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Evaluation of Infrastructure of Kocaeli Metropolitan Municipality Information Technology In Terms of Disaster Management

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ABSTRACT *It is inevitable to ensure the security of social life and to do preparatory work against disasters at regional and national levels in order to create communities that are resistant to disasters causing financial and spritual losses. Therefore, regional and national planning are very important and one of the most important parts of this planning is undoubtedly the active use of computer technologies in this field. As in all fields, the effective use of any piece of information obtained in terms of disaster and emergency management is very crucial. In this regard the use of information technologies has come to the fore as an essential part of disaster management.*

In this study, Metropolitan Municipality Information Technologies infrastructure was evaluated with in-depth interview method in terms of disaster management in Kocaeli province which, due to its geographical position, contains risks of natural disasters as well as emergency situations with its dense population and industry. During the study period other relevant institutions/units in the province (Disaster and Emergency Management Authority- AFAD, Fire Department) were interviewed and inter-institutional cooperation activities were put under the microscope.

In conclusion; It has been seen that Kocaeli Metropolitan Municipality (KMM) Geographic Information System (GIS) has an infrastructure that can exchange data with the relevant institutions, yet it was found that damage estimation work has not been done and the decision support systems were not created due to the lack of information on building inventories, and industrial organizations.

Keywords: *Disaster Management, Information Technologies, GIS, Kocaeli Metropolitan Municipality*

Kocaeli Büyükşehir Belediyesi Bilgi Teknolojileri Altyapısının Afet Yönetimi Açısından Değerlendirilmesi

ÖZ *Toplumsal yaşamın güvenliğini sağlamak, maddi ve manevi kayıplara neden olan afetlere karşı dirençli topluluklar oluşturmak için bölgesel ve ulusal düzeyde afete hazırlık çalışmaları yapmak kaçınılmazdır. Bu nedenle ülkesel ve bölgesel planlama çalışmaları oldukça önemlidir ve bu planlama çalışmalarının en önemli parçalarından biri de kuşkusuz bilgisayar teknolojilerinin bu alanda aktif olarak kullanılmasıdır. Her alanda olduğu gibi afet ve acil durum yönetimi açısından da elde edilen her bilginin etkin kullanımı son derece önemlidir.*

Bu noktada bilgi teknolojilerinin kullanımı afet yönetiminin vazgeçilmez bir parçası olarak ön plana çıkmaktadır.
Bu çalışmada coğrafi konumu itibariyle doğal afetlerin yanı sıra yoğun sanayisi ile acil durumları barındıran Kocaeli iline ait Büyükşehir Belediyesi Bilgi Teknolojileri altyapısının afet yönetimi açısından değerlendirilmesi derinlemesine mülakat yöntemi ile yapılmıştır. Çalışma sürecinde ildeki diğer ilgili kurumlar/birimler (Afet ve Acil Durum Yönetim Başkanlığı- AFAD, İtfaiye Daire Başkanlığı) ile de görüşmeler yapılarak kurumlar arası işbirliği çalışmaları da mercek altına alınmıştır.
Çalışma sonucunda; Kocaeli Büyükşehir Belediyesi (KBB) Coğrafi Bilgi Sistemi (CBS) altyapısının ilgili kurumlar ile veri alışverişi yapabilecek bir altyapıya sahip olduğu, ancak bina stokları ve endüstriyel kuruluşlara ait bilgilerin eksikliğinden dolayı hasar tahmini çalışmalarının yapılmamış ve karar destek sisteminin oluşturulmamış olduğu görülmüştür.

Anahtar kelimeler: *Afet yönetimi, bilgi teknolojileri, CBS, Kocaeli Büyükşehir Belediyesi*

INTRODUCTION

Natural phenomena such as earthquakes, storms, floods and volcanic eruptions, are actually constructive forces which are effective in shaping the physical characteristics of the earth.

Natural phenomena such as storms, floods, earthquakes, fires, landslides and volcanic eruptions that occur in the world every year in various magnitudes and frequencies, currently people's inability to perceive their environment well, establishing unplanned settlements areas at risk without taking necessary measures, and wrong policies could cost thousands of human lives (Birand and Ergünay, 2001; Demirci and Karakuyu, 2014).

