DEVELOPMENT OF A ROAD MAP AND EMERGENCY HELP AND DETECTION SYSTEM FOR DISASTER SEARCH AND RESCUE OPERATIONS

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF SOCIAL SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY
İLKER YONCACI

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF DOCTOR OF PHILOSOPHY
IN
THE DEPARTMENT OF SCIENCE AND TECHNOLOGY
POLICY STUDIES

FEBRUARY 2020

Approval of the Graduate School of Social Sciences

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ABSTRACT

DEVELOPMENT OF A ROAD MAP AND
EMERGENCY HELP AND DETECTION SYSTEM FOR DISASTER SEARCH AND RESCUE OPERATIONS

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February 2020, 347 pages

Despite humanity is advanced so much in information and technology, it is still not able to interfere or change natural disasters like earthquakes, volcanic explosions and droughts. Along with natural disasters, caused by immersive improvements made in information technologies, technological disasters are also become a big problem in our societies today. New researches need to be made in order to minimize or completely eliminate the effects of these human-based disasters. There is a common understanding that disasters cannot be avoided and studies had been made to minimize the effects of disasters, to reduce life losses, to bring order back to life as soon as possible and to lighten communal effects. For this to happen, a lot of work force and commitment are needed by search and rescue teams. In this research, the time passed for the search and rescue teams to reach the data of the survivors under the wreckage and how reducing this time affects the actual rescuing process and disaster management politics is being investigated. An innovative model proposed to minimize the search period and make it available for local search & rescue operations especially for first responders. In this thesis; a model is developed from both expert opinions and data from the project. With this model, a recommendation set is produced intended for the technologies used, processes that are applied and

policies that are used in disaster management in Turkey. In the last part, suggestions on lessons learned and further studies are explained.

Keywords **:** Turkey, Search and Rescue, Life Detection, Emergency Help and Detection System, Inovation.

ÖZ

AFET YÖNETİMİ ARAMA VE KURTARMA OPERASYONLARI İÇİN YOL HARİTASI VE ACİL DURUM YARDIM VE TESPİT SİSTEMİ GELİŞTİRİLMESİ

Yoncacı, İlker

Doktora, Bilim ve Teknoloji Politika Çalışmaları Bölümü

Tez Yöneticisi : Doç. Dr. Serhat Çakır

Şubat 2020, 347 sayfa

İnsanoğlu gelmiş olduğu bilgi ve teknoloji düzeyine karşın, doğal afetlere neden olabilen deprem, kuraklık, volkanik patlama gibi doğal olayların oluşumu ve engellemesinde yetersiz kalmaktadır. Bilgi ve iletişim teknolojilerindeki üssel artış ile insan nüfusunun ve hareketliliğinin artması sonucu doğal afetlerin yanı sıra insan kaynaklı teknolojik afetler de toplumsal yaşantıyı ve ekonomileri derinden etkiler hale gelmiştir. Bu afetlerin etkilerinden kurtulmak veya bunların toplum üzerindeki etkilerini en aza indirmek için araştırmalar yapmak, çeşitli planlar geliştirmek gerekmektedir. Afetlerin önlenemez olduğu konusunda ortak bir anlayış mevcuttur ve afetlerin etkilerini en aza indirmek, can kaybını azaltmak, toplumsal etkilerini hafifletmek ve hayatı bir an önce normal akış düzenine geri döndürebilmek için yöntemler araştırılmıştır. Bu konuda afet sonrasında görev alacak arama ve kurtarma ekiplerine çok iş düşmektedir. Bu araştırma çalışmasında, arama ve kurtarma ekiplerinin enkaz altında hayatta kalan insanların bilgilerine ulaşma süresinin, kullandıkları teknolojilerin kurtarma faaliyetleri ve arama kurtarma politikaları üzerine etkisi araştırılmıştır. Afet sonrası bölgede bulunanlar tarafından kullanılabilecek ve arama süresini kısaltacak bir inovatif model önerisi sunulmuştur. Bu tez çalışmasında hem uzman görüşlerinden hem projeden elde edilen verilerle bir model ortaya konulmuştur. Bu model üzerinden Türkiye'de afet yönetiminde uygulanan politikalar, uygulanan süreçler ve kullanılan teknolojilere yönelik öneri seti geliştirilmiştir. Son bölümde ise alınan dersler ve sonraki çalışmalara esas öneriler anlatılmıştır.

