ISTANBUL TECHNICAL UNIVERSITY ★ INSTITUTE OF SCIENCE AND TECHNOLOGY

DETERMINING APPROACHES FOR THE MANAGEMENT OF EMERGENCY SERVICES BY GEOGRAPHICAL INFORMATION SYSTEMS: FIRE CASE

M.Sc. Thesis by
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Department : Geomatics Engineering

Programme : Geomatics Engineering

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JANUARY 2011

İSTANBUL TEKNİK ÜNİVERSİTESİ ★ FEN BİLİMLERİ ENSTİTÜSÜ

COĞRAFİ BİLGİ SİSTEMLERİ İLE ACİL DURUM HİZMETLERİNİN YÖNETİMİNE YÖNELİK YAKLAŞIMLARIN BELİRLENMESİ: YANGIN ÖRNEĞİ

YÜKSEK LİSANS TEZİ

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FOREWORD

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ABBREVIATIONS

CRM : Consequence Based Risk Management
DEM : Disaster-Emergency Management
EMA : Emergency Management in Australia
EM-DAT : Emergency Events Database
EU : European Union
FEMA : Federal Emergency Management Agency
FGDC : Federal Geographic Data Committee
GDI : Geo-Data Infrastructure
GDI4DM : Geographical Data Infrastructure for Emergency Management
GeoDRM : Geospatial Digital Rights Management Reference Model
GeoDSS : Ground Based Electro-Optical Deep Space Surveillance
GEOSS : Global Earth Observation System of Systems
GII : Geo-Information Infrastructure
GIS : Geographical Information Systems
GIT : Geo-Information Technologies
GMES : Global Monitoring for Environment and Security
GML : Geography Markup Language
GNP : Gross National Product
GPS : Global Positioning System
HAZTURK : Earthquake Loss Estimation for Turkey
ICT : Information and Communication Technologies
INSPIRE : Infrastructure for Spatial Information in Europe
ISMEP : Istanbul Seismic Risk Mitigation and Preparedness
ISO : International Organization for Standardization
ISTABIS : Istanbul Disaster Information Systems
JICA : Japan International Cooperation Agency
KOERI : Kandilli Observatory and Earthquake Research Institute
MAE : Mid-America Earthquake
MDA : Model-Driven Architecture
MEER : Marmara Earthquake Emergency Reconstruction
NFPA : National Fire Protection Association
NGO : National Government Organizations
OASIS : Open Advanced System for Disaster-Emergency Management
OGC : Open Geospatial Consortium
OpenLS : The OpenGIS Location Service
ORCHESTRA: Open Architecture and Spatial Data Infrastructure for Risk Management
PS : Public Safety
RABIS : Rize Disaster Information and Meteorological Early Warning System
RM-OA : Reference Model-ORCHESTRA Architecture
RS : Remote Sensing
SAFM : Digital Space Model
SAR : Search and Rescue

SBA : Small Business Administration
SDI : Spatial Data Infrastructure
SMM : Digital Disaster Model
SOA : Service Oriented Architecture
SOP : Standard Operating Procedures
TABIS : Turkey Disaster Information System
TABIS-OK : TABIS Object Catalogue
TURKVA : Turkish Geo-Information Infrastructure
UML : Unified Modelling Language
USD : United States Dollar
UVDM : Geo-Data Exchange Model of Turkey
W3C : World Wide Web Consortium
XML : Extensible Markup Language

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DETERMINING APPROACHES FOR THE MANAGEMENT OF EMERGENCY SERVICES BY GEOGRAPHICAL INFORMATION SYSTEMS: FIRE CASE

SUMMARY

Human life and property losses caused by natural and man made disasters have been increasing as the time passes. Planning faults in parallel with the increase in population causes to important losses as a result of the disasters such as earthquake, flood, fire, etc. The response of the actors such as fire brigade, ambulance etc. involved in Disaster-Emergency Management (DEM) in a well coordinated manner, in an effective way and in a short period of time has become a crucial need. DEM is a complex and very wide discipline that includes many actors and needs large amount of information. Geo-data, which are obtained from location-based observations and expressed as map information, is extensively used in different phases of DEM. Interoperable geo-data is urgent need for DEM, in mitigation and preparation phases, access to the region, monitoring of rescue operations, control and management activities of various logistics services depending on the quality of data. Within this scope, Geographic Information Technologies (GIT) can help the reduction of the results of disaster that caused damage, protect lives and resources, with dynamic use of geo-data in DEM. In parallel with the technological development, in the use of geo-data from different sources, the concept of Spatial Data Infrastructure (SDI) which provides interoperability through communication networks has emerged. Therefore, to provide an integrated DEM, geo-data must be modelled in interoperable structure.

In this study, the concept of disaster and emergency and defined disaster types for country were examined. By this means, disaster types for Turkey which is important for determining the scope of DEM could be determined. The concepts and the standards of DEM were also examined to determine the approach for DEM in Turkey. Legislation and GIS projects for DEM in Turkey were analyzed in the scope of determining the current situation. Actors that could act in a GIT-based DEM were defined according to current legislation in Turkey. GIT-based DEM approach for the management centres of Provincial Disaster and Emergency Directorates supposed to be established in each province of Turkey was developed. Main activities in mitigation, preparation, response and recovery phases of urban-fire event were determined with the sub-activities performed by various actors. Work-flow for sample activities of urban-fire event were defined according to DEM legislation. Use-case descriptions and uml diagrams for sample urban-fire activities were formed. With this approach, actors can access to data in need with electronic communication networks to perform the activites with defined work-flow, they can update the data and use the data in their applications.

COĞRAFİ BİLGİ SİSTEMLERİ İLE ACİL DURUM HİZMETLERİNİN YÖNETİMİNE YÖNELİK YAKLAŞIMLARIN BELİRLENMESİ: YANGIN ÖRNEĞİ

ÖZET

Doğal ve insan yapımı afetlerin neden olduğu can ve mal kaybı her geçen gün artmaktadır. Nüfus artışının paralelinde yapılaşmadaki planlama hataları, deprem, sel, yangın vb. afetlerde önemli kayıplara neden olmaktadır. Bu nedenle afet-acil durumlarda görev alan itfaiye, ambulans vb. aktörlerin koordineli, etkin ve kısa zamanda müdahalesi gereksinim haline gelmiştir. Afet-Acil Durum Yönetiminde (AAY) görevli bu aktörlerin farklı aşamalarda yürüttükleri faaliyetler birbiriyle ilişkili yönetilmelidir. Zarar Azaltma; afet-acil durum öncesinde muhtemel zararların önlenmesi ve azaltılması için risk yönetimi ve planlamanın yapılmasını hedeflemektedir. Afet-acil durum bölgelerini tespit etmek ve önleyici tedbirleri ilan etmek, zarara uğraması muhtemel yerlerin plan, proje ve imar esaslarını belirlemek vb. aktiviteler bu aşamada yapılması gerekenler arasındadır. Hazırlık; afet-acil durumlara etkin bir müdahale amacıyla önceden plan, eğitim vb. yapılan her türlü aktiviteyi ifade etmektedir. Müdahale; afet-acil durum anında ilgili kamu, özel, sivil toplum kuruluşları vb. aktörlerle koordineli olarak afet-acil durumun etkilerini gidermeye yönelik müdahale çalışmalarını içermektedir. Arama kurtarma, itfaiye, güvenlik, sağlık, mal ve çevre koruma vb. faaliyetlerin ilgili aktörlerle birlikte yürütülmesi bu aşamanın kapsamındadır. İyileştirme; afet-acil durum sonrası hayatın normale dönmesine yönelik aktiviteleri ve yeniden yapılanma aktivitelerini içermektedir. Etkilenen yerlerde diğer kamu kurumları ile birlikte yeniden yapılanma ve iyileştirme planlarını hazırlar ve uygulamaya konulması sürecini koordine eder. Afet-acil durum yönetiminin tüm aşamalarıyla ele alınmasıyla bütünleşik ve etkin yönetim anlayışı oluşturulabilir.

Etkin bir AAY için en önemli altlık ise bölgeye ait sağlıklı ve doğru üretilmiş haritalardır. Haritalar, herhangi bir afet veya muhtemel acil durumda ilgili bölgede bulunan bilgiyi konumsal olarak bünyesinde barındıran altlıklardır. Haritalar içerdiği bilgiye göre, acil durum anında bölgeye ulaşımın sağlanması, kurtarma çalışmalarının takip edilmesi ve çeşitli lojistik hizmetlerin organize edilmesinde gereklidir. Coğrafi Bilgi Sistemleri (CBS), acil durum yönetiminde güçlü karar destek sağlar ve karmaşık problemlere optimum çözümler bulmaya yardımcı olur. CBS fonksiyonları sayesinde farklı kaynaklardan gelen bilgiler ve harita bilgisi birlikte işlenebilmektedir. Böylelikle yol, bina, dere, topografya, arazi örtüsü vb. farklı katmanlardaki verilerin kullanılması ile acil durum hizmetlerine yönelik analizler gerçekleştirilmektedir. Harita bilgisi olarak da ifade edilen konuma dayalı gözlemlerle elde edilen coğrafi veri, AAY farklı aşamalarında yoğun olarak kullanılmaktadır. Bu anlamda AAY için CBS kullanılması; yıkımların kontrolü, afetin zarara neden olan sonuçların azaltılmasına, yaşamların ve kaynakların korunmasına yardımcı olacaktır. Bu da yüksek kalitede bilgi sağlanmasıyla mümkündür. Ancak AAY'de karar verme süreci çok karmaşıktır. Özellikle acil durumun müdahale anında, polis, belediye, itfaiye, vb. birçok aktöre mümkün olduğu kadar hızlı, doğru ve etkili bilgi akışı sağlanmalıdır.

CBS, belirli kullanıcı grupları ve projelerde yoğun olarak kullanılıyorken, çeşitli uygulamalarda üretilen coğrafi verinin kullanımında karar verme sürecine katkı sağlayarak zaman ve emek yönünden bilgi kaybını önleyecek bir yapının oluşturulması için bu sistemlerin bütünleştirilmesi yönünde eğilim ortaya çıkmıştır. Bu yaklaşımla coğrafi verilerin birlikte çalışabilirliği olarak ifade edilen, farklı idari düzeylerde coğrafi verinin etkin kullanımı ve paylaşımını sağlayan, politikalar, standartlar ve teknolojilerin oluşturduğu çatı olarak kabul edilen Konumsal Veri Altyapısı (KVA) kavramı ortaya çıkmıştır. Acil durum hizmetlerinde farklı kaynaklardan gelen coğrafi verinin elektronik iletişim ağları üzerinde birlikte çalışabilirliğine ihtiyaç duyulduğundan, KVA geliştirilmesi karar vericiler için kritik öneme sahiptir. Dünyada birçok ülke bu yaklaşımla harita-destek sistemleri geliştirmektedir. INSPIRE girişimi, Avrupa ülkelerinde coğrafi veriye erişim ve kullanılması ile ilgili teknik standartlar ve politikalar belirleyerek Avrupa KVA çalışmalarında yönlendirici bir rol almayı hedeflemektedir. Avrupa'da Afet Yönetiminde Açık Servis Mimarisi (ORCHESTRA) projesi, Avrupa'da farklı kurumlar tarafından üretilmiş acil durum ve harita bilgisinin elektronik iletişim ağları üzerinden birlikte çalışabilirliğine yönelik standartlar geliştirmektedir.

Çalışmanın genel kavramsal yaklaşımı; Sektör-Aktör-Aktivite-İş-Veri üst sınıfları ile tanımlanmıştır. Aktör; AAY'de Planlama ve Zarar Azaltma, Müdahale, İyileştirme, Sivil Savunma Daire Başkanlığı, Deprem Daire Başkanlığı hizmet gruplarını, itfaiye, polis, ambülans, zabıta, sivil savunma, arama kurtarma vb. acil durum yönetiminde görev alan kurumları veya ekipleri ifade etmektedir. Her aktör; güvenlik, belediye, sağlık, vb. farklı bir sektör de çalışır. Aktivite, AAY'de zarar azaltma, hazırlık, müdahale ve iyileştirme aşamalarındaki coğrafi veri kullanımına ihtiyaç duyulan uygulamaları ifade etmektedir. Örneğin; zarar azaltma aşamasında sel risk ve yangın risk haritaları üretilebilir. Müdahale aşamasında; gaz patlaması trafik kazası vb. aktivite olarak ifade edilebilir. Her aktivite, belirli aşamalardaki işlerden oluşmaktadır. Örneğin; kaza yerinin kaydedilmesi, itfaiye ekip güzergahlarının belirlenmesi, tehlikeli alanların belirlenmesi vb. işler aktivitenin bir aşamasıdır. Aktör, işi uygular. Örneğin; Müdahale Dairesi yangın yerinin belirlenmesi ve güzergahların belirlenmesi işini yaparken, itfaiye yangın söndürme işini yapar. Aktör, uyguladığı iş için coğrafi veriye ihtiyaç duyar ve acil durum süresince yeni coğrafi veri üretebilir. Böylelikle iş, veritabanındaki mevcut ve/veya dinamik veriye ihtiyaç duyar. Ayrıca acil durum müdahale süresince veritabanında dinamik veri üretir.

Yaklaşımdan beklenen, AAY öncesindeki hazırlık ve zarar azaltma, olay sırasındaki müdahale ve olay sonrasındaki iyileştirme aşamalarında ihtiyaç duyulan coğrafi verinin (harita bilgisi) belirlenmesiyle, farklı uygulamalarda erişilebilir ve ortak kullanılabilir nitelikte coğrafi veritabanı modelinin tasarlanabilmesidir. Böylelikle, Türkiye'nin illerinde kurulacak Afet ve Acil Durum Yönetim Merkezi'ne AAY'nin farklı aşamalarında hizmet sunacak, diğer birimlerle işbirliği içinde müdahalenin koordine edildiği ve karar vericilere destek sağlayacak konumsal veri altyapısı tasarlanabilecektir. Elektronik iletişim ağları üzerinde veriye açık erişimi sağlamak için Açık Coğrafi Veri Konsorsiyumu (OGC) standartlarına ve Risk Yönetiminde Açık Servis Mimarisi (ORCHESTRA) projesi standartlarına uyumlu olmalıdır. Acil durum aktörlerinin elektronik iletişim ağları üzerinde farklı kaynaklardan gelen konumsal verilere erişerek, koordineli, en etkili ve kısa zamanda karar destek sağlaması yaklaşımın ana hedefidir.

Bu çalışma kapsamında, afet ve acil durum kavramı incelenerek yönetimin sınırları ve çatısı belirlenmiş, ülkeler için tanımlanmış afet türleri incelenerek Türkiye'de oluşturulacak AAY kapsamın da ele alınması gereken afet türleri araştırılmıştır. Ülkede geçmişte yaşanan afetler ve iklimsel değişikliklerle ileride potansiyel risk oluşturacak afetler belirlenerek AAY'nin kapsaması gereken afet türleri sıralanmıştır. AAY yaklaşımları incelenerek Türkiye için oluşturulacak yönetimin kapsamı belirlenmiş böylece bütünleşik AAY için sağlanması gereken koşullar belirlenmştir. AAY'ye yönelik oluşturulan standartlar ve yapılan CBS temelli projeler incelenerek, Türkiye için ihtiyaçlar belirlenmiştir. Türkiye'de bulunan mevzuat AAY yaklaşımına göre irdelenerek, CBS destekli AAY de görev alabilecek aktörler, devlet, ulusal, bölgsel, il ve lokal düzeyde ilişkisel olarak tanımlanmıştır. Muhtemel yangın afetinin zarar azaltma, hazırlık, müdahale ve iyileştirme aşamalarında ki aktiviteleri ve uygulama amaçlı seçilen aktiviteleri oluşturan iş adımları belirlenmiştir. Seçilen aktivitelerin gerçekleşmesi için aktörlerin uyguladığı iş adımları için gererkli coğrafi veriler tanımlanmış ve aktörlerin bu iş adımlarını uygularken veritabanına ürettiği veriler belirlenmiştir. Böylece örnek aktiviteler için kullanıcı gereksinim tanımları oluşturulmuştur. Bu yaklaşımda acil durum aktörleri, elektronik iletişim ağları üzerinden örnek aktivitelerle ihtiyacı olan veriye erişebilir, güncelleyebilir ve uygulamalarında kullanabilir. CBS teknolojisine dayalı geliştirilen harita-destek sistemi, AAY'nin farklı aşamalarında acil durum aktörlerine etkin bilgi akışı sağlanmasında katkı verecektir.

1. INTRODUCTION

Frequency of disasters and loss of life and property caused by these disasters have been increasing constantly because of the increase in human population, destruction of nature, unconscious urbanization and technological developments. According to World Disasters Report (2009); 7191 disasters are chained in the World between 1999-2008. 1,243,480 people died and 2,695,812,000 people were affected from these disasters. All disasters since 1999, caused 1,082,391 million American dollar (USD) financial damage to the World.

Because of the its geological, topographical and meteorological features, disaster events that caused great loss of life and property occurred frequently in Turkey (Ozey, 2004). In 1999, Sakarya-İzmit-Gölcük earthquake had big social, psychological and economic impacts on the community (Pinar and Gunok, 2009). According to EM-DAT data (2010), 17,127 people died and 1,589,000 people were affected from this disaster. The financial damage of this disaster was about 20 million USD.

Economic losses caused by natural disasters are 1-3 % of GNP (Gross National Product) every year. As natural disasters in Turkey; earthquake, flood, landslide, rock fall, fire and avalanche cause significant loss of life and property, respectively. In addition, man-made disasters such traffic accidents, fires and work accidents cause also important loss of life and property. According to General Directorate of Security data, traffic accidents and casualties continue to increase. Just in the first half of 2009, 1,881 people died, 87,995 people injured in 145,330 traffic accident. All these accidents caused 455,605,014 TL financial damage (DPT, 1999; Gokturk ve Yilmaz, 2005).

Disasters have different effects upon the community and community life in different countries. In this context, there can be significant differences among developing countries and developed countries exposed to disaster. Considering especially the last ten years, disasters that cause the loss of life in developed countries decreases with the help of the precautions taken, but there is an increase at financial damage, in

contrast to developing countries such as Turkey (UN, 2010). There is an increase in both of loss of life and property in parallel with the rapidly increasing population, unplanned growth and ineffective Disaster-Emergency Management (DEM).

Factors causing disasters can be reduced or mitigated with an effective DEM approach, which should be considered as an integrated system including before, during and after disaster occurs. Integrated DEM includes all valuable resources of all disaster types and emergencies and all issues related to the phases of DEM. The integrated nature of DEM is not only limited with evaluating and planning the tasks before, during and after disaster occurs. Integrated definition of DEM means; the disaster is not only related with just a group of people but also the entire population closely; all social, economic, political and cultural factors and processes about living safe is taken into account and in this context, common purpose and action for public, private, civil people and organizations are predicted. All communications and organizational methods and styles for implementation of integrated model are determined according to own policies of every country and disaster zones (Bhugra, 2005; GRSP, 2007; Vakis, 2006).

The most important base for an effective DEM is the accurate spatial data provided by a map. Maps are the bases that incorporate regional information related to any disaster or potential emergency case. According to the information contained, accurate, produced map information, also known as geo-data is the first necessity for a DEM activity such as accessing to the region in emergency cases, keeping track of rescue operations and various logistics services in DEM mitigation and preparation phases. In this context, using Geographical Information Systems (GIS) in DEM can help to control destructions, reduce damage results of disasters and protect lives and resources (Aydinoglu, 2009; Samadi and Delavar, 2009; Ware, 2003).

GIS support decision-making process for a DEM and facilitate optimum solution finding for complex problems. Due to the GIS functions, information from other sources can be processed with the data from maps. That way, analysis related to emergency are performed with different input layers such as; road, building, watercourse, land cover and so on. Geo-data, that is obtained from location-based observations and expressed as map information, is extensively used in different phases of DEM (Greenwood, 2006; Liu et al, 2006).

At first using by certain groups of users and projects, GIS provides integration of systems to contribute decision-making of geo-data used in different applications and mitigate loss of time and effort for creation of this structure. In parallel with the technological development, in the use of geo-data from different sources, the concept of Spatial Data Infrastructure (SDI), which provides interoperability through communication networks, has emerged. Development of a SDI is a critical step for decision-makers because of the need of interoperability of geo-data from different sources on electronic communications network (Chertoff, 2008). SDI provides information from different sources for effective delivery of government services. By this way, SDI is increasingly considered a critical aspect of decision-making and response in DEM.

1.1 Problem Statement

Disaster events are phenomena that are out of the normal life and normal treatment. As a result of this, the need of management type that can take different aspects of every disaster phase is clear. DEM is concerned by different disciplines and have different perceptions in every country (Alwang et al, 2001). In this context, to find an exact solution for DEM is a very difficult task. Despite these difficulties, modern approaches to solve problems caused by disasters has become a necessity to countries which are faced with disaster risk at any time.

Decision-making process in DEM is complex because of the need of large spatial data group and component. Fast, accurate and efficent flow of spatially based information must be provided to actors such as police, local services, ambulances and firefighters especially in the response phase of the disaster (London Resilience, 2006). Undetermination of the task definition of actors and needed data standards in response phase is an important part in the entire DEM coordination process. The most basic needs for an active and coordinated response phase is developing dynamic geo-data provider systems (Oasis, 2008).

GIS can supply a powerful decision support and find optimal solutions to complex problems in DEM process. But, required maps and geo-data produced in Turkey could not be qualified for these thematic applications of public institutions and accessing the map information is a difficult task. Public institutions and

municipalities in Turkey produce maps serving only their own needs without considering possible DEM activities.

Mostly, the geo-data was produced with different scales, accuracies and standards. To share and manage data among many organizations to support decision making on DEM is almost impossible.

In Turkey, DEM studies were made by different institutions until 2009. Disaster and Emergency Management Presidency was established by the Prime Ministry of Turkey based on law number 5902. In this context, the main aim is to manage all disaster events under a single administration state that good coordination can provided for all provinces within the country. Effective coordination of actors that are staffed in response phase of disaster is provided with DEM centers established in provinces. However, for determining management strategies with GIS, the defined data types are needed. Disaster types, the production standarts of these data and management, use and sharing of the data among disaster actors have not been determined yet. For instance, there are not explanations of the standarts of producing risk maps for any disaster type, although the actor responsible for determination of activity is discussed.

The most important problem of DEM is a poor approach managed by different institutions with effective data flow for activities in various disaster types. This leads to complexity, especially in response phase and infeasible effective management of data in coordination between actors involved in the operation. It is clear that an approach provides a well management of an activity in any time of the disaster by effective data flow from different institutions is needed (James, 2010; UN/ISDR, 2007; Yodmani, 2001).

Especially after the earthquake in 1999, DEM has become main point of topic very long time and management development studies were made in Turkey. Disasters such as fire and avalanche lead important loss of life and property as well as earthquake, flood and landslide in Turkey. In terms of frequency of occurrence, fire takes the first rank among all other disasters. For instance, an average 20.000 to 25.000 fire cases occur annually in Turkey (EM-DAT, 2010). Because they occur in a limited area, fire damages are less than the damages caused by other types of disasters when taken individually. Coordinately work of the actors must be provided for mitigating the results of the fire event.

1.2 Purpose of the Thesis

The main aim of this thesis is to determine a common approach in order to manage disaster management activities by geographic information technologies. To conclude this aim, it is focused on following targets:

- To determine disaster and emergency perception by examining the concepts about disaster definitions and disaster types in the World by a literature review.
- To determine state-of-play with legal arrangements and actors that can take roles for a DEM in Turkey.
- To develop an activity based approach with sub-tasks to manage geo-data effectively in different phases of DEM with a case study as fire.

To design and to develop GIS based fire disaster that support to use geo-data corporately between sectors and actors.

1.3 Methodology

In this study, scenario based GIS aplications, that support activity based actor-activity-data-task work flow, are developed with the case of fire event by using GIS. In this context, the base work-flow of the study can be summarized as follows:

- Literature:
    - The concepts about disaster types in the world are examined.
    - The concepts of DEM and DEM standards are examined.
- State-of-play in Turkey:
    - DEM legislation in Turkey is examined.
    - Actors that behave as emergency organizations are determined according to current legislation in Turkey.
    - GIS projects for DEM in Turkey are examined.
- Design:
    - GIS approach for DEM is determined.

- Geo-data model for DEM approach is determined

- Practice:
  - Activities of urban-fire event in DEM phases are determined according to legislations, national and international literature
  - Tasks performed by actors are defined for example urban-fire activities.
  - Use-case descriptions and uml diagrams for example urban-fire activities are formed.

2. DISASTER-EMERGENCY MANAGEMENT

2.1 Disaster and Emergency Concepts

In the literature, there are many definitions of disaster. These definitions are meaningly parallel to each other; however, these definitions of disaster generally differ from country to country, organization to organization due to the kinds of disasters that they suffered and the effects on the foundations.

In the literature, words like; catastrophe, calamity, tragedy, misfortune, act of god, trouble and reverse are used in the same meaning with disaster. Emergency is frequently used to emphasize the moment that the actual disaster occurs.

2.1.1 What is disaster?

According to modern dictionaries; disaster is a sudden calamitous, unexpected event such as a very bad accident, a flood or fire which brings great damage, loss, or destruction and which kills a lof of people (Driscoll, 2008; Gove, 1993; Hornby, 2005; Wehmeier, 2005).

According to law N.5902 dated May 29, 2009 in Turkey, “Organization and Duties of Disaster and Emergency Management Presidency”, disaster is a natural, manmade or technological event which causes physical, economics and social losses for all or a part of the community, and which stops or suspends the daily life activities.

Disaster has also various definitions in different sources. The definitions of disaster can be gropued as follows:

According to national or local bodies and agencies: Disaster is a serious disruption to community life which threatens or causes death or injury and/or damage to property or the enviroment or distrubition to the community, which because of the scale of its effects cannot be dealt with by the emergency services and local authorities as part of their day to day activities and which requires special mobilisation and organisation of resources other than those normally available to

those authorities (ARC, 2000; CPS, 2006; EMA, 1998; FEMA, 1990; Home Office, 2004; ODPEM, 2010; WRZO, 2007; Znaidi, 2002).

According to international organizations: Disaster is situation or event, which overwhelms local capacity, necessitating a request to national or international level for external assistance; an unforeseen and often sudden event that causes great damage, destruction, ecological disruption, loss of human life and deterioration of health and health services (ICRC, 1995; IDNDR, 1992; UNISDR, 2004; WHO, 2005).

According to the meaning of academic: A disaster is entered into the Emergency Events Database (EM-DAT) if at least one of the following criteria is fulfilled (ADRC, 2003; CRED, 2000):

a)ten people are reported killed, b)100 people are reported affected, c)an appeal for international assistance is issued and/or, d)a state of emergency is declare.

According to astrology: The word 'disaster' is derived from the French word 'désastre'(1537) which in turn originates from the Italian word 'disastro'(before 1450). This was composed from the prefix 'dis' (= reversing or negativing the meaning of the primitive) and 'astro' which was derived from the Latin word 'astrum' which in turn originates from the Greek word 'astron' (Debacker, 2009).

According to the meaning of economics: A disaster is an extraordinary event of limited duration (such as war or civil disturbance) or a natural disaster (such as an earthquake, flood, or hurricane) that seriously dislocates a country's economy and creates an inability on the organization's part to provide critical business functions for some predetermined period of time (Cohen and Werker, 2008; Debacker, 2009; Dynes, 1997; Fitzsimons, 2004; World Bank, 1989; UN, 2009).

According to the meaning of sociological: A disaster is an event, concentrated in time and space, in which a society, or a relatively self-sufficient subdivision of society, undergoes severe danger and incurs such losses to its members and physical appurtenances that the social structure is disrupted and the fulfillment of all or some of all essential functions of the society is prevented (Barton, 1969; Debacker, 2009; Fritz, 1961; Kumar, 2000; Nasreen, 2004; Quarantelli, 2005; Wilson and Yemaiel, 2001).

According to the meaning of psychological: A disaster is primarily disruption in the routine behaviour of groups rather than interruptions of the every day actions of individuals, that is catastrophic in nature, involves threatened or actual loss of life or property, disrupts the sense of community, and often results in adverse psychological consequences for the survivors (Crocq, et al, 1998; Lindell and Perry, 2007; McCaughey, 1987; Mitchell, 1999; Kar, 2000; Kreps, 1985; Lifton, 1995; Witham, 2005; Wolfenstein, 1977).

According to the meaning of medical: A disaster is a situation in which the need of acute medical care exceeds the immediately available resources and in which extraordinary and coordinating measures are necessary if normal quality standards are to be maintained (Chapman and Arbon, 2008; Cummings, et al, 2006; De Boer and Dubouloz, 2000; Debacker, 2009; EMA, 2003; Hodgetts and Mackway, 1995; Hsu et al, 2004; Jennings, 2004; Lumley and Ryan, 1998; Mahoney and Reutershan, 1987; McFarlane and Norris, 2006; Noji, 2005).

Finally disaster can be defined as a sudden and unplanned calamitous event of limited duration or a natural disaster that causes

- great damage to property or the environment,
- death or injury in the community,
- necessity of a request to national or international level for external assistance,
- disruptions in the sense and the routine behaviour of the community,
- an inability on the organization's part to provide critical business functions.

2.1.1.1 Categories of disaster

There are also several categories of disasters (ARC, 2009; Debacker, 2009; EMI, 2010):

a)Major disaster is any natural catastrophe, or, regardless of cause, any fire, flood or explosion, which causes damage of sufficient severity and magnitude to warrant major disaster assistance to supplement the efforts and available resources of states, local governments, and disaster relief organizations in alleviating the damage, loss, hardship, or suffering caused thereby.

b)State disaster is a disaster that affects multiple family units, occurs within the jurisdiction of one or more units within a single state service consortium, generally requires the focused commitment of human and material resources from the affected unit(s), and may require and assistance from other units either through mutual aid agreements or through the state lead unit for disaster services.

c)Local disaster is a disaster that affects more than one family unit, occurs within the jurisdiction of a single unit, and generally requires the application of limited human and material resources from the unit.

2.1.2 What is emergency?

According to modern dictionaries, emergency, which is an urgent need for assistance or relief, is an unforeseen combination of circumstances or the resulting state that calls for immediate action (Driscoll, 2008; Gove, 1993; Wehmeier, 2005).

Emergency is an event or situation of urgent need for action or assistance that:

- endangers or threatens to life, property or the environment, and which requires a significant and coordinated response (EMA, 1998).
- arises internally or from external sources which may adversely affect the safety of persons in a building or the community in general and requires immediate response by the occupants (FEMA, 1997).
- calls for immediate measures to minimize its adverse consequences (UNISDR, 2004).
- is an unforeseen combination of circumstances or the resulting state that calls for immediate action (CRED,2000).

There are several different categories of emergencies (CRED, 2010):

a)Disaster: Any condition (man-made or natural) which results in significant disruption to the mission of the region and requires a community wide coordinated effort to control effectively.

b)Major Emergency: Any incident, potential or actual, which affects the entire physical plant or property, and which will disrupt the operations. Outside emergency services will probably be required, as well as major efforts from region support

services. Major policy considerations and decisions will usually be required from region administration during major emergencies.

c)Minor Emergency**:** Any incident, potential or actual, which does not seriously affect the overall functional capacity of the region.

2.1.3 Comparison of disaster and emergency

Emergency is a more serious situation than an incident, but less serious than a disaster (Pearce, 2000). An emergency situation may arise as a result of a disaster, a cumulative process of neglect or environmental degradation, or when a disaster threatens and emergency measures have to be taken to prevent or at least limit the effects of the eventual impact (Blanchard, 2002).

The time between the beginning of the disaster and the moment that life turns back to its normal state can be explained by emergency. Disaster refers to a more serious and unavoidable situation than emergency. Emergency can either occur at the time of disaster or refer to other situations not related to disasters. Disasters affect masses, but emergency can be used to characterize the situations that affect a small group of people or just one person.

2.2 Disaster Classification

As defined in the previous section, disasters differ in both their effect of scales and their reasons of occurrence. In the literature, classification of the reasons of their occurrence exists in many different ways, general tendency is using the classification of both major and minor groups which is shown in Figure 2.1. The review of classification of disasters in the literature can be done as shown below. Moreover, short definitions of kinds of disasters that constitute the content of this classification are shown below.