Although emergency situations can be devastating, the emerging dangers are of a size that can be dealt with in a local scale. Disasters, however, require help in a larger scale than an emergency situation, cause great economic and human loss, and they require the declaration of a crisis situation. Building the capacity for disaster recovery is by no means limited to just fast and effective response at the time of the disaster. Moreover, it is difficult to produce universal solutions because disasters requiring different solutions depending on various reasons might show differences in different countries. Therefore, it is necessary to develop models containing training and management phases and management where scientific and technological developments at national levels are used (Press and Hamilton, 1999). In other words, countries having the possibility of facing a disaster at any moment need to develop modern approaches to reduce losses caused by disasters and solutions to problems (Iwan et al., 1999). The definition of a disaster management covering all the work for disaster and emergency management is given by Ergünay (2002) as follows;

"Disaster management is a very broad concept which requires the management of all institutions, organizations and resources of the society in line with the common objectives to be able to plan, direct, coordinate, support and implement the works necessary in each phase of a disaster in order to prevent disasters and reduce the damages. Therefore, in literature

"Comprehensive Disaster Management" is more commonly used" (Ergünay, 2002). (Figure 1).

Figure 1. Phases of Disaster and Emergency Management

As seen in Figure 1, disaster and emergency management is generally addressed in a number of phases.

Mitigation: Mitigaiton is defined by Federal Emergency Management Agency (FEMA), (2014) as efforts to reduce the loss of property and life caused by the impacts of disasters. All of this can be achieved with risk analyses, risk reduction activities, corporate initiatives and investments related to them. Türkoğlu et al., (2001) defines risk reduction activities as all the efforts and measures aimed at eliminating, if possible, the loss of life and property that may occur in the face of dangerous situations or reducing them as much as possible. Physical infrastructure, selecting living spaces, determining construction standards, and determining all the necessary regulations and economic methods form the basis for the damage reduction phase. Investments aimed at reducing disaster damage can be achieved by corporate work, education, and creating social culture (Gülkan ve diğ, 2003).

Preparation: Today, while some countries show efforts to live together with the presence of disaster risk, many prefer to ignore these risks Waugh and John, 1990). However, it is an inevitable reality that damage reduction activities can not completely prevent disasters and we always need to be prepared. It may not be possible to avoid the negative effects of especially natural disasters. Therefore, the national wealth and lives and property of the community must be protected from the devastating effects of the disaster with the

preparatory work prior to the disaster. This protection may be possible by carrying out certain activities as necessary. It is inevitable to organize the society in case of a disaster. The main objective of the preparatory phase is to do preliminary preparation for right timing and effective response by taking precautions against the adverse consequences of dangers on communities and living spaces.

The activities that need to done in the preparation phase can be summarized as the preparation and development of disaster plans at central and provincial levels, training of personnel that will work on these plans, increasing knowledge and skills with drills, stocking material at needs centers at regional levels, establishing and developing alert and early warning systems, performing activities for the community (organization, education), executing repair, reinforcement and urban renewal projects for the buildings believed to be damaged in case of a disaster.

Among the preparation phase activities, with the developing technology especially studies regarding forecast and warning systems that are developed for unavoidable and inevitable events arouse interest. The main components of warning systems are understanding the danger, analysing the date, scientific forecasting, briefings and warning (Güler, 2009). It is very important to be able to warn natural disasters, which might cause loss of life and property, even a short time before it happens in order to reduce loss of life. The majority of human-induced disasters and some natural disasters such as tornados, hurricanes, floods are events that can be predicted with adequate technical information and equipment (Demirci and Karakuyu, 2014).

Response: According to Can (2005), response is all the activities that are carried out within a 1-2 month period depending on the magnititude of the disaster starting right away following the disaster. The first objective in the response phase is to save as many lives as possible in the shortest period of time. This is followed by other activities such as the dispatch and treatment of injured people, provision of shelter and other vital needs for people. Such activities as "Disaster Action Plan" and "Disaster Management Information System" prepared with damage reduction activities can also contribute to a healthy response during the disaster (Şengezer and Kansu, 2001).

With the slogan "Natural disasters are in fact not natural disasters", United Nations Natural Disaster Reduction Year (IDNDR) Secretariat emphasized the importance of preventing disasters and the role of everbody from the individual to society in this process. For this purpose disaster prevention will be possible with continuous improvement (Güvel, 2001). A total of 357 disasters have occurred in the world in 2012. As a result of these disasters, there have been 9.655 casualties while the economic losses are estimated at 157 billion dollars. As a result of the 127 disasters that occurred in the first six months of 2013, 8250 people lost their lives and 16,416,723 people suffered from the diasasters. The cost of the damage from disasters was over 45 billion dollars. According to the global data and figures in 2013, 90% of all the disasters with fatalities happened in poor countries (Ersoy, 2013). Due

to its geological, topographical and meteorological conditions, our country is exposed to the frequent disasters or events that can be regarded as emergencies. Depending on the economic conditions and population density of the area where the incident occurred, losses show a growing trend day after day. As a result of the disasters happening in our country, on average above 100 fatalities happen annually. It is very important to keep the necessary information in order and ready and accessible in areas having a high risk of facing a disaster prior to disasters threatening our country with varying densities and magnititutes.