Anahtar Kelimeler **:** Türkiye, Arama ve Kurtarma, Canlı Tespit, Acil Durum Yardım ve Tespit Sistemi, İnovasyon.

To My Wife and My Son

ACKNOWLEDGMENTS

The author wishes to express his deepest gratitude to his supervisor Assoc. Prof. Dr. Serhat Çakır for his guidance, advice, criticism, encouragements and insight throughout the research.

The author would also like to thank Prof. Dr. Ali Kalkanlı, Prof. Dr. Türksel Kaya Bensghir, Prof. Dr. Murat Paşa Uysal and Assist. Prof. Dr. Ender Sevinç for their suggestions, encouragements and comments.

The author is sincerely grateful for the support of the advisors who didn't stop sharing their upmost assistance despite all illnesses, pains, losses and troubles in their lives, during this thesis process.

The implementation part (Chapter 5) of this study was supported financially by the Scientific and Technological Research Council of Turkey (TÜBİTAK) Prj. No. 7150684.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

EHU	:	Emergency Help Unit
EHDS	:	Emergency Help And Detection System
EHDU	:	Emergency Help Detection Unit
AFAD	:	Prime Ministry Disaster and Emergency Management Presidency (Afet ve Acil Durum Yönetimi Başkanlığı)
AHDER	:	Disaster Preperation and Education Society (Afete Hazırlık ve Deprem Eğitimi Derneği)
AKFEN	:	Disaster Temporary Urban Management System (Afet Geçici Kent Yönetim Sistemi)
AKOM	:	İstanbul Municipality Disaster Coordination Center (İstanbul Büyükşehir Belediyesi Afet Koordinasyon Merkezi)
AKUT	:	Search and Rescue Organization (Arama Kurtarma Teşkilatı)
API	:	Application Programming Interface
AVEA	:	A Telecom Operator in Turkey
AYDES	:	Disaster Management and Decision Support System (Afet Yönetim ve Karar Destek Sistemi)
BLUETOOTH	:	Wireless Personal Area Network
BIM	:	Building Information Modeling
CBRN	:	Chemical, Biological, Radiological and Nuclear
CRED	:	Centre for Research on the Epidemiology of Disasters
DBM	:	Power ratio in decibels (dB) of the measured power referenced to one milliwatt (mW).
DDK	:	Earthquake Advisory Council (Deprem Danışma Kurulu)
DRR	:	Disaster Risk Reduction
EM-DAT	:	CRED International Disaster Database
EYDAS	:	Electronic Help Disbursement System (Elektronik Yardım Dağıtım Sistemi)

FDMA	:	Fire and Disaster Management Agency of Japan
FEMA	:	Federal Emergency Management Agency
FM	:	Frequency Modulation
GHZ	:	Giga Hertz
GIS	:	Geographic Information System
GPS	:	Global Positioning System
GSM	:	Global System for Mobile Communications
HF	:	High Frequency
HZ	:	Hertz
ICDRM	:	Institute for Crisis, Disaster and Risk Management
IDME	:	International Disaster Management Exhibition
IDRM	:	International Institute for Disaster Risk Management
IEMS	:	Integrated Emergency Management System (IEMS) (Bütünleşik Acil Durum Yönetim Sistemi)
İZAYBİS	:	İzmir Disaster Information Management System (İzmir Afet Bilgi Yönetim Sistemi)
INSARAG	:	International Search and Rescue Advisory Group (Uluslararası Arama ve Kurtarma Danışma Grubu)
JMA	:	Japan Meteorological Agency
JICA	:	Japan International Cooperation Agency
MHZ	:	Mega Hertz
MW	:	Moment Magnitude
OCHA	:	Humanitarian Help Coordination Organization (İnsani Yardım Koordinasyon Örgütü)
OFDA	:	Office of U.S. Foreign Disaster Assistance
OKS	:	Incident Command System (Olay Komuta Sistemi)
OSOCC	:	On Site Operation Coordination Center (Saha Operasyon Koordinasyon Merkezi)
RF	:	Radio Frequency
RSSI	:	Received Signal Strength Indicatior
SAR	:	Search and Rescue (Arama ve Kurtarma)

