SYSTEM DESIGN OF DISASTER MANEGEMENT INFORMATION SYSTEM IN TURKEY AS A PART OF E-GOVERNMENT

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ABSTRACT:

With the new advances in computer technology, information management has become easier than ever. Every governmental office has started to develop electronic systems according to their purposes. Hence, e-government has become an important tool in our daily lives. As a result, Turkish government has resolved to provide public services online in accordance with EU targets. As a part of this process, the prime ministry of Turkish republic has chosen Istanbul as a pilot project area where many complex tasks carried out by governmental offices. Since Istanbul has been growing rapidly without proper planning, severe precautions should be taken specifically against natural disasters. Therefore, it has been decided to build immediate natural disaster management information system. The consultancy of this project has been given to Yildiz Technical University (YTU).

This project aims to determine the risky areas by geographical analyses before natural disasters. The other goal of this project is to manage an urgent and effective help services during and after the disaster.

Before the design of the system, a questionnaire was given to many governmental offices and some other companies which can be possible data sources. After the analysis of the current situation is completed, the data and the data sources have been decided.

The designed system is basically divided into two parts namely database design and communications design. The aim of the communication design is data update before disaster and to provide continuity of the data.

Consequently a disaster information system is designed according to the standards of e-government which is all ways always up to date. When the system is setup Istanbul is going to be ready to deal with unwanted results of disasters.

1. INTRODUCTION

Today society started to adapt information technologies and as citizens they want to benefit governmental services in electronic environment. According to this situation some associations started to invest in developing their systems in order to service online. It appeared that there has to be coordination between these systems in order to accomplish effective and productive usage of the sources, correct investment planning and to form productive decision support systems. Also it is agreed that coordination is needed for obtaining opportunity equality in reaching information and to associating with the world, etc. For that reason Prime Ministry of Turkey decided governmental services to be online according to EU targets. After the problems at 17 Th August 1999 earthquake as a part of e-Government project Disaster and emergency management system is decided to be build. Istanbul is selected for pilot project area because of being a perfect model of whole country and being the highest populated city which will suffer the worst from possible earthquake. The consultancy of this project has been given to Yildiz Technical University (YTU) by Prime Ministry of Turkey. Information about the design of Disaster and Emergency Management System is given in this paper.

1.1 E-Government

It is defined as proceeding the responsibilities and the services & duties of the government against the citizens, and the responsibilities and the services & duties of the citizens against the government mutually in the electronic communication & processing environment without any interruption but safely. (Türkiye Bilişim Şurası, 2002).

"E-Government is the use of information and communication technologies in public administrations combined with organizational change and new skills in order to improve public services and democratic processes and strengthen support to public policies." (Corbin, 2003)

1.2 Disaster and Emergency Management

The concept of Disaster and Emergency management can be described as; guiding, coordinating and application of all the sources of all organizations and associations for the common purpose of preventing loss and decreasing disaster damage.

Hence it is not possible to prevent many of the disasters, precautions that should be taken by the associations for preventing disasters or minimizing disaster damage can be listed as below.

Before Disaster:

- To take technical, legal, administrational precautions in order to survive the society with less damage and physical loss
- To include disaster damage mitigation studies in all stages of development in order to stop growing of present risk and to obtain sustainable development
- To obtain effective and fast preparation
- To carry out effective educational programs that would help all parts of society to be saved with minimum damage

During disaster and after the disaster:

- To rescue maximum number of effected people and heal them
- To create a secure and developed living environment for the people who are effected by the disaster
- To supply all vital needs of survivors and providing the daily life to be brought on normal
- To compensate possible economical and social loss as soon as possible

2. DISASTER AND EMERGENCY MANAGEMENT SYSTEM (AFAYBIS)

Disaster and Emergency Management System is an information system developed in order to handle the studies in a coherent and trustable way and to reach the perfect data while application. It consists of Administrative, Geographic and Decision- Support Information Systems.