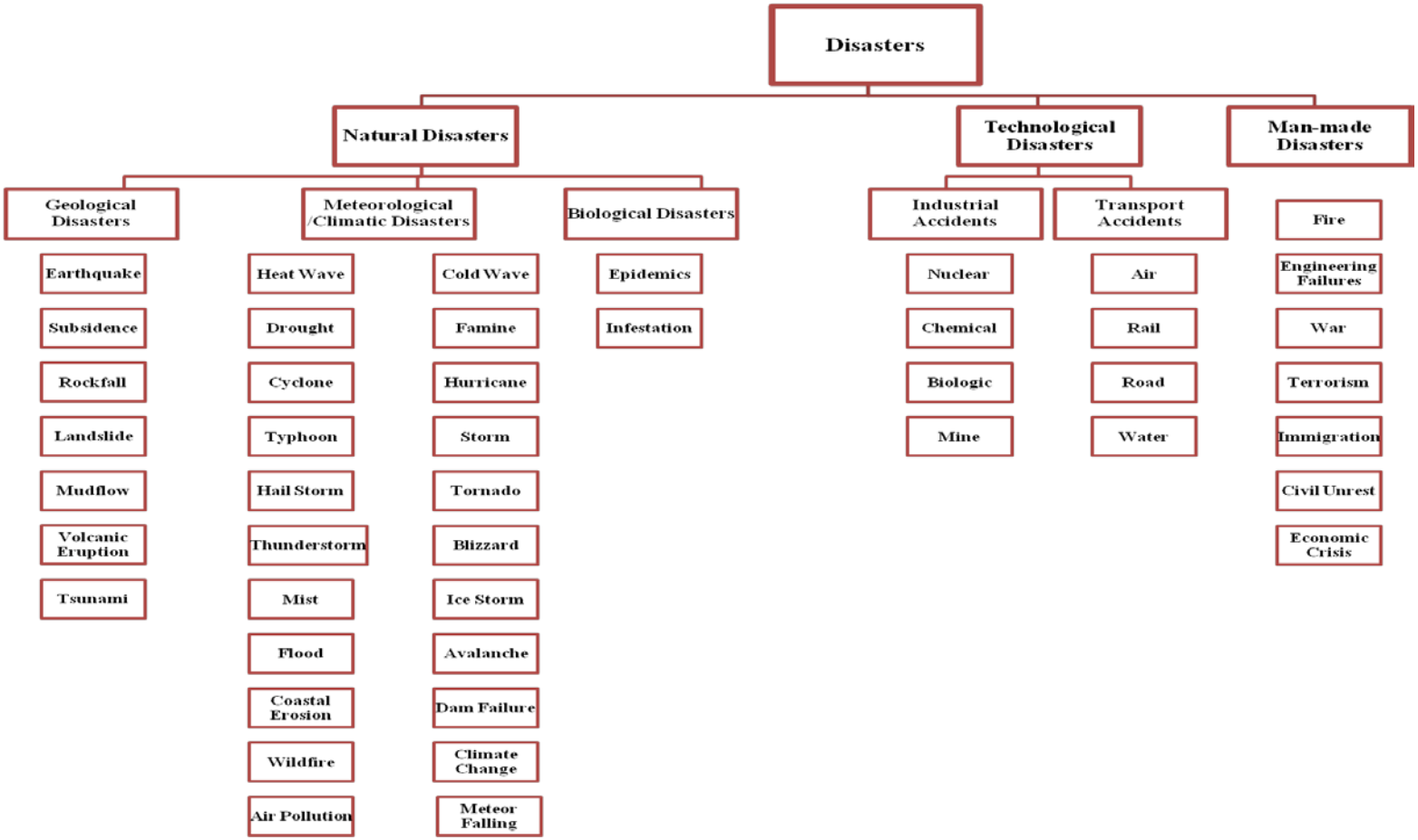

Figure 2.1 : Disaster classification

- Natural Disaters
    - Geological Disasters

Earthquake: The vibrations of the earth caused by the passage of seismic waves radiating from some source of elastic energy (Bryant, 1991).

Landslide: The general term given to movement of material downslope in a mass (Bureau of Meteorology, 1994).

Mudflow: The down-slope transfer of fine earth material mixed with water (EMA, 2002).

Rockfall: Free-falling or precipitous movement of a newly detached segment of bedrock of any size from a cliff or other very steep slope (EMA, 2002).

Subsidence: Collapse of a considerable area of land surface, due to the removal of liquid or solid underlying or removal of soluble material by means of water (EMA, 2002).

Tsunami: It is used to define a water wave generated by a sudden change in the sea bed resulting from an earthquake, volcanic eruption or landslide (Bureau of Methodology, 1994).

Volcanic Eruption: The discharge (aerially explosive) of fragmentary ejecta, lava and gases from a volcanic vent (EMA, 2002).

    - Meteorological/Climatic Disasters

Air Pollution: Introduction of chemicals, particulate matter, or biological materials cause harm or discomfort to humans or other living organisms, or damages the natural environment into the atmosphere (EMA, 2002).

Avalanche: Mass of snow and ice falling suddenly down a mountain slope and often taking with it earth, rocks and rubble of every description (EMA, 2002).

Blizzard: Violent winter storm, lasting at least three hours, which combines below freezing temperatures and very strong wind laden with blowing snow that reduces visibility to less than 1 kilometre (EMA, 2002).

Climate Change: Long-term change in the statistical distribution of weather patterns over periods of time that range from decades to millions of years (EMA, 2002).

Coastal Erosion: Wearing away of land or the removal of beach or dune sediments by wave action, tidal currents, wave currents, or drainage (EMA, 2002).

Cold Wave: Weather phenomenon that is distinguished by marked cooling of the air, or the invasion of very cold air, over a large area (EMA, 2002).

Cyclone: A large-scale, closed circulation system in the atmosphere with low barometric pressure and strong winds that rotate counterclockwise in the northern hemisphere and clockwise in the southern hemisphere (EMA, 2002).

Dam Failure: The uncontrolled release of the contents of a dam through collapse of the dam or some part of it, or the inability of a dam to perform functions such as water supply, prevention of excessive seepage or containment of hazardous substances (EMA, 2003).

Drought: an extended period of months or years when a region notes a deficiency in its water supply (EMA, 2002).

Famine: A catastrophic food shortage affecting large numbers of people due to climatic, environmental and socio-economic reasons (EMA, 2002).

Flood: The overflowing by water of the normal confines of a stream or other body of water, or the accumulation of water by drainage over areas which are not normally submerged (UN, 1992).

Hail Storm: Thunderstorm produces a numerous amount of hailstones which damage the location in which they fall (EMA, 2002).

Heat Wave: A long lasting period with extremely high surface temperature (EMA, 2002).

Hurricane: Name given to a warm core tropical cyclone with maximum surface wind of 118 kilometres/hour (64 knots) or greater (hurricane force wind) in the North Atlantic, the Caribbean and the Gulf of Mexico, and in the Eastern Pacific Ocean (EMA, 2002).

Ice Storm: Intense formation of ice on objects by the freezing, on impact, of rain or drizzle (EMA, 2002).

Meteor Falling: Natural object originating in outer space that survives impact with the Earth's surface (EMA, 2002).

Mist: Airborne droplets of substances that are normally liquid at ambient temperatures. Mists may form through condensation of vapour or through spraying of liquids (EMA, 2008).

Storm: An atmospheric disturbance involving perturbations of the prevailing pressure and wind fields, on scales ranging from tornadoes (1 kilometre across) to extratropical cyclones (2,000-3,000 kilometres across) (EMA, 2002).

Thunderstorm: Sudden electrical discharges manifested by a flash of ight (lightning) and a sharp or rumbling sound (thunder) (UN, 1992).

Tornado: A violently rotating storm of small diameter; the most violent weather phenomenon (EMA, 2002).

Typhoon: The name given to a tropical cyclone with maximum sustained winds of 64 knots or more near the centre in the western North Pacific (UN, 1992).

Wildfire: Any uncontrolled fire in combustible vegetation that occurs in the countryside or a wilderness area (EMA, 2002).

- Biological Disasters

Epidemics: An unusual increase in the number of cases of an infectious disease which already exists in an endemic state in the region or population concerned (CHEMSAFE, 2006).

Infestations: Refers to parasitic diseases that are caused by animals, including worms and arthropods, but excluding protozoan infections, fungal infections, and bacterial infections (EMA, 2002).

- Technologic Disasters:
  - Industial Accidents

Biologic Accidents: Disaster caused by the exposure of living organisms to germs and toxic substances (EMA, 2002).

Chemical Accidents: An event resulting in the release of a substance or substances hazardous to human health and/or the environment in the short or long term (EMA, 2002).

Mining Accidents: An accident that occurs in the process of mining minerals (EMA, 2002).

Nuclear Accidents: Accidental release of radiation occurring in civil nuclear facilities, exceeding the internationally-established safety levels (EMA, 2002).

- Trasportaion Accidents

Air: Occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight and all such persons have disembarked, in which a person is fatally or seriously injured, the aircraft sustains damage or structural failure or the aircraft is missing or is completely inaccessible (EMA, 2002).

Rail: Involving one or more trains. Train wrecks often occur as a result of miscommunication, as when a moving train meets another train on the same track; or an accident, such as when a train wheel jumps off a track in a derailment; or when a boiler explosion occurs (EMA, 2002).

Road: Occurs when a road vehicle collides with another vehicle, pedestrian, animal, road debris, or other geographical or architectural obstacle. Traffic collisions can result in injury, property damage, and death (EMA, 2002).

Water: Accidents occured in the sea about a ship, oil, etc (EMA, 1995).

- Man-made Disasters

Civil Unrest: Symptom of, and a form of protest against, major socio-political problems; the severity of the action coincides with public expression(s) of displeasure (EMA, 2002).

Economic Crisis: Applied broadly to a variety of situations in which some financial institutions or assets suddenly lose a large part of their value (EMA, 2002).

Engineering Failures: Engineered systems that failed in a spectacular, historic or edifying way (EMA, 2002).

Fire: Fire is the rapid oxidation of a material in the chemical process of combustion, releasing heat, light, and various reaction products (EMA, 2002).

Immigration: Introduction of new people into a habitat or population. It is a biological concept and is important in population ecology (EMA, 2002).

Terrorism: The calculated use of violence or the threat of violence to attain goals that are political, religious, or ideological in nature (EMA, 1995).

War: Phenomenon of organized violent conflict, typified by extreme aggresion, societal disruption and adaptation, and high mortality (EMA, 2002).

2.2.1 Disaster types in World

Ten countries all over the world are selected to analyze disaster types defined in their laws. Because of their strong disaster policies U.S.A, Canada, Australia and Japan, because of their closer approach to European general disaster management Norway, Spain, Switzerland and France, to describe general attitude New Zealand and Sri Lanka are selected. Disaster laws and regulations of these countries are examined and their official disasters together with 46 defined disasters are shown in Table 2.1.

As it can be seen from the table, defined official disaster types of chosen countries are shown by "x". To illustrate, volcanic eruption is an official disaster type in U.S.A, New Zealand, France, Norway, and Spain whereas climate change is an official disaster type in Norway only.

For chosen 10 countries, between 1900-2010, the tables related to 10 disasters being most frequent, causing the highest death rate, affecting most people, and giving ultimate material damage are shown in Appendix A.1. For 110 years, disaster types that affect the countries the most, are shown by yellow in the matrix in the table. By this way, official disaster types and the types that affect the most can be compared.

For example, earthquake, landslide, storm, flood, and fire disasters are official disasters and determined as one of the most devostating disasters among those countries. Fire disaster is separated into two classes as wildfire and urban fire. Some countries use this separation while defining but some countries choose not to.

Moreover, cold wave, drought, epidemics, industrial accidents, and transport accidents are among the most devastating disaster types although they are not listed as official disaster types.

Mudflow, volcanic eruption, and infestation disasters are classified as devastating in some countries due to environmental factors and in this context, they are counted as official disaster types in some countries.

Apart from these disaster types, in some countries some disaster types classified as official disaster types but not classified as most devastating disaster types.

Table 2.1: Disaster types in the world

DISASTER TYPES / COUNTRIES	America (FEMA)	Canada (PS)	Australia (EMA)	Sri Lanka (Act N13)	New Zelland (Act N84)	France (Act N80)	Japan (FY 2005)	Norway (Act N70)	Spain (Act N30)	Switzerland (Act N311)
Earthquake	x	x	x	x	x	x	x	x	x	x
Flood	x	x	x	x	x	x	x	x	x	x
Landslide	x	x	x	x	x	x	x	x	x	
Storm	x	x	x	x		x	x	x	x	x
Fire	x	x	x		x	x	x	x	x	x
Tsunami	x	x	x	x	x	x		x		x
Volcanic Eruption			x		x	x	x	x		x
Hail Storm	x		x	x		x			x	x
Industrial Acc.	x	x	x	x			x		x	
Hurricane	x	x	x		x	x				
Tornado	x	x	x	x	x					
Blizzard	x		x		x		x		x	
Mudflow			x			x		x	x	
Drought	x	x		x			x			
Cyclone		x	x	x		x				
Thunderstorm	x	x			x		x			
Ice Storm	x			x		x	x			
Avalanche	x					x	x		x	
Wildfire	x	x		x	x					
Chemical Accident	x	x		x	x					
Transport Acc.	x		x	x		x				
Terrorism	x		x		x					x
Rockfall			x					x	x	
Epidemics	x	x		x						
Nuclear Accident		x		x	x					
Sea Accident		x		x				x		
War				x				x		x
Civil Unrest	x	x	x							
Heat Wave	x				x					
Cold Wave	x						x			
Typhoon	x									x
Coastal Erosion		x						x		
Dam Failure			x		x					
Urban Fire		x		x						
Hazardous Material			x		x					
Subsidence						x				
Climate Change							x			
Meteor Falling			x							
Infestation	x									
Air Accidents		x								
Engineering Fail.			x							
Criminal Act				x						
Explosion		x								

2.2.2 Disaster types in Turkey

Due to the geologic and topographic structue and climate attributes of Turkey, it is frequently confronted with natural disasters which lead to immense loss of life and property (Gunok and Pinar, 2009).

Natural disasters for Turkey that affect the country can be put in order according to their severity (EM-DAT, 2010; Gunok and Pinar, 2009);

- Earthquakes: due to the geologic and faultline structue.
- Landslides: due to the vegetation cover, land use, geomorphologic structure and climate factors
- Floods: due to the amount of rainfall, vegetation cover, land use and geomorphologic structure
- Fires: due to the location, human factors, geomorphologic structure and climate factors
- Avalanches: due to vegetation cover, geomorphologic structure and climate factors

Over the past 60 years, when the statistics of structural damage caused by the natural disasters in Turkey are taken into consideration, it is seen that two thirds of this damage occurs due to earthquakes. As a result, in Turkey when natural disasters are mentioned, the first thing that comes to people's mind is earthquake. The seismic zones map in effect at the present time show that 96% of the territories of Turkey are inside the seismic zones that possess various ratios of risk, and that 98% of inhabitants of Turkey are located in these areas. These ratios dramatically reveal the fact that Turkey is a land of earthquake (Can, 2010).

In the maps shown as Figure 2.2, it can be seen that landslide, flood and earthquake occurs most frequently in Turkey. Likewise, total numbers of disasters in Turkey is ranked at the top throughout the world.

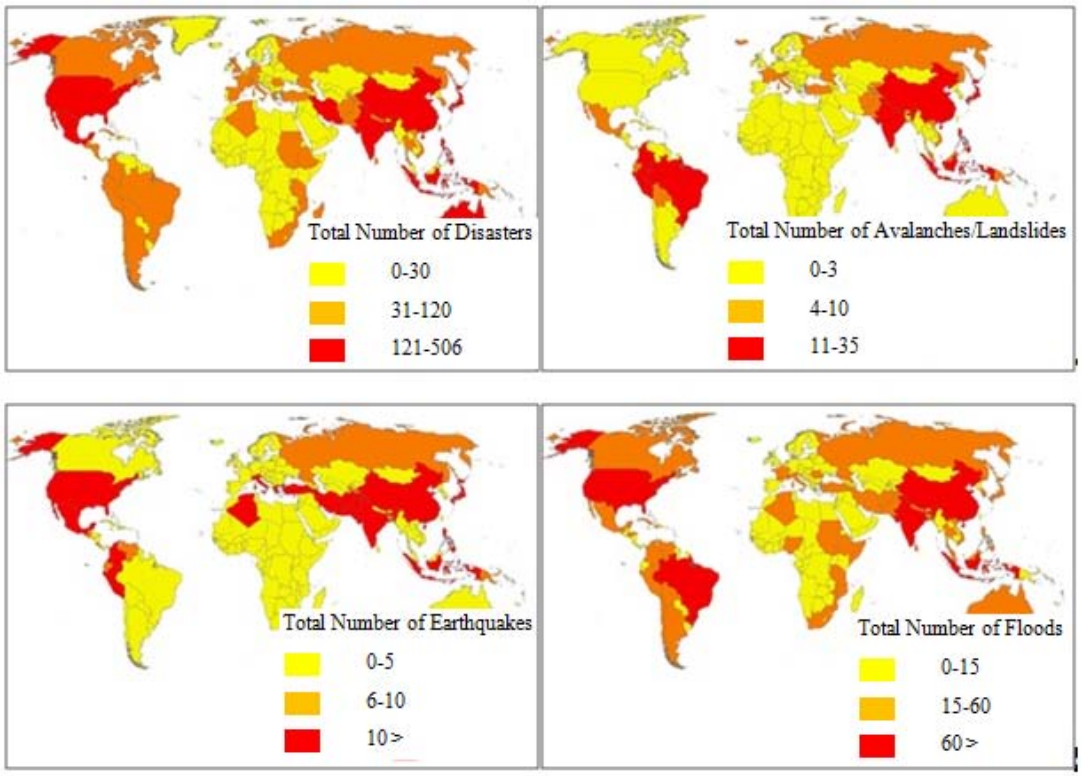

Figure 2.2 : Total number of disasters and occurrence number of avalanche/ landslide, earthquake and flood disasters: 1974-2008 (EM-DAT, 2010)

In Turkey, there have been 237 disasters that are officially recorded between 1900-2010. As a result of these disasters, 37.174 people died, 8.840.323 people were affected in a way that they cannot maintain their normal life (Table 2.5). These disasters costed Turkey approximately 25 billion USD (EM-DAT, 2010). When the tables in Table 2.2 are analyzed, it can be seen that most of the loss is caused by the earthquake in İzmit in 1999. In the topic of tangible damage, earthquake and flood disasters should be given more importance. When look at the number of people died because of disasters, the massive loss is given due to the 1939 earthquake (Table 2.3). Earthquake disaster is ranked the first when the disasters that caused massive destruction or death are examined in the last 110 years. Moreover, the earthquake in 1999 is the most devastating disaster in relation with the number of people that are affected by the disasters (Table 2.4).

Table 2.2: Top 10 natural disasters damaged to economy for the period 1900 to 2010 in Turkey (EM-DAT, 2010)

Disaster	Date	Damage (million USD)
Earthquake	17.08.1999	20.000
Flood	20.05.1998	1.000
Earthquake	12.11.1999	1.000
Earthquake	13.03.1992	750
Earthquake	28.06.1998	550
Flood	07.09.2009	550
Flood	27.10.2006	317
Earthquake	01.10.1995	205
Flood	18.06.1990	150
Earthquake	01.05.2003	135

Table 2.3: Top 10 natural disasters killing people for the period 1900 to 2010 in Turkey (EM-DAT, 2010)

Disaster	Date	No. of Killed People
Earthquake	26.12.1939	32.962
Earthquake	17.08.1999	17.127
Earthquake	29.04.1903	6.000
Earthquake	26.11.1942	4.000
Earthquake	01.02.1944	3.959
Earthquake	24.11.1976	3.840
Earthquake	20.12.1942	3.000
Earthquake	26.11.1943	2.824
Earthquake	19.08.1966	2.394
Earthquake	06.09.1975	2.385

Table 2.4: Top 10 natural disasters affecting people for the period 1900 to 2010 in Turkey (EM-DAT, 2010)

Disaster	Date	No. of Affected People
Earthquake	28.06.1998	1.589.600
Earthquake	17.08.1999	1.358.953
Flood	20.05.1998	1.240.047
Earthquake	30.10.1983	834.137
Earthquake	18.09.1984	375.038
Earthquake	18.10.1984	375.035
Earthquake	13.03.1992	348.850
Earthquake	22.07.1967	326.073
Flood	04.11.1995	306.617
Earthquake	01.05.2003	290.520

Table 2.5: Effect of disasters for the period 1900 to 2010 in Turkey (EM-DAT, 2010)

Disaster Types	Occured Disaster Type	No. of People Killed	No. of People Affected	Economic Damage (000 USD)
Earthquake	49	31.558	6.815.970	22.921.400
Epidemic	8	613	204.855	-
Extreme Temprature	7	100	8.450	1.000
Flood	33	752	1.778.517	2.195.500
Industrial Acc.	19	849	594	-
Mass Movement Dry	1	261	1.069	-
Mass Movement Wet	10	419	13.281	26.000
Miscellaneous Acc.	11	276	1.223	-
Storm	9	100	13.639	2.200
Transport Acc.	85	22.31	1.575	-
Wildfire	5	15	1150	-
Total	237	37.174	8.840.323	25.146.100

In Figure 2.3, the maps that are arranged by worldwide disaster data are shown. Countries according to their disaster density are shown by 5 different colors. Among these, whose data are not exist are shown by gray, others are shown by light yellow, yellow, orange and red colors in the ascending order. While Turkey exists in yellow group according to frequency of disasters and caused deaths, it exists in the orange group according to affected people and material damage. With functional and effective DEM this situation can be reversed, how often the disasters take place, the harm can be kept in minimum. To do this, firstly the structure of the country and the disasters that occurred or could occur in the country should be investigated in more detail.

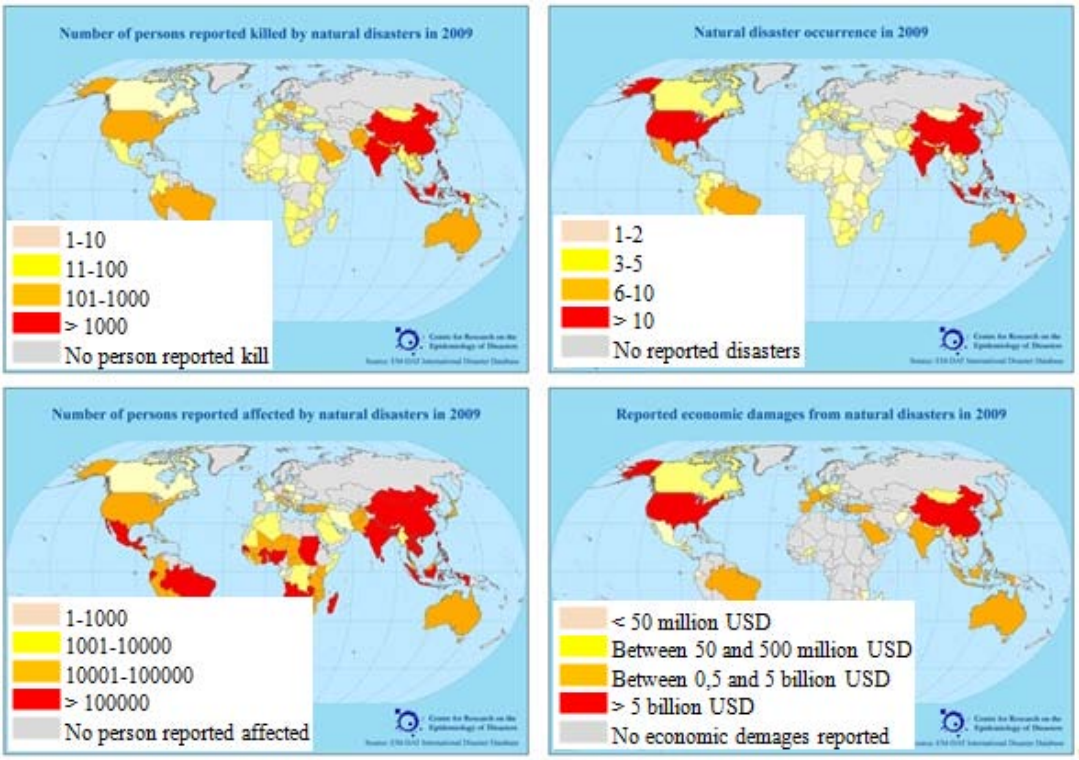

Figure 2.3 : Comparison of disaster effects on different countries (EM-DAT, 2010)

A comprehensive study to determine the type of disaster has not been done officially in Turkey. There is only an explanation of the measures to be taken in the No.7269 Law on Relief and Prevention of Disasters Effective on Public Life, Article 1 regarding earthquake, fire, flood, landslide, rock fall, avalanche, subsidence and similar disasters.

The general approach in the legislation is to address special studies/efforts for common types of disasters in the country. There is instead of a special planning, regular operations for the disasters affecting the normal life are preferably mentioned for DEM. The necessary conditions for any event to be considered as disaster are mentioned in the Article 2 and 5 of the Basic Rules Related Effectiveness of Disasters Regulation.

It is scientifically argued that whether some kind of meteorological disasters, which are results of climate changes and which have not much effects on the country, are potential disaster types for Turkey or not.

After considering the disasters mentioned in regulations and potential disasters, disasters in terms of historical point of view can be classified as follows (Table 2.6).

Table 2.6: List of disaster types in Turkey

Air Pollution	Drought	Mining Accidents
Air Trasportation Acc.	Earthquake	Mist
Avalanche	Economic Crisis	Rail Trasportation Acc.
Biologic Acc.	Epidemics	Road Trasportation Acc.
Blizzard	Fire	Rockfall
Chemical Acc.	Flood	Storm
Civil Unrest	Hail Storm	Terrorism
Climate Change	Heat Wave	Tsunami
Coastal Erosion	Immigration	Water Trasportation Acc.
Cold Wave	Landslide	Wildfire
Dam Failure	Nuclear Acc.	War

2.3 Disaster-Emergency Management

DEM is generally defined in literature as an organisation, a management of resources and responsibilities and a profession of applying science, technology, planning and responding to disasters and management to assist comunities to respond both pre- and post- disaster activities in such a way to save lives, to preserve property; and to maintain the ecological, economic, and political stability of the impacted region (Blanchard, 2007; Driscoll, 2008; EMA, 1998; Gove, 1993; Wehmeier, 2005; Znaidi, 2002).

According to FEMA (2007), DEM should be considered as a sum of the actions to prevent, prepare for, respond to, and recover from terrorist attacks, major disasters, and other emergencies, has become a highly multidisciplinary field requiring input and expertise from numerous scientific branches, such as mathematical and computational modeling, engineering sciences, (GIS and Remote Sensing (RS)) technologies, information technologies, operations research and management sciences, economy, and social sciences, etc.

As a continuous and integrated multi-sectoral, multi-disciplinary process of planning and implementation of measures, DEM aims at (Beeckman, 2007; DM Policy, 2001):

- preventing or reducing the risk of disasters;
- mitigating the severity or consequences of disasters;

- emergency preparedness;
- a rapid and effective response to disasters; and
- post-disaster recovery and rehabilitation.

DEM involves the plans, structures and arrangements which are established to bring together the normal endeavours of government, voluntary and private agencies in a comprehensive and coordinated way to deal with the whole spectrum of emergency needs (FEMA 2003; UN, 1992).

Three key stages of activities that are taken up within DEM are (Beeckman, 2007):

- Before a disaster (pre-disaster): Activities taken to reduce human and property losses caused by a potential disaster. For example, carrying out awareness campaigns, strengthening the existing weak structures, preparation of the DEM plans at household and community level etc.
- During a disaster (disaster occurrence): Initiatives taken to ensure that the needs and provisions of victims are met and suffering is minimized.
- After a disaster (post-disaster): Initiatives taken in response to a disaster with a purpose to achieve early recovery and rehabilitation of affected communities, immediately after a disaster strikes.

DEM is also a range of measures to manage risks to communities and the environment. These measures are described as follows (Peters and McEntire, 2010):

a)*The comprehensive approach*: Comprehensive DEM concerns strategies for risk assessment, mitigation, preparation, response and recovery. It is not enough to wait for emergencies to occur and then react, risks to the community and the environment must be managed in a rational manner.

b)*The all hazards approach*: The all hazards approach concerns arrangements for managing the large range of possible effects of risks and emergencies. This concept is useful to the extent that a large range of risks can cause similar problems, and such measures as warning, evacuation, medical services and community recovery will be required during and following emergencies. Many risks will, however, require specific response and recovery measures, and will almost certainly require specific prevention and mitigation measures.

c)*The all agencies (or integrated) approach*: All agencies should be involved to some extent in DEM. The context of DEM for specific agencies varies, and may include:

- ensuring the continuity of their business or service;
- protecting their own interests and personnel;
- protecting the community and environment from risks arising from the activities of the organisation; and
- protecting the community and environment from credible risks.

DEM measures may thus be couched in a number of organisational and community contexts, including risk management, environmental management, occupational health and safety, quality management, and asset management.

d)*The prepared community*: The concept of the prepared community concerns the application of the comprehensive, all hazards and all agencies approaches at the local level (typically the local government level). The body of policy and administrative decisions and operational activities which pertain to the various stages of a disaster at all levels.

2.3.1 Phases of disaster-emergency management

DEM activities can be grouped into four main phases that are related by time and function to all types of emergencies and disasters. These phases are also related to each other, and each involves different types of skills (Figure 2.4).

Figure 2.4 : Disaster-emergency management circle

2.3.1.1 Mitigation phase

Disaster mitigation is the means taken in advance of, or after, a disaster aimed at decreasing or eliminating its impact on society and the environment. It is the ongoing effort to lessen the impact disasters have on people and property. The implementation of mitigation initiatives can offer sustainable cost savings to communities and government in the event of a disaster. Activities that actually eliminate or reduce the probability of a disaster (for example, arms build up to deter enemy attack, or legislation that requires stringent building codes in earthquake prone areas) (FAO, 2004; Twigg, 2004; Abrahams, 2001).

It also includes long-term activities designed to reduce the effects of unavoidable disaster (for example; land use management, establishing comprehensive emergency management programs such as vegetation clearance in high fire danger areas, or building restrictions in potential flood zones). The resulting maps in turn can be used, for example, to build scenarios and aid planning. Different organizations will follow different methodologies to analyse and produce results on different scales for disaster, hazards, vulnerabilities and risks (Atkinson, 2005; Johnson, 2000).

2.3.1.2 Preparation phase

The preparation phase includes arrangements ensured that, should an emergency occur, all resources and services which are needed to cope with the effects can be efficiently mobilised and deployed, the attention is focused upon the means of reducing negative consequences of disaster events that cannot be mitigated. Disaster preparation involves a range of players including governments, NGOs, and companies, and each of these entities has a role to play. Community, volunteer and agency preparation is critical to assist in minimising the impact of an event on the community and to ensure effective and timely operational response in the event of a disaster (Brugnoli, 2009; Twigg, 2004).

Preparation measures also seek to enhance disaster response operations (for example, by stockpiling vital food and medical supplies, through training exercises, and by mobilizing emergency response personnel on standby). From analysis in the mitigation phase, emergency plans will be validated. When an alarm is activated, emergency scenarios could be run to determine how best to organize the territory in order to minimize the impact of the event. This could include the need to use sophisticated forecasting models. Additionally, pre-emergency plans might be used to communicate to the affected stakeholders, and alert the appropriate decision makers (Atkinson, 2005; Johnson, 2000).

2.3.1.3 Response phase

During the response phase, largely there is a local effort to cope with the disaster itself as it happens, to rescue victims, and to provide short-term relief to victims. It involves mobilizing and positioning emergency equipment; getting people out of harm's way; providing needed food, water, shelter, and medical services; and bringing essential services back on line.

Disaster response includes the actions taken in anticipation of, during, and immediately after an emergency to ensure that its effects are minimised. The importance of a timely, coordinated approach to disaster response is essential with greater demands being placed upon resources due to the increase in urbanisation, proximity of industry to high-density areas, and urban congestion (Atkinson, 2005; Johnson, 2000; Lynn, 2007).

This timely, coordinated approach requires the clear definition of roles and responsibilities of those involved in response activities. Activities are designed to

provide emergency assistance for victims (for example, search and rescue, emergency shelter, medical care, and mass feeding). They also seek to stabilize the situation and reduce the probability of secondary damage (for example, shutting off contaminated water supply sources, and securing and patrolling areas prone to looting) and to speed recovery operations (for example, damage assessment). Geo-spatial information accessible through information services allows more timely interventions of teams and more efficient management of the operation on site. Additionally, non-spatial information like procedures, emergency plans and authorization modules can be quickly accessed and communicated (Atkinson, 2005; Johnson, 2000).

2.3.1.4 Recovery phase

In recovery, public organizations turn to the task of restoring the social systems with concerns including rehabilitation, restoration, assembling a record of damage, and turning to the policy concerns about preparing for future incidents. The recovery phase is the process of rebuilding so individuals, businesses, and communities can function on their own. Timely coordinated deployment of disaster relief and recovery is equally important as effective disaster response in minimising the impact on the communities affected by a disaster (Beck, 2005; Wiles and Selvester, 2005).