Using Information Technologies

In particular, management of natural disasters is multi-layered and multi-step process. International organizations, governments, local authorities, professional associations, universities, non-governmental organizations, corporations, and individuals are multi-layered because they take a part at certain points in the process. Disaster prevention and damage reduction are also multi-step due to a process such as preparedness, forecasting and warning, rescue and first aid, improvement, and rebuilding. (Durduran and Geymen 2008). Various methods are developed and used in our country and the world to minimize the disaster damages. The purpose of these methods is to determine the disaster risk of the area and make the necessary plans in this direction. In line with the development of technology, the technologies used in disaster management are Forecasting and Modeling, Remote Sensing and Geographic Information Systems (GIS) and the Mobile and Wireless Technologies.

Remote Sensing

Remote sensing and GIS come to the forefront for the technologies actively used in local governments. Remote sensing is based on the principle that an object is observed from a certain distance without actually making a contact with it. It is faster than ground-based observations, and information regarding a wider area can be collected at a time. Recording information from remote sensing, and the images and pictures collected over the sensors can be used for the development of integrated disaster and emergency situation planning and for the evaluation of disasters. Today, remote sensing is actively used in many scientific studies for the topography map of investigated area in the desired scale, its formation, settlement and land-use maps, determining water basins and river-flood plains, monitoring and mapping the time-dependant developmental stages of various natural events such as volcanic activities, flooding, landslide, avalanche, and storms. Thanks to remote sensing, earth changes in time (e.g. changes occuring due to earthquakes) and the factor causing these changes can be revealed (Demirci ve Karakuyu, 2014).

Besides natural and biological hazards, disasters are also caused by complex socio-political emergencies and industrial hazards. The extent of damage caused by a danger not limited to the severity of the hazard, but it is also related to the preparation capacity of the region. Agencies that will take an active role in disaster and emergency management prefer

more useable and sharable structure over their current available data and information in order to carry more efficiently and faster the services expected from them (Bank, 2013). Ilter and Özkes (2007) emphasize that provincial information systems are taken as the basis within the scope of disaster management information systems in the world, and that being able to dynamically record, analyze, and manage the assets belonging to the city on a GIS-based source is the first step in disaster management information systems. In a study, Bank (2013) defines working in an integrated structure as implementing all the work processes in an institution in relation to each other and it is usable and sharable in given works and operations. In the same study, Bank states that geographic data is of a life process and this collated date is maintained by serving in various areas. Bank also notes it is very important that the geographic data used in this process is up-to-date, and this date can change hands in life process.

Geographic Information System

As it can be understood, disaster management is the collection of studies including the implementation of multiple studies simultaneously and analyzing the date coming from various sources. In order to develop an effective management model, it is necessary to obtain data regarding such factors of the disaster area as the physical structure, settlement and population on the one hand, and to use all this data to plan and develop forward emergency situation response strategies. In this scope, Geographic Information Systems is known as systems that make it possible to examine date from various sources simultaneously considering the relationships between each other, and to analyze all kinds of date from various aspects (Bilir, 2009; Demirci and Karakuyu, 2014; SDN, 2014; Yomralıoğlu, 2000; Greene, 2002).

GIS techniques are seen as preferable vehicles in terms of their reliability in damage reduction, and their easy and fast use. Reasons to use GIS in disaster management; controlling destruction, reducing consequences of a disaster causing damage, it helps to protect lives and resources (Aydınoğlu et al., 2009).

The advantages of using Geographic Information Systems in studies related to disaster management system; it is a reliable tool to obtain data, it can bu updated, it presents fast and easy solutions, it has versatile visual support.

On the surface of the earth, above or below, all kinds of natural (rivers, lakes, etc.) or soncrete details (roads, buildings, etc.) having a certain location and shape, and demographic information all constitute geographic data. This date serves many purposes depending on the needs and what institution uses them. The use of these data integrated with each other in the service of local government means the integration of Management Information Systems and Geographic Information is gaining more importance day by day. Moreover, various information systems are developed in line with technological developments and needs. However, it is necessary to design and apply these systems developed by different units integrated. Including baseline data into the system that will be designed integrated is

necessary to develop a quick and effective response organization. On the other hand, geographic information systems supported with remote sensing and the use of city information systems before, during and after the disaster will provide many opportunities to decision-makers and enforcers, accelerate decision-making process, and improve response capacity (Akkoç, 2011).