2.1 The Aim of the System

AFAYBIS is designed as a minor project of e-Government. Turkey is situated on an important earthquake zone. (North Anatolian Fault Line) (Alkis , 2003) Moreover; it faces many disasters such as floods, fires, avalanches, etc. each year. Financial and social payback is a big deal for the country. Thus the importance of the Disaster and Emergency Management System can not be ignored.

Disaster and Emergency Management System is basically to benefit modern technology to standardize, organize and manage the data and information about disaster management. To realize this, it aims at making it possible to reach the data quickly during or before a disaster, to create the maps and statistical information, to present the data in different multi user media and on internet. To practice all, city of Istanbul is chosen as the pilot area. The studies in Istanbul, producing standardized data and converting the existing data, are planned to form a background for the e-government.

2.2 Place of Disaster and Emergency Management System in e-Government

In a totally electronic governing, all administration, analyses and decision making studies are realized in e-government. Disaster and Emergency Management System is the minor system of e-government which makes it easy to accelerated and productive decision making. It is the most challenging problem to organize the Non-governmental organizations, governmental institutions and civil people in such an emergency case. The disaster management information system that is developed to solve this problem will result in optimum efficiency during interference.

3. SYSTEM DESIGN

An analysis study is carried out before system design in order to realize current organizational structure, determine existing and needed data with data sources.
After the work of analysis, the design of system is divided in two parts: (i) analysis of data and process, (ii) analysis of communication.

3.1 Recent Situation Analysis:

3.1.1 AFAYBIS Questionnaire

The Institutions related with AFAYBIS are determined and a questionnaire is arranged to be informed about the condition of data that is used by these institutions.

- Regulations and law that the institutions are bounded.
- The official responsibilities and duties of the institution.
- Organizational structures, data and standards used by the institutions at conveying the services
- The relationship and duties of the institution
- Hardware and software used by the institutions
- Existence of the material and equipment
- Existing human resources
- Institutional relation and communication between the institutions
- The existence of the institutions in relation
- Researches on the question whether the institution is ready for e-government or not (the subject that the services of the institution are held online or the possibility for this are researched).

System is designed after the evaluation of the questionnaires and obtaining the other data needed about the institutions.

3.2 Data and Process Design

In AFAYBİS project, the system is designed by CASE tools (Computer Aided System Engineering) with a modern view, appropriate to technological developments; in case of traditional approaches.

Unified Process (UP), which is known as the most widespread system design and development methodology in the world (RUP, 2003) is used for designing AFAYBIS. During this process, Use Case and UML (Unified Modeling Language) are used to modeling the design. UML is accepted as the conceptual modeling language by ISO (ISO/TC 211, 2003).

3.2.1 Determining the Standards

When the questionnaires are evaluated and the GIS' are examined, it is observed that there is no common standard for the data produced in Turkey. Standards are suggested after examining many institutions and examples in the world. Unfortunately, it is observed that there are different standards at especially obtaining the geographical data. This will result in great problems at developing the AFAYBIS in e-government project. This problem will cause discordance while trying to unite e-Turkey with e- Europe. In this study, the standards in

the world are researched and the ones that Turkey has to apply are determined, considering the criteria below (Batuk, 2004):

- The definition of the data, the coordinate system, datum/ellipsoid information, digitizing type, accuracy/scale, data quality, exchange format, documentation standards
- The definition of the product, symbology, accuracy and quality, documentation standards
- The definition of the process and documentation standards.
- Geometry, topology and raster data storing structure, query language, interoperability, web portal, software standards and etc.
- Hardware standards

3.2.2 Organizational Structure of the System

This system is designed, containing the relationships about data and information access, disaster management communication, risk reducing and preparation, post-disaster problems between prime ministry, governorship and other institutions. The service and duty of the institutions are taken into consideration and adapted to the system, without making crucial modifications in their existent organizational structures. On the other hand, a particular care is taken to create a structure that will not be influenced by the public management reform that is being discussed in TBMM.