Activities necessary to return all systems to normal or better. They include two sets of activities: (1) short-term recovery activities return vital lifesupport systems to minimum operating standards (for example, cleanup, temporary housing, and access to food and water), and (2) long-term recovery activities may continue for a number of years after a disaster. Their purpose is to return life to normal or improved levels (for example, redevelopment loans, legal assistance, and community planning) (Atkinson, 2005; Johnson, 2000).

Primarily, information on damaged infrastructures and services will be needed as well as possible population location, in order to prioritise actions to restore them. Further on, in order to start re-building both analysis of the impact event and the results of previous risk analysis (from the Prevention and Mitigation phase) will be needed in order for decision makers and stakeholders to agree on the best actions to take (Atkinson, 2005; Johnson, 2000).

3. DISASTER-EMERGENCY MANAGEMENT IN TURKEY

In Turkey, DEM was governed by three actors until 2009. These are General Directorate of Disaster Affairs under Ministry of Public Works and Settlement, General Directorate of Civil Defense under Ministry of Interior, and General Directorate of Turkey Emergency Management under Prime Ministry. With the law N.5902 issued in 2009, the activities of those three departments were ended and the Disaster and Emergency Management Presidency has become operative since 17 December 2009. The Law N.5902 defines the central and provincial level structure of this new unit (Aydinoglu and Demir, 2010).

Amongst the Governmental, Non-Governmental Oganizaiton (NGO) and private institutions, presidency provides coordination, formulates policies and implements policies. Director-General of the Presidency is a conducting the Presidency' services according to legislation provision, development plans and annual plans, aims and policies, strategic plans, performance criteria, service quality and standarts and integrated disaster management policies of the Presidency (AFAD, 2010).

Provincial Directorate for Disaster and Emergency Management should be built in each province, which is directly attached to the governor of the city. Determination of the disaster and emergency risk of the city, constitution and application of response plans for the cities, and managing the logistic services at the time of disaster and emergency are the roles of Provincial Directorate for Disaster and Emergency Management. Loss and damage assessment, preparation and application of civil defence plans are the authorization of this directorate. They also manage Management Center for Disaster and Emergency which is a center working 24 hours, coordinates the response in disaster and emergency. The center is appointed with secure data processing and communication emergency services (Aydinoglu and Demir, 2010).

3.1 Organizational Structure of Disaster and Emergency Management Presidency

According to the Law N.5902 there are six departments at central levels. These are Deparment of Planning and Mitigation, Deparment of Response, Deparment of Recovery, Deparment of Civil Defence, Deparment of Earthquake and Deparment of Administrative Affairs (Figure 3.1).

- Some missions of the Planning and Mitigation Department are;

a) To prepare disaster and emergency plans,

b) To determine risk areas,

c) To determine reconstruction, plan and project rudiments of disaster prone areas,

d) To work for informing and raising awareness of public,

e) To collect and evaluate informations,

f) To determine standarts of common communication and data,

g) To determine administrative strategies,

h) To establish and operate communication, early warning, data and prediction centers,

i) To do or get trainings and exercises, and

j) To determine and supervise service and acreditation standards.

- Duties of the Response Department are;

a) To carry out works to resolve the effects of disaster and emergency sitiuations by evaluating any source belong to public, private and NGOs, foreigners and organizations,

b) To define the standarts of Fire Brigade and Search and Rescue (SAR) Teams,

c) To co-operate with the agencies and institutions provides Fire and SAR services,

d) To encourage and arrange volunteer Fire Fighting and SAR services, and

e)To cooperate with the international agencies and foreign goverments in its own field.

- Duties of the Recovery Department are:

a) To take necessary measures for normalising life after disaster and emergency situations,

b) To assure temporary settlement at disaster and emergency areas, and

c) To provide psychological support, social aid, food and medical treatment to effected people and to prepare reconstruction and recruitment plans for post-disaster period in cooperation with govermental agencies, local authorities, universities and NGOs.

- Duties of the Civil Defence Department are;

a) To plan, carry out and supervise Civil Defence Services in governmental and private institutions/organisations,

b) To plan and conduct all kind of activities for non-armed protection, rescue measures emergency rescue and first aid activities,

c) To determine civillian sources that would be needed during mobilization and war and to determine measures to be taken and identify works to be done against chemical, biological, nuclear and radiological threats and hazards, and

d) To ensure coordination between ministiries, govermental and private institutions/agencies in this regard.

- Duties of the Earthquake Department are;

a) To carry out of reconstruction, plan and project works of earthquake effected and earthquake prone areas, determination and efficient usage of any source belong to public, private or NGOs and foreigners or foreign institutions that might be used preparation, response and recovery phase of earthquake, and

b) To define, follow on and evaluate policies to ensure awareness of public about earthquakes and consultation to other departments of agency on earthquake related services.

- Duties of the Department of Administrative Affairs are;

a) To determine policy of human resources and performance criteria of the presidency,

b) To manage resources related with disaster and emergency,

c) To do or get logistic services at national level, support local goverments, other govermental instutions and NGOs, and

d) To compile and classify publications and scientific studies related to DEM, serve as a library and publish periodical and non-periodical publications.

Figure 3.1 : Organizational structure of Disaster and Emergency Management Presidency

3.2 Legal Arrangement of Disaster-Emergency Management

Laws shown as Table 3.1, decree laws shown as Table 3.2, guidelines shown as Table 3.3, manuals shown as Table 3.4, bylaws shown as Table 3.5, instructions shown as Table 3.6 and regulations shown as Table 3.7 discussed below, were examined in the scope of search DEM legislation. A part of these directly related with DEM, relation of another is indirect. Examined legislation is not only DEM legislation but also other legislations that define actors and their tasks. Likewise, information about Disaster and Emergency Management Presidency organizational structure and duties is obtained from definitions in the 5902 numbered law.

DEM related information is obtained from laws on organization and tasks or different laws that refer to disasters in addition specifically enacted laws on disasters. To illustrate, when defining tasks of municipality in case of disaster and emergency in municipal laws, tasks of interior ministery and actors of subunits is defined in 3152 numbered law, related tasks about disaster management is emphasized in 5302 numbered special provincial administration law and 5188 numbered private security services law. Activities for forest fire and flood disasters are defined in 442 numbered village law while some activities for forest fire disaster are defined in 6831 numbered forest law. Actors and their responsibilities for mitigation and recovery phase in DEM are defined in 3194 numbered construction law and 5403 numbered soil conservation and land use law. 7269 numbered law on disaster statute defined precautions and relief of disasters on damages of structures and public facilities that can affect on daily life or have possibility of damage. Actors and activities that provide aid and help conduction of normal life and the elimination of damage and destructions, are defined in the law no.4123. Preparation and organization from peacetime to state of mobilization and war are defined by the law no.2941. This law also determines responsibilities, duties and authorization of public\private institutions and real persons. Furthermore, obligations due to all kinds of goods and services are defined by the law.

The legal arrangement about DEM can be summerized as follows:

Table 3.1: Laws related to disaster-emergency management

Law No.	Law Name	Date
442	Village Law	18.03.1924
634	Property Ownership Law	02.07.1965
697	Law on Execution of Transport and Communication Services Under Emergency and War Conditions	26.07.1965
711	Law on the Establishment of on Duty Officer and Maintanence of the 24-hour Overtime During a State of Emergency Exercises	29.01.1966
775	Anti-Squat Law	30.07.1966
2813	Law on Establishment of Information Technologies and Communication Agency	07.04.1983
2935	State of Emergency Law	27.10.1983
2941	Mobilization and State of War Law	08.11.1983
2945	National Security Council and Secretariat of National Security Council Law	11.11.1983
3152	Law on Organization and Duties of the Ministry of Interior Affairs	23.02.1985
3194	Law on Public Improvement	09.05.1985
3634	National Defence Obligation Law	16.06.1939
3780	National Protection Law	26.01.1940
4342	Pasture Law	28.02.1998
4452	Empowering Law on Arrangements of Preventions Against Natural Disasters and Recovery of Losses Arising from Natural Disasters	29.08.1999
4708	Law on Construction Inspection	13.07.2001
4735	Public Procurement Contracts Law	22.02.2002
5018	Public Finance Management and Control Law	24.12.2003
5188	Law on Private Security Services	26.06.2004
5302	Special Provincial Administration Law	04.03.2005
5312	Law on an Emergency Response to Pollution of the Marine Environment by Oil and Other Harmful Substance and Compensation for Losses	11.03.2005
5327	Law on Surrounding Areas of Denizli- Buldan , Hakkari, Bingöl-Karlıova and Erzurum-Cat Earthequake Disasters and Amendment of Some Laws	06.04.2005
5393	Municipal Law	13.07.2005
5403	Soil Conservation and Land Use Law	19.07.2005
5543	Settlemet Law	26.09.2006
5593	Additional Law to Law on Protection Against Air Attacks	18.03.1950
5902	Law on Organization and Duties of Disaster and Emergency Management Presidency	17.06.2009
6831	Forest Law	08.09.1956
7126	Civil Defence Law	13.06.1958
7269	Law on Relief and Prevention of Disasters Effective on Public Life	25.05.1959

Table 3.2: Decree laws related to disaster-emergency management

Decree Law No.	Decree Law Name	Date
180/2680	Decree Law on the Organization and Duties of The Ministry of Public Works and Settlement	13.12.1983
576/4452	Decree Law on the Organization of Natural Disaster Aids and Time Extension of Tax Payment and Amendment of Some Laws	14.09.1999
587/4452	Decree Law on the Compulsory Earthquake Insurance	25.11.1999

Table 3.3: Guidelines related to disaster-emergency management

Relevant Institutions	Guideline Name	Date
Ministry of Internal Affairs General Directorate of Civil Defence	Guideline for Civil Defence Affairs of Deparments and Institutes	2003

Table 3.4: Manuals related to disaster-emergency management

Relevant Institutions	Manual Name	Date
Ministry of Internal Affairs Chairmanship of Supervisory Board	Inspection Manual of Civil Defence Search and Rescues Unit Directorates	2008
Ministry of Internal Affairs Chairmanship of Supervisory Board	Inspection Manual of Provincial Civil Defence Directorate	2008
Ministry of Internal Affairs Chairmanship of Supervisory Board	Inspectation Manual of County Civil Defence Directorate	2008

Table 3.5: Bylaws related to disaster-emergency management

Based Law	Bylaw Name	Date
2690	Radiation Safety Bylaw	24.07.1985
2908	Turkish Red Crescent Bylaw	06.04.1993
2941	Mobilization and Stateof War Bylaw	24.05.1990
3634	National Defence Obligation Bylaw	22.06.1940
7126	Civil Defence Interinstitute Cooperation and Mutual Asistance Bylaw	16.05.1959
7126	Bylaw on the Due Applicable Principles about the City and Town Plans along with Important Structures and Facilities	09.06.1959
7126	Personal Liability Related to Civil Defence, Evacuation and Lessening, Planning and Other Services Bylaw	05.06.1964
7126	Formation and Prevention Related to Civil Defence Bylaw	05.06.1964

Not also DEM actors but also responsibilities of different institutions and organizations are defined in detail in directives. Regulation on the Planning and Organization Principles for Emergency Aid for mitigation phase, Bylaw on Execution of Organization, Planning, Supply and Other Services of Hospitals to be

Established in Sensitive Areas, Regulation on prevention, extinguishing and rescue precautions for the fires on land or fires at sea, port and shores which can access and spread to the lands or for the fires on land which can access to coast, ports and seas, Regulation for Protection against Sabotages, Regulation for Radiation Security, Regulation on the Organization and Measures to be taken for Civil Defense by public for preparation phase, National Application Regulation on Status of Nuclear and Radiological Hazards for response phase and Bylaw on Construction of Buildings in Earthquake Region for recovery phase of DEM are examined and the activities about the concept and the actors performed these activities are determined. Furthermore, responsibility of fire brigade by Municipal Fire Brigade Directives, responsibilty of search-rescue teams and units by Turkish Search and Rescue Directives, actors and actors` duties by emergency health services directives.

Table 3.6: Instructions related to disaster-emergency management

Relevant Institutions	Instruction Name	Date
Ministry of Internal Affairs General Directorate of Civil Defence	The Establishment, Duties and Operating Procedures of Civil Defense Warning and Alarm Centres via Radiologic Defence Agency Instructions	16.09.1974
Ministry of Internal Affairs General Directorate of Civil Defence	Fm Radio Phone Communication System of Civil Defence Organization Instruction	22.02.1990
Ministry of Internal Affairs General Directorate of Civil Defence	The Establishment, Duties and Operating Procedures of Civil Defense Services via Emergency Rescue and Support Teams Instructions	09.01.1997
Ministry of Internal Affairs General Directorate of Civil Defence	Volunteer Participation to Civil Defence Services Principals Instruction	05.05.2000
Ministry of Internal Affairs General Directorate of Civil Defence	General Diroctacate of Civil Defence Diver Personnel Instruction	19.01.2009
Ministry of Internal Affairs General Directorate of Civil Defence	Civil Defence Directive on Recognition and Publication Instruction	19.01.2009

Table 3.7: Regulations related to disaster-emergency management

Based Law	Regulation Name	Date
7269	Basic Rules Related Effectiveness of Disasters Regulation	21.09.1968
7269	Regulation on Construction of Buildings in Earthquake Region	22.01.2002
6/3150	Execution of Organization, Planning, Supply and Other Services of Hospitals to be Established in Sensitive Areas Regulation	26.04.1966
3194	Additional Regulation on Shelters to Public Improvement Regulations Organised by the Law No. 3194	28.09.1998
5442, 7126, 7269	Regulation on Prevention, Extinguishing and Rescue Precautions for the Fires on Land or Fires at Sea, Port and Shores which can Access and Spread to the Lands or for the Fires on Land which can Access to Coast, Ports and Seas.	06.08.1975
2632	Regulation on the Duties and Responsibilities of Duty Officers and Their Work Schemes	20.12.1966
2690	National Application Regulation on Status of Nuclear and Radiological Hazards	15.01.2000
3359, 1219, 2918, 181	Emergency Health Services Regulation	11.05.2000
3348, 4749, 2920, 6812, 3169, 3171, 2692, 491,	Turkish Search and Rescue Regulation	12.12.2001
3344	Prime Ministry-Crisis Management Office Regulation	30.09.1996
2495	Regulation for Protection against Sabotages	16.10.1988
7269	Regulation on the Planning and Organization Principles for Emergency Aid Agency	01.04.1988
7126, 586	Regulation on Foundation, Duties, Working Procedures and Principles of Civil Defence Search and Rescue Units and Teams	21.07.2000
5393	Municipality Fire Brigade Regulation	21.10.2006
7126, 3152, 180	Regulation on Protection of Buildings from Fire	19.12.2007
2495, 3832	Regulation on the Implementation of Law for the Protection and Security of Some Institutions and Organizations	28.03.1004
2690	Radiation Safety Ragulation	24.03.2000
7126	Regulation on Civil Defence Revenue and Nest-Egg	24.02.1999
7126	Military Cooperation in Civil Defence ServicesRegulation	24.05.1966
7126	Civil Defence Agency Goods Regulation	20.01.1967

Explanations above show that there is a need of detail research on determination of actors and activities of DEM in accordance with statute. Despite the fact that detail definitions and descriptions are made, there is a deficiency in descriptions that provide integrated task description and coordinate work between institutions. The main reason of this deficiency is scattered presence of content in statute.

3.3 Actors in Disaster-Emergency Management According to Legislation

There are plenty of actors involved in different levels to act on for mitigation, preparation, response and recovery phases of DEM. It is noted as necessary for institutions to take actions regarding the DEM upon checking with not only laws but also with institution regulations.

It is shown in Appendix A.2; the actors which take part in DEM activities are leveled and displayed as governmental, national, regional, provincial and local accordingly to their hierarchical relation. In this regard, there are 17 actors determined on governmental level. There are 187 actors in national level which are composed of; 37 of them (actors) are on central organization of the governmental level, 39 of them (actors) are on permanent/related organizations of Governmental level, 29 of them are in the related governmental organizations, 3 of them are in the in-charge-organizations of the governmental level and 79 of them are in the central organizations of related organizations of the governmental level. Along with 102 actors on Provincial level, the actors in charge at DEM are determined as 306 in totals. It is expected from DEM that active duties of every single actor from local to national level should be predetermined.

The actors in governmental level have plenty of activities they take part in regarding the legal contents. These are composed of a bunch of activities such as setting the standards in the mitigation phase, protection of buildings it holds within its structure which require safety in the preparation phase, providing coordination and external support afterwards of the big disasters in the response phase, and creation of new living quarters for sufferers in the recovery phase. Besides this, it has many important responsibilities and duties such as determination of DEM policy, forming related central institution and organizations, making country-wide security, safety policies, furnishing international support and its coordination along with national institutions and agencies.

The national level actors are composed of agencies and institutes which are directly connected to governmental level actors. The actors of operation steps which form the activities in the phases of DEM are the agencies and institutes at this level. In addition, it is in charge of; the actors who retain and are entitled to activities at provincial level, employment standards, its coordination and necessities and work scheme. The Disaster and Emergency Management Presidency, which is directly connected to prime ministry stands as the head actor at national level and its purview is composed of duties and responsibilities and authorization of the office of prime ministry. It is responsible with its sub-divisions from setting the plan of country's DEM, acting upon for the different phases of disaster and directing Provincial Directorate of Disaster and Emergency Management.

It is the provincial level that is directly in charge of managing disaster and emergency at the most efficient way and at the most necessitated response phase via directly and actively involving and its coordinating feature and structure that carries the utmost important actors in protecting life and capital. Considerable part of provincial level actors is composed of national level actors' sub-units who are responsible on provincial scale. The activities that national level actors are responsible of planning are done by these provincial level actors. At the response phase, provincial units' coordinated and effective work is at the utmost importance in terms of saving lives and minimizing damages and costs for all kinds of disasters. Also, Youth and Sports Provincial Directorates are connected to national level Youth and Sports General Directorates, and at the governmental level, they are connected to Office of Prime Ministry. Moreover, these Youth and Sports Directorates are assigned as the actors responsible for the activities defined and determined at the Establishment and Duties of the Bureaus of the State of Emergency Committee and Determination and Payment Regarding the Provision for Liabilities and Regulation on Turkish Search and Rescue. In many instances, Underwater Sports Federation that is connected to the Youth and Sports Provincial Directorates play role at the phases of disasters. Underwater Sports Federation was the actor during the case of ship fire at the response phase, within the scope of search-rescue attempts. The people enlisted in the Federation with the required capabilities are chosen to save human lives and for equipment searching attempts, play a very vital and effective role.

Gendarmerie could be counted among the actors of local level which takes part in most of the legal contents with many significant roles by its different activities. Provincial level Gendarmerie Headquarters of which gendarmerie is connected to, regional level gendarmerie commander of the gendarmerie zone, national level General commander of the gendarmerie and at the governmental level; the Ministry of Internal Affairs of which General commander of gendarmerie is connected to are all defined as actors with its activities in different parts of the legislation. When all these activities are analyzed, it is seen that all agencies and organizations are held somehow responsible for coordination at some changing amounts. One of the important activities that Gendarmerie is in charge of at the local scale is the disaster response activity at which it coordinately collaborates with civil defense.

It is possible to determine the actors according to the types of disasters within the legislation scope to a certain degree. Yet again, it is required to determine the activities at different levels of the management for a comprehensive examination/study and it is needed to determine the study/task steps and their responsible actors.

4. GIS IN DISASTER-EMERGENCY MANAGEMENT

Geo-data is involved in all phases of risk management processes from mitigation to response. Most disaster management activities require geo-spatial information to determine where events have occurred, who is at risk, and how the risk varies geographically, and such factors as what routes are available to ship supplies, where to set up medical facilities and shelters, what the impacts might be on surrounding places (Hiltz et al, 2010). As a result, GIS provides a powerful decision support and helps to find optimal solutions to complex problems on disaster management. While GIS is largely designed to serve specific projects or user communities, the focus is now increasingly shifting to the challenges associated with integrating these functions (Aydinoglu et al, 2009). GIS have the potential to make a substantial positive impact on our ability to plan for and cope with crises of many kinds (Yomralioglu, 2009).

Disaster events vary in both spatial and temporal extent. Impacts from a disaster event can be as temporally and spatially broad as a month-long flooding of a major river, or as temporally and spatially local as a chemical tank explosion. The spatial aspect of disasters requires maintaining awareness of the geographic characteristics of the natural and built environment in order to manage disaster events in ways appropriate to the places in which they happen. Planning a response or responding to a disaster requires access to and management of accurate geo-referenced information (Kouna et al, 2010). A GIS has the potential to enable crisis managers to gather, store, integrate, analyze, share, and apply geo-spatial information to evaluate and manage a disaster efficiently (Brooijmans, 2008).

Most large-scale disasters have fundamental geographic components related to the geographic distribution of vulnerability and impacts, location of facilities at risk and those with resources, evacuation of people and routing of supplies, and others (Hiltz et al, 2010). GIS has the capacity to help identify emergency shelters or immediate locations that have suffered heavy damage, and to inventory and track resources to these locations in a more efficient and timely manner. Access to data about critical

factors such as the number and location of assisted-living facilities or hospitals in an area that might require special evacuation assistance, distribution of supplies, identification of sites to evacuate, and evacuation routes are some of the support provided by GIS. To analyze the way approach for geocollaborative support can accommodate disaster management tasks and to provide additional support for disaster management tasks beyond current GIS use, DEM phases are related to actors, their roles and tasks, and tools needed to accomplish the tasks (Figure 4.1).

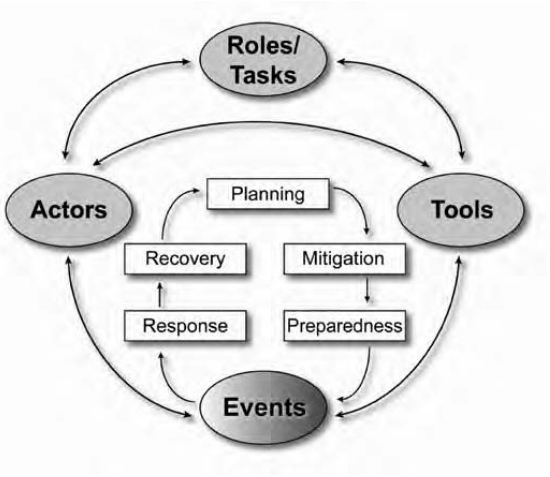

Figure 4.1 : Disaster-emergency management phases and context of support (Kouna et al, 2010)

DEM requires multiple individuals and organizations sharing information, expertise, and resources in support of rapid situation assessment and decision making (Cai et al, 2005). A team may work together at the same or different time and at the same or different places (Armstrong, 1993; Ellis et al, 1991). Furthermore, effective DEM requires acquisition and dissemination of historical and real-time information from many sources. GIS in DEM has been recognized to provide access to spatial information during a disaster event to a larger group of people, in a fast, easy, and cost-effective manner (Cai, 2005). GIS has the potential to increase the usage and accessibility of geo-spatial data. It provides a platform for exchanging ideas, knowledge, and the latest information during the event (Kouna et al, 2010).

GIS applications can be useful in creating hazard inventory maps for the pre-feasibility study of development projects, locate critical facilities such as shelters, drains, etc., creating and managing associated database and vulnerability assessment

to boost diasaster awareness with government and the public, so that decisions can be taken to establish DEM organizators.

All phases of emergency management depend on data from a variety of sources, that has to be gathered, organized, and displayed logically to determine the size and scope of disaster management programs (Johnson, 2000). The most critical stage of DEM is the realization that there is a need for planning based on the risk that is present. By utilizing a GIS, all phases of DEM can be most effective.

Mitigation; The use of GIS in DEM can help with structural and nonstructural mitigation. GIS allows spatially represent areas at risk and the level of risk associated with a particular hazard, which can be a guide in decision making. It will facilitate the implementation of necessary mechanisms to lessen the impact of a potential emergency. Human life and other values (property, habitat, wildlife, etc.) at risk from these emergencies can be quickly identified and targeted for protective action. With GIS, disaster managers can determine the level of mitigative structures that should be in place given the vulnerability of an area or population effectively.

Preparation; GIS can help with the identification and location of resources and "at risk" areas in preperation phase of disaster management. It establishes a link between partners and critical agencies, which allow disaster managers to know where relevant partner agencies are stationed. In the context of disaster management, GIS maps can provide information on the human resources present in an Emergency Operation Centre as well as on the ground personnel such as security, health providers and other key responders (Johnson, 2000). GIS helps to answer the question of who is to be based where and at what phase during the emergency. It can help to determine whether or not road infrastructure and communications networks are capable of handling the effects of disaster and, if necessary, guide in the placement of resources.

Response; GIS can provide the user with accurate information on the exact location of an emergency situation. This would prove useful as less time is spent trying to determine where the trouble areas are. The closest response units can be selected, routed, and dispatched to an emergency once the location is known. Depending on the emergency, a GIS can provide detailed information before the first units arrive.

Recovery; Mapping and geo-spatial data will provide a comprehensive display on the level of damage or disruption that was sustained as a result of the emergency.

GIS can provide a synopsis of what has been damaged, where, and the number of persons or institutions that were affected. This kind of information is quite useful to the recovery process.

The use of GIS technology takes DEM planning information off the shelf for utilization by response personnel for real-world operations. In short, the thoughtful application of a GIS can take much of the panic and surprise out of emergencies. In this context there are a lot of challenges of using GIS in DEM. Based on the information obtained from GIS mapping, it may require taking critical decisions in the best interest of the affected area. GIS being a technological tool can be complex and a bit difficult to grasp initially. The decision-making process may be stalled during an emergency due to: the large volume of information required by the GIS system, the vast amount of time require to analyze the information before a decision is finally made.

4.1 Geo-Data and Disaster-Emergency Management

DEM is an inherently spatial problem. As it can be realised many activities in the disaster master plan are related to availability of geo-information, the interest in geo-information increases worldwide. Informed decisions are a prerequisite for the formulation of successful mitigation, response, preparation and recovery strategies of DEM. To a large extent, however, successful strategies depend on the availability of accurate information presented in an appropriate and timely manner (Montaya, 2002). Information is also important as it increases the transparency and accountability of the decision-making process and it can therefore contribute to good governance.

Decision-makers are often provided with maps of disaster zonation, population density, urban growth and land-use, on which to base their decisions. However, as little attempt had been made to integrate the data sets, the implications of the information are not immediately visible, causing confusion and in the worst cases, the formulation of inadequate policies. Simply stated, decision makers require information that allows them to establish the cost–benefit implications of the various strategies that can be implemented (Montoya, 2002). First, Cova (1999) describes how GIS, can be used in the four phases of emergency management. In the mitigation phase geo-data is used to perform analytical modelling for long-term

planning and forecasting. In the preparation and response phases, timely and accurate answers to geographical queries are needed to support decision making by the emergency managers. Second, the GIS is used for information integration and dissemination (command & control). In the recovery phase GIS is used as a spatial inventory system for coordinating recovery activities.

GIS support decision making and facilitate optimum solution finding for complex problems. Due to GIS functions, information from other sources can be processed with geo-data. That way, analysis related to emergency are performed with different input layers such as; road, building, watercourse, land cover and so on. Geo-data which is obtained from location based observations and expressed as map information, is extensively used in different phases of DEM. GIS-based simulation systems are also necessary to develop useful and realistic scenarios to be used in preparation phase. In recovery phase, there is often a high public and political interest to see a situation before and after an emergency and to set priorities for the rebuilding (Abdulharis, 2005).

Geo-information is scattered in different organizations, systems, formats and applications, devoted to completely different tasks. It is often discussed that the real barriers for the use of geo-information in DEM sector are difficulties in making data available, finding the most appropriate data and making systems cooperate (Zlatanova, 2005). Many actors are involved and must coordinate their activities; decisions have to be made quickly and often under extreme pressure; there is a lot of uncertainty, due to lack of timely information; and decision making is often based on experience and intuition rather than information (Scott and Simpson, 2009). Similarly, to be fully utilised the GIS tools require data that is often dispersed across different organisations, information systems, formats, and applications, that are devoted to completely different business requirements. It is commonly stated that the real barriers to the use of geo-information in DEM are the difficulties in making the data available in a timely manner that is fit for purpose in an interoperable or common operating environment. The lack of interoperability, due to proprietary standards and developments, delays systems to be connected and updated without massive investments, which are too expensive for many organisations. This results into islands of automation on dedicated tasks, unable to deliver intelligence to multi-user groups (Abdulharis, 2005).

Existing data will be combined with the dynamic data gathered during the management of the disaster. The analysis performed before and during an incident is the input for decision support systems and simple geographic viewers.

Existing data, were produced by different organizations on heterogeneous environment such as topographic maps, administrative units and risk objects; vulnerable objects like schools, government buildings, hospitals and the location of emergency response teams.

Dynamic data, are collected during the disaster from the activities of DEM such as incident data includes location, nature, and scale. Effects of disasters should be determined with real time data including damaged objects, buildings, and infrastructures, affected and threatened areas. Casualties as a possible result of disasters include wounded and trapped people. In addition to this, meteorological data includes wind, humidity, and precipitation. This up-to-date geo-data is obtained on actual situation and can help to analyze possible effects and to determine precautions. The location of emergency response teams are needed as a moving object for giving the route to incident location. This dynamic data is very wide depending on the nature and data needs of emergency situations. By this way, dynamic data produced on real time can support controlling emergency response activities together with the use of existing data.

4.2 Spatial Data Infrastructure in Disaster-Emergency Management

The growing need to organise data across different disciplines and organisations and also the need to create multi-participant, decision-supported environments has resulted in the concept of Spatial Data Infrastructure (SDI) (Rajabifard et al, 2006).

A SDI is an initiative intended to create an environment that will enable a wide variety of users to access and disseminate spatial data in an easy and secure way (Nebert, 2004). SDI are the fundamental spatial datasets, the standards that enable integration, the distribution networks that provide access, the policies and administrative principles that ensure compatibility, the people including users, providers, and value adders, at each level; local through to state, national, regional and global.

A SDI should be developed to support decision-making and based on partnerships at corporate, local, state/provincial, national, multi-national and global levels (Rajabifard and Williamson, 2004). SDI component as a framework of spatial, metadata, users and tools that are interactively connected in order to achieve the flexibility to meet user decision-making requirements and to support disaster management objectives (Rajabifard, 2002).

By designing an SDI model for a disaster management community, and by utilizing relevant Information and Communication Technologies (ICT) in DEM, it is possible to have better decision-making and increase the efficiencies and effectiveness of all level of disaster management activities from mitigation to preparation, response and recovery phases. The result of such quality decision-making then can directly contribute to the sustainable development of the jurisdiction or community in terms of social, economical and environmental development. SDI as an innovation in spatial data management can provide an appropriate environment in which spatial datasets are always available and accessible as well as integratable for use in DEM. Without spatial data one cannot expect effective and efficient disaster management, as spatial data is the essential element of Emergency Response Systems. It is about maximizing the use of geo-spatial information to meet the real needs of users across a wide variety of different sectors and disciplines (Baker, 2005; Mansourian et al, 2004; Rajabifard, 2001).

SDI also provide accessing and sharing up-to date maps and tables between responsible organizations to response to the disaster in emergency situations in short time. In principle, SDIs allow sharing of data, which is extremely useful, as it enables users to save resources, time and effort when trying to acquire new datasets by avoiding duplication of expenses associated with generation and maintenance of data and their integration with other datasets (Diehl et al, 2006; Mansourian, 2005).

Spatial data is especially useful in the response phase. GIS specialists generate maps of the source areas of the disaster, hazardous and safety locations, ingress and egress routes. Other maps include for instance travel plans; emergency forces drop points and logistical support facility locations. During the response phase action plans are developed constantly. Maps are the key component of these plans. They will be updated all the time and will provide an overview of the disaster spread conditions and the affected and potential effected areas. It will help crew to get a comprehensive

situation overview and to be aware of the context of the disaster and it helps them to formulate strategies and tactics (Borkulo et al, 2005; Diehl and Heide, 2005).

The integration of geo-information through interoperable systems is the central role of SDI or Geographic Information Infrastructure (GII) because it provides information from different sources for effective delivery of government services. By this way, SDI is increasingly considered a critical aspect of decision-making and response in emergency management.

From a technical point of view, standard implementations are required for access and exchange of geo-information. These include OGC Web Services, GML, Geo-decision support services (GeoDSS), Geo-Digital Right Management (GeoDRM) and Open Location services (OpenLS). The use of web services and XML can be considered for the communication between the systems in this architecture (OGC, 2008). On networked environment, there are a great diversity clients ranging from rich clients based on web browsers over classic workstation applications to mainframes with terminals (Aydinoglu et al, 2009). Geo-information should be shared and can be immediately retrieved from the sources involved in different databases. The services should be a part of SDI that integrates and facilitates access to existing and dynamic data on emergency management. Defining and implementing a SDI within context aware services is the main focus as seen on Figure 4.2. The applications are directly communicating with services within these data driven SDIs.