With Turkey Disaster Response Plan (TAMPA) roles and responsibilities have defined for the coordination units and service groups that will take part in emergency response activities in disaster and emergency situations, and basic principles of pre and post response planning have been determined. In this plan, important roles fall to the municipalities in provincial disaster and emergency coordination committee. Therefore, regarding the use of GIS where the data is stored within local governments based on the principle of integrated disaster management in provincial disaster and emergency situation coordination committee comes to the fore in the following;

Before the disaster; Locating areas which are at risk, determining regional disaster types, times and durations, determining the superstructures and infrastructures that might be affected, determining the facilities and needs areas (drinking water) that can used during the disaster, and planning shelters and food sources,

During the disaster; Managing the search and rescue and first aid activities after locating the disaster and the affected areas (such determing demoslihed or damaged buildings or industrial establishments and roads),

After the disaster; Damage assessment and planning needs.

Methodology

In this study, the analysis of information technologies on organizational basis which has an important place in providing instant and efficient intervention in the disaster management system for the emergency cases taking place not to turn out to be a disaster in Kocaeli province which has a population of 1,722,795 and hosts 13 organized industrial sites and natural and technological dangers is evaluated with the case of Kocaeli Metropolitan Municipality.

Information technologies and GIS are identified as important tools by local governments for the preparation of positional reports that provides instant and accurate decision making and management of cities. GIS enables the preparation of positional reports by investigating changes in different levels with local governors at the same time.

In-depth investigation techniques are used in this study. In the scope of the study, answers are searched for the questions below by making interviews with the executives of Kocaeli Metropolitan Municipality (KMM), IT and GIS departments, KMM department of fire brigade, Provincial disaster and emergency directorate (Kocaeli AFAD).

- What are the practices of KMM and relevant organizations related to disaster and emergency management on provincial basis?
- How is the IT and GIS infrastructures of KMM?
- What are the practices for the use of technological infrastructure in emergency interventions?
- What is the information kept in GIS database?
- What are the collaboration practices among institutions related to GIS?
- Is there a GIS based instant intervention system?
- Are there damage estimation practices for instant intervention?
- Is GIS infrastructure appropriate for inter-institution integration?
- Is there GIS based decision support system?
- Does the GIS database include information about industrial facilities in the scope of the province?

Moreover, information about GIS infrastructure and data kept in GIS database are obtained by the interviews with department executives. The information about the institutions and organizations with which KMM GIS system shares data is presented in Figure 2.

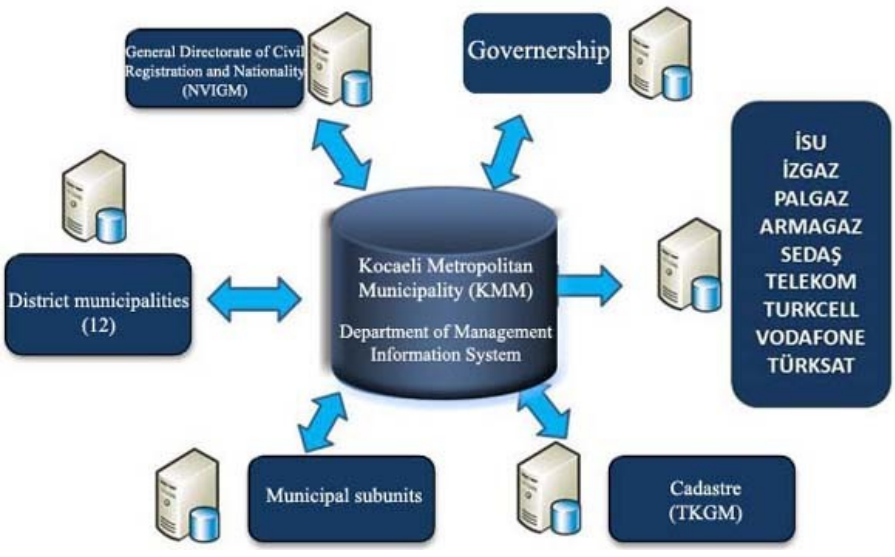

Figure 2. GIS data sharing of KMM

As seen in Figure 2, data exchange is carried out between KMM and several institutions by means of GIS Service of KMM Management Information System Branch Office. The institutions from which data is obtained are General Directorate of Census (license, housing, address), Kocaeli Directorate for National Education (school location and

address information), General Directorate of Land Registry and Cadaster (Parcel İnformation), Infrastructure Institutions (infrastructure information). The institutions with which data is shared are İzmit, Darıca, Kartepe, Başiskele and Gölcük Municipalities, İSU General Directorate, Sedaş Electricity Corporation and South Marmara Development Agency (MARKA). Data exchange with these institutions is on address basis. Moreover, data is also shared with all the units within the institutions.