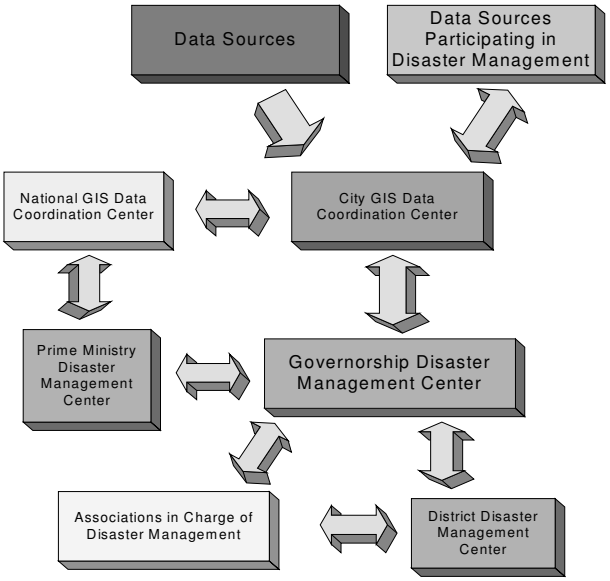

Figure 3.1 AFAYBIS Data sharing organization

3.2.3 Data Design

Disaster and emergency management is vertical application from the view of GIS, that is to say, it is connected to the several institution and data. It is determined that there are 3 data groups as base for disaster and emergency management (OAS, 1990). These are as follows:

- Natural hazards information, which denotes the presence and effect of natural phenomena. This information should ideally include the location, severity, frequency, and probability of occurrence of a hazardous event. Location is the easiest for planners to find; the rest can often be obtained from sectoral agencies, natural hazard research and monitoring centers, and, increasingly, integrated development planning studies.
- Information on natural ecosystems (e.g., slopes and slope stability, river flow capacity, vegetation cover), which provides the basis for estimating the effect natural hazards can have on the goods and services these systems offer and also determines the factors or conditions that create, modify, accelerate, and/or retard the occurrence of a natural event.
- Information on population and infrastructure, which is the basis for quantifying the impact natural events, can have on existing and planned development activities. Large scale data describing lifeline infrastructure and human settlements, for example, are critical elements for preparing vulnerability assessments and for initiating disaster preparedness and response activities.
- And other inventory data.

Depending on this basic information the data that has to be used while designing AFAYBIS is grouped at below and classes are created according to that. The classes in these data groups are designed using object oriented methodology. The class diagrams are created in UML

- Base Data: Buildings, administrative boundaries, hydrography, elevation information, referance points, city development plans, land usage, soil and geology maps, Existing ortophotos and large scale maps, cadastral information etc.
- Transportation Data: Land-sea and airways etc.
- Infrastructure Data: Gas, electricity, water, sewer system and telecommunication etc.
- Data about Critical Areas: Important or hazardous areas (Fuel-oil stations etc.), historical places, high populated settling and business centers, health, education, security etc.
- Data for disaster- emergency conditions: Temporary residences to be built after the disaster; disaster management centers and the staff in charge etc.
- Institutions and inventory data: Equipment inventory to be used during the disaster (working machines, transportation vehicles etc.), medical equipments, food and water stocks, inventory for the staff in duty (medical, security).
- Data for the Risky Areas: Risky areas that are planned according to various scripts (erosion, landslide, soft ground etc.)

3.2.4 Work Flow and Process Design

This part is considered as the chain of duties before, during and after the disaster that will reduce the risk taken. On the other hand, to manage the work flow and process design on the electronic media, the question of which institution will be renewing which data is answered. (Table 3.1 and Table 3.2)

	Process	Content Of Process	Methodology	Input for AFAYBİS	Produced in AFAYBİS
Mitigation	Spatial determination of risks	Earthquake, Flood, Fire, Landslide, Storm, Diseases, Tsunami, Thunderbolt, pollution, accidents, others	Creation of simulations and determination of risky areas with GIS	Possible risk areas and allocation of these areas	Maps about hazardous areas.
	Determination of risks for buildings.	Examination of public buildings, critical institutions, houses and other buildings.	Examination on the project or at survey and deciding at the office depending on zoning	Buildings that need precautions	Risk zones determined after examination and geoprocessing of the data
	Determination of risks for infrastructures and transportation	Electricity Water Gas Sewers Telecommunication Transportation	Examination on the project or at survey and deciding at the office depending on zoning	Technical Infrastructure lines and instutitons, transportation data, Technical infrastructures and transportation elements that needs strengthening	Buildings, critical instutions and technical infrastructures such as bridges tunnels etc. that needs precaution
	Damage Mitigation	Plans and permits	Control	New buildings and data	
		Education Announcements		Criteria's	Education Materials
		Mitigation and announcements of risks	Suggestions, Notices	Precautions that are already been taken	Reduced risk areas