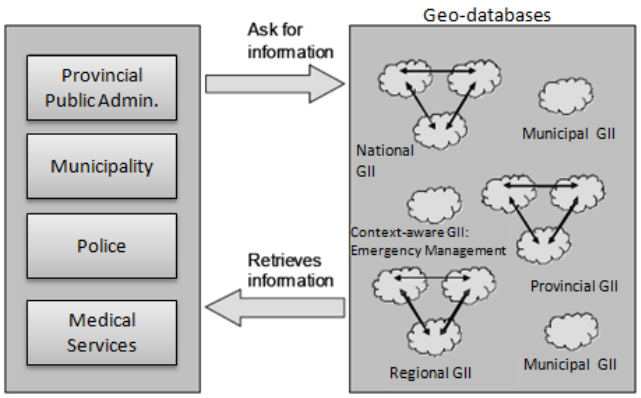

Figure 4.2 : An overview of context-aware spatial data infrastructure for disaster-emergency management (adapted from Barkulo et al, 2006)

There are many approaches mentioned for reaching semantic interoperability on highly heterogeneous programming and data models. Important technology progress has been made in the discipline of knowledge engineering such as Unified Modeling Language (UML), ontology, and semantic web. For example, UML is a standardized modeling language for object modeling, is a graphical modeling tool with well defined semantics and underlying computer model in a Model Driven Approach (MDA). It is developed for the purpose of general domain modeling, application system design, database design, business modeling and so on.

Thus, data provide the solution to analyze, visualize and understand the problems caused by the disaster. In DEM many different actors are involved in and they use much spatial data. For effective DEM these data should be exchanged. Because there is a disaster situation this should be exchanged in a very fast and secure way. SDI provides a lot of benefits for the emergency management disciple. Some benefits of data sharing among emergency management organizations are listed bellow (Diehl et al, 2006; Taher, 2001; Yue et al, 2007):

• GIS requires large quantities of current and accurate digital data. It is not necessary for each organization to try to possess all the data in their own GIS. The emergency forces can safe significant time, money and effort when they share the burden of data collection and maintenance. Especially the savings in time are very relevant for DEM during the disaster response phase, making the difference in the number of victims and the size of the disaster areas.

• Within the emergency management discipline in the municipalities are a huge source of (static) spatial information. The fire department is the organization that delivers the most information about the disaster during the response phase (=dynamic data) and this information is the basis for decision making of all the emergency forces.

• Shared data allows more users to work with data and consequently estimate the quality of data. In the preparation phase an increased number of users can find and correct errors in the data. For the disaster response phase it is also important that a lot of people are familiar with the spatial data sets. This will reduce the number of mistakes that will be made because of lack of time due to the disaster.

• Sharing data of common interest will reduce duplication and it will enable the emergency forces to defray some of the costs of producing and maintaining the data. Mechanisms to facilitate the use and exchange of data are a major justification for developing and expanding a SDI.

• Sharing of spatial information in the preparation phase helps the policy makers to develop high quality contingency plans because a complete overview of the spatial data availability will provide a better understanding. It also provides an overview whether the amount of data is complete or insufficient and whether the data is up-to-date.

• Sharing data would allow for producing overviews of the disaster situation and informing citizens and press with very little effort. The benefits for the emergency forces will come from trust of the citizens in emergency management. Thus the benefits of shared data go beyond the organization involved in emergency management.

Shortly, it can be concluded that data sharing increases efficiency of work and provides a better method for communication and collaboration among the different actors within and among the emergency forces. This is a very important conclusion for a common framework for shared decision support.

4.3 GIS Examples in Disaster-Emergency Management

4.3.1 Spatial data standards of disaster-emergency management

Due to organizational and technological barriers, actors involved in the management of natural or manmade risks cannot cooperate efficiently. Various projects are started in an attempt to solve some of these problems. Some of these are:

Open Architecture and Spatial Data Infrastructure for Risk Management Project

The objective of ORCHESTRA (Open Architecture and Spatial Data Infrastructure for Risk Management) was to improve interoperability among risk management authorities in Europe in order to support more effective disaster risk reduction strategies and emergency management operations. According to this objective the main goal was to design and implement an open service-oriented software architecture, which improves the interoperability among actors involved in multi-risk

management. Another objective in the design process was to pay special attention to the combination of spatial and non-spatial data and services. A solution that follows the ORCHESTRA approach should be capable of making maps and related information from documents or databases readily accessible. From the beginning of the project, the ORCHESTRA architecture has been anticipated as a precursor of the INSPIRE and GMES infrastructure. One of the project objectives is to assist and support the development of INSPIRE technical specifications and guidelines in the INSPIRE preparatory phase and to develop the software infrastructure for enabling risk management services (Klopfer, 2008).

The Reference Model for the ORCHESTRA Architecture (RM-OA) provides a specification framework for system architects, information modellers and system developers. The ORCHESTRA Architecture is a platform-neutral (abstract) specification of the informational and functional aspects of service networks taking into account and evolving out of architectural standards and service specifications of ISO, OGC, W3C and OASIS (Atkinson, 2005).

Three different communities of users were identified that would benefit from ORCHESTRA results (Klopfer, 2008):

- System users such as IT architects, system developers and integrators that conceive and develop risk management applications would be enabled to share and integrate data that can be transformed into relevant information. By facilitating the integration of their current technological solutions this group would be able to provide improved services to their end users.
- Providers of data and application services that are used for risk management will benefit from thematic information services that can be applied in many different risk scenarios. Information services represent a new channel to be exploited by this group. These information services should be more profi table, since they can be directed to more customer segments than mere data services.
- End-users such as members of public, agencies or private companies that use the thematic applications (built according to the ORCHESTRA specifications and using the ORCHESTRA services) benefit from more efficient interoperable services that easily integrate with the current technological

reality. To coherently handle both spatial and non-spatial data and to assure the exchange of information among different actors at different levels from local to national is a major efficiency and effectiveness benefit.

Inspire Project

The INSPIRE (Infrastructure for Spatial Information in the European Community) directive aims to create a European Union (EU) spatial data infrastructure. This will enable the sharing of environmental spatial information among public sector organisations and better facilitate public access to spatial information across Europe (AGI, 2007).

INSPIRE is based on a number of common principles (INSPIRE, 2008):

- Data should be collected only once and kept where it can be maintained most effectively.
- It should be possible to combine seamless spatial information from different sources across Europe and share it with many users and applications.
- It should be possible for information collected at one level/scale to be shared with all levels/scales; detailed for thorough investigations, general for strategic purposes.
- Geographic information needed for good governance at all levels should be readily and transparently available.
- Easy to find what geographic information is available, how it can be used to meet a particular need, and under which conditions it can be acquired and used.

Global Monitoring for Environment and Security Project

GMES (Global Monitoring for Environment and Security) is a European initiative for the implementation of information services dealing with environment and security. GMES will be based on observation data received from Earth Observation satellites and ground based information (GMES, 2010).

Through GMES the state of the environment and its short, medium and longterm evolution will be monitored to support policy decisions or investments. GMES is a set of services for European citizens helping to improve their quality of life regarding

environment and security. GMES is the European main contribution to GEOSS (Global Earth Observation System of Sytems) (GMES, 2008).

The different services developed under GMES and its underlying infrastructure are relevant to most SBAs and to the four horizontal activities covered by specific GEOSS Committees (Architecture and Data, User Interface, Science and Technology and Capacity Building Committee) (GMES, 2008).

Open Geospatial Organisation Project

The OGC (Open Geospatial Organisation) is an international industry consortium of 409 companies, government agencies and universities participating in a consensus process to develop publicly available interface standards. OGC Standards support interoperable solutions that "geo-enable" the web, wireless and location-based services and mainstream IT. The standards empower technology developers to make complex spatial information and services accessible and useful with all kinds of applications (Bermudez, 2010; Klopfer, 2008).

The strategic goals of the project is (Doyle and Reed, 2001; Bermudez, 2010);

- To provide free and openly available standards to the market, tangible value to members, and measurable benefits to users,
- To lead worldwide in the creation and establishment of standards that allow geospatial content and services to be seamlessly integrated into business and civic processes, the spatial web and enterprise computing,
- To facilitate the adoption of open, spatially enabled reference architectures in enterprise environments worldwide,
- To advance standards in support of the formation of new and innovative markets and applications for geospatial technologies and
- To accelerate market assimilation of interoperability research through collaborative consortium processes.

Open Advanced Systems for Disaster and Emergency Management Project

The OASIS (Open Advanced Systems for Disaster and Emergency Management) Project addresses the Strategic objective, "Improving Risk Management", of the second call for tender of the European Commission FP6 Information Society

Technologies program. The objective of OASIS is to define and develop an Information Technology framework based on an open and flexible architecture and using standards, existing or proposed by OASIS, that will be the basis of a European Disaster and Emergency Management system.

OASIS is intended to facilitate the cooperation between the information systems used by civil protection organisations, in a local, regional, national or international environment. This Disaster and Emergency Management system aims to support the response operations in the case of large scale as well as local emergencies. OASIS provides within this framework an initial set of applications which cover the main needs that are identified by the end-users. Clear situation awareness is a key factor for the effectiveness of disaster and emergency operations. It is based on the compilation of information collected from the different teams of responders. The building of such a picture relies on exchanging information.

In order to facilitate these exchanges, the Consortium has defined a "standard instrument" which carries the description of the situation between systems (OASIS, 2005).

World Wide Web Consortium Project

The W3C (World Wide Web Consortium) is an international community where Member organizations, a full-time staff, and the public work together to develop Web standards (W3C, 2010).

The W3C mission is to lead the World Wide Web to its full potential by developing protocols and guidelines that ensure the long-term growth of the Web. Important aspects of this mission, all of which further W3C's vision of One Web.

The social value of the Web is that it enables human communication, commerce, and opportunities to share knowledge. One of W3C's primary goals is to make these benefits available to all people, whatever their hardware, software, network infrastructure, native language, culture, geographical location, or physical or mental ability (W3C, 2010).

Geographical Data Infrastructure for Emergency Management Project

GDI4DM (Geographical Data Infrastructure for Emergency Management) seeks to develop a Geo-spatial Data Infrastructure to support decision-making and information exchange during the disaster management phase.

The central purpose of the project is to establish a well-functioning Geo-spatial Data Infrastructure as well as a set of context-aware services, in order to facilitate the exchange and supply of information during the disaster management phase. As such, the project seeks to support the emergency services and decision-makers and further enable them to respond in a timely and effective way when disasters and emergencies take place (Basta et al, 2006).

Standard on Disaster/Emergency Management and Business Continuity Programs

The NFPA (Standard on Disaster/Emergency Management and Business Continuity Programs) Standards Council established the Disaster Management Committee in January 1991. The mission of the international non-profit NFPA is to reduce the worldwide burden of fire and other hazards on the quality of life by providing and advocating consensus codes and standards, research, training, and education. This standard establishes a common set of criteria for disaster management, emergency management, and business continuity programs hereinafter referred to as the program.

NFPA standard shall provide those with the responsibility for disaster and emergency management and business continuity programs the criteria to assess current programs or to develop, implement, and maintain a program to mitigate, prepare for, respond to, and recover from disasters and emergencies (NFPA, 2007).

Federal Geographic Data Committee Project

The FGDC (Federal Geographic Data Committee) is an interagency committee that promotes the coordinated development, use, sharing, and dissemination of geospatial data on a national basis.

The FGDC is an organized structure of Federal geospatial professionals and constituents that provide executive, managerial, and advisory direction and oversight for geospatial decisions and initiatives across the Federal government (FGDC, 2010).

4.3.2 Disaster-emergency management examples in Turkey

Turkey Disaster Information System Catalogue

The objective of TABIS (Turkey Disaster Information System Project) is to use Remote Sensing System, Global Positioning System (GPS) and other data gathering systems especially for emergency planning, the implentation of emergency and any disaster situation, can be used disaster management and damage estimation. The system can be utilized as a decision support system for the central and provincial administration (ministries, governorates, prefectures, municipalities). The other objective of the sytem is to improve standards to provide a basis for countrywide application GIS-based information and management system. The project creates regional, environmental and administrative information system by generating standards that provide coordination and compatible working between provinces regarding disaster planning and management of Turkey (Sahin et al, 2006).

Expected benefits of TABIS-OK (Object catalogue) that generated within TABİS project; prevent uncontrolled growth of data and management of same data by different institutions, by interdisciplinary work increase efficiency and provide basis to standards regarding data exchange. Target is integration of geographical datas of relevant institutions.

TABİS reference model is compose of two basic object oriented and vectoral models called digital disaster model (SMM) and digital space model (SAFM). TABIS object index is composed of Basic Topographic-Spatial Fields Catalogue (TABIS-TOK) and TABIS- Disaster Mangement Object Fields Catalogue (TABIS-AOK) that prepared in parallel with SMM and SAFM approaches. Decending decomposition method was followed during creation of TABIS-OK.

Hazards-Tukey Project

Geographical information system based and disaster management objected HAZTURK (Earthquake Loss Estimation For Turkey) is a earthquake damage estimation software. The software improve methods that can be used for Turkey. Software eradicated errors caused by geographical differences. Furthermore units of measurement and administrative units was adapted to Turkey, specific decrement relation in Istanbul and construction vulnerability curves based on specific strong ground motion of Istanbul. Methodology of the study is CRM (Consequence Based

Risk Management) which was developed by Mid-America Earthquake (MAE) Center. The study is seperated three major topics; disaster, inventory and vulnerability, earthquake loss analysis survey was prepared in accordance with results of these topics.

Rize Disaster Information and Meteorological Early Warning System Project

The objective of RABIS (Rize Disaster Information and Meteorological Early Warning System) is carrying out a system which minimize loss of life and tangible damage against natural disasters in Rize by using especially remote sensing technique, geographical information systems and meteorological early warning systems. Disaster information system and meteorological early warning are two sub-divisions of project in Rize province. Project conducts a system which can be used as emergency preparation planning and implementation, and also disaster management and damage estimation. Besides, the system is objected to implement GIS based information and management system standard model in Rize for Turkey. This sample model set a precedent for implementing decision support system for the central and provincial administration (ministries, governorates, prefectures, municipalities).

Istanbul Disaster Information System Project

ISTABİS (Istanbul Disaster Information System) create interprovincial cooperation standards related to disaster management/planning of Turkey with these standards, a regional information system model is conducted which enable to reach accurate, current and consistent datas with geographical information system infrastructure. Objective is utilizing qualifed information in order to plan and manage disasters by preventing excess information and informational convergence. Database studies as part of GIS; TABIS object catalog was utilized as GIS-based administrative database within in the contex of disaster management. Object oriented database model TABIS-OK and relational database model IBB-VT (experimentally established by Istanbul municipality) were compared and differrences between models were introduced for logical database design. A new object catalog was produced as a joint product in consequence of this interrelated improvement of two databases. Geographical database structure which is used for data storage of TABIS-OK, was conducted with the help of ArcGIS softwares. Operations related with the logical design of database; design of geographical objects and layers, design of tables and

relation between them, design of other database subjects and preparation of UML database models.

Japan International Cooperation Agency Project

The objective of JICA (Japan International Cooperation Agency) study was announced in project result report as “prepare seismic microzonation maps that can provide the basis of seismic disaster preventation/damage reduction plan of Istanbul and environs, make recommendations on building techniques for earthquake resistant urbanization and effective technical transfers on related planning techniques” (JICA, 2001).

IBB Emergency Transportation Network Planning Project

Scientific studies and analyses of JICA used as the source data of Istanbul Evacuation Routes and Main Transportation Planing. 1st,2nd,3rd degrees of transportation road network was conducted as a result of JICA data. Quality of roads, risk analyses of demoliton of buildings to roads and risk analyses of road blockage were considered during conducting road network. Evacuation routes and main transportation were planned regard to recommended roads.

İstanbul Seismic Risk Mitigation and Emergency Preparedness Project

Strengthening institutional and technical capacity of emergency management, increasing emergency preparedness and response awareness, retrofitting/reconstruction of priority public buildings, vulnerability inventory and sample retrofitting design for cultural and historical heritage assets, taking supportive measures for the efficient implementation of development law and building codes are objectives of ISMEP (Istanbul Seismic Risk Mitigation and Emergency Preparedness Project). Expiration date for the project is 2014.

Kandilli Observatory and Earthquake Research Institute Project

Boğaziçi University Kandilli Observatory and Earthquake Research Institute conducted “Earthquake Risk Assessment for Istanbul Metropolitan Area” survey aimed at whole of Istanbul province earthquake risk assessment. KOERI (Kandilli Observatory and Earthquake Research Institute) study was carried out in order to develop risk model of Istanbul metropolitan area. Besides model provide infrastructre and building damage estimation and also the loss estimation.

Disaster Information System Project

MEER (Marmara Earthquake Emergency Reconstruction) Project, carried out with the World Bank loan, conduct “Disaster Information System Software, Software Development, National Disaster Archive Data Entry and Equipage Purchase” studies for “Land Use Management and Building By-law”. “Disaster Inventory Update and Inquiry Software” is made up components; damage assessment software, damage assessment approval software, geological survey software, geotechnical survey software, earthquake software, earth sliding software, avalanche software, rock fall software, telemetry software, site selection software, map-plan software, charter space software, charter space approval software and temporary settlement software. Furthermore “right owners and debiting software” added software repository. Crisis management counter software, electronic document management system, Turkey national disaster archive software and security software were conducted for reporting of software above.

5. EMERGENCY MANAGEMENT FOR FIRE CASE

5.1 An Approach to Manage Disaster and Emergency Activities

There is an absolute need of effective DEM in order to mitigate loss and damage of disasters. Potential case of country have to be well analyzed for management effectiveness. Potential disasters for country must be determined by assessment of geographical, geological, geomorphological structure of country and climate change. Work-flow of every phase has to be determined; mitigation phase that aims prevention of disaster, preparation phase that aims minimization of loss and damage, response phase during the disaster that aims emergency intervention and recovery phase that contains works for return to normal life after disaster. Coordinate and effective work of institutions and organisations must be provided by defining work-flow of four DEM phases in national statutes and directives.

Healthy and proper map information in other words geo-data is important requirement for management effectiveness of disaster and emergency. Mitigation and preparation phases of DEM, providing access to region, following rescue works, organization of various logistic services etc. are works that conducted in consideration of geo-data. In this sense use of GIS helps control of corruptions, damage mitigation of disaster results, protection of life and sources.

In this context, general conceptual approach of DEM is can be defined with Actor-Sector-Activity-Task-Data upper classes. Explaination of framework is;

- *Actor* expresses units like planning and mitigation, response, recovery, civil defense department, earthquake department service groups, fire department, ambulance, police, municipal police, search and rescue teams, etc. that take in charge in DEM.
- Every actor work in different *Sector*; like security, municipal, health etc.
- *Activity*, expresses geo-data use required situations during loss mitigation, preparation, response and recovery phases of DEM. To illustrate; flood and fire-risk maps can be produced in loss mitigation phase. Traffic accident and

gas explosion etc. can be explained as activity during emergency response phase.

- Every activity are formed by *task* in specific phases. For example, record of scene of the accident, establishment of fire-fighter team route, determination of affected zones etc. are works that appointed as part of activity.
- *Actor* execute the task such as when response department execute works like determination of routes and fire event zone, fire-fighter teams execute firefighting.
- Actor is in need of *geo-data* and can produce new geo-data during the task performing. Hereby, the task needs existing data or dynamic data in database. Furthermore, produce dynamic data in database during emergency response process. Geo-Data Exchange Model of Turkey (UVDM) is based on geo-data used in this study.

Every upper divisions include related sub divisions (Figure 5.1).

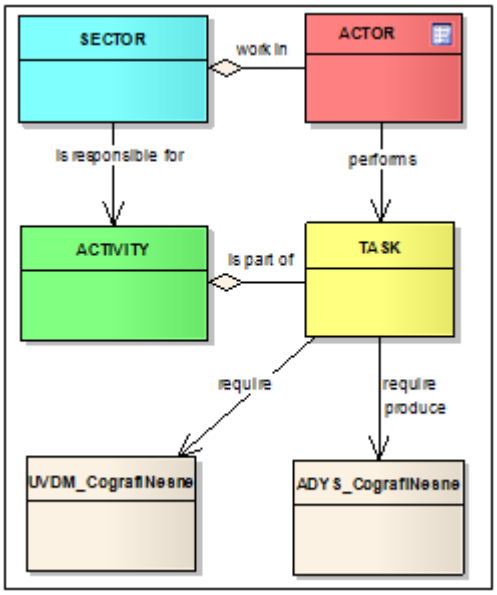

Figure 5.1 : Actor-Sector-Activity-Task-Data Approach

Works in the scope of study, the urban-fire has been examined and actor-sector-activity-task-data work-flow has been evaluated in this perspective.

Actors are determined by legacy applications, statute and the law on Disaster and Emergency Management Department Organization and Functions. Determination of actors is based on Prime Ministry web portal and objectives of institutions.

Administrative hierarchical relation is grouped by governmental, national, regional, provincal and local, in consideration of areas of responsibility and scope of application. Mitigation, preparation, response and recovery phases of DEM activities for urban-fire event are based on applications and directives. Furthermore, required work-flows that several different actors are responsible, are determined. Actors which responsible for tasks with work-flow of selected activity, are determined and graphically displayed. DEM actors are direct users of geodatabase. In the scope of the study, geo-data are determined that required by actors during disaster and emergency activities. Geo-data that required different phases of disaster and emergency, are determined in Activity/Data matrix.

Actors of emergency management sectors need base existing geo-data that was maintained by local government and public institutions. On this scope, TURKVA:UVDM can be accepted as a base model of emergency management activities because it was supposed that UVDM includes the date shared by all geo-data users at local level.

5.1.1 Geo-data model

5.1.1.1 Turkish GII: geo-data exchange model

For this study, The Turkish GII: Geo-data Exchange Model (TURKVA:UVDM) that was produced by Aydinoglu (2009) in a research was accepted as a base and existing data model. It is accepted that UVDM is a harmonized GI model of Turkey and was designed to get the data enabled for multiple uses. UVDM as a geo-database model is based on the geo-data user requirements and defines specifications of geo-data themes with documents and application schemas on a platform independent from any particular software or hardware.

UVDM is complying with ISO/TC 211, INSPIRE data specifications, and Turkey National GIS vision. UVDM is an object-relational data model that enables users to store objects and their associated attribute data in a single geo-database system. UVDM is a semantic model because a harmonized model provides a common domain of interaction and the related information. UVDM is designed with UML.

UVDM generic conceptual model specifies the components to determine the application schemas of geo-data themes and to harmonize geo-data. These components were defined and divided into two sections, scope/application area and technical components (Aydinoglu and Yomralioglu, 2010);

- Scope and Application Area Components include; Standard Hierarchy, Scale-resolution, Generalization Approach, Building Province Level GII

- Technical Components include; Principles, Terminology, Reference Model, Application Schema Rules, Spatial and Temporal Aspects, General Feature Model, Identifier and Versioning Management, Registers and Registries, Portrayal, and Multiple Representation.

This model is focused on the application and use of information, rather than a specific workflow for an organization. The base principle is that if a geo-database is modeled for a province, it could then be a model from local to national level.

The spatial hierarchy approach enables the collection of data at province level, larger than 1:5000 scale and 50 cm resolution, and then generalizes to different levels.

The UVDM geo-data themes are Administrative Unit (IB), Address (AD), Land Ownership/ Building (MB), Hydrography (HI), Topography (TO), Transportation (UL), Land Cover/Use (AR), and Geodesy (JD). Application schemas of UVDM data themes were described with documentation, feature catalogues, and UML application schemas. Feature types in data themes are defined with definition, geometry, attributes, attribute values, relationships, topology, and constraints (Figure 5.2).

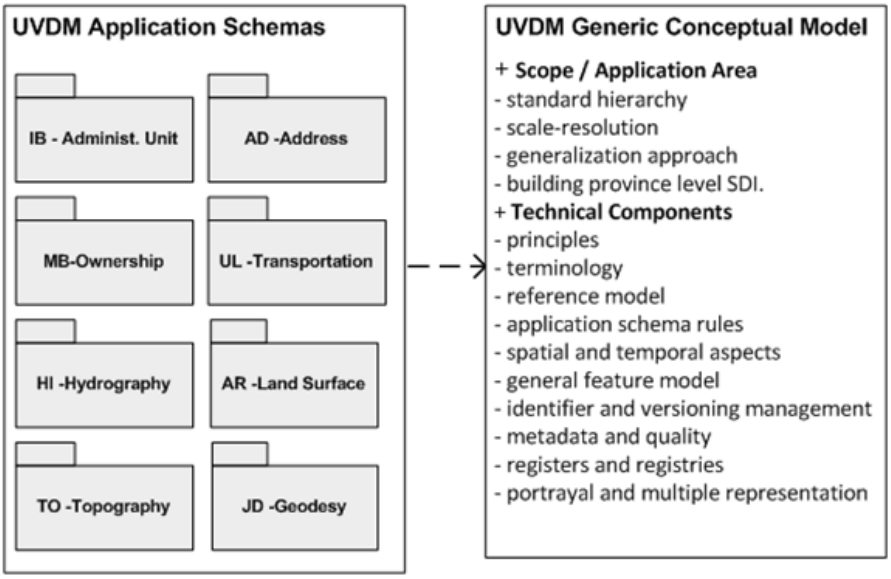

Figure 5.2 : UVDM conceptual model (Aydinoglu, 2009)

If the use of UVDM data themes on disaster management is emphasized;

- IB data theme can be effective on the coordination of disaster management activities.

- AD data theme provides a simple data structure for address matching and controlling locations of actors and emergency structures.

- MB data theme includes classes of buildings and parcels. It is related to address information. Detailed building information provides enough detail for emergency management personnel to effectively respond to local emergencies.

- HI data theme includes data about rivers and lakes that can be used on controlling floods.

- TO data theme includes elevation and surface data that can be used on determining landslide and flood risks.

- UL data theme is to capture basic infrastructure information for water, air, road, transit and rail networks. This can be effective on logistics and navigating emergency actors.

- AR data theme includes classes that relate to environmental monitoring and response. Most of these are oriented more towards natural disasters and recovery efforts rather than environmental monitoring for homeland security purposes.

5.1.1.2 Designing geo-data model for disaster-emergency management

UVDM includes the date shared by all geo-data users at local level. This is a starting point to create sector models in different thematic areas like DEM. DEM geo-data Model, abbreviated as TURKVA:ADYS, is being developed as an extension and sector model of TURKVA:UVDM.

ADYS has the same conceptual model components as an extension of UVDM. ADYS has existing and dynamic data to use during emergency events. For example; Incident, Casualty, DisasterArea, and RiskArea are continuously changing data during emergency events as seen on Figure 5.3. Incident manages information about incident time, type, time, and like these. Casualty stores trapped, wounded, missing as a result of an incident. While DisasterArea stores the spread of disaster, RiskArea controls possible risk zones if disaster continues. EmergencyBuildings includes buildings that need to get special attention during disasters such as schools, shopping areas, governmental buildings, etc. Emergency Buildings can be related to Building (YAPI), Address (ADRE) via YAPI, and other feature types in UVDM. Incident can be related to ADRE and Road (YOLH) to get the location and route information (Aydinoglu and Demir, 2010).

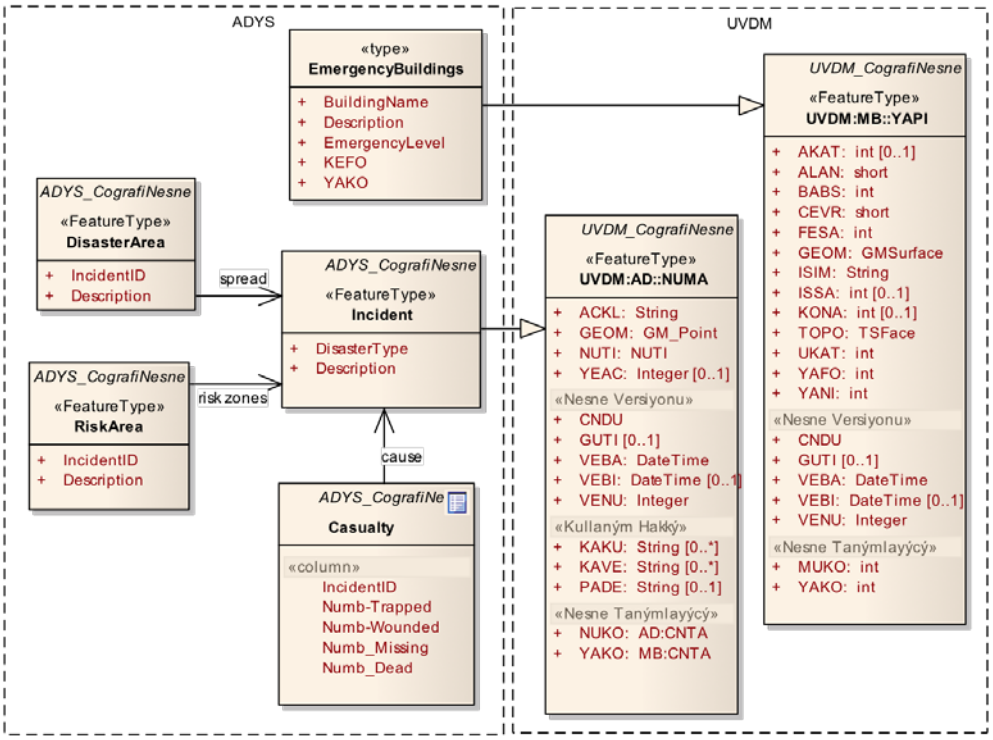

Figure 5.3 : A profile of UVDM and ADYS geo-data model (Aydinoglu, 2009)

5.2 Fire Event

In this study, the fire disaster as of forest and urban fire that we take as an example could be also distinguished according to its scale or to its location whether it is happening at sea or land.

Fire is rapid, self-sustaining oxidation process accompanied by the evolution of heat and light in varying intensities. Four things must be present at the same time in order to produce fire (SDMC, 2010):

- Enough oxygen to sustain combustion,
- Enough heat to raise the material to its ignition temperature,
- Some sort of fuel or combustible material, and
- The chemical, exothermic reaction that is fire.

Oxygen, heat, and fuel are frequently referred to as the fire triangle. Adding in the fourth element, the chemical reaction, and a fire "tetrahedron" is actually haven (Figure 5.4).

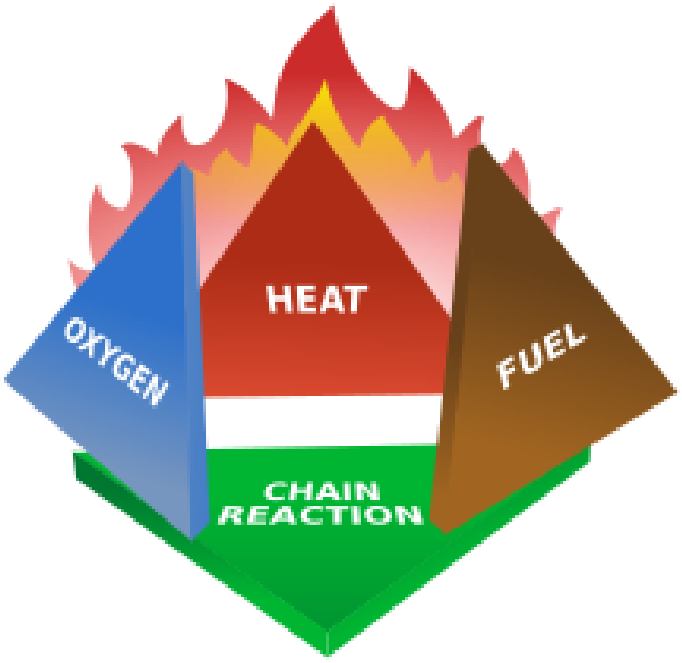

Figure 5.4 : Fire tetrahedron (FAU, 2002)

Fires in literature are classified into five main group according to the type of burned material (IBB, 2010

- A Class: contains solid, organic material.
- B Class: contains liquid or liquefiable solid fires.
- C Class: contains gas fires.
- D Class: contains metallic fires.
- F Class: contains fires of herbal and animal oil.

All fire events can be divided in many ways depending on the cause of fire outbreak, but broadly there are two types of fires, one is natural and other is manmade. All residential and non-residential structural fires are largely manmade. Similarly, all industrial and chemical fires are due to explosions or fires made humans or due to machine failures (SDMC, n.d.).