SSA	:	Shared Situational Awareness
SMS	:	Short Message Service
SUPER-MAN	:	Mobile Temporary Network Using Urban Disaster Preparation and Emergency Response
TABB	:	Turkish Disaster Data Bank (Türkiye Afet Bilgi Bankası)
TAMP	:	Turkey Disaster Intervention Plan (Türkiye Afet Müdahale Planı)
TDVM	:	Turkey Earthquake Data Center (Türkiye Deprem Veri Merkezi)
TEYDEB	:	Technology and Innovation Funding Programmes Directorate
TURKCELL	:	A Telecom Operator in Turkey
TÜBİTAK	:	The Scientific and Technological Research Council of Turkey (Türkiye Bilimsel ve Teknolojik Araştırma Kurumu)
UDAP	:	National Earthquake Research Programme (Ulusal Deprem Araştırma Programı)
UDSEP	:	National Earthquake Strategy and Action Planı (Ulusal Deprem Stratejisi ve Eylem Planı)
UHF	:	Ultra High Frequency
UN	:	United Nations
UNDP	:	United Nations Developing Program
UNICEF	:	United Nations International Children's Emergency Fund (Birleşmiş Milletler Çocuklara Yardım Fonu)
UNISDR	:	United Nations Office for Disaster Risk Reduction
UNOSAT	:	The United Nations Institute for Training and Research’s Operational Satellite Applications Programme
UNU-EHS	:	Environment and Human Security Institute of United Nations University
USAR	:	Urban Search and Rescue
USB	:	Universal Serial Bus
VHF	:	Very High Frequency
WHO	:	World Health Organization

WIFI	:	Wireless Fidelity
WFP	:	World Food Programme

CHAPTER 1

INTRODUCTION

Disasters are known as the great influences with an immense power to change the lives of people and the foundation of the societies since the beginning of the history. Both natural disasters and manmade disasters affected and still affecting the lives and people by creating immense destruction power. Disasters that happened in the past in different locations and time, are the events that are still affecting our lives today. In Turkey, along with the most important example of disaster of the earthquake with the magnitude of 7.4 in epicenter of Gölcük that happened on 17^{th} August 1999, different kinds of disasters in different locations are seen. Gölcük earthquake is known as the biggest disaster that happened in Turkey during 20^{th} Century (JICA, 2004). In near history, loss of lives in the world are recorded as 22.000 in 2013, 10.000 in 2014 (Ersoy, 2014), 7628 in 2016 (Gerdan, 2019), 9697 in 2017 (Kishore et al., 2018). The numbers affected from the natural disasters are about 100 million per year.

Among with the dead, masses affected from the disasters, however are recorded as millions in each year (Guha-sapir, Hoyois, & Below, 2014)Figure 1). Only in first 3 months of 2015 there were 2581 earthquake with more than 4.0 magnitude (M>4.0), two volcanic eruption, numerous floods, severe storms and hurricanes, tornados, landslides, avalanches and frosts. This situation shows the effects and of the natural disasters to the societal living and the inevitableness of them.

Perpetual repetition of the disasters and the inevitable natures of them cause different results and effects all around the world. According to Erkal & Değerliyurt (2009) the most important factor in this subject is the different precision and approach of the societies.

Table 1 Loss of Lives Caused by the Disasters Around The World During 2007-2016 Period

Types Of Disaster	Loss of Life*
Earthquake	35.174
Drought	2.004
Extreme Temperature	7.452
Flood	5.553
Landslide	830
Storm (Hurricane, Cyclone, Typhoon)	17.114
Mass Movement	23
Volcanic Activity	46
Wildfire	78
Total	**68.274**

* Between 2007-2016, (Kishore et al., 2018)

Erkal & Değerliyurt (2009) mentioned a striking example of two different earthquakes that occurred in very little time differences like 17th August 1999 in Turkey and 2003 in Japan. Earthquake in Japan was more effective than the earthquake in Turkey, however there was only one person who passed away in Japan during that earthquake with the reason of heart attack, meanwhile in Turkey, the number of losses were around 16.000 people. Similarly, economical losses that show parallelism are a common fact.