Table 3.1 Process' before the disaster

Task definition	Content	Data	Produced in AFAYBİS
Personnel, vehicle, tools, supplies	Associations agreed to participate in with their personnel, vehicle, tools, supplies, etc	Alarm Level Risk Zones Service groups	
Areas	Shelters Waste disposal zones Helicopter ,airlines sea lines, railroad transportation areas Supply depots, supply distribution points Morgues and burial zones Hospitals, portable hospitals, blood centres, ambulances Buildings in which chemical, nuclear, biological, explosive, flammable, materials are produced and sold Public buildings that needs to be protected and secured Historical signs, banks, shopping centres Planning of distribution of exterior aids Alternate communication ways Determination of radio stations, radios and broadcasts of security, rescue, first aid teams Planning of alternate transportation and public transport Planning of alternate seaports and harbours Determination of alternative railroad stations and vehicles Planning of alternate aerial transportation Determination of alternate fuel-oil stations Traffic Control Points	Criteria's (depending on alarm zones and scenarios) Sources (Building, Land usage, human, tools, supply) Content and location of protocols with private sector Properties lines and instutions of technical infrastructures Critical instutions that need electricity, water, gas, communication. Communication power supplies. Capacities of radio and broadcasting stations Highway lines, properties and instutions. Roads that needs to be held open Important bus lines Harbour, sea transportation, metro and railroad lines, aerial transportation vehicles, capacities and instutions of vehicles,	**Plan assignments and informing** Plan assignments depending on examination of Location + capacity + needs + average fullness ratios + alarm level Teams: Personnel, vehicles, tools, supplies **Team - location** Location- technical substrucure –transportation Team - technical substrucure -transportation

Table 3.2 Process' during and after the disaster

3.2.5 Pre- Disaster Data Synchronisation

Data that will be used for the interrogations is one of the most important parameters to realize the AFAYBIS for Istanbul. This data has to be updated in order to take accurate decisions. To keep the data updated, databases have to be syncronised with Disaster Management Centre databases. This process of equalisation is called Data Synchronisation.

The sources that will be synchronized before the disaster are the institutions that produce the data. For this reason, institution analyses reports prepared for the Istanbul AFAYBIS project and source institutions that will be equalised with the reports on Disaster Management Centre database, charts and area are determined. The relationship of the institutions with AFAYBIS centre is given in Figure 3.2.

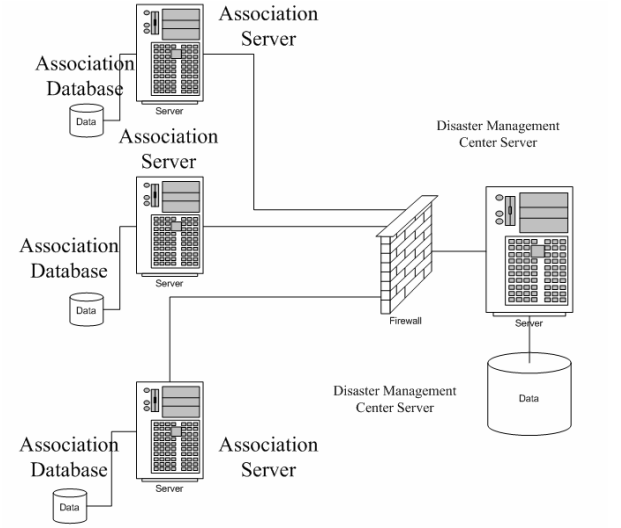

Figure 3.2 Connection between association servers and AYM

3.3 Communication Design

Communication works as a backbone before, during and after the disaster for organization and gathering of the information and for quick and accurate implementation of the decisions. The earthquake on August 17, 1999 has revealed the importance of communication during and after the earthquake. Under this heading the concepts, standards and methods of communication infrastructure that is to be set up for fulfilling duties like reaching and updating data that are being kept in a completely numerical environment will be analyzed and drafted.