- Natural Fires: Fires which are considered as natural are basically earthquake, volcanic eruption and lightning generated fires. The fire and explosion risk associated with an earthquake is a very complex issue. Compared with ordinary (normal) fires the fire and explosion hazard related to earthquakes can constitute a substantial and heavy risk. Damage to natural gas systems during an earthquake is a major cause of large fires. Again probably the most significant direct impact of power systems on fire following an earthquake is that electric power is a major fire ignition source. In addition to dropped distribution lines, power circuits in damaged houses are another major ignition source. There have been cases where as many as two-thirds of all ignitions after an earthquake has been attributable to power system.
- Manmade Fires: Fire caused by human/machine errors are considered as manmade fires, e.g. industrial or chemical fire disasters, fires at social gatherings due to electrical short circuit fires, accidental fire and kitchen-fires. Rural and urban residential and non-residential structural fires are also largely manmade fires. Any confined fire could be due to many reasons like, cooking fire confined to container, chimney or fuel fire confined to chimney, incinerator overload or malfunction, fuel burner/boiler malfunction, and trash fire.

5.3 Activities in Fire Event

The activities which require geo-data for different phases of DEM (mitigation, preparation, response and recovery) are determined based on the conceptual model for urban-fire. The legislation, national and international literature is used as a source while deciding on these activities.

Representation of the fire event is shown as "YAN". In the fire event, YAN.O presents the mitigation phase, YAN.H presents the preparation phase, YAN:M presents the response phase and YAN.I presents the recovery phase.

5.3.1 Activities in mitigation phase

Mitigation phase of the fire event is composed of activities as creation of planning basemaps and mitigation plans within the sphere of many different actors (Table 5.1).

Table 5.1: Activities of mitigation phase

YAN.O.01: Creation of Planning Basemaps	
Sub-Activities	
YAN.O.01.01	Analyzing Fire Events
YAN.O.01.02	Production of Fire Risk Map
YAN.O.01.03	Technical Infrustructure Planning
YAN.O.01.04	Social Infrustructure Planning
YAN.O.01.05	Power Plants Planning
YAN.O.01.06	Sensitive Area Planning
YAN.O.01.07	Regulation of Land Use Plan
YAN.O.01.08	Regulation of Zoning Plan
YAN.O.01.09	Regulation of Environmental Plan
YAN.O.01.10	Regulation of Region Plan
YAN.O.02: Mitigaiton Planning	
Sub-Activities	
YAN.O.02.01	Determination of Patrol Control Points
YAN.O.02.02	Determination of Hazardous Substances Locations
YAN.O.02.03	Transportations of Hazardous Substances
YAN:O.02.04	Determination of Risk Building
YAN.O.02.05	Environmental Planning of Risk Building

YAN.O.01: The first activity of the mitigation phase is the creation of planning basemaps and covers analyzing fire evets, production of fire risk map, technical and

social infrasturucture planning, power plants planning, sensitive area planning, and regulation of plans as sub-activities.

YAN.O.01.01: Fire reasons, that can be changed from society to society in view of the culture, must be analyzed to determine the risk values of the objects for the provience. Fire statistics for provience are used to determine the subjects of fire events for the society within the scope of analyzing fire events sub-activity.

YAN.O.01.02: Fire Brigades are in charge of production of the fire-risk map in the provinces. In creating fire-risk maps, criterias such as past fires, industrial facilities and other workplaces, narrow streets, stocks of flammable material are taken into consideration accordingly to their weighted priority that are determined in the former sub-activity. As a result, it aims fire-risk zones of the cities are to be identified to take the necessary precautions.

YAN.O.01.03: Technical infrastructure planning sub-activity is at the utmost importance in terms of response activities and it is stated in the legislation that in case of an identification of these facilities adequacy for a disaster, there should be an emergent determination. It is essential to apply to fire-risk maps in case of finding of sufficency.

YAN.O.01.04: It carries great importance with social infrastructure planning, training to increase public awareness and field exercise and in terms of providing temporary shelter after disaster in the acceptance zone.

YAN.O.01.05: Power plants planning is pretty much important for mitigation phase of fire event due to the huge disadvantagedness of the facilities. The factors such as how far the settlement areas should be away from energy facilities is stated clearly in the legislation.

YAN.O.01.06: Sensitive area planning sub-activity, which covers regulating the use of buildings, is formed in risky zones for fire event.

YAN.O.01.07, YAN.O.01.08, YAN.01.09, YAN.01.10: The governorates are responsible for the activity of creating the planning basemaps for fire event at the provincial level. According to results of the fire-risk map, there might be a need of change, revision or addition at hand in the present regional plans, zoning plans or in environmental plans and land use plans or maybe a need for creating localized land

use plans. There are flexible approaches and priorities in the legislation against the possibility of making changes in the plans within the scope of disaster mitigation.

YAN.O.02: Second activity of the fire mitigation phase is the mitigation planning that covers determination of patrol control points, determination of hazardous substances locations, transportation of hazardous substances, determination of risk buildings and making their environmental planning.

YAN.O.02.01: The buildings to be protected from fire and checked for fire safety are determined for necessary controls and checked on many grounds such as the possibility of sabotage, the substances in the buildings, populations of the building, the effect that could create on the environment and many others. Among those buildings, the ones who cannot guarantee their own safety due to the acceptable reasons are chosen as patrol control points and left out for policemen and gendarmerie control.

YAN.O.02.02, YAN.O.02.03: Facilities and warehouses containing hazardous substances are of great importance in terms of fire risk. Necessary checks shall be done through spotting the points where these substances are found and among those; the ones considered as risky for populated areas shall be transferred to the designated safe areas.

YAN.O.02.04, YAN.O.02.05: It is also important to spot and take necessary precautions for the buildings which are open to fire-risks stated in the regulations such as palaces, historical structures and their surroundings. The mandatory precautions that shall be followed accordingly of buildings type and environmental factors are stated clearly in the legislation.

5.3.2 Activities in preparation phase

The preparation phase of fire event covers the activities determination of response units locations and fire-fighting resources locations, evacuation planning and determination of aid materials warehouse locations (Table 5.2).

Table 5.2: Activities of preparation phase

YAN.H.01: Determination of Response Unit Locations	
Sub-Activities	
YAN.H.01.01	Determination of Health Service Locations
YAN.H.01.02	Determination of Ambulance Station Locations
YAN.H.01.03	Determination of Fire-Fighting Station Locations
YAN.H.01.04	Determination of Police Station Locations
YAN.H.01.05	Determination of Rehabilitation Center Locations
YAN.H.01.06	Determination of Blood Center Locations
YAN.H.02: Determination of Fire-Fighting Resource Locations	
Sub-Activities	
YAN.H.02.01	Determination of Fire Pool Locations
YAN.H.02.02	Determination of Water Supply Point Locations
YAN.H.02.03	Determination of Pumping Station Locations
YAN.H.02.04	Determination of Reserve Water Tank Locations
YAN.H.02.05	Determination of Reservoir Locations
YAN.H.02.06	Determination of Hydrant Locations
YAN.H.03: Evacuation Planning	
Sub-Activities	
YAN.H.03.01	Determination of Acceptance Regions
YAN.H.03.02	Determination of Evacuation Routes
YAN.H.03.03	Determination of Superstructure Requirements of Acceptance Regions
YAN.H.03.04	Determination of Buildings Containing Noteworthy Documents
YAN.H.03.05	Determination of Safe Buildings for Noteworthy Documents
YAN.H.03.06	Determination of Noteworthy Documents Transport Routes
YAN.H.04: Determination of Aid Material Warehouse Locations	
Sub-Activities	
YAN.H.04.01	Determination of Civil Defence Material Warehouse Locations
YAN.H.04.02	Determination of Pharmaceutical Warehouse Locations
YAN.H.04.03	Determination of Equipment Warehouse Locations
YAN.H.04.04	Determination of Essential Need Warehouse Locations

YAN.H.01: Determination of response units locations activity covers health services, ambulance vehicles and stations, fire-fighting stations, police stations, rehabilitation and blood centers location determination.

YAN.H.01.01: Determination of health service locations include public and private hospitals, health centers and dispensaries that victims of disasters will be sent to right

after the first response. According to the regulations, health services which are located out of sensible zones are established to the critical points of safe areas.

YAN.H.01.02: Determination of ambulance vehicle and station locations include the locations where the emergency response to the incidents and assurance of first-aid by ambulances. During the ambulance location determination, some criterias such as the number of people that will be served, transportation facilities, frequency of events are taken into consideration.

YAN.H.01.03: Determination of fire-fighting station location is done by considering the criterias like road conditions, fire statistics and distance from hazardous substances containing places, buildings at risk and sensible zones.

YAN.H.01.04: Determination of police station locations is substantial not only for security in fire scene but also for security in the fire event round to prevent the ruction.

YAN.H.01.05: Rehabilitation center locations should be selected on the outside of the fire-risk zones with the purpose of support the disaster victims.

YAN.H.01.06: The most important criter for determining the blood center location is the access to hospitals as many as possible.

YAN.H.02: Determination of fire-fighting resources locations activity includes resources for the response to fire event such as fire pools, water supply points, pumping stations, water tank, reservoir and hydrants.

YAN.H.02.01, YAN.H.02.02, YAN.H.02.03, YAN.H.02.04, YAN.H.02.05, YAN.H.02.06: As stated in the regulations, while creating the land use plans it is required to segment housing, commerce, industry and organized industrial zones within the function units. Moreover, it is also required to place fire pools and water supply points with 50 m distances between units. Underground fire pools will be constructed and there will be no construction permit on those spaces and they should be reforested, as indicated again in the regulations. It is mandatory to build fire pools and tanks equipped with fire surface hydrants or pump in adequate capacity in the settlement areas with no transportation facility, no room for maneuvers or not possible for vehicles entry; as stated in the regulations about the fire protection of buildings. In the process of hydrant location determination, the most important point

is the easy access for fire trucks and hydrants should be placed accordingly to cover all buildings.

YAN.H.03: Activity of creating the evacuation plans contains the determination of acceptance regions, evacuation routes, superstructure needs of acceptance regions, buildings containing the document/substance in need of security and the places which these materials will be transferred to and transport routes.

YAN.H.03.01: Acceptance regions are chosen in safe zones that are outside of the critical regions. These regions are the ones in which the evacuated people are brought to right after the first response and these people cannot exceed more than 1 times of the population in terms of numbers in the evacuated regions in line with the legislation. In this context, planning should be done in line with the population information.

YAN.H.03.02: The roads to acceptance regions are accepted as evacuation routes and again it is standardized from the width of evacuation roads and their traffic conditions in case of disasters to the surrounding structures.

YAN.H.03.03: In case of lack of evacuation roads, the construction of roads, bridges and so on is carried on through informing directorate of highways.

YAN.H.03.04, YAN.H.03.05, YAN.H.03.06: While evacuating people in disaster zones, transportation of important documents, papers and also hazardous substances which can increase the threat of danger are also performed. Therefore, transportation routes and locations of the places containing these types of materials as mentioned above should be predetermined.

YAN.H.04: Determination of aid material warehouses locations activity includes civil defense material warehouse, pharmecautical warehouses, equipment/machine warehouses and essential need warehouses.

YAN.H.04.01, YAN.H.04.02, YAN.H.04.03, YAN.H.04.04: In the civil defense material warehouses, there are materials to be used in search and rescue efforts and some other supplies to be brought to disaster zone. These warehouses are designed as not to be damaged in case of a disaster in the safe areas. During the event, civil defense forces gather at these points and collect materials and then are directed to disaster zone. Pharmaceutical warehouses containing pharmaceutical supplies reside in safe zones which are close to the hospitals and sensitive zones. Equipment/

machine stores contain necessary equipment for evacuation and debris removal operations. Since debris removal operations are urgent especially on the evacuation roads, they shall be installed near these points. Essential supplies are comprised of aid materials such as food, beverages, clothing and tent and so on to be sent to acceptance regions.

5.3.3 Activities in response phase

Due to the direct response in human life, response phase is supposed to be the most effective one that system is used. It covers the activities of determination of response area, response planning, evacuation planning and recovery plans and aid planning. Coordinated work of actor agencies carries great importance in terms of effective performance of activities at the response phase of the disaster management (Table 5.3).

Table 5.3: Activities of response phase

YAN.M.01: Determination of Response Area	
Sub-Activities	
YAN.M.01.01	Registration of Fire Event
YAN.M.01.02	Determination of Affected Area
YAN.M.01.03	Determination of Buildings Requiring Security
YAN.M.01.04	Determination of Probable Rapine Points
YAN.M.01.05	Determination of Exit Zones
YAN.M.01.06	Determination of Traffic Control Points
YAN.M.02: Response Planning	
Sub-Activities	
YAN.M.02.01	Determination of Fire-Fighting Vehicles
YAN.M.02.02	Determination of Ambulance Vehicles
YAN.M.02.03	Determination of Security Units
YAN.M.02.04	Determination of Civil Defence Teams
YAN.M.02.05	Determination of Natural Gaz/Electricity Breakdown Teams
YAN.M.02.06	Determination of Fire-Fighting Vehicles Route
YAN.M.02.07	Determination of Ambulance Vehicles Route
YAN.M.02.08	Determination of Security Units Route
YAN.M.02.09	Determination of Civil defence Units and Vehicles Route
YAN.M.02.10	Determination of Health Services
YAN.M.02.11	Determination of Ambulance Route to Health Services

Table 5.3: Activities of response phase (continued)

YAN.M.03: Evacuation Planning	
Sub-Activities	
YAN.M.03.01	Determination of Evacuating Zones and Buildings
YAN.M.03.02	Determination of Acceptance Zones
YAN.M.03.03	Determination of Evacuation Routes
YAN.M.03.04	Directing Security Units to Evacuation Routes
YAN.M.03.05	Directing Teams to Evacuation Zones
YAN.M.03.06	Directing Teams to Acceptance Zones
YAN.M.03.07	Transfering Noteworty Documnets to Safe Zones
YAN.M.04: Aid Planning	
Sub-Activities	
YAN.M.04.01	Determination of Temporary Housing Lications
YAN.M.04.02	Directing Teams to Aid Material Warehouse
YAN.M.04.03	Directing Aids to Event Zone
YAN.M.04.04	Directing Aids to Acceptance Zone
YAN.M.04.05	Determination of Locations Convenient to turn into Hospitals
YAN.M.04.06	Determination of Infrastructure/Superstructure Facilities Required Urgent Repair

YAN.M.01: The activity of determination of response area is composed of some operation steps such as registration of fire event, determination of risk zones and building requiring security, determination of probable rapine points, determination of the ban on entry and exit zones and determination of traffic control points.

YAN.M.01.01: During the registration of fire event, the zone and the type of fire event should be determined and recorded together with the caller's name and number, calling time and the exit time of fire-fighter teams according to Fire Regulation of Municipality.

YAN.M.01.02: In determination of the affected area, factors such as the meteorological data which is very effective in taking fire under control, flammable substances present near the event location, environmental design which is effective in spreading fire are taken into consideration and regions that are very likely for fire spreading and holding the damage-risk are determined.

YAN.M.01.03: Measures shall be taken along with the buildings that carry the risk of fire-spreading and increase the effects of disaster due to the materials used in their construction or the materials that they contain, and regarding the buildings that require protection in terms of safety.

YAN.M.01.04: There might be some people who want to benefit from the chaos during the disaster and might attempt to rapine. In order to prevent such rapine attempts, markets, stores and places like those shall be ensured for their safety.

YAN.M.01.05: All these structures that require safety and regions with the possibility of chaos shall be identified and then on some locations there should be a decision of ban from entry and exit. Policemen and gendarmerie are responsible for ensuring the application of this ban and in case of lack of these forces, security guards and volunteers might be held chargeable.

YAN.M.01.06: The last operation step of this activity is the determination of traffic control points. This sub-activity is in the coverage of the assurance of the staff placement process for the routes to be open or have not so heavy traffic for the fire trucks, ambulances and so on to reach the region.

YAN.M.02: The activity of response planning is comprised of some operation steps such as fire-fighter vehicles and ambulances, security and civil defense units, and natural gas/ electricity breakdown teams determination and direction of them to the event zone and also determination of the health services for the woundeds transfer and directing ambulances to these services.

YAN.M.02.01, YAN.M.02.02, YAN.M.02.03, YAN.M.02.04, YAN.M.02.05, YAN.M.02.06, YAN.M.02.07, YAN.M.02.08, YAN.M.02.09, YAN.M.02.10: In the fire event, adequate number of vehicles is chosen from the fire-fighter and ambulance and security units those will be the first and qucikest to intervene and they are directed within the determined routes. At the same time, natural gas and electricity teams are directed to the event zone to ensure the necessary precautions to get the fire under control. After determination of civil defense units to be sent to the approprioate civil defense warehouses and then they are ensured to reach the event zone from there. Right after the first aid into the event zone by ambulances, it is decided about the victim to which health service to send and ambulances are directed according to the victims, transfer routes and the capacity of hospitals' conditions.

YAN.M.03: The activity of evacuation planning is composed of operation steps such as; determination of acceptance regions, routes of evacuation, building or regions to be evacuated, directing security units to the evacuation routes and evacuation units to

the evacuation zones and direction of them to the acceptance regions through the designated routes and lastly important papers/materials' transfer to safe areas.

YAN.M.03.01, YAN.M.03.02, YAN.M.03.03, YAN.M.03.04, YAN.M.03.05, YAN.M.03.06, YAN.M.03.07: Evacuation procedure is performed in two ways; one of them is total evacuation of the event zone and the other is to make there sparse. To decide on the evacuation type; factors such as the magnitude of the event, the damage it caused to the environment and the event's threat on the environment and its duration are taken into consideration. Evacuation routes shall be checked constantly and be ensured that they are clear for traffic. Evacuation procedure covers the people who will be evacuated to the safe zones as it is also valid for transfering the documents to be protected to predetermined safe institutions.

YAN.M.04: Aid planning activity is comprised of operation steps such as; determination of the temporary housing locations, directing units to the warehouse with aid materials and aids to the event zones to acceptance zones and to the temporary housing location and again determination of places like barracks and tents convenient to turn into hospitals and also determination of infrastructure and superstructure facilities that require urgent repair.

YAN.M.04.01, YAN.M.04.02, YAN.M.04.03, YAN.M.04.04: During the preparation phase, all below operations are parts of the activity: essential supply warehouse whose locations are determined, pharmaceuticals warehouses, civil defense warehouses containing aid materials; like tent and similar equipments shall be taken by assigned units from warehouses and be given to those in need. Moreover, it is stated in the legislation that any damage on the superstructure or infrastructure that prevents meeting the mandatory requirements shall be repaired urgently.

5.3.4 Activities in recovery phase

The activities of settlement determination, land use and determination of the structural damage can be listed in the recovery phase of the fire event (Table 5.4).

Table 5.4: Activities of recovery phase

YAN.I.01: Determination of Structural Damage	
Sub-Activities	
YAN.I.01.01	Damage Estimation
YAN.I.01.02	Determination of Buildings to be Demolished/Mended
YAN.I.01.03	Determination of Temporary Settlements
YAN.I.01.04	Evacuation of the Buildings to be Demolished Mended
YAN.I.02: Determination of Settlement	
Sub-Activities	
YAN.I.02.01	Determination of New Settlements
YAN.I.02.02	Providing Land Supply
YAN.I.02.03	Infrastructure/Superstructe Planning
YAN.I.03: Land Use	
Sub-Activities	
YAN.İ.03.01	Expropriation
YAN.İ.03.02	Disaster Cadastre
YAN.İ.03.03	Consolidation

YAN.I.01: Determination of the structural damage activity is composed of operation steps such as damage estimation, determination of temporary settlements and the buildings whether to be demolished or mended and accordingly their evacuations.

YAN.I.01.01, YAN.I.01.02, YAN.I.01.03, YAN.I.01.04: First of all, to determine the structural damage, primarily damaged zones shall be detected. Later, necessary checks and controls could be done in these areas. Consecutively, roads, bridges and similarly some transportation divisions to be mended and buildings to be mended or demolished are determined according to the results. Temporary settlement where tent or prefabricated structures are determined to be established on for the evacuation procedures of the buildings to be demoslihed or mended and also people who resides in those buildings should be provided with evacuation facilities to these areas.

YAN.I.02: Determination of settlement activity is composed of some procedures such as determination of new settlement areas, creation of land/ land plants and planning the infrastructure.

YAN.I.02.01, YAN.I.02.02, YAN.I.02.03: Depending on the magnitude of the disaster, buildings in the residential areas might be damaged so heavily that cannot be used anymore or commercial zones damage in the region might be so great as well that may cause the population to get hurt economically. There exists a clause regarding

the obligation not only providing housing for the people who get hurt from the disaster but also re-opening the trade places which are in an unusable condition for the convenience of the owners of rights. In this perspective, new settlement areas are considered for the people who get hurt due to a great disaster, and made sure of creation of living spaces is provided by Housing Development Administration of Turkey (TOKI). New areas are allocated to the owners of damaged commercial lots and are provided assistance to re-open their businesses.

YAN.I.03: Land use activity is composed of operations such as; expropriation, disaster cadastre and land consolidation.

YAN.I.03.01, YAN.I.03.02, YAN.I.03.03: To reduce the losses of the victims or to prevent of a new disaster risk as consequence of re-use plots of land which would not be used as a result of disaster are expropriated by the state. As a result of a disaster usage of the land may change with new planning. In this situation with the aim of having cadastral survey, transactions begin immediately with condition those requirements of the regulation about cadastre become invalid. In addition, as a result of fires in the villages, village consolidation is required to be done and efficient re-use of regions is very essential.

For mitigation, preparation and response phases of DEM, there are detailed descriptions in legislation, but for recovery phase these descriptions are not detailed. This deficiency is tried to be removed by adopting resolutions on any change about the laws and enactments after disasters. This work can be observed when the legislation of the DEM case in Section 4 is examined.

5.4 Activity-Data Assessment for Fire Event

Definite data sets are to manage the tasks that form the activities performed by the actors. According to fieldwork as build, data sets needed to perform activities are defined. Geo-data required for actors to perform the tasks of activities are shown as in Appendix A.3. The activities of four DEM phases as coloumn and geo-data needed for activities as row are existing within the activity-data assesment for fire event table.

5.5 Case Study for Fire Event

5.5.1 Study area and scope

In this study, Beşiktaş district used for exercising is selected as a pilot area (Figure 5.5). Beşiktaş is a district of İstanbul provience which is reserved one fifth of population of Turkey. Beşiktaş district incorporated great numbers of shopping center, trade center, building complex and historical building with great population is in need of active response in disaster event.

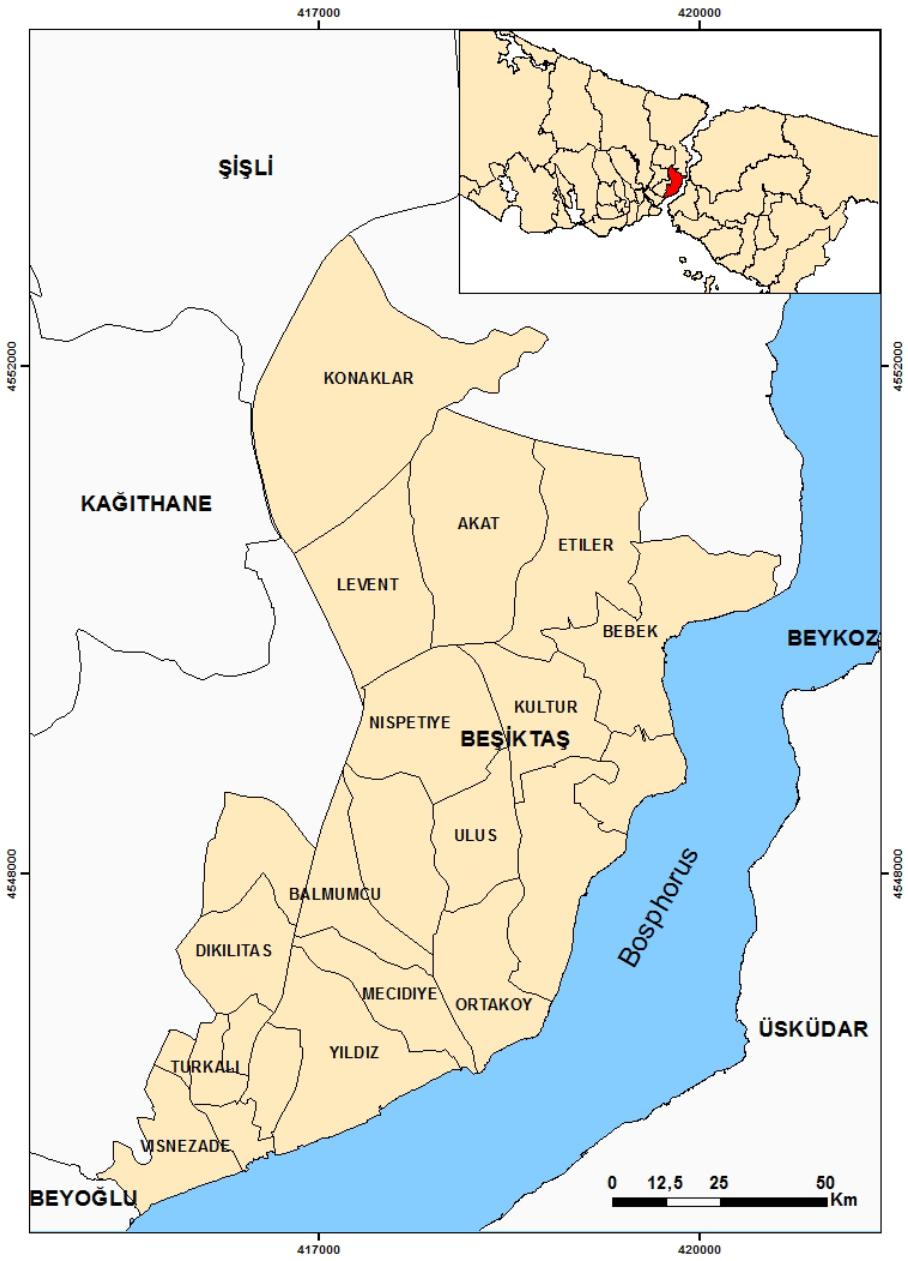

Figure 5.5 : Study area: Beşiktaş

5.5.2 YAN.O.01.02: Production of fire risk map

Production of fire-risk map is a sub-activity of planning base maps creation activity which is the part of fire event mitigation phase. Analyzing fire events as a first sub-activity of planning base maps is the requirement for fire risk map production as a second sub-activity of planning base maps.

Fire-risk map provide an integrated national assessment of risk based on digital fire event data and web-accessible data. Lead and support national, provincial and local communities to effectively engage in risk-based mitigation planning resulting in sustainable activities. Fire-risk map information and tools help communities develop informed mitigation plans that will reduce losses from fire events (USG, 2010).

Fire-risk maps are tools used to identify, evaluate and prioritize a group of fire risks. The map allows you to visualize risks in relation to each other, gauge their extent, and plan what type of controls should be implemented to mitigate the risks.

Fire risk differs from a society to another society according to social structure and urban infrastructure. In this study, Regulation on Protection of Buildings from Fire, the fire risk research of Istanbul Fire Brigade and the statistics formed by Istanbul Fire Briagde have been used to specify the risk criterias for Istanbul provience.

The fire risk research of Istanbul Fire Brigade has evaluated the fire events occured for ten years, industrial plants, other workplaces and norrow streets on the basis of quarter within the scope of research. In this scope, risk levels of buildings has been determined. Explosive substances, filling facilities, industrial plants, factories, museums and palaces have been determined as first level risk group and buildings, shopping centers, hotels and manufacturing plants have been determined as second and third level risk group (IBB, 2010).

Statistical data for fire reasons shown as Figure 5.6 and fire places shown as Figure 5.7 provided from Istanbul Fire Brigade website have been evaluated when determining the fire-risk criterias.

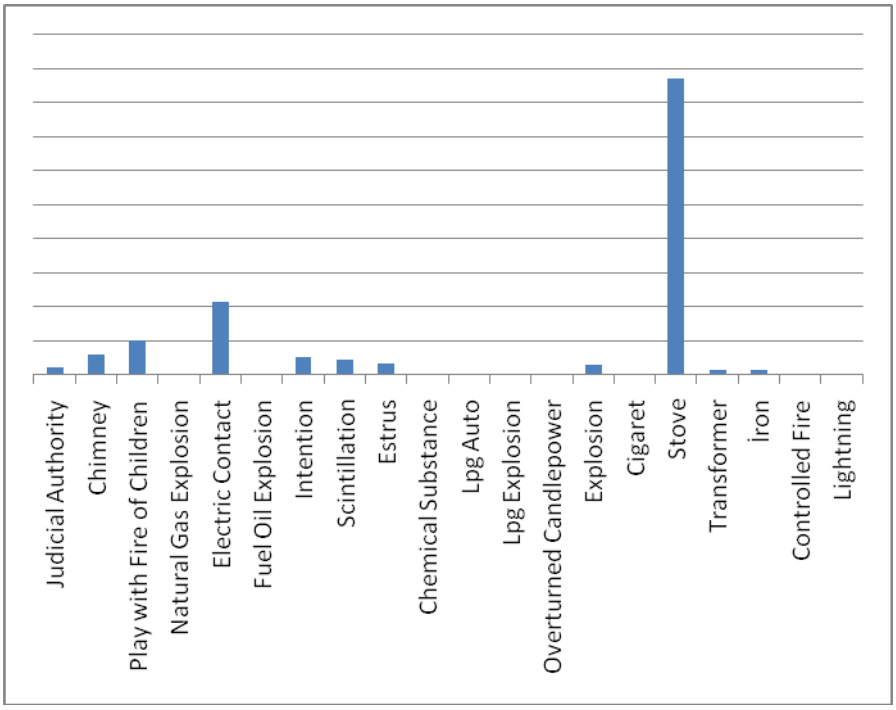

Figure 5.6 : Fire reasons for Istanbul (Istanbul Fire Brigade, 2010)

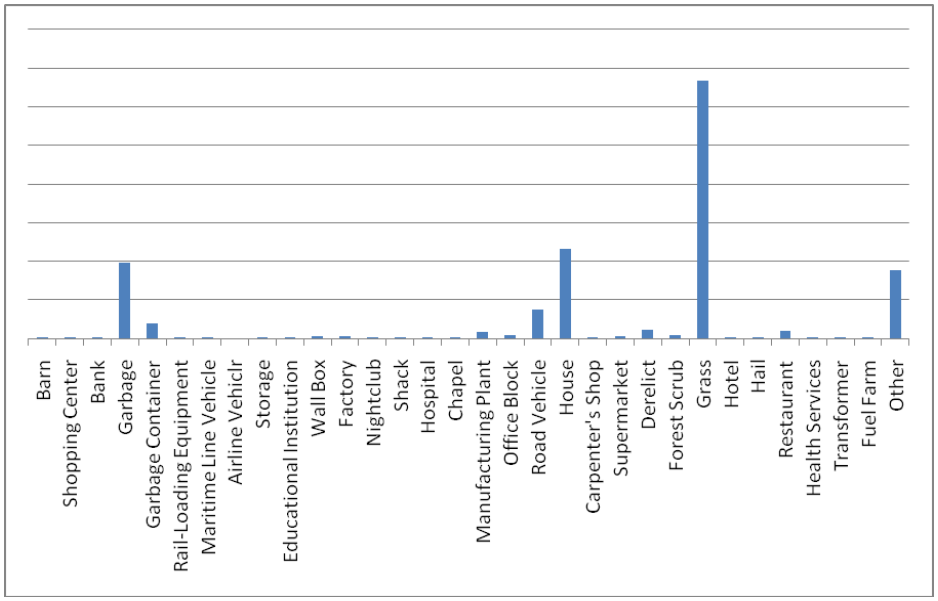

Figure 5.7 : Fire places for Istanbul (Istanbul Fire Brigade, 2010)

Regulation on Protection of Buildings from Fire has been used in classification of the buildings according to the fire risk. The classification of buildings according to fire resistance time is defined in Article 7. The classification of buildings according to usage property is defined in Article 8, 9, 10, 11, 12, 13, 14, 15, 16 and 17. Article 103 describes the classes of hazardous substances and Article 19 describes danger levels of the buildings including three classes.

Regulation on Protection of Buildings from Fire:

Article 7 - Fire resistance level defines the fire resistance time determined as a result of fire resistance experiments specified in European Standards related to TS 1263, TS 4065 for a construction material and/or a constructional component under proper heating and pressure conditions.

a) Fire resistance time is 30-59 minutes: F30,

b) Fire resistance time is 60-89 minutes: F60,

c) Fire resistance time is 90-119 minutes: F90,

d) Fire resistance time is 120-179 minutes: F120,

e) Fire resistance time is 180 minutes and above: F180

Article 8 - Classifications of buildings according to usage properties;

Buildings for reunion - Buildings for education - Buildings for health service - Prison, roundhouse and reformatories - Buildigs for stopover - Buildings for commerce - Buildings for offiice - Industrial plants - Facilities for storage - Buildings for complicated use.