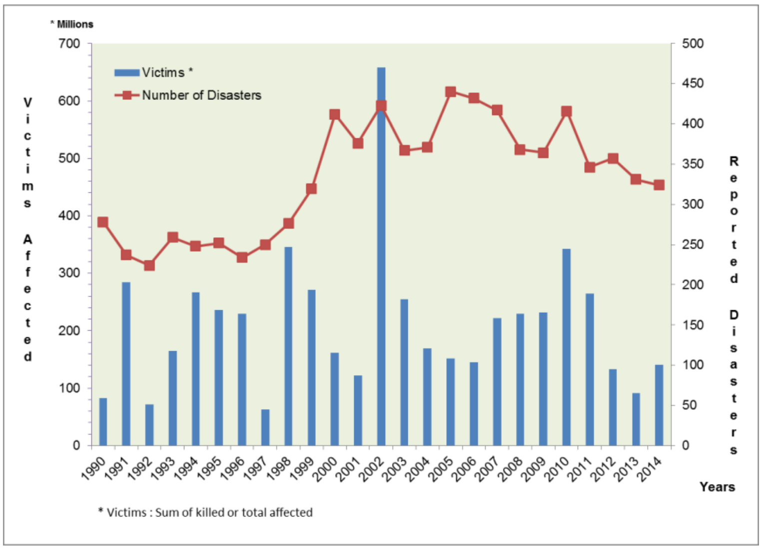

Figure 1 Number of Masses and Disasters Between 1990-2014
(Guha-sapir et al., 2014)

This situation is an important one for focusing on and for studying, from the viewpoint of Turkey. There are many similar results and studies in the literature related to this situation. There are studies related to health informatics in disasters by Ada (2013); change in disaster management by Aktel (2010a); troubles that are faced during disaster management Statheropoulos et al. (2015) and by Akyel (2010); reconstruction after disaster by Arslan (2009); search and rescue units' activities by Aydoğdu (2010); search and rescue techniques under avalanche by Ayuso, Cuchi, Lera, & Villarroel (2015); wreck survivor specification techniques by Brough, Morgan & Rutty (2015) and Mcconnell et al. (2010); optimal distribution and assignment of search and rescue teams by Lichun Chen & Miller-Hooks (2012); usage of robot technologies during disasters by Lin Chen, Wang Lu, & Xu (2011), Lin Chen et al. (2011), Reddy, Kalyan & Murthy (2015), Tokuda, Yagi, Kinugasa, & Miwa (2010); usage of wireless technologies for reducing searching period during search and rescue activities by Chenji, Zhang, Won, Stoleru, & Arnett (2012), Fujiwara & Watanabe (2005) and Ochoa & Santos (2015); usage of sensors during search and rescue activities by Dandoulaki & Andritsos (2007); modelling situational awareness in search and rescue by Dilo & Zlatanova (2011), and Seppänen &

Virrantaus (2015); search and rescue dogs by Greatbatch, Gosling, & Allen (2015); survivor detection techniques under the wreck by Hu (2012).

Turkey faces with natural and man-made disasters that cause great number of loss of life and property, due to its climatic characteristics and geological structure that it is positioned. 97% of the live and property loss that caused by the natural disasters in Turkey occurs due to earthquake (Macit, 2010). Therefore, when disasters are discussed, earthquake comes at first place. 66% of the country's land and 70% of the population is living in first and second degree seismic zone. 11 cities with more than a million of population and 75% of the industrial sites that are in, include a great risk of earthquake in any moment (AFAD, 2012a).

When we look at the World, natural disasters occur in every corner of the Earth, along with Turkey. In both 2014 and 2016 World Risk Report which is prepared by the Environment and Human Security Institute of United Nations University (UNU-EHS), Turkey is listed as 106^{th} under the low risk countries with the 5.20 points of World Risk Index among with 171 countries (Comes et al., 2016) (Figure 2). However, Turkey is a country with high risk when an evaluation for population that can be troubled with disasters is made. Although its Exposure percentage (%12,25) is low according to the World Risk Index, Lack Of Coping Capabilities (%69,11), Lack Of Adaptive Capabilities (%38,79) and Vulnerability (%42,44) percentages are high. This situation can be called as the cause for disaster management sensibility and communal approaches. Because of the low probability of the exposure percentage of the country, it can be seen that the communal approach can include a weakened sensibility of the subject with the idea of "nothing can happen to us". However, one of the main approaches to the disasters for reducing the effects before and after the disasters is about increasing the ability to be ready for, fight with and adapt to disasters. When our country is being considered with high risks, even though it is located in low risk geography, it can be seen that Turkey is a country with disaster risks in general (Gerdan, 2019).