The design is in a modular and expandable structure. It constitutes Disaster Management Centre, its upper (Disaster Management Centre of the Prime Minister's Office and the Governorship of Istanbul) and sub-units. The information that the Disaster Management Centres of the districts and all the related institutions have will be sent first to Istanbul Disaster Management Centre and to the Prime Minister's Office from there. The design, if necessary, makes it possible, for the institutions that belong to the system and Disaster Management Centres of the districts, to get the information from their sub-units.

Considering the possibility that the Disaster Management Centre might itself be damaged during a possible disaster, a copy of its original is planned to be kept in another city.

3.3.1 Communication Infrastructure of the Disaster Management Centre

Istanbul Disaster Management Centre is the vital point of AFAYBIS. It is important, because it is the centre that all the information that is going to be used for decision making is collected. For fulfilling this duty, a local area network (LAN), to be used for sending data to the centre, and a wide area network (WAN), to be used for exchange of data among the units within the system, is designed for the Disaster Management Centre.

The width of the band that will send the data is perceived as the most important parameter in selecting the communication technology. The width of the band is determined as medium because of the fact that the amount of data that will be sent by to the Disaster Management Centre is changeable. Communication technologies that are planned to be used and the width of the band can be re-arranged according to the need. By this approach, it is aimed to set up a progressive system.

3.3.2 Communication During and After the Disaster

The design is done considering the possibility that all the communication lines through LAN and WAN may be broken during the disaster and the sub-units, districts and fields may be damaged. Technologies that can secure communication during the disaster without any interruptions will be used. During the setup and operation of the system these possibilities will be taken into account and the most appropriate one will be chosen. Technologies that can be used are listed as:

- Radio
- GPRS
- Wireless Networks
    - Wireless WAN
    - Wireless LAN
    - Wireless PAN
- Satellite Communication

4. CONCLUSIONS

The Disaster Management Information System (AFAYBIS) project is prepared by YTU Department of Remote Sensing and Photogrammetry with the aim of managing and organizing the units, information, tools and equipments necessary for minimizing the damages of the disaster by using the latest technology. AFAYBIS is a project that based on information technology and Geographical Information System (CBS/GIS).

During the analysis phase of AFAYBIS United Modelling Language (UML) is used and within the concept of UML, disaster management scenarios are modelled with use-case diagrams. Thus, the stages of the disaster management are designed within a clear system and therefore the roles and responsibilities of the institutions for disaster management have become much clearer.

The communication within and among the institutions is provided by telephones and faxes. Despite the current situation, e-government, shortly, is the efficient use of electronic environment for the public institutions' operations, for the coordination within and among institutions and for services designed for the citizens that can be done by using internet. Taking into account the fact that 80 % of the public services are in connection with the spatial data, it is clear that the e-government will not meet the expectations if it is not based on

the spatial data (AFAYBIS, 2004). AFAYBIS project is prepared with this vision.

In AFAYBIS, one of the most important things is communication. Considering that all the information that is going to be used for decision making is collected online. For fulfilling this duty, a local area network (LAN), to be used for sending data to the centre, and a wide area network (WAN), to be used for exchange of data among the units within the system, is designed for the Disaster Management Centre.

Foreseeing the fact that the existing communication infrastructure can be damaged during the disaster, wireless communication technologies that can be used are chosen. In this respect, advantages and disadvantages of the technologies that the personnel will use during and after the disaster have been explained. Technologies that are independent of foreign resources and are still in existence are suggested to be used during the disaster.

Data production that is designated within the framework of AFAYBIS project will enable efficient data sharing between the institutions. This efficient and rapid share of data between and among the institutions will in turn enable the decisions to be made more accurately and more quickly. This will eventually positively affect the development of our country.

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