Article 9 – Buildings for reunion contians all buildings or the parts of buildings in which 50 people or more than this are leagued together on the purpose of ceremony, worship, entertainment, food and beverage and transportaion.

Shooting galleries - Pool halls - Bowling halls - Night clubs - Discotheques - Hearing rooms - Wedding Saloons - Libraries - Motion picture theaters - Chapels - Highway, airway, maritime line and metro passenger stations - Club and institution rooms - Conference Halls - Assembly - Museums and galleries - Auditoriums - Recreation centers - Reataurants, cafes - Health clubs and fitness centers - Exhibition halls and expos - Theathre halls - Ceremony halls - University, academy, collogues.

Article 10 – Buildings for education contains all buildings or the parts of buildings used by six or more people on the purpose of education for more than twelve-hour week or four-hour day or more.

Infant schools - Elementary schools - Secondary schools - Private teaching institutions - Private schools.

Article 11 – Buildings for health service contains all buildings or the parts of buildings used for children with mental, physical and social disabilities, elder in need of nursing with four or more hospitalization capacity.

Nurseries - Maternities - Hospitals - Rest homes - Medical centers - Community health centers - Creches.

Article 12 – Buildings sheltered people constrainted with different levels and people limited liability due to security.

Roundhouses - Reformatories - Rehabilitation centers - Prisons

Article 13 – Buildings for stopover used for quartering contains buildings situated parts for sleeping purpose.

Hotels, motels, accommodations - Dormitories, dorms - Resorts - Apartment buildings - Rest houses.

Article 14 – Buildings for commerce contains all buildings or the parts of buildings used for sale or exhibit of merchandise.

Shopping centers - Hair dressers - Stores - Shops - Super markets - Auction halls - Rastaurants and bars (less than 50 people).

Article 15 – Buildings for office are buildings that is used for office services, account and registration procedures.

Ambulatory medical centers - Banks - Municipal buildings - Recording studios - Physicians offices - Office buildings - Airport traffic control towers - Public buildings - Court houses - Radio and television stations - University, academy, collegues (less than 50 people).

Article 16 – Industrial plants contains all factories, buildings and structures used for processing, assembly, jamming, degreasing, lustration, wrapping, storing, handling and patching.

Sawmills - Launderettes - Power plants - Gas plants - Food processing establishments - Sheds (maintenance and repair services) - Harbors, jetties, filling facilities - Factories - Dry cleaners - Pumping stations - Refineries - Switch boards.

Article 17 – Buildings for storage contains all buildings and structures used for storing the goods, chattel, product, vehicle and animal.

Barns - Storehouses - Oil pans - Warehouse - Storage sheds - Caravan parks - Parkings and garages - Granaries - Tank farms - Cold stores.

Article 19 – Hazard class of the building is determined depending on the process and the operations performed in buildings and the properties of the buildings. If the building has complicated structure, higher hazard class has to be standed.

a) Low danger consists of the materials that have low flammability.

   House - Place of worship - Hospitals - Schools - Libraries - Museums - Offices - Restaurants - Theatres - Auditorium – etc.

b) Mid danger consists of the materials that have probability of burning with exteremely smoke and mid speed.

   Parking area - Bakeshop - Launderette - Restaurant service areas - Dry cleaner - Leather production - Firm - Paper production - Post office - Publishing firm - Printing house - Automobile repair shop - Textile production - Rubber production - Carpenter's shop – etc.

c) High danger consists of the materials that have probability of explosion and burning with high speed.

   Aircraft shed - Place of inflammable liquid and gas manufacture - Place of inflammable liquid and gas storage - Place of inflammable liquid and gas handling - Place used material with flammability temperature lower than $38^{O}C$ - Plastique production - Dyehouse – etc.

Article 103 – Hazardous substances can be classified as follows.

Explosive materials - Explosive gas - Inflammable liquid - Inflammable solid - Oxiding agent - Toxic substance - Radioactive substance - Etching agent.

Once the risk criterias are specified, rate each risk with 4 being the most significant and 0 being the least significant. The tasks of fire-risk map production are shown in the Table 5.5. A statistical approach was used in the construction of the model, on the basis of the level of risk.

Use-case description arranges in order of tasks to perform the sub-activity. Use-case descriptions are used by users wtih Service-Oriented architecture (SOA) approach to perform their responsibilities.

Table 5.5: Use-case description of fire-risk map production sub-activity

Use-Case Description: YAN.O.01.02	
Name	Production of Fire-Risk Map
Priority	High
Description	The user specifies the fire risk zones for jurisdiction area with using GIS.
Pre-condition	Analyzing Fire Events sub-activity coded YAN.O.01.01
Work-flow	
Task.1	**Import "Building" Feature Class** Import "Building" polygon feature class from UVDM geo-database.
Task.2	**Add "risk" Attribute** Add "risk" attribute column for "Building" feature class.
Task.3	**Determining Risk Groups of Buildings According to "use type"** "use type" attribute of "Building" includes the use types of the buildings. Risk value of historical buildings, filling facilities and industrial plants are equal to 4. Risk values of comminal life places like health facilities, educational institutions, public buildings and shopping centers are equal to 3. Risk values of apartment buildings are equal to 2. Risk values of detached houses and ruin buildings are equal to 1. Risk values of empty houses are equal to 0.
Task.4	**Determining Risk Groups of Buildings According to "structure type"** "structure type" attribute of "Building" includes the structure types of the buildings. Each structure type has different resistance time as defined in regulation. Risk value of structure coded F30 is equal to 4. Risk value of structure coded F60 is equal to 3. Risk value of structure coded F90 is equal to 2. Risk value of structure coded F120 is equal to 1. Risk value of structure coded F180 is equal to 0.
Task.5	**Determining Fire Risk Levels of Buildings** Determine the "risk" values of the buildings taking account of the determined risk groups according to use type and structure type.

Table 5.5: Use-case description of fire-risk map production sub-activity (continued)

Task.6	**Import "LandUse" Feature Class** Import "LandCover" polygon feature class from UVDM geo-database.
Task.7	**Determining Risk Areas in "LandUse" Feature Class** Determine the area featured fire risk and the fire risk values of these araes. "land use type" attribute of "LandUse" includes use type, flora and vegetation cover of the area.
Task.8	**Determining Risk Objects** Merge "Building" polygon feature class and "LandUse" polygon feature class. Composed "RiskObject"polygon feature class has "risk" attribute that defines the fire risks of the objects.
Task.9	**Import "Transportation" Feature Class** Import "Transportation" line feature class from UVDM geo-database.
Task.10	**Determinig Risk Values of Risk Objects** Adjecency of the risk objects must be taken as a parameter while determining the risk values of the risk objects.
Task.11	**Convert "RiskObject" to Point Feature Class** "RiskObject" polygon feautue class should be converted to point feature class.
Task.12	**Determining Fire-Risk Zones** Inverse Distance Weighted (IDW) interpolation method is implemented to specify the fire-risk levels for the region.
Data source: UVDM-Conformant Data Set Provided by Focal Point	
Description	Turkish GII: Geo-data Exchange Model (TURKVA: UVDM)
Data provider	National Focal Point
Geographic scope	Turkey wide, although a smaller area may be selected
Thematic scope	TURKVA:ADYS
Scale, resolution	As made applicable by data provider
Delivery	Textual report and associated geometry information
Documentation	TURKVA:UVDM

SOA, which facilitates the integration and exchange between different systems that may not have communicated with one another, enables them to share within a much broader global community. SOA would be an enabler that can help business, government, and non-profit organizations achieve vast improvements in efficiency

and cost reduction. SOA facilitates the integration and exchange between individual systems that may have only communicated within a specific community and enables them to share in a much broader base, using existing software, hardware, and data rather than having to completely redesign systems in order to modernize and save costs (Li and Wang, 2008).

Geographic information sharing has experienced two stages: file-sharing and spatial database sharing. Now with the development and application of services, Service GIS, a new model characterized by sharing services ushered in a serviceoriented geographic information sharing. Based on GIS components, Service GIS encapsulates all the GIS functionalities as web services by applying service-oriented software engineering methods, which realizes the crossplatform, cross-network and cross-language interaction (Yang et al, 2007; Jia et al, 2005).

In this scope, integrated DEM with dynamic data is possible with using actor-sector-activity-task approach. Users can import related data from UVDM and produce data for ADYS. These produced data can use from different actors which are the part of DEM. In Figure 5.8 actor-sector-activity-task-data relations are showed for fire-risk map production. This relation includes the tasks explained in the use-case description.

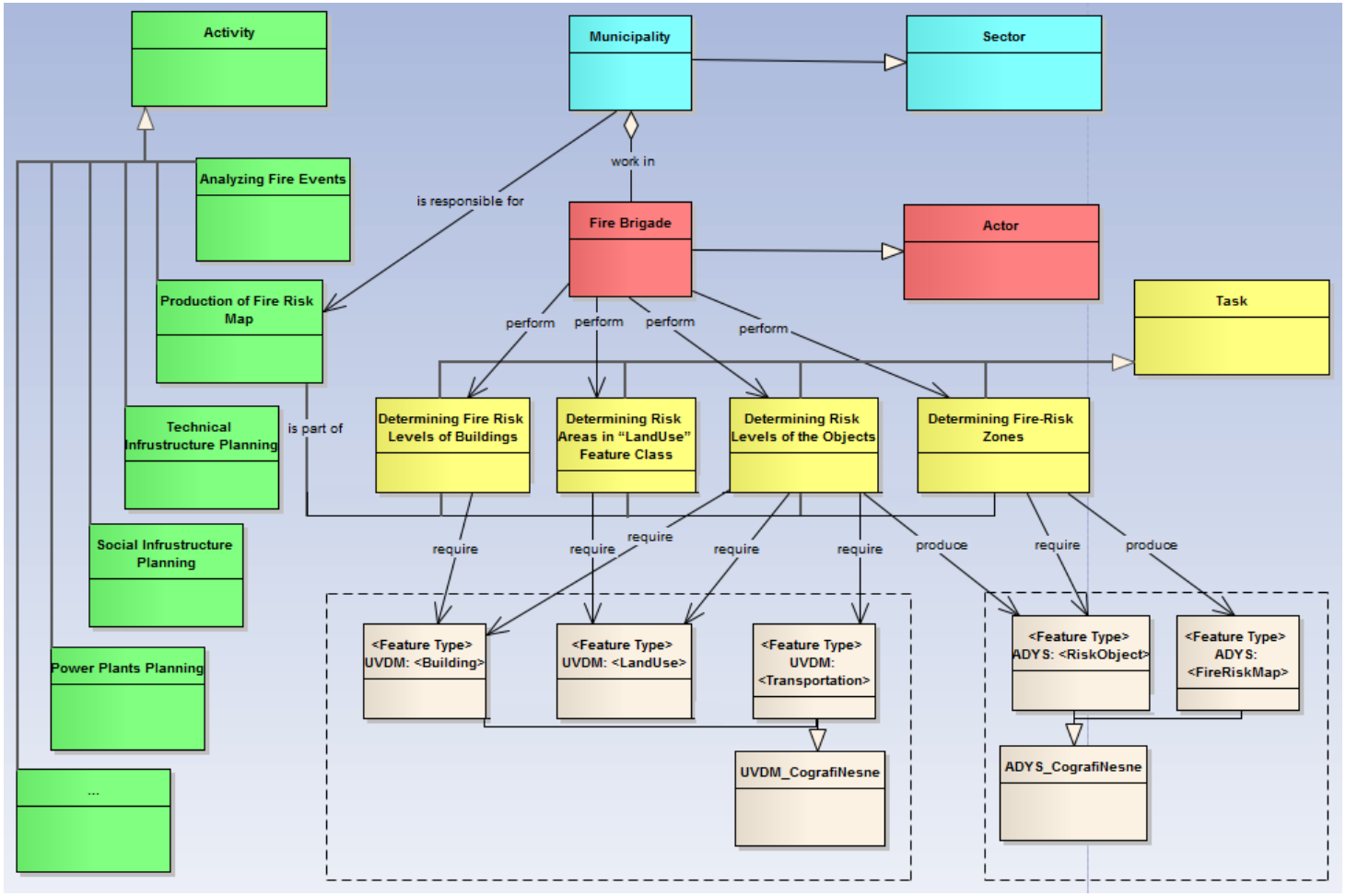

Figure 5.8 : UML class diagram for the production of fire-risk map sub-activity

Buildings are evaluated with respect to fire risk according to the use type of buildings shown as Figure 5.9. This figure is the outcome of Task 3. for the fire risk map production sub-activity. Use type attribute of the buildings consist of industrial, historical, commercial, health, education, house, public, ruin, empty, fuel filling and shopping centers. Buildings like historical buildings, filling facilities and industrial plants are grouped as fourth risk level. Comminal life places like health facilities, educational institutions, public buildings and shopping centers are grouped as third risk level. Apartment buildings are grouped as second risk level. Detached houses and ruin buildings are grouped as first risk level.

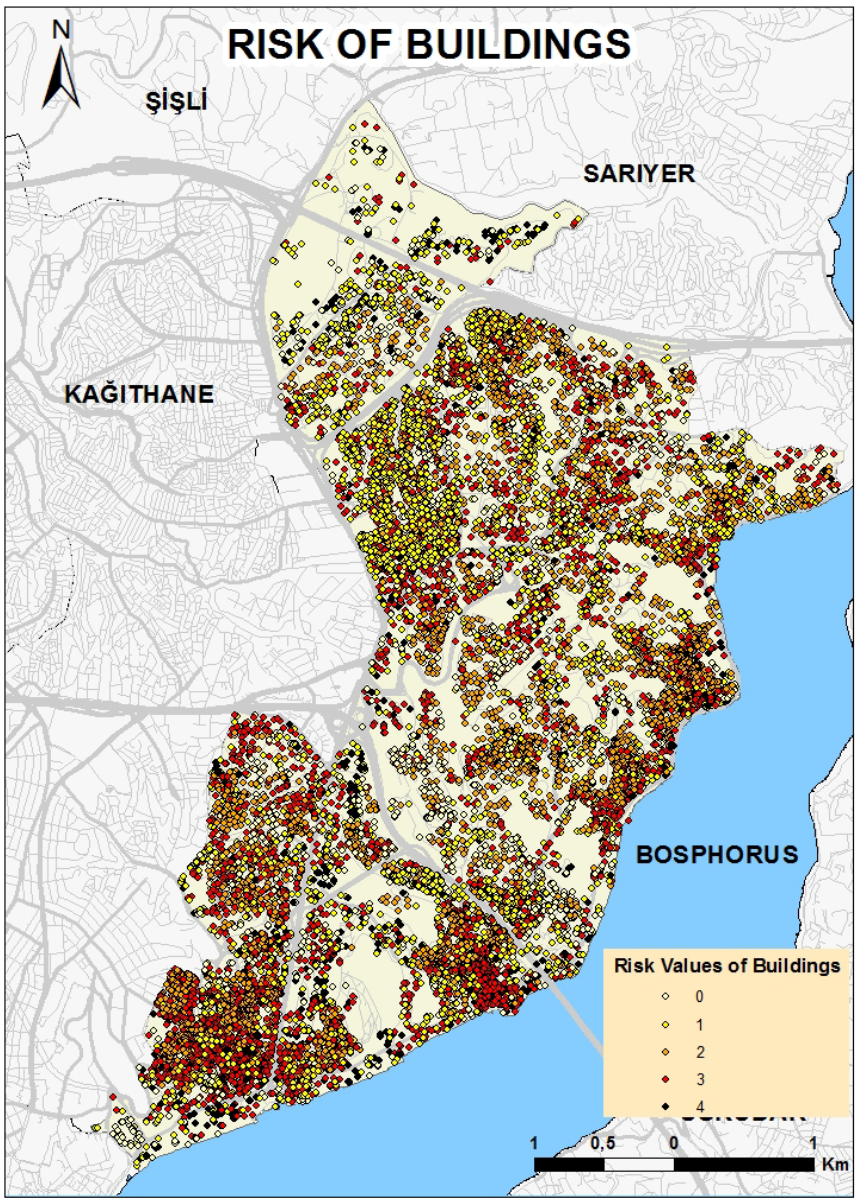

Figure 5.9 : Buildings with fire risk

The result map of the fire-risk map production sub-activity as a part of fire disaster management mitigation phase is shown as Figure 5.10.

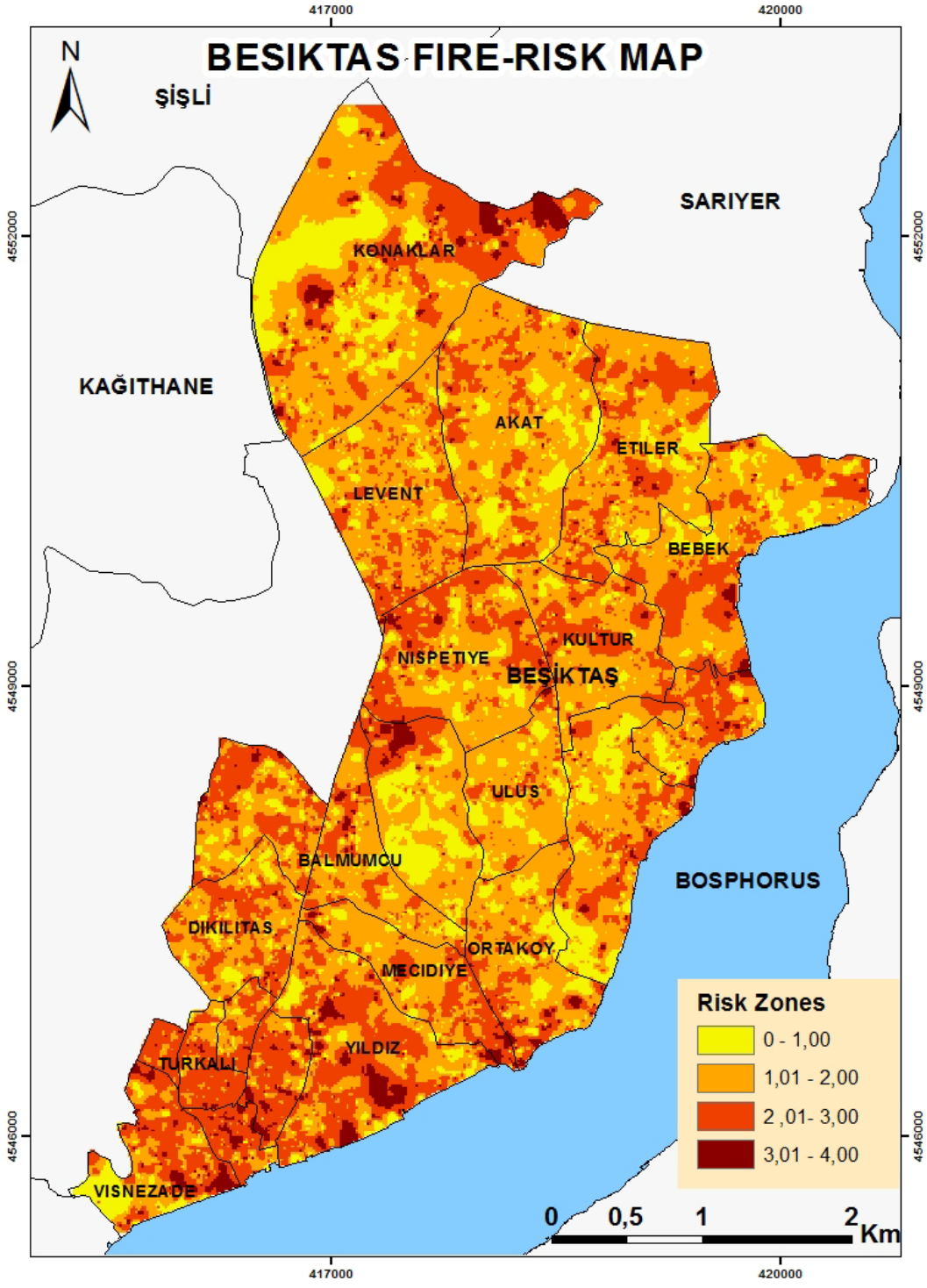

Figure 5.10 : Fire-risk map of Besiktas

5.5.3 YAN.H.02.06: Determination of hydrant locations

Emergency preparation is evaluated in terms of response times, and risk is measured in terms of affected population, disaster potential, and the emergency preparation of the area. For emergency preparation and DEM key objects include locations of emergency responders such as police stations, ambulances, firefighters, hazardous material response teams. All these actors must be distributed effectively to reduce the damage caused by an event. Optimization process of emergency responders' locations is used to identify the maximum coverage that can be achieved from location given specific constraints. Thus, the optimization process, links of a network are assigned to a center until the maximum impedance limit is reached. It is very effective in evaluating response times of emergency response units that shows the service area covered by the emergency responder within a specific time given specific travel times. With the emergency response units serving as centers, the extent of the coverage available for various desired response times can be evaluated.

Determination of hydrant locations is a sub-activity of determination of fire-fighting resource locations activity which is the part of fire event preparation phase. Production of fire-risk map is the requirement for determining hydrant locations.

A hydrant is an outlet from a fluid main often consisting of an upright pipe with a valve attached from which fluid (e.g. water or fuel) can be tapped. Depending on the fluid involved, the term may refer to: fire hydrant (Figure 5.11), oil depot, yard hydrant, flushing hydrant, wall hydrant and pillar hydrant (CAG, 2009).

Figure 5.11 : Fire hydrant

A fire hydrant is an active fire protection measure, and a source of water provided in most urban, suburban and rural areas with municipal water service to enable firefighters to tap into the municipal water supply to assist in extinguishing a fire. Buildings near a hydrant may qualify for an insurance discount since firefighters should be able to more rapidly extinguish a fire on the insured property.

Considering rapid spread of fire, it is clear that immediate response to fire is of vital important. Optimal positioning, spacing, location, and marking of fire hydrants can aid the fire service during emergency operations. When determining locations to place fire hydrants, consideration should be given to accessibility, obstructions, proximety to structures protected, driveway entrances and other circumstances where adjustments to a specific hydrant's location would be warranted. Criters for determining hydrants location are explained in Article 95 of Regulation on Protection of Buildings from Fire.

Article 95-

(1) Fire hydrant system constituted in such a way that covers entire surrounding of the building must be regulated in deference to accessibility of firefighter.

(3) a) The maximum distance between fire hydrants must be 50 m in fourth level risk zones. b) The maximum distance between fire hydrants must be 100 m in third level risk zones. c) The maximum distance between fire hydrants must be 125 m in second level risk zones. d) The maximum distance between fire hydrants must be 150 m in first level risk zones.

(4) The distance between fire hydrant and protected building for security must be between 5m and 15 m.

(7) External hydrant system must be constituted in settlements of which land use planning area is greater than 5000 m^2 and of which usage area is various.

(8) Ground fire hydrants must be constituted in settlements where the transport facilities do not exist.

According to the criterias given in Regulation on Protection of Buildings from Fire and according to waterworks, fire hydrants are located. The tasks of determining fire hydrant locations are shown as in Table 5.6.

Table 5.6: Use-case description of determining hydrant locations sub-activity

Use-Case Description: YAN.H.02.06	
Name	Determination of Hydrant Locations
Priority	High
Description	The user determines the locations of hydrants as a source of water provider for jurisdiction area.
Pre-condition	Production of Fire Risk Map sub-activity coded YAN.O.01.02
Work-flow	
Task.1	**Import "Hydrant" Feature Class** Download "Hydrant" point feature class from UVDM geo-database. "hydrant_type" attribute of "Hydrant" feature class to use is "fire hidrant".
Task.2	**Import "FireRiskMap"** Import "FireRiskMap" from ADYS geo-database. Fire-risk map contains four risk levels. Fourth being the most significant and first being the least significant.
Task.3	**Import "RiskObject" Feature Class** Import "RiskObject" polygon feature class from ADYS geo-database.
Task.4	**Determining Security Required Buildings** Select the buildings (from "RiskObject" feature class) of which risk values are 4. These buildings require protection from fire.
Task.5	**Import "LandUse" Feature Class** Import "LandUse" polygon feature class from UVDM geo-database.
Task.6	**Import "Transportation" Feature Class** Import "Transportation" line feature class from UVDM.
Task.7	**Import "Hydrography" Feature Class** Import "Hydrography" line feature class from UVDM. Locations of hydrants must be determine according to accessibility of waterworks.
Task.8	**Determining the Risk Zones of Existing Hydrants** Use the masking tool to convert the raster fire-risk map. Open both masked "FireRiskMap" and "Hydrant" feature class.
Task.9	**Add "Risk" Attribute** Add "Risk" attribute for "Hydrant" feature class.

Table 5.6: Use-case description of determining hydrant locations sub-activity (continued)

Task.10	**Appoint the Risk Value to Hydrants** Risk values of zones are appointed to the "Risk" attribute of "Hydrant". Finally, hydrant and zone hold this hydrant have the same risk value.
Task.11	**Determining Hydrant Locations According to Risk Zones** Distance between fire hydrants must be 50 m in 4. level risk zones, 100 m in 3. level risk zones, 125 m in 2. level risk zones and 150 m in 1. level risk zones.
Task.12	**Determining Hydrant Locations According to Protected Buildings** The distance between fire hydrant and protected building for security must be between 5m and 15 m.
Task.13	**Determining Hydrant Locations According to Transportation** Fire hydrants must be constituted in settlements where the transport facilities do not exist.
Task.14	**Determining Hydrant Locations According to Land Use** External hydrant system must be constituted in settlements of which land use planning area is greater than 5000 m^2 and of which usage area is various.
Data source: UVDM-Conformant Data Set Provided by Focal Point	
Description	Turkish GII: Geo-data Exchange Model (TURKVA: UVDM)
Data provider	National Focal Point
Geographic scope	Turkey wide, although a smaller area may be selected
Thematic scope	TURKVA:ADYS
Scale, resolution	As made applicable by data provider
Delivery	Textual report and associated geometry information
Documentation	TURKVA:UVDM

In Figure 5.12 actor-sector-activity-task-data relations are described for determination of hydrant locations sub-activity. This relation includes the tasks explained in the use-case description.

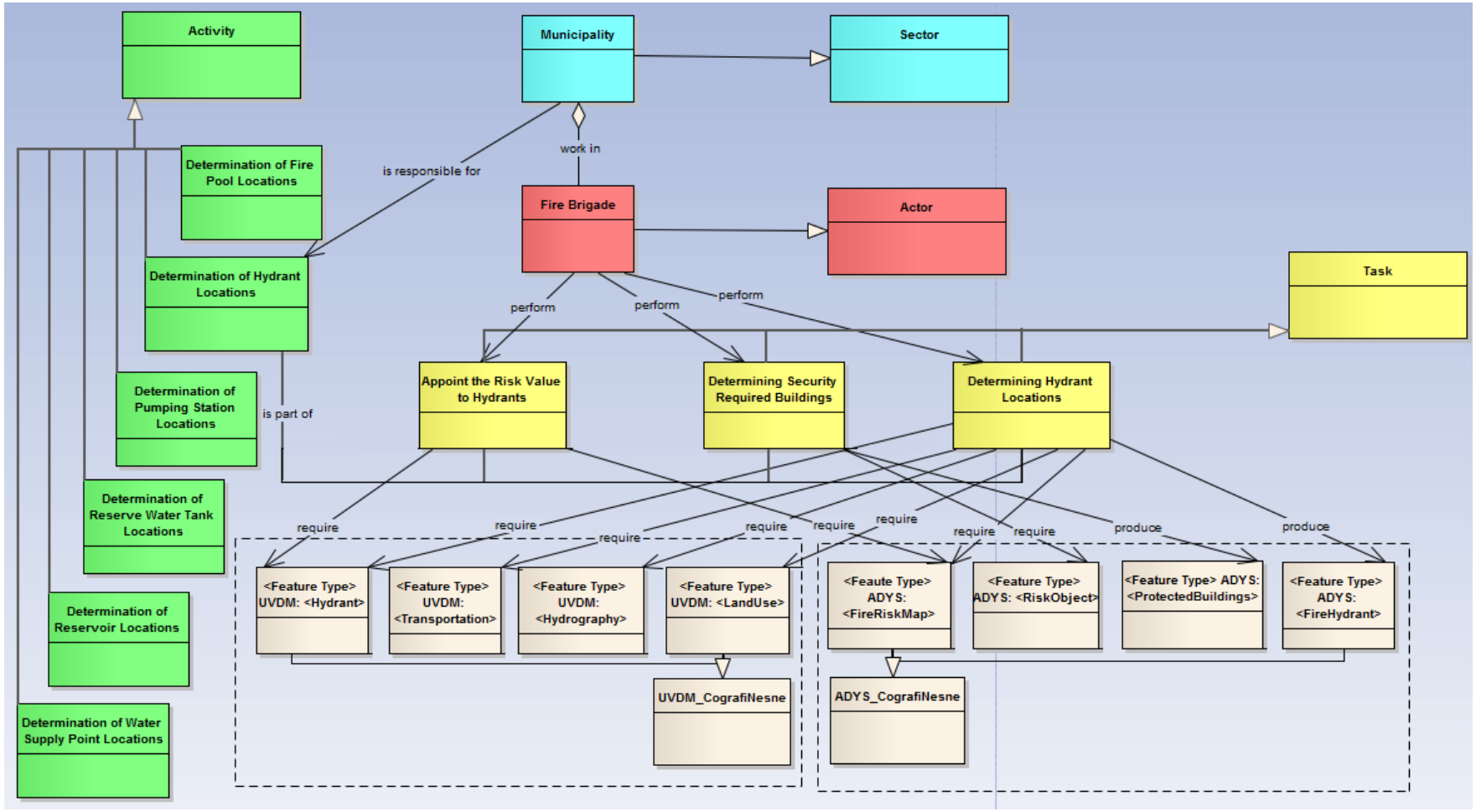

Figure 5.12 : UML class diagram for the determination of hydrant locations sub-activity

Hydrants are evaluated with th fire risk zone in which these hydrants exist. Hydrants in Besiktas are shown in Figure 5.13 with their risk zone.

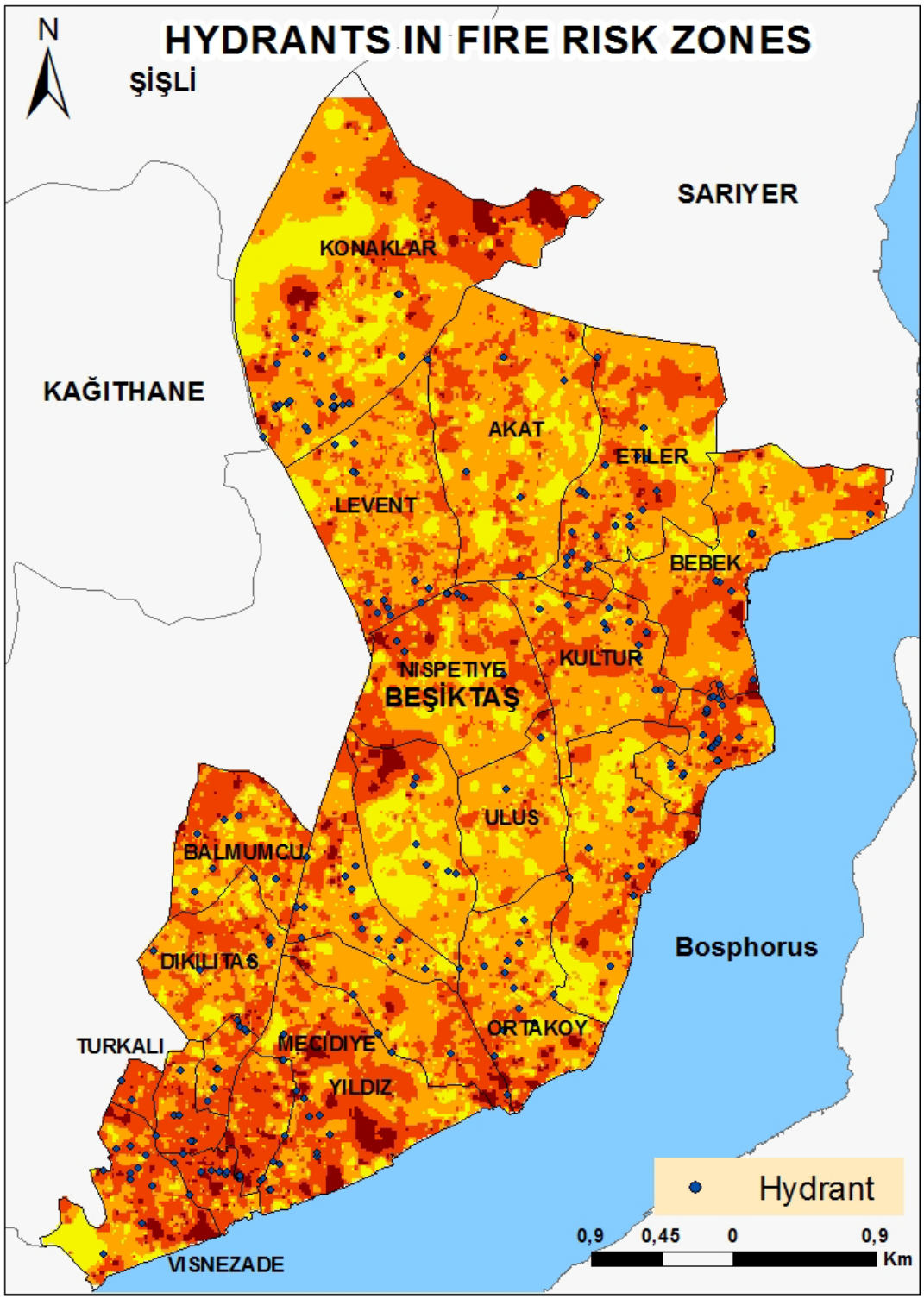

Figure 5.13 : Hydrants with fire-risk map

Hydrants are located according to risk zones. Thus, hydrants must have different interval in different rik zones because of the hydrant need of the region. Therefore, hydrants take the risk value from the risk value of the zone (Figure 5.14).