The number of licensed buildings registered in the system is 53218, and total number of buildings is 275030. While the number of buildings registered to the system between 2007 and 20th of December 2015 with the new construction license is 36177, license information before 2007 is not available in the system.

In the interviews carried out with KMM executives with the aim of evaluation of GIS infrastructure in terms of disaster management, the answers obtained for the questions listed above are summarized as the following:

- KMM GIS system has an infrastructure that is open to other institutions and appropriate for collaboration with them.
- GIS data includes limited demographic information and data aren't up-to-date.
- Satellite images belong to 2014.
- Information about the static construction regulations of buildings is available only for the buildings constructed after 2007.
- Information about the damage analysis of buildings is not included in GIS data.
- The institution lacks GIS based damage estimation studies.
- The institution lacks GIS based decision support system.
- Information about industrial institutions is not available in GIS.
- Although business license is given after license supervisions and fire security reports by the relevant branch office (except for organized industrial sites), the data is not registered to GIS system.
- A common standard wasn't determined for inter-institution addresses (İSU, İZGAZ vs).
- In the planning stage of the studies done by AFAD, the registered data related to disaster and emergency cases (such as determining assembly areas) are designed on a district based only by considering free fields and infrastructure is overlooked.
- Within the scope of Infrastructure Coordination Center (AYKOME), all the infrastructure data (İSU, İZGAZ) are archived in GIS in appropriate format.

- In the context of the protocol with Directorate of National Education, information about schools is registered to the system via the web interface provided by KMM. The registered information is limited with school name, level (primary, middle etc.) and contact information.

Results and Suggestions

Several natural disasters have happened in our country and province due to geological features. These disasters caused loss of lives, physical losses and great economical losses. Therefore, the losses to be experienced and the dimensions of damage can be reduced with an efficient disaster management. When the extent of losses experienced around the world and in our country are considered, earthquake disasters come into prominence. When the fact that Kocaeli also includes industrial risks since it is an industrial region is considered, the extent of possible damage tends to increase.

Local governments which are the locomotives of public service are utilizing electronical applications and information systems in parallel with the developing technology. Especially when security of life is the matter, services related to it comes into prominence firstly. However, in order to provide instant and efficient interventions in disaster and emergency cases and keep losses at the lowest level, it is necessary to be well-prepared, to meet basic needs and to make all the preparations in advance. The use of information systems for the efficient management of these resources has been inevitable in today's world. Especially when the importance and effect of each piece of information on decision making for the local governments is considered, being well-prepared for disasters with the help of GIS based management information systems should be a priority. Moreover, it is another important issue to integrate GIS and YBS applications that institutions carry out independently from each other by forming an effective Decision Support System. KMM, which is the subject of this study, generally shares its GIS infrastructure and a great deal of its data with several institutions in harmony. For Kocaeli, having experienced 1999 earthquake and suffered from great losses, the fact that information about building stocks and damage levels of buildings constructed before 2007 is not available in the system, is an obstacle for damage estimation and an important shortcoming that may challenge decision makers in case of a possible disaster. It also should be noted that registration of all the information about industrial organizations in the province to the system is an important component for instant and efficient intervention in case of a disaster and emergency. The infrastructure of Directorate of National Education provided by KMM and the information kept in the system should be developed and they should be converted to active data that can be utilized in disaster and emergency cases. Similarly, that the data shared with Directorate of Census is limited and relies on the authority of supreme institutions is another issue that challenges the interventions in case of an emergency. In this context, it should be noted that intervention teams need the critical information about the people in the intervention area such as the number of people, age and sex for instant and efficient intervention. In addition

to the current KMM GIS data, the necessary improvements must urgently be done in order to create a decision support system for the management of emergencies and GIS infrastructure should be developed. It is noteworthy that this will facilitate interventions to disasters and emergencies in Kocaeli and neighboring provinces and decrease losses to minimum level.

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