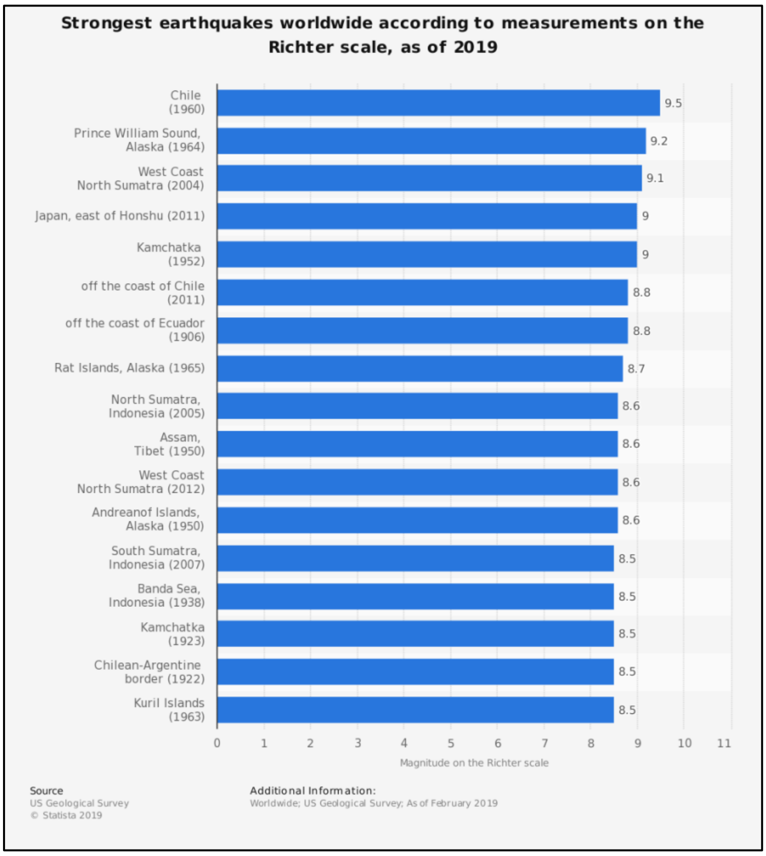

Figure 2 Strongest Earthquakes Worldwide (Statista.Com, 2019)

On the other hand, when developing communication and transportation technologies, crisis and conflicts, terrorism activities are taken in account, number of the manmade disasters are increasing as much as natural disasters. Due to the development in industrial area, demand for the raw materials are increased; however, with the demand for raw materials, the waste of these materials is also increased to threat the environment. Existence of these materials guide people into take necessary measures for technological disasters. Events such as mine accidents, wrecks, transportation accidents, environmental pollution, climate changes, cyber-attacks, terrorism (radiologic, biologic, nuclear weapons and accidents, industrial accidents) that occur with the effects of manmade or natural disasters are called technological disasters (Akyel, 2007). Technological disasters are quite common to come across despite all security measurements and technological developments. Natural and technological disasters gained a great level of importance due to the fast development of technology and industry. Even though earthquakes are considered as the big and most unexpected disasters, pressure effect after terrorist attacks (Comfort & Kapucu, 2006), explosions after industrial accidents or gas leakages, avalanches, and volcanic eruptions are constitute some part of disasters that cause traumatic results, economical loss and effects in social life (Arya, Anand S., Karanth & Agarwal, 2011).

Industrialization and development of the technology after the industrial revolution affected greatly the community life and people. When the worldwide EM-DAT (Centre for Research on the Epidemiology of Disasters International Disaster Database) records are investigated, since 1900, 7825 accidents and technological disasters in big scale that cause loss of life and property have happened (AFAD, 2014a). These disasters can be full-scale disasters that affect more than one country or region, without distinction. As an example, if an explosion on a natural gas pipeline in a country happens, the other countries on the same gas pipeline shall be affected too. Therefore, technological disasters became global events that make singular measurements created by one country is inadequate. Especially the disasters in the cities carry great scale of effects on complicated streets and tall buildings, and population of variety regarding ethnic and religious beliefs. Due to the nature of technological disasters that can be triggered by people, with the reasons regarding international economic and social differences, unjust sharing of profits in the world, and competition, technological disasters will become a serious issue to handle with utmost diligence in international grounds.