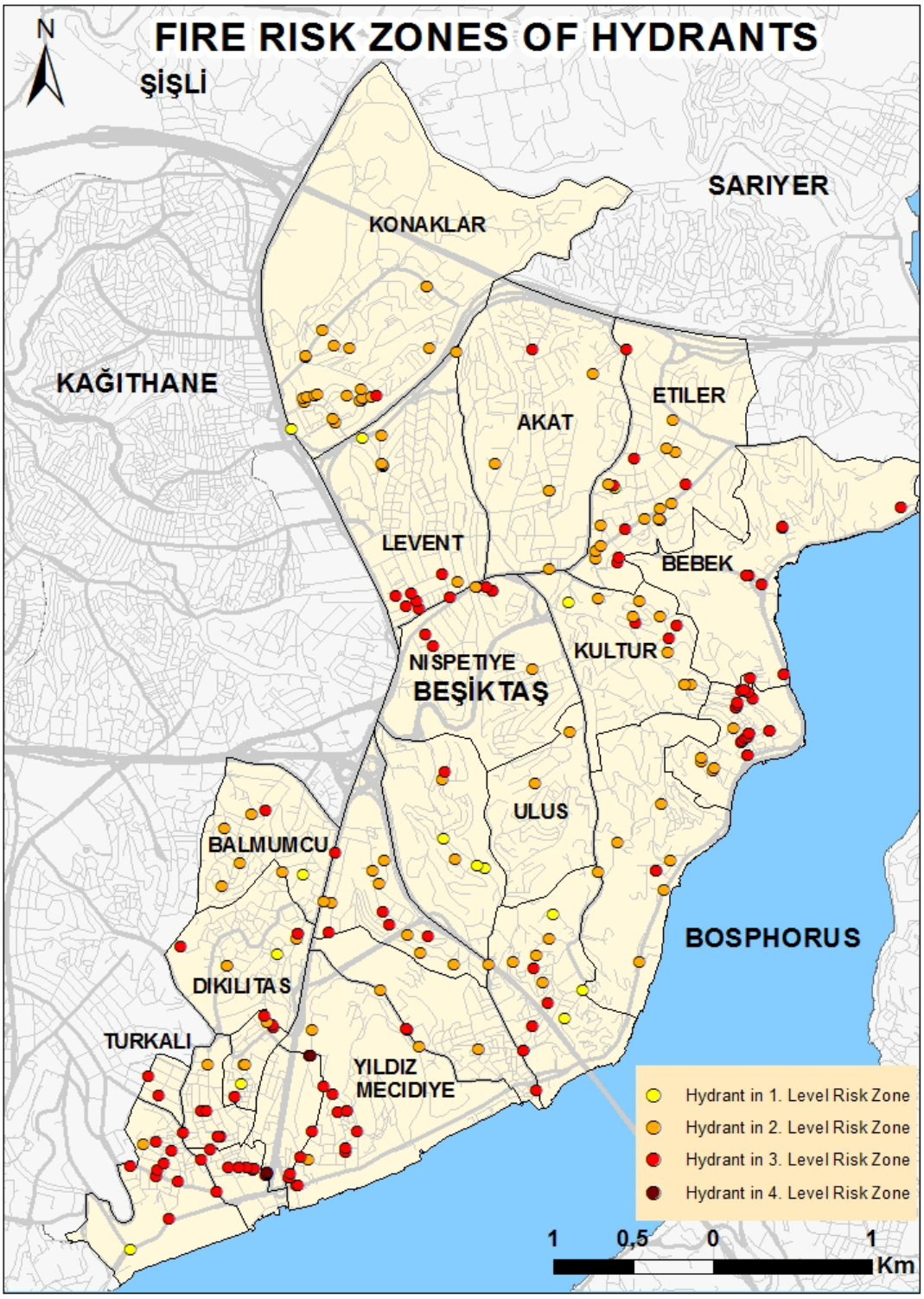

Figure 5.14 : Fire-risk zones of hydrants

There are twenty-one existing hydrants in Etiler and these hydrants are not enough for fire safety precautions. Fire hydrant locations are selected according to regulation as decribed in the use-case description. In this regard, there are 63 hydrant locations determined in Etiler which are composed of; 12 of them are in first fire-risk zone, 22 of them are in second fire-risk zone, 18 of them are in third risk zone and 11 of them are in fourth fire-risk zone. Finally, numbers of hydrants in etiler must be increased from 21 to 84 for fire disaster preparedness. Figure 5.15 shows the location of these hydrants.

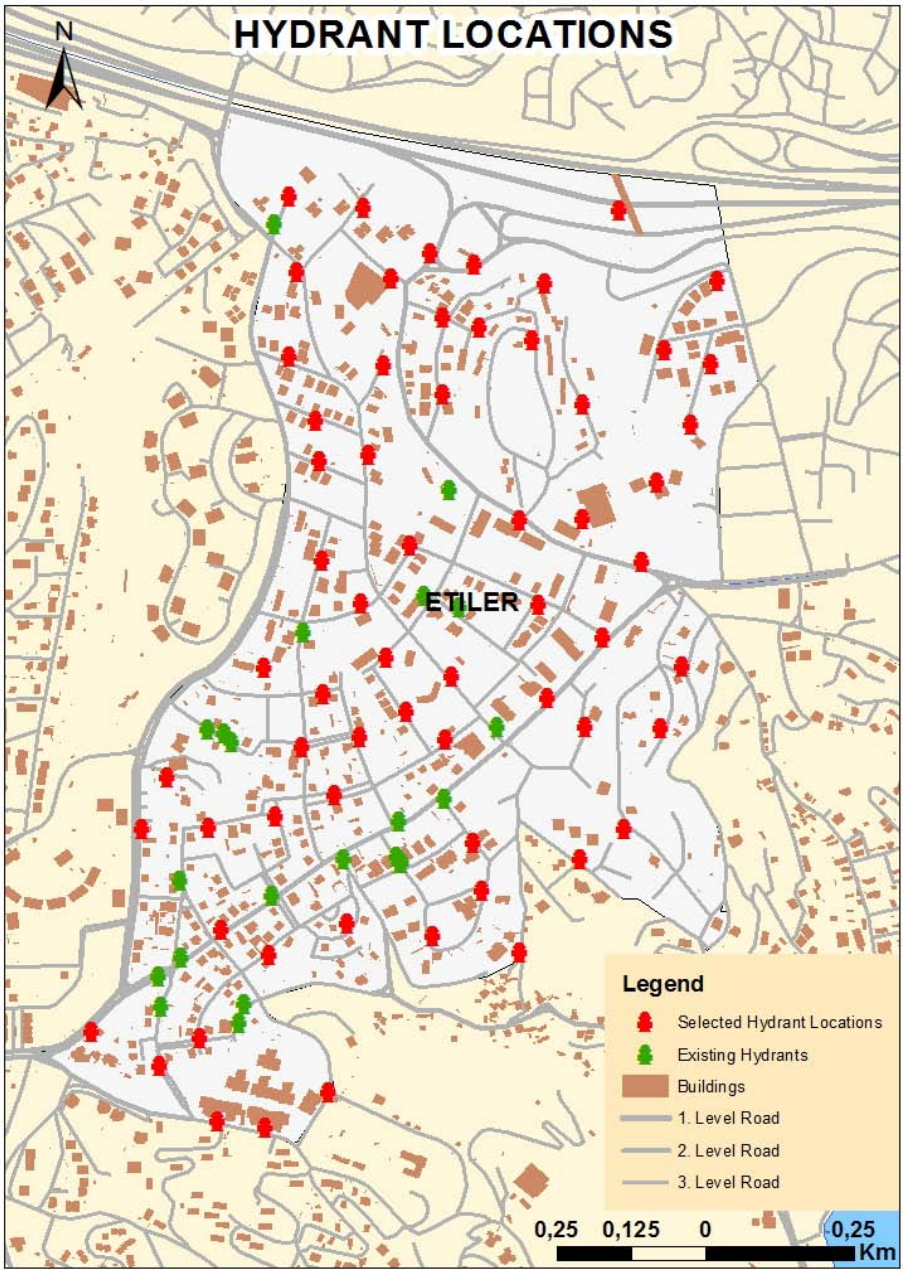

Figure 5.15 : Hydrant locations in Etiler

5.5.4 YAN.M: Fire event response

When disaster occurs, it is required to react accurately, fast and effectively. Various actors from different sectors such as police and municipality are involved in DEM. Building a good collaboration mechanism and cross-sector services have critical importance to manage emergency tasks that are rather different than their daily work routines (Scholten et al., 2008). There are various necessary information in DEM and response. Almost everything in a disaster is related to a location, and often location is the most important attribute of information. Various geo-data sets, existing and dynamic data are needed on emergency response and management.

During this phase two factors are important: Time-stress and Collaboration-communication.

Time is the main factor to be considered during disaster response. Involved organisations need to take decisions rapidly and under stress conditions. To make appropriate decision, the decision makers need to have access to the appropriate (and up to date) information in very short time. Furthermore, they need an easy to use interface to the information.

The second factor is the collaboration-communication between the services involved in DEM, such as police, fire brigade, paramedics and civil protection. The multitouch multiuser system allows for improved collaboration and cooperation in a multi-sectoral team.

SOA of which common working principle is approach to interact the independent applications from the location on electronic communication network is all-important for response phase of DEM. Tasks for performing DEM activities must be determined in SOA as a service. In this scope, same service can be used for another activity that performs the same task. Tasks determined to perform activities are developed as of services in SOA and managed in user interface according to activity. Users access the service as in the manner of identified in the application or aceess the needed services or the service sets with making a search in catalogue.

To manage emergency response activities, it is required to produce Standart Operating Procedures (SOP) with detailed description of actors, activities, and working cycle that describe required geo-data. SOPs are formal written guidelines or instructions for incident response. SOPs typically have both operational and technical

components and enable emergency responders to act in a coordinated fashion across disciplines in the event of an emergency. SOP describes the recognized need for procedures and lists agencies that will share the procedures. The introduction can also serve to specify the capability or resource in which the procedures are being established and provide reasons why it is important to establish such procedures.

Emergency response scenarios can be determined to manage emergency activities. For example, fire caused by the explosion in the school laboratory as the activity has following work cycle as seen below;

- Various actors such as “Police, Ambulance, Fire Brigade, Electricity Distribution Inc. (BEDAS) and Natural Gas Distribution Company (IGDAS)” have responsibilities on fire event.
- The activity “Fire” is one of the activities for which “Fire Brigade” is responsible.
- The tasks such as “registering incident, determining affecting areas and building, navigating emergency services for response (police, firefighter, utility service), evacuating and controlling affecting area, fire response, and saving casualties” are parts of the activity “Fire”.
- After getting an urgent call, Fire Brigade performs the task ‘registering the incident’. This requires “Road” and “Numbering” data on main geo-database. This task produces the location of “Incident” which is dynamic data on DEM database.
- Fire Brigade performs the tasks “determining affecting area and building” requiring “Numbering”, “Road”, and “Building” data. This task produces “AffectingArea” on main geo-database.
- Fire Brigade performs the task “navigating emergency services for response” requiring “Incident”, “Road”, “Teams” data to produce “Traffic Access Map” on emergency management database
- Beside these, geo-data is required and produced to execute other tasks of this emergency response.

In Figure 5.16 actor-sector-activity-task-data relations are described for fire event response.

- YAN.M.01: Determination of Response Area

YAN.M.01.01: Registration of Fire Event: 112 services take the call and determine the location

YAN.M.01.02: Determination of Affecting Area: Affecting area is determined according to risk objects

YAN.M.01.03: Determination of Buildings Requiring Security: Protected buildings are determined in affecting area

YAN.M.01.04: Determination of Probable Rapine Points: Buildings with valuable goods are determined in disaster zone

YAN.M.01.05: Determination of Exit Zones: Hazardous area is determined with using dynamic data like meteorologic data

YAN.M.01.06: Determination of Traffic Control Points: Entrance and exist roads are determined to control

- YAN.M.02: Response Planning

YAN.M.02.01: Determination of Fire-Fighting Vehicles: Fire-fighting vehicles are determined according to required quantity, avalibility of the fire-fighting vehicle, and the current locations of the vehicles.

YAN.M.02.02: Determination of Ambulance Vehicles: Ambulance vehicles are determined according to required quantity, avalibility of the ambulance vehicle, and the current locations of the vehicles.

YAN.M.02.03: Determination of Security Units: Security units are determined according to required quantity, avalibility of the unit, and the current locations of the unit.

YAN.M.02.04: Determination of Civil Defence Teams: Civil defence teams are determined according to required quantity and the current locations of the team.

YAN.M.02.05: Determination of Natural Gaz/Electricity Breakdown Teams: Natural Gaz/Electricity Breakdown Teams are determined according to required quantity, avalibility of the team, and the current locations of the team.

YAN.M.02.06: Determination of Fire-Fighting Vehicles Route: Fire-fighting route is determined with shortest path according to closed roads and traffic jams.

YAN.M.02.07: Determination of Ambulance Vehicles Route: Ambulance route is determined with shortest path according to closed roads and traffic jams.

YAN.M.02.08: Determination of Security Units Route: Security units route is determined with shortest path according to closed roads and traffic jams.

YAN.M.02.09: Determination of Civil Defence Units and Vehicles Route: Civil defence units route is determined with shortest path according to closed roads and traffic jams.

YAN.M.02.10: Determination of Health Services: Hospitals are determined according to hospital locations, free capacities, and hospital availabilities.

YAN.M.02.11: Determination of Ambulance Route to Health Services: Ambulance is redirected from the scene to the available hospital or health center with the shortest path.

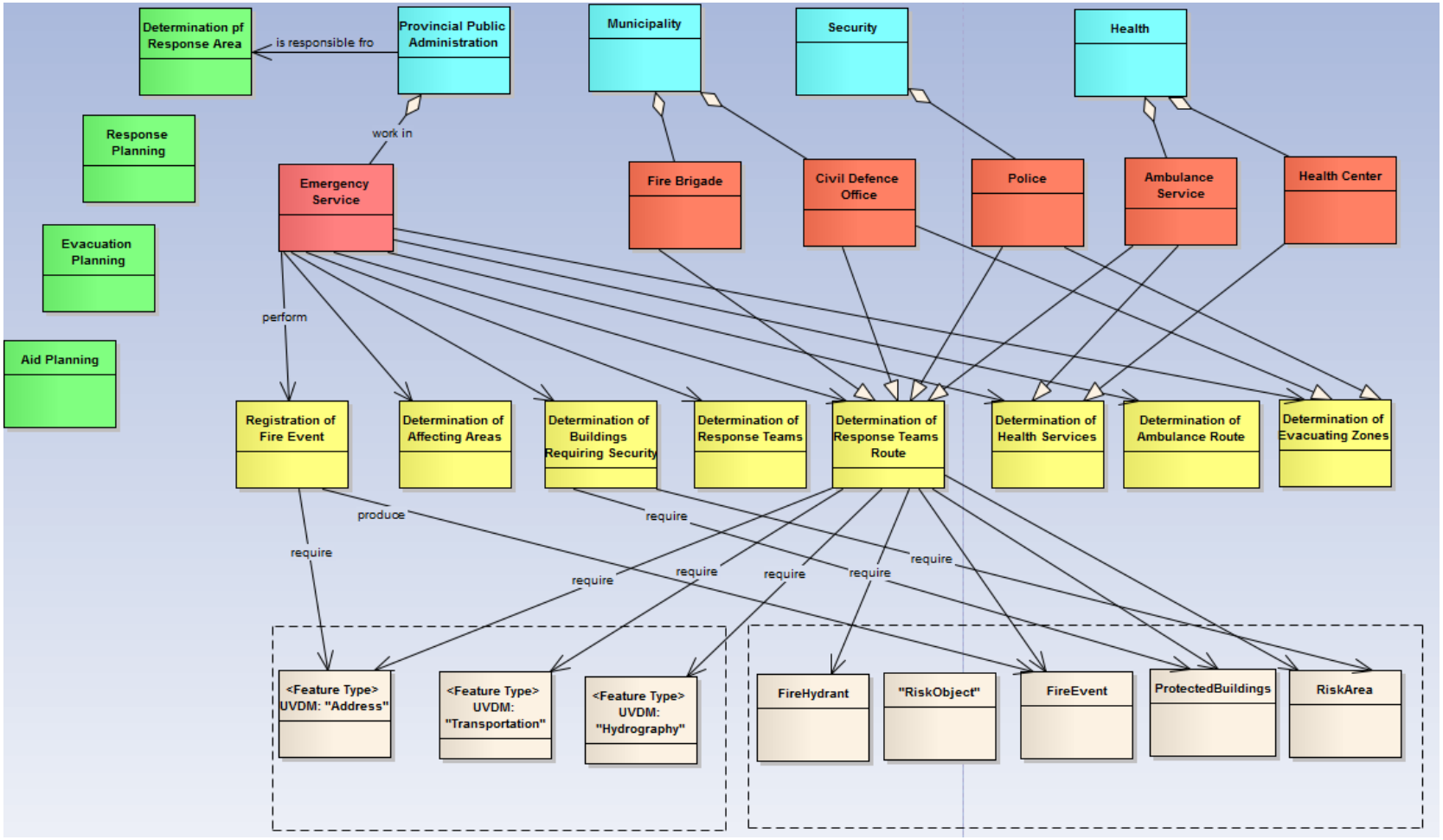

Figure 5.16 : UML class diagram for fire event response

Fire event is occured because of the explosion in the laboratory of the school in Besiktas district. First activity is the registration of the event as is seen in Figure 5.17. In the past 110 is called as emergency fire number, 112 is called as emergency medical number, 155 is called as police number and 156 is called as gandermarie number. In the year of 2007, 112 has become the only number for emergency services. Therefore, the registration of the fire event is the duty of 112 service. After the registration of the event, affecting area is determined. Buildings and structures within this area are analyzed and finally response need can be determined.

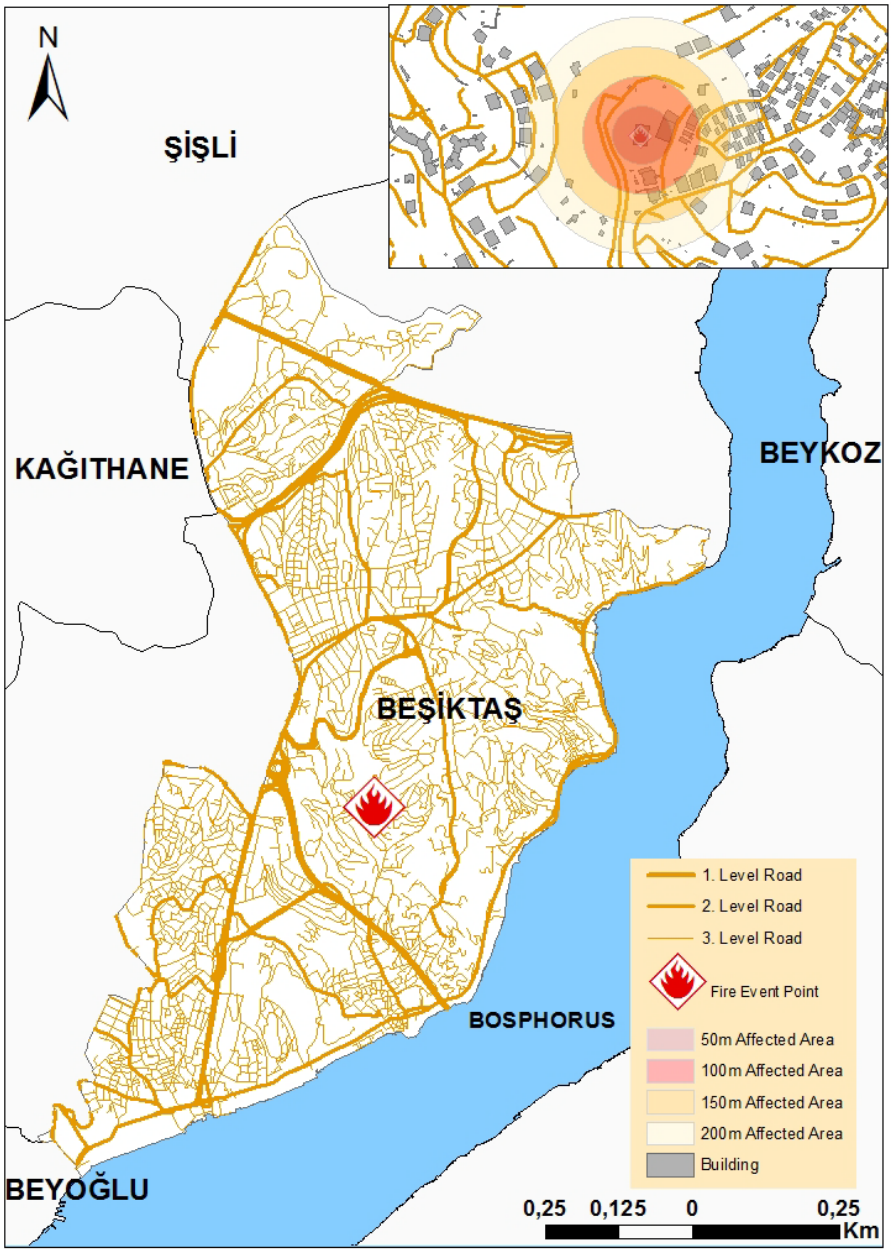

Figure 5.17 : Fire event registration

The required quantity of emergency teams and firefighter brigades are calculated for the response activity according to fire class and the types of the buildings within the affected area. The availability of emergency and traffic police teams, and fire fighter brigades are determined and finally the current location of emergency teams, firefighter brigades and traffic police teams are determined. In Figure 5.18, current locations of avaliable response teams are seen.

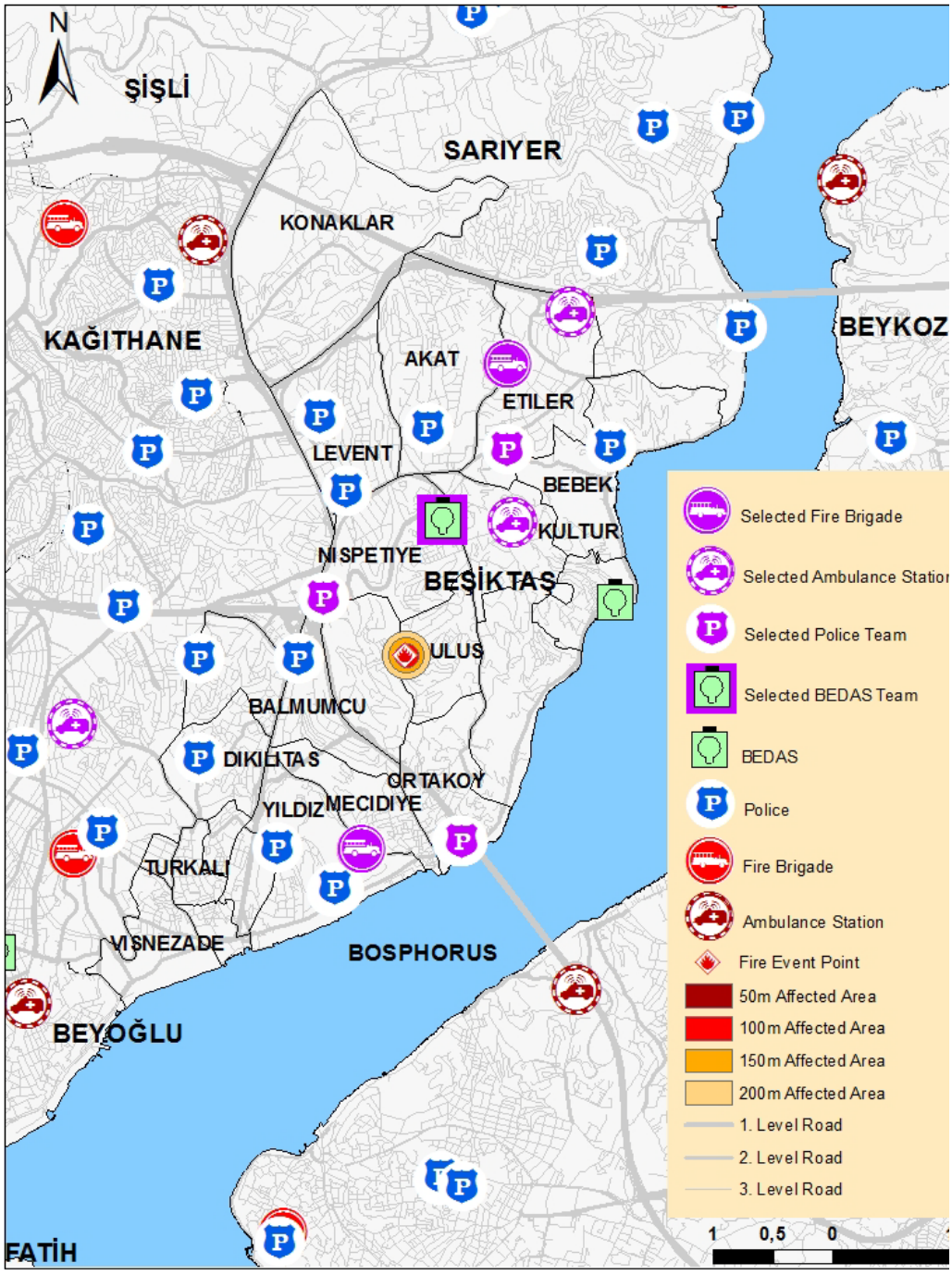

Figure 5.18 : Locations of response teams

Availability of a particular route depending on its type taking into account: a) the types of vehicles used by the emergency teams, firefighter brigades and police teams; b) the closed roads; c) the traffic jams; and d) the weather conditions. The shortest routes for appropriate acting resources. In Figure 5.19 the routes of selected response teams are shown.

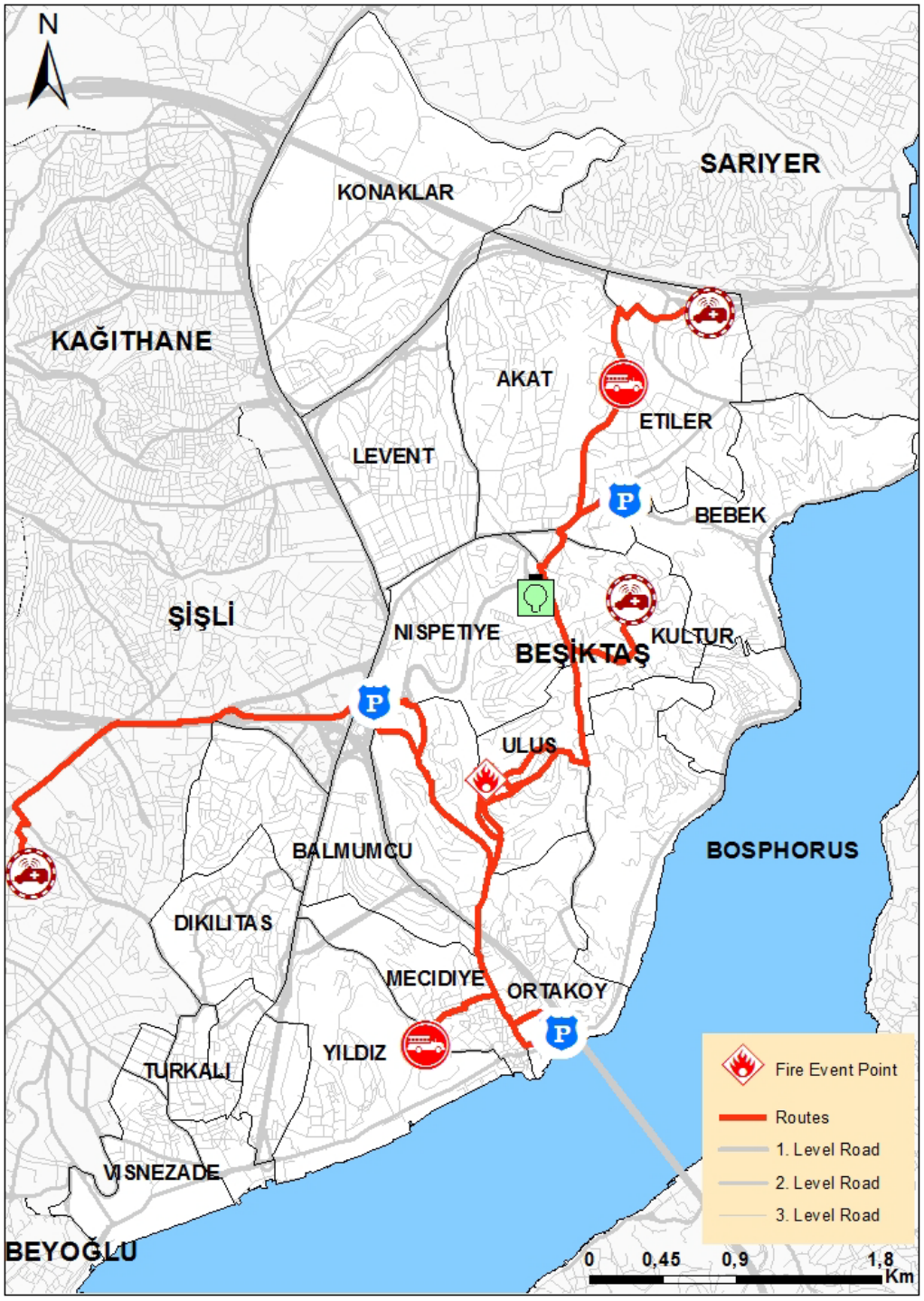

Figure 5.19 : Routes of response teams

Hospital availability returns a list of hospitals of the region, hospital addresses, free capacities, and hospital availabilities. Ambulance is redirected from the scene to the available hospital or health center (Figure 5.20).

