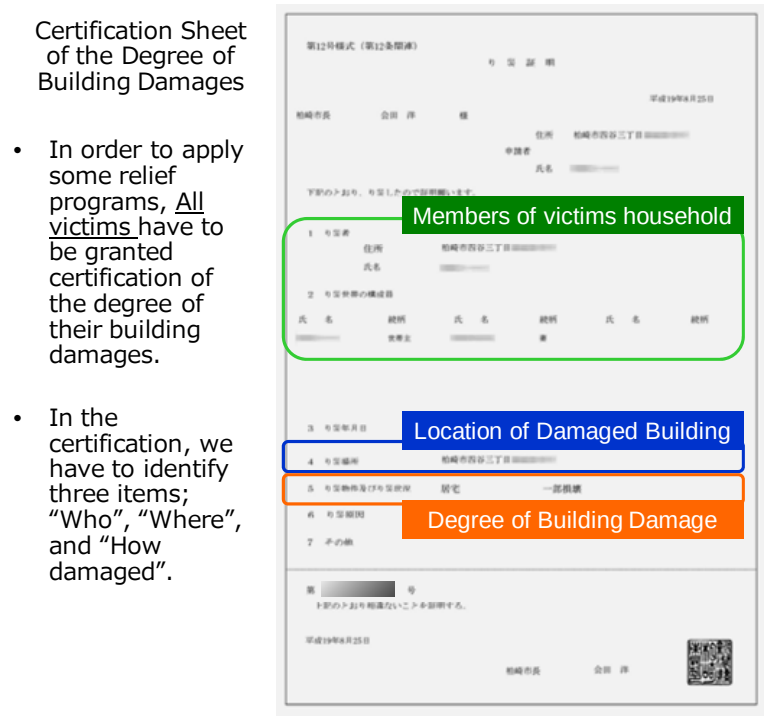

Figure 5. Certification Sheet of the Degree of Building Damages

4.3. Realized a System to Support Flexibility in Methods used to Issue Certificates

Disaster Victim Certificates can be issued from multiple terminals, and it is also possible to share the same information through a website. As multiple channels to accept applications and issue certificates are opened it becomes possible to share the latest information. Even if counters used to issue certificates are located in physically separate locations, it is possible to issue certificates while sharing the same information.

5. FUTURE CHALLENGES

Due to its natural conditions, including its location on the globe, geography, geology, and climate, Japan is likely to be hit by disasters, such as typhoons, torrential rain, heavy snow, floods, landslides, earthquakes, tsunamis, and volcanic eruptions. The likelihood of occurrences of disasters in Japan compared to the whole world is: earthquakes of magnitude 6 or greater, 20.5%; number of active volcanoes, 7.0%; deaths, 0.3%; and amount of damage, 11.9%. These are very high figures compared to its land area that is only 0.25% of the whole world. Therefore, in order to support victims it is necessary to provide an environment where the Victims Master Database can be operated immediately after a disaster strikes.

We believe that it is essential to employ cloud computing for the wide spread use of the Victims Master Database. Cloud computing allows for minimal provisions on the part of the users, that are cities, districts, and villages. In fact, all they need to provide is basic connectivity — clients including personal computers and mobile information terminals, browser to operate on them, and Internet connections.

Once these have been provided, it becomes possible to start providing services based on necessary data from the Basic Resident Register and Property Taxation Database.

Foreseen challenges to be resolved here include the following: (a) who shoulders preparation costs to launch a system, (b) who takes a responsibility to administer and operate the system and to administer the accumulated data, (c) how do we deal with cost in normal times for services that are to be used only in emergency. Additionally, another issue could be establishing a service environment for cloud computing during a disaster response.

Our research and development team installed a server in Iwate Prefecture after it was struck by the Tohoku Earthquake, and it is currently operating a Victims Master Database for the afflicted cities, districts, and villages. Our activities are two-fold: (1) Providing a system for life rebuilding support services using a basic database built from the Victims Master Database and (2) Verifying the disaster response operation support services to be used with cloud computing.

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