Both natural and technological disasters are unpreventable and therefore necessary measures shall be taken (Fujiwara & Watanabe, 2005). For example; to prevent the dangerous situations during earthquake a planning before disaster shall be executed (Güzel, 2013; INSARAG, 2012; Emin, 2011); for the damages that occurred after the earthquake there are necessity of preparation of another planning after disaster. Planning before disaster is crucial step to prepare situations to prevent or reduce the damages of earthquake. Each country developed different measures for prevention and designated disaster management types according to the disasters they suffer most.

Today in the world several effective and productive disaster management systems are developed to prevent or reduce loss of life and property due to the disasters before they occur (Akyel, 2007; Özerdem & Jacoby, 2006). Generally, disaster management systems consist of actions for reducing damage before the disaster, and the intervention activities that reduce the loss of life such as search and rescue during and/or after disaster. Disaster management systems also include temporary house constructions, improvement activities such as staple food and nutriment supplies for short term; include reconstruction of physical and social structure of affected area for long term (Arslan, 2009).

Disasters can be faced with in any moment, because of their unpredictable nature. In disaster management systems, search and rescue teams are the most important units to prevent or reduce the loss of life during a disaster. It is the utmost necessity of search and rescue teams to start working immediately after the disaster to rescue disaster victims as soon as possible. These works bring their own importance to reduce the casualties of disasters.

The works that are performed to rescue disaster victims and speed up the search and rescue activities are being held by the central organizations and institution systems. Especially during a disaster with full scale, it is known that central systems become out of order right after the disaster because of the destruction of infrastructures of power and communication, increasing number of communication traffic and effects of chaotic setting. In such cases, search and rescue teams who work as first responder (including fire and police departments) happen to be trained to start working without losing any second with the conscious of critical aspect of time (Statheropoulos et al., 2015a). Without the central systems and information flow, search and rescue works lose their effect and disaster victims start to lose faith to stay alive. Studies and suggestions in this thesis are designed to provide opportunities to information flow for search and rescue teams during interventions, speeding up the interventions, being able to work independently from central systems and work with volunteers at the same time, in a disaster management system.

1.1. Purpose of the Study

Disasters are inevitable in Turkey as in everywhere around the world. All the stages in disaster management processes are crucial and directly affects the chances of the survival of people. But search and rescue activities are one of the critical processes which races against time in order to save more lives (Caymaz, Akyon, & Erenel, 2013). One of the most important aspects that provides search and rescue success after the disaster is the availability of information (Statheropoulos et al., 2015a) that can ease and speed up the search and rescue activities of the teams. But currently search and rescue teams can not access local and victim information in a fast and reliable way. With the interviews with search and rescue experts and findings regarding the subject, we observed that the information technology use to provide more time and efficiency is a subject that did not gain enough attention.

After an earthquake, disaster victims are in a situation where they are wounded, hungry, in shock and fear and defenseless against the natural elements. Generally, person who is under a wreck is stuck or wounded, immobile under tons of wreckage. Thereby, with usage of resources under the search and rescue activities with efficiency and swiftness, disaster victim should be addressed with knowledge, experience and coordination. Limited resources, bad weather conditions and the behaviors of the people who reached to the victim affect the whole rescue activities. Under these circumstances, one of the most important aspects that provides the success of search and rescue activities is about receiving the information that can ease and speed up the search and rescue activities (such as disaster area, people who are under wrecks, building's intended use, floor number, number of people in the building, hazardo us material in the building etc.) immediately (Pehlevan, Talay, Güven, & Avdan, 2009; Avdan, 2011; Dilo & Zlatanova, 2011). With receiving the information that can ease and speed up the search and rescue activities, search and rescue teams will be able to work according to the right way in a swiftness.

The objective of this doctoral thesis is;

✓ Investigation of search and rescue activities during intervention at disaster management in Turkey,

✓ Determining the parameters that affect the search and rescue activities,

✓ Determining the factors that affect the time of rescuing the victim alive during search and rescue activities,

✓ Having a confirmation of information that can be used to speed up and making more efficient of the search and rescue activities from the experts of search and rescue team by conducting a poll,

✓ Proposing an innovative model that provides benefits to duty security and situational awareness and planning by shortening the getting of information of victims underground during search and rescue,

✓ Proposing a roadmap for short and long terms and some suggestions for disaster management processes in Turkey.

To reach these objectives, our main approach includes gathering information by the opinions of search and rescue professionals regarding a new wireless technology tool to shorten the time for gathering information of survivors under wreckage with the detection of necessary data that teams can use for search and rescue.