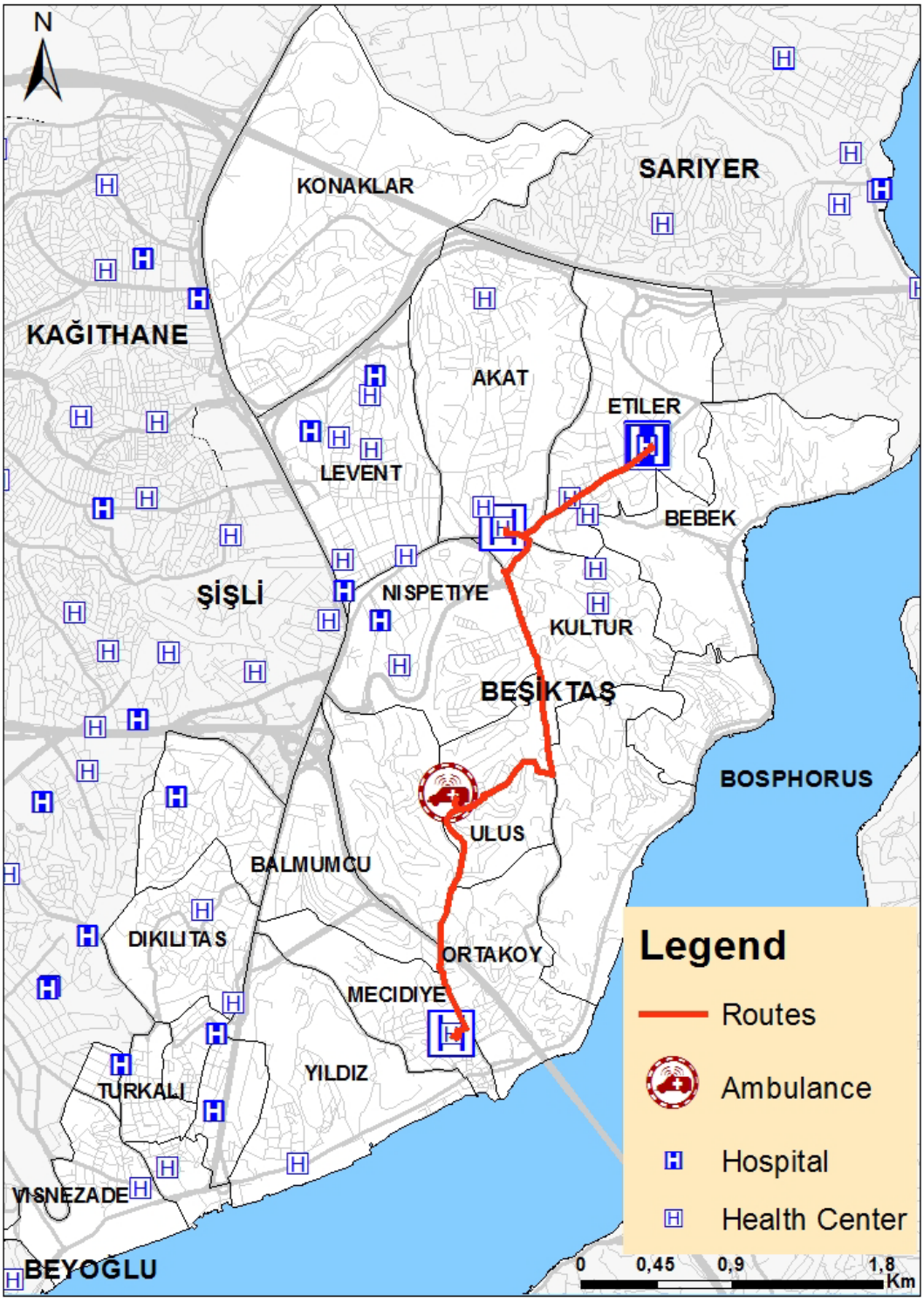

Figure 5.20 : Ambulance routes from the scene to the hostital

6. CONCLUSION

There are 72 statutes in DEM legislation which is complicated and deficient for activity based DEM approach with multi-actor. For mitigation, and response phases of DEM, there are detailed descriptions in legislation, but for preparation and especially recovery phases descriptions are not detailed. This deficiency is tried to be removed by adopting resolutions on any change about the laws and enactments after disasters. Explanations show us there is a need of detail research on determination of actors and activities of DEM in accordance with statute. Despite the fact that detail definitions and descriptions are made, there is a deficiency in descriptions that provide integrated task description and coordinate work between institutions. The main reason of this deficiency is scattered presence of content in statute.

The actors which take part in DEM activities are leveled and displayed as governmental, national, regional, provincial and local accordingly to their hierarchical relation. In this regard, there are 17 actors determined on governmental level. There are 187 actors in national level which are composed of; 37 of them (actors) are on central organization of the governmental level, 39 of them (actors) are on permanent/related organizations of Governmental level, 29 of them are in the related governmental organizations, 3 of them are in the in-charge-organizations of the governmental level and 79 of them are in the central organizations of related organizations of the governmental level. Along with 102 actors on Provincial level, the actors in charge at DEM are determined as 306 in totals. It is expected from DEM that active duties of every single actor from local to national level should be predetermined.

Various activities performed by different actors has been defined for urban-fire event. These 13 activities has been specified with 77 sub-activities.Each sub-acticity has tasks to perform the activity which is responsible of the actors.

Geo-data used by actors to perform the tasks has great importance at different phases of DEM; preparation, mitigation, response, and recovery. As emergency management is a multi-disciplinary activity, the most fundamental asset is the data

itself that needs to be shared or to be integrated between different partners. GII provides the tools giving easy access to distributed databases for DEM actors who need geo-data for their own decision making and emergency tasks. Processes with tasks were being formalized sequentially while required data for each task were defining to manage emergency events within GII mechanism. When web based user interface developed with Service Oriented Architecture (SOA) is configured on the web and data servers, it will be possible to manage and to use dynamic geo-data on electronic communication networks. Related stakeholders could manage and update the data with GII approach at a place where the data is maintained effectively. With this view as explained the fire case examples with use-case description approach, described data managed in the geo database with GII approach provide actors interoperability in DEM.

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APPENDICES

APPENDIX A : Tables

APPENDIX A.1 : Disaster Statistics

Table A.1 : Top 10 natural disasters in countries for the period 1900 to 2010

Occured Disaster Type	Killed	Affected People	Economic Damage
Australia			
Drought	Drought	Storm	Drought
Extr. temperature	Trans. accident	Flood	Storm
Storm	Wildfire	Wildfire	Flood
Flood	Extr. temperature	Trans. accident	Wildfire
Wildfire	Storm	Drought	Earthquake
Earthquake	Flood	Other accident	Insect infestation
Indust. Accident	Other accident	Extr. temperature	Epidemic
Trans. accident	Mass movem. wet	Earthquake	Extr. temperature
Other accident	Earthquake	Indust. Accident	Indust. Accident
Mass movem. wet	Indust. Accident	Insect infestation	Mass movem. dry
Canada			
Indust. Accident	Trans. accident	Flood	Wildfire
Flood	Other accident	Storm	Drought
Wildfire	Storm	Trans. accident	Storm
Drought	Indust. Accident	Wildfire	Extr. temperature
Storm	Epidemic	Indust. Accident	Flood
Other accident	Mass movem. dry	Other accident	Earthquake
Mass movem. dry	Flood	Epidemic	Insect infestation
Epidemic	Wildfire	Drought	Epidemic
Trans. accident	Drought	Extr. temperature	Indust. Accident
Extr. temperature	Extr. temperature	Mass movem. dry	Mass movem. Dry
France			
Storm	Extr. temperature	Storm	Storm
Flood	Trans. accident	Flood	Extr. temperature
Indust. Accident	Other accident	Trans. accident	Flood
Extr. temperature	Storm	Other accident	Drought
Wildfire	Flood	Indust. Accident	Indust. Accident
Other accident	Indust. Accident	Extr. temperature	Other accident
Trans. accident	Mass movem. wet	Wildfire	Mass movem. wet
Mass movem. wet	Mass movem. dry	Mass movem. wet	Wildfire
Mass movem. dry	Wildfire	Drought	Earthquake
Epidemic	Epidemic	Mass movem. dry	Insect infestation

Occured Disaster Type	Killed	Affected People	Economic Damage
Japan			
Flood	Earthquake	Storm	Earthquake
Storm	Storm	Earthquake	Storm
Epidemic	Flood	Flood	Flood
Earthquake	Trans. accident	Trans. accident	Mass movem. wet
Indust. Accident	Mass movem. wet	Mass movem. wet	Indust. Accident
Volcano	Indust. Accident	Other accident	Volcano
Mass movem. wet	Other accident	Indust. Accident	Other accident
Other accident	Extr. temperature	Volcano	Extr. temperature
Extr. temperature	Volcano	Epidemic	Drought
Transport accident	Epidemic	Extr. temperature	Wildfire
New Zelland			
Flood	Trans. Accident	Flood	Flood
Indust. Accident	Storm	Storm	Earthquake
Earthquake	Flood	Earthquake	Extr. Temperature
Storm	Earthquake	Trans. Accident	Drought
Other accident	Mass Movem. Wet	Indust. Accident	Drought
Mass Movem. Wet	Indust. Accident	Mass Movem. Wet	Other accident
Wildfire	Other accident	Other accident	Mass. Movem. Wet
Volcano	Extr. Temperature	Volcano	Indust. Accident
Epidemic	Volcano	Epidemic	Volcano
Extr. Temperature	Epidemic	Extr. Temperature	Wildfire
Norway			
Flood	Trans. accident	Trans. accident	Flood
Storm	Indust. Accident	Storm	Storm
Trans. accident	Flood	Flood	Earthquake
Indust. Accident	Storm	Indust. Accident	Extr. temperature
Earthquake	Earthquake	Earthquake	Drought
Other accident	Mass movem. wet	Mass movem. wet	Other accident
Mass movem. wet	Other accident	Other accident	Mass movem. wet
Wildfire	Extr. temperature	Volcano	Indust. Accident
Volcano	Volcano	Epidemic	Volcano
Epidemic	Epidemic	Extr. temperature	Wildfire
Spain			
Drought	Extr. temperature	Trans. accident	Drought
Flood	Trans. accident	Flood	Indust. Accident
Indust. Accident	Flood	Storm	Flood
Storm	Indust. Accident	Wildfire	Storm

Occured Disaster Type	Killed	Affected People	Economic Damage
Spain (continue)			
Wildfire	Other accident	Indust. Accident	Wildfire
Epidemic	Storm	Other accident	Extr. temperature
Other accident	Mass movem. wet	Extr. temperature	Earthquake
Trans. accident	Wildfire	Drought	Mass movem. wet
Mass movem. wet	Epidemic	Epidemic	Trans. accident
Extr. temperature	Earthquake	Earthquake	Other accident
Sri Lanka			
Flood	Earthquake	Flood	Earthquake
Drought	Flood	Trans. accident	Flood
Storm	Storm	Drought	Storm
Earthquake	Trans. accident	Epidemic	Drought
Epidemic	Epidemic	Storm	Indust. Accident
Other accident	Mass movem. wet	Mass movem. wet	Wildfire
Trans. accident	Other accident	Indust. Accident	Mass movem. Wet
Mass movem. Wet	Indust. Accident	Other accident	Extr. temperature
Indust. Accident	Extr. temperature	Earthquake	Trans. accident
Wildfire	Wildfire	Wildfire	Other accident
Switzerland			
Drought	Drought	Drought	Storm
Storm	Epidemic	Epidemic	Drought
Flood	Storm	Storm	Flood
Epidemic	Trans. accident	Flood	Earthquake
Wildfire	Wildfire	Trans. accident	Indust. Accident
Trans. accident	Earthquake	Wildfire	Wildfire
Earthquake	Flood	Mass movem. wet	Extr. temperature
Other accident	Mass movem. wet	Indust. Accident	Mass movem. wet
Mass movem. wet	Other accident	Other accident	Trans. accident
Indust. Accident	Indust. Accident	Earthquake	Other accident
United States			
Storm	Storm	Storm	Storm
Flood	Extr. temperature	Flood	Flood
Wildfire	Trans. accident	Trans. accident	Earthquake
Epidemic	Other accident	Indust. Accident	Wildfire
Indust. Accident	Flood	Other accident	Extr. temperature
Earthquake	Mass movem. wet	Wildfire	Drought
Trans.accident	Earthquake	Earthquake	Indust. Accident
Other accident	Epidemic	Extr. temperature	Volcano
Volcano	Indust. Accident	Drought	Trans. accident
Mass movem. wet	Wildfire	Epidemic	Other accident

APPENDIX A.2: Responsible Organizations in Disaster-Emergency Management

Table A.2 : Disaster-emergency management actors in Turkey

GOVERNMENT	NATIONAL	REGIONAL/PROVINCIAL/COUNTY
Grand National Assembly of Turkey		
Presidency		
Office of the Prime Minister		
1. Central Organization		
1.1. General Directorate of Security Affairs **1.2. General Secreteriat of Ministerial Cabinet** **1.3. Directorate of Strategy Development** **1.4. General Directorate of Legislation Development and Publication** **1.5. Secreteriat of Defence** **1.6. State of Emergency Coordination Commission**		
2. Permanent/Related Organizations		
2.1. Disaster and Emergency Management Presidence		Provincial Directorate of Disaster and Emergency Management Directorate of Civil Defence Search and Rescue Unit
2.1.1. Central Organization		

2.1.1.1. **Department of Planning and Mitigation** 2.1.1.2. **Department of Response** 2.1.1.3. **Department of Recovery** 2.1.1.4. **Department of Civil Defence** 2.1.1.5. **Department of Earhquake** 2.1.1.6. **Department of Administrative Affairs**	
2.2. General Directorate of Family and Social Research	
2.3. General Directorate of Press and Information	Provincial Directorate of Press and Information
2.4. Undersecretariat of Maritime Affairs	Regional Directorate of Maritime Affairs Port Authority Regional Directorate of Maritime Lines
2.4.1. Central Organization	
2.4.1.1. **General Directorate of Marine Transport**	
2.5. State Personnel Presidency	
2.6. State Planning Organization	
2.7. General Directorate of Youth and Sports	Provincial Directorate of Youth and Sports
2.7.1. Central Organization	
2.7.1.1. **Federation of Underwater Sport** 2.7.1.2. **Federation of Mountaineering**	
2.8. Undersecretariat of Customs	Office of the General Director of Customs and Enforcement Regional Directorate of TASİŞ Management
2.9. Undersecretariat of Treasury	
2.9.1. Central Organization	
2.9.1.1. **General Directorate of Insurance**	

2.9.1.2. **Turkish Catastrophe Insurance Pool**	
2.10. Housing Development Administration of Turkey	Department of Application
2.10.1. Central Organization	
2.10.1.1. **Department of Housing Estate Projects and Research** 2.10.1.2. **Department of Urban Regeneration** 2.10.1.3. **Department of Zonning and Planning**	
2.11. Secretariat General of the National Security Council	
2.12. Undersecretariat of National Intelligence Organization	
2.13. Social Assistance and Solidarity General Directorate	Social Assistance and Solidarity Foundation (for province)
2.14.	Social Assistance and Solidarity Foundation (for county)
2.14.1. Central Organization	
2.14.1.1. **Department of Resource Management** 2.14.1.2. **Department of Subsidies** 2.14.1.3. **Department of Voluntary Agency Cooparative and External Affairs** 2.14.1.4. **Department of Statistics, Research and Publicity**	
2.15. Turkish Atomic Energy Authority	Directorate of Research and Education Centre
2.15.1. Central Organization	
2.15.1.1. **Department of Nuclear Safety** 2.15.1.2. **Department of Radiation Health and Safety**	
2.16. The Scientific and Technological Research Council Presidency of Turkey	

2.17. Turkish Statistical Institute Presidency	Regional Directorate of Turkish Statistical Institute
2.18. Darulaceze Institution	
2.19. The Presidency of Religious Affairs of the Republic of Turkey	Provincial Directorate of Mufti County Directorate of Mufti
2.20. Social Services and Child Protection Agency	
2.21. General Directorate of Foundations	Regional Directorate of Foundations
3. Relevant Organizations	
3.1. General Directorate of Anadolu Agency	
3.2. General Directorate of Halkbank	
3.3. General Directorate of Radio-Television Authority of Turkey	Regional Directorate of Turkish Radio-Television
3.4. General Directorate of Vakıf Bank	
3.5. General Directorate of Ziraat Bank	
3.6. Central Bank Presidency	
3.7. Development Bank of Turkey	
3.8. Capital Markets Board Presidency	
3.9. Banking Regulation and Supervision Agency	
3.10. Radio and Television Supreme Council	
4. Responsible Organizations	
4.1. Turkish General Staff	
4.1.1. Central Organization	
4.1.1.1. **Military Intelligence Division** 4.1.1.2. **Operations Devision** 4.1.1.3. **Logistics Division** 4.1.1.4. **General Plans and Policies Division** 4.1.1.5. **Communications Electronics and Information Systems Division**	
4.1.2. Permanent/Related Organizations	

4.1.2.1. **Ground Forces Command** 4.1.2.2. **Naval Forces Command** 4.1.2.3. **Air Forces Command**	
Ministry of National Defence	Induction Centers Provincial Directorate of Civil Defence Disaster Management Fire Department Gendarmerie Coastal Safety Police
1. Central Organization	
1.1. Department of Insourcing **1.2. Department of Outsourcing** **1.3. Department of Defence Industry External Affairs** **1.4. Department of Mobilization** **1.5. Department of Health**	
2. Permanent/Related Institutions	Turkish Armed Forces
2.1. Mnd. Fuel Supply and Nato Pol Presidency	
2.2. General Command of Mapping	
2.3. Command of Pharmaceutical Plant	
2.4. Undersecretariat of Defence Industries	
2.4.1. Central Organization	

2.4.1.1. Department of Land Platforms **2.4.1.2. Department of Naval Platforms** **2.4.1.3. Department of Air Platforms** **2.4.1.4. Department of Electronic Communications and Information Systems** **2.4.1.5. Department of Electronic Conflict and Sensors** **2.4.1.6. Department of Rocket-Misille and Ammunition**	
Ministry of Internal Affairs	Provincial Directorate of Population and Citizenship Affairs Regional Directorate of Rural Affairs Governorate
1. Central Organization	
1.1. General Directorate of Provincial Administration **1.2. General Directorate of Local Administration** **1.3. General Directorate of Civil Defence** **1.4. Department of Smuggling, Security Intelligence, Proceedings and Storage** **1.5. General Directorate of Population and Citizenship Affairs** **1.6. General Directorate of Rural Affairs**	
2. Permanent/Related Institutions	
2.1. General Directorate of Security	Directorate of Provincial Security
2.1.1. Central Organization	

2.1.1.1. **Department of Security** 2.1.1.2. **Department of Communication** 2.1.1.3. **Department of Aviation** 2.1.1.4. **Department of Security Intelligence** 2.1.1.5. **Private Security Services** 2.1.1.6. **Department of Special Operation** 2.1.1.7. **Department of Health Affairs** 2.1.1.8. **Department of Civil Defence** 2.1.1.9. **Department of Social Services** 2.1.1.10. **Department of Counter-Terrorism and Operations** 2.1.1.11. **Department of Traffic Services**	
2.2. General Command of Gendarmerie	Gendarmerie Regional Command Gendarmeria Provincial Command Gendarmerie County Command Gendarmerie Station Command
2.2.1. Central Organization	
2.2.1.1. **Gendarmerie Commando Unit** 2.2.1.2. **Gendarmerie Aviation Unit**	
2.3. Coast Guard Command	Coast Guard Regional Command
Ministry of Foreign Affairs	
1. Central Organization	
1.1. **General Directorate of Security Intelligence and Research** 1.2. **General Directorate of International Security Affairs** 1.3. **General Directorate of Dual Politic Affairs** 1.4. **General Directorate of Dual Politic Affairs Naval-Aviation** 1.5. **Secretariat of Defence**	

Ministry of Finance	
1. Central Organization	
1.1. General Directorate of National Estate	
2. Relavent Organizations	
2.1. General Directorate of State Supply Office	Regional Directorate of State Supply Ofiice
Ministry of National Education	Provincial Directorate of National Education County Directorate of National Education
1. Permanent/Related Organizations	
1.1. General Directorate of Higher Education Credit and Hostels Institutions	
Ministry of Public Works and Settlement	Directorate of Public Works and Settlement
1. Central Organization	
1.1. General Directorate of Construction Affairs **1.2. General Director of Disaster Affairs**	
2. Permanent/Related Organizations	
2.1. General Directorate of Land Registry and Cadastre	Regional Directorate of Land Registry and Cadastre Directorate of Land Registry and Cadastre
3. Relavent Organizations	
3.1. General Directorate of Provincial Bank	Regional Directorate of Provincial Bank
3.1.1. **Central Organization**	

3.1.1.1. **Department of Loans and Banking** 3.1.1.2. **Department of Mapping** 3.1.1.3. **Department of Zonning** 3.1.1.4. **Department of Potable Water** 3.1.1.5. **Department of Drainage** 3.1.1.6. **Department of Construction Affairs** 3.1.1.7. **Department of Provisions** 3.1.1.8. **Department of Machine and Boring**	
Ministry of Health	Provincial Directorate of Health
1. Central Organization	
1.1. **General Director of Basic Health Services** 1.2. **General Director of Treatment Facilities** 1.3. **General Directorate of Medicine and Pharmacy**	
2. Permanent/Related Organizations	
2.1. **General Directorate of Health for Border and Coastal Areas**	Supervision Centre of Coast Health
2.2.	Supervision Centre of Airport Health
2.2.1. Central Organization	
2.2.1.1. Department of Health Supervision Affairs **2.2.1.2. Department of Health Certificate and Ships's Company** **2.2.1.3. Department of Epidemiology and Journey Health**	
Ministry of Transport and Communications	Regional Directorte of Transport and Communications
1. Central Organization	

1.1. **General Directorate of Civil Aviation** 1.2. **General Directorate of Railways, Harbours and Airports Construction** 1.3. **General Director of Highway Transportation** 1.4. **General Director of Communications**	
2. Permanent/Related Organizations	
2.1. **General Directorate of Highways**	Regional Directorate of Highways
3. Relavent Organizations	
3.1. **General Directorate of State Railways Authority** 3.2. **General Directorate of State Airports Authority** 3.3. **General Directorate of Coastal Safety and Salvage Authorities** 3.4. **General Directorate of PTT** 3.5. **General Directorate of Turkish Telecom**	Regional Directorate o State Railways Directorate of Airport/Airfield Regional Directorate of Coastal Safety Ofiice of the General Director of PTT Regional Directorate of Turkish Telecom Provincial Directorate of Turkish Telecom
Ministry of Agriculture and Regional Affairs	Provincial Directorate of Agriculture, Forest and Regional Affairs Directorate of Veterinarian Parking and Health Directorate of Agricultural Quarantina
Ministry of Labour and Social Security	Regional Directorate of Labour
1. Central Organization	
1.1. General Directorate of Labour **1.2. General Directorate of Socil Security Institutes** **1.3. General Director of Worker Health**	
2. Relavent Organizations	

2.1. Directorate of Vocational Qualifications Authority	
2.2. Diractorate of Social Security Institution	Provincial Directorate of Social Security
2.3. General Directorate of Turkish Labor Institution	Provincial Directorate of Labour Institution
Ministry of Industry and Trade	Provincial Directorate of Industry and Trade
1. Central Organization	
1.1. General Directorate of Measurements and Standards	
2. Relavent Organizations	
2.1. Turkish Standards Institution	Regional Directorate of Turkish Standard Institution
2.2. Presidency of Development and Suppot of Small and Medium Sized Enterprises Administration	Regional Directorate of Improvement
Ministry of Energy and Natural Resources	
1. Central Organization	
1.1. General Directorate of Energy Affairs	
1.2. General Directorate of Mining Affairs	
2. Permanent/Related Organizations	
2.1. General Directorate of Electrical Power Resources Survey and Development Administration	
2.1.1. Central Organization	
2.1.1.1. **Directorate of Energy Resources**	
2.1.1.2. **Directorate of Hydraulic**	
2.2. General Directorate of Mineral Research and Exploration	Regional Directorate of Mineral Research and Exploration
2.2.1. Central Organization	

2.2.1.1. **Directorate of Worker Health and Security** 2.2.1.2. **Directorate of Mine Analysis and Technologies** 2.2.1.3. **Department of Civil Defence**	
2.3. General Directorate of Petroleum Affairs	
3. Relavent Organizations	
3.1. Petroleum Pipeline Corporation	Regional Directorate of Natural Gas Regional Directorate of Petrol
3.1.1. Central Organization	
3.1.1.1. **Directorate of Natural Gas Underground Storage** 3.1.1.2. **Directorate of LNG**	
3.2. General Directorate of Zink-Lead-Metal	
3.3. Turkish Electricity Transmission Company	
3.4. General Directorate of Turkish Electromechanics Industry	
3.5. General Directorate of Turkish Coal Enterprise	
3.6. Turkish Petroleum Corporation	
3.7. General Directorate of Electricity Generation	
3.7.1. Central Organization	
3.7.1.1. **Directorate of Thermal Power Plant and Mine Sites** 3.7.1.2. **Directorate of Nuclear Projects** 3.7.1.3. **Directorate of Hydraulics Power Plant**	
Ministry of Culture and Tourism	Directorate of Cultural and Natural Heritage Provincial Directorate of Culture and Tourism
1. Central Organization	
1.1. General Directorate of Cultural Property	
Ministry of Environment and Forest	Provincial Directorate of Environment Ministry Directorate of Environment and Forest
1. Permanenr/Related Organizaitons	

1.1. General Directorate of State Hydraulic Works	Regional Directorate of State Hydraulic Works
1.1.1. Central Organization	
1.1.1.1. Directorate of Dams and Hydrolectric Power Plant **1.1.1.2. Directorate of Potable Water and Drainage**	
1.2. General Directorate of State Meteorological Service	Regional Directorate of Meteorology
1.2.1. Central Organization	
1.2.1.1. Directorate of Weather Forecasts	
1.3. General Directorate of Forestry	Regional Directorate of Forestry
1.3.1. Central Organization	
1.3.1.1. Directorate of Forest Protection and Fire Fighting **1.3.1.2. Directorate of Forest Administration and Planning**	
Council of Higher Education	Universities
1. Professional Organizations	The Banks Association of Turkey Turkish Pharmacists Association The Union of Chambers and Commodity Exchanges of Turkey Turkish Medical Association The Confederation of Turkish Tradesmen and Craftsmen

PROVINCIAL	LOCAL
Governerate	
Responsible Organizations	
1.1. District Governorate **1.2. County Municipality** **1.3. General Directorates** **1.4. Regional Directorates** **1.5. Provincial Directorates** **1.6. Head of Departments** **1.7. Provincial Special Administration**	Department of Health Affairs Department of Agriculture and Forstry Affairs Department of Zoning, Investment and Construction Department of Education, Culture and Social Services
1.8. Provincial Municipality	Department of Culture and Social Affairs Department of Health and Social Services Department of Police Department of Support Services Department of Zonning and Urbanism Department of Earhquake Risk Management and Municipal Restoration Department of Transportation Department of Information Technologies Department of Fire Stations

APPENDIX A.3 : Geo-data for Disaster-Emergency Management

Table A.3 : Geo-data for disaster and emergency management activities

Activities	Creation of Planning Basemaps	Mitigaiton Planning	Determination of Response Unit Locations	Determination of Fire-Fighting Resource Locations	Evacuation Planning	Determination of Aid Material Warehouse Locations	Determination of Response Area	Response Planning	Evacuation Planning	Aid Planning	Determination of Structural Damage	Determination of Settlement	Land Use
Thematic Data	**Mitigation Phase**		**Preparation Phase**				**Response Phase**				**Recovery Phase**		
Geodesy													
Geographic Reference Systems	+	+	+	+	+	+	+	+	+	+	+	+	+
Geographic Grids	-	-	-	-	-	-	-	-	-	-	-	-	-
Densification Network	-	-	-	-	-	-	-	-	-	-	-	+	+
Geographic Names	+	+	+	+	+	+	+	+	+	+	+	+	+
Topography													
Terrestrial Elevation	-	-	-	-	-	-	-	-	-	-	-	+	+
Bathymetry	-	-	-	-	-	-	-	-	-	-	-	-	-
Land Surface													
Land Cover	+	+	-	+	+	+	-	-	-	-	+	+	+
Orthophoto-Image	-	-	-	-	-	-	-	-	-	-	-	-	-
Satellite Image	+	+	-	-	+	-	-	-	-	-	+	+	+
Hydrography													
Lake/Ponds	+	-	-	+	-	-	-	-	-	-	-	-	-
River/Brook	+	-	-	+	-	-	-	-	-	-	-	-	-
Shore Edge Line	+	-	-	+	-	-	-	-	-	-	-	-	-
Oceanographic Details	-	-	-	-	-	-	-	-	-	-	-	-	-
Sea Regions	+	+	-	+	-	-	-	-	-	-	-	-	-

Activities	Creation of Planning Basemaps	Mitigaiton Planning	Determination of Response Unit Locations	Determination of Fire-Fighting Resource Locations	Evacuation Planning	Determination of Aid Material Warehouse Locations	Determination of Response Area	Response Planning	Evacuation Planning	Aid Planning	Determination of Structural Damage	Determination of Settlement	Land Use
Transportation													
Highway	+	+	+	+	+	+	+	+	+	+	-	+	+
Airway	+	+	+	+	+	+	-	+	+	+	-	+	+
Railway	+	+	+	+	+	+	+	+	+	+	-	+	+
Maritime Lines	+	+	+	+	+	+	-	+	+	+	-	+	+
Transport Facilities	+	-	-	-	-	+	-	+	+	-	-	-	+
Properties/Buildings/Addresses													
Land Registry/Cadastre	+	-	-	+	+	+	-	-	+	-	+	+	+
Buildings	+	+	+	+	+	+	+	+	+	-	+	+	+
Agriculture/IndustryPlants	+	+	+	+	+	+	+	+	+	-	+	+	+
Commercial Facilies	+	+	+	+	+	+	+	+	+	-	+	+	+
Addresses	+	+	+	+	+	+	+	+	+	-	+	+	+
Administrative Units													
Official Administrative Units	+	-	-	-	+	-	-	-	+	-	+	+	+
Government Management Zones	+	-	-	-	+	-	-	-	+	-	+	+	+
Blocks/Census/Statistical Districts	+	-	+	+	+	-	-	-	+	-	+	+	+
Geo-physical environment													
Geology	+	-	-	-	-	-	-	-	-	-	+	+	-
Geo-morphology	+	-	-	-	-	-	-	-	-	-	+	+	-
Soil	+	-	-	-	-	-	-	-	-	-	+	+	-
Air and climate													
Air/Atmospheric Conditions	-	-	-	-	-	-	+	-	-	-	-	-	-
Meteorological	-	-	-	-	-	-	+	-	+	-	-	-	-
Climate Zones	+	-	-	-	-	-	-	-	-	-	-	-	-
Bio-Diversity													
Vegetation	+	+	-	+	+	-	+	-	-	-	-	-	-
Bio-Geographical Regions	+	-	-	-	-	-	-	-	-	-	-	-	-
Habitats and Biotopes	+	-	-	-	-	-	-	-	-	-	-	-	-
Species Distribution	+	-	-	-	-	-	-	-	-	-	-	-	-
Society and Population													
Urban and Rural Settlement	+	+	-	+	+	+	+	-	+	+	+	+	+

Activities	Creation of Planning Basemaps	Mitigaiton Planning	Determination of Response Unit Locations	Determination of Fire-Fighting Resource Locations	Evacuation Planning	Determination of Aid Material Warehouse Locations	Determination of Response Area	Response Planning	Evacuation Planning	Aid Planning	Determination of Structural Damage	Determination of Settlement	Land Use
Population Distribution/Demography	+	+	+	+	+	-	+	-	+	+	+	+	+
Tourism Heritage	+	+	-	-	-	-	-	-	-	-	-	-	-
Cultural Heritage	+	+	-	-	-	-	-	-	-	-	-	-	-
Human Health and Safety	-	-	-	-	-	-	-	+	-	-	-	-	-
Infrastructure													
Potable Water	+	-	-	+	+	-	-	-	+	-	+	+	+
Drainage	+	-	-	-	-	-	-	-	-	-	+	+	+
Communication	+	-	-	-	-	-	-	-	-	-	+	+	+
Natural Gas	+	+	+	-	-	-	+	-	+	+	+	+	+
Petroleum pipelines	+	+	+	-	-	-	+	-	+	+	+	+	+
Electricity	+	+	-	-	-	-	+	-	+	+	+	+	+
GeoThermal	+	-	-	-	-	-	-	-	-	-	+	+	+
Plan													
Regional Planning	+	-	+	+	+	-	-	-	-	-	+	+	+
Landscape Planning	+	-	+	+	+	-	-	-	-	-	+	+	+
Provincial Landscape Planning	+	-	+	+	+	-	-	-	-	-	+	+	+
Land Use Plans	+	-	+	+	+	-	-	-	-	-	+	+	+
Protected Sites													
Historical-Natural	+	+	-	-	-	-	+	-	-	-	-	-	-
Environmental Protection	+	-	-	-	-	-	+	-	-	-	-	-	-
Military Forbidden	+	-	-	-	-	-	+	-	-	-	-	-	-
Urban Conservation	+	-	-	-	-	-	+	-	-	-	-	-	-
Watershed Conservation	+	-	-	-	-	-	-	-	-	-	-	-	-
Natural Resource													
Ecosystem Resources	+	-	-	+	+	-	-	-	-	-	-	-	-
Water Resources	+	-	-	+	+	-	+	-	-	-	-	-	-
Agricultural Land/Soil Resources	+	-	-	+	+	-	-	-	-	-	-	-	-
Forest Resources	+	-	-	+	+	-	-	-	-	-	-	-	-
Fishery Resources	-	-	-	-	-	-	-	-	-	-	-	-	-
Geological Resources	+	-	-	-	-	-	-	-	-	-	-	-	-
Renewable Energy Resources	+	-	-	-	-		-	-	-	-	-	-	-

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Publications:

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