Implementation proposal of these objectives modeled by developing a system that can locate a help signal that comes from an accessory (like a watch) on a disaster victim under wreckage to a mobile tool (tablet and phone) of search and rescue team on the area of disaster, and testing the technological utilities in direction of the objectives of the study. Providing an effective and efficient search and rescue activities, more disaster victims can be rescued alive (Avdan, 2011). With the consideration of factors that reduce the time of search and rescue activities, efficiency of search and rescue teams can be increased, searching times can be decreased, a better planning can be made, and especially in international duties, field operations can be prepared more efficiently.

1.2. Motivation

In this doctoral thesis, the effects of the arrival time of the information of search and rescue teams regarding disaster victims under wreckage who are still alive are investigated. Several polls, interviews and face-to-face meetings with active search and rescue experts (between 2013-2015) in Turkey are conducted for this study. Findings of the test and poll results of the search and rescue teams are recorded in the study. After getting some outcomes from these studies, a technological tool is developed to improve the efficiency of search and rescue activities and for rescuing more alive victims. In the period of this tool development, search and rescue activities are tested comparatively with traditional methods.

Table 2 Big Scale Earthquakes of Last 19 Years in Turkey

No.	Date	Location	Magnitude (M_w)
1	17th August 1999	İzmit / Gölcük	7.4
2	12th November 1999	Bolu / Düzce	7.2
3	02nd February 2002	Afyon / Sultandağı	6.1
4	27th January 2003	Tunceli / Pülümür	6.4
5	01st May 2003	Bingöl / Center	6.1
6	15th July 2008	Akdeniz	6.1
7	23rd October 2011	Van / Center	6.7
8	10th June 2012	Muğla / Fethiye	6.0
9	28th December 2013	Akdeniz	6.0
10	12th June 2017	İzmir / Karaburun	6.2
11	20th July 2017	Muğla / Bodrum	6.5

Statistically, one of each 233 days, a large-scale disaster occurs with the results of at least 100 casualties (Gülkan, Balamir, & Yakut, 2003). The last 19 years' (just after 1999 Gölcük Earthquake) earthquakes with more than 6,0 Mw (magnitude) in Turkey can be found in Table 2 (deprem.gov.tr).

Past disasters bring the result of failure to reach necessary information about disaster victims under wreckage who are still alive by the search and rescue teams (Hu, 2012). Organizations which lost its effectiveness by the earthquake's devastating effects, people who lost their conscious with the shock or pain comes after the disaster, and problems regarding transportation and communication caused more difficulty in these activities. In fact, after 24 hours after the disaster, chances of rescuing people from wreckage are decreased of %50 or more (Mizuno, 2001). Prime Ministry Disaster and Emergency Management Presidency (AFAD) mentioned the importance of first 72 hours after the earthquakes (Kundak & Kadıoğlu, 2011).

In the meetings with expert teams in Ankara, it is learned that there is no such tool or system that is searching for help signal, in the hand of search and rescue teams in Turkey (AKUT, 2018). However, wireless mobile device usage increased to very high levels. These devices can execute wireless connections via WiFi and Bluetooth and even 4.5 G with GSM networks. Thereby, it is possible to use these wireless mobile devices with GSM and local wireless systems with their flexible usages and application developing infrastructures for search and rescue activities effectively and commonly. In addition to this, mobile devices are also known for low resource based devices. Batteries of these devices are highly limited, endurance to environmental conditions are low, their storage capacity are scarce and their network connections are weak or easy to interrupt.

The old studies which is made to speed up the search and rescue activities grounded on central systems. In such cases, after the disaster, because of the increasing number of communication traffic or collapsing infrastructure, suggested systems do not work. With the developed system in this thesis, information of alive victims by the search and rescue is collected independently from the central communication infrastructure.

In this thesis, an innovative model is proposed in order to get the local information an a fast and reliable way regarding to the importance of time at search and rescue operations. Due to the main goal as saving lives as much as possible, expert experiences collected and a system designed to make the survival rate increase after a disaster in Turkey.

1.3. Scope of Study

In the scope of this study, related works and surveys are conducted according to the methodology and extend in below (Figure 3). At first, many studies are conducted in Turkey for survivor information gathering methods and techniques, and the aspects of shortening the periods of reaching to data, affects of these aspects to search and rescue activities, necessary information, and researches related to solutions for gathering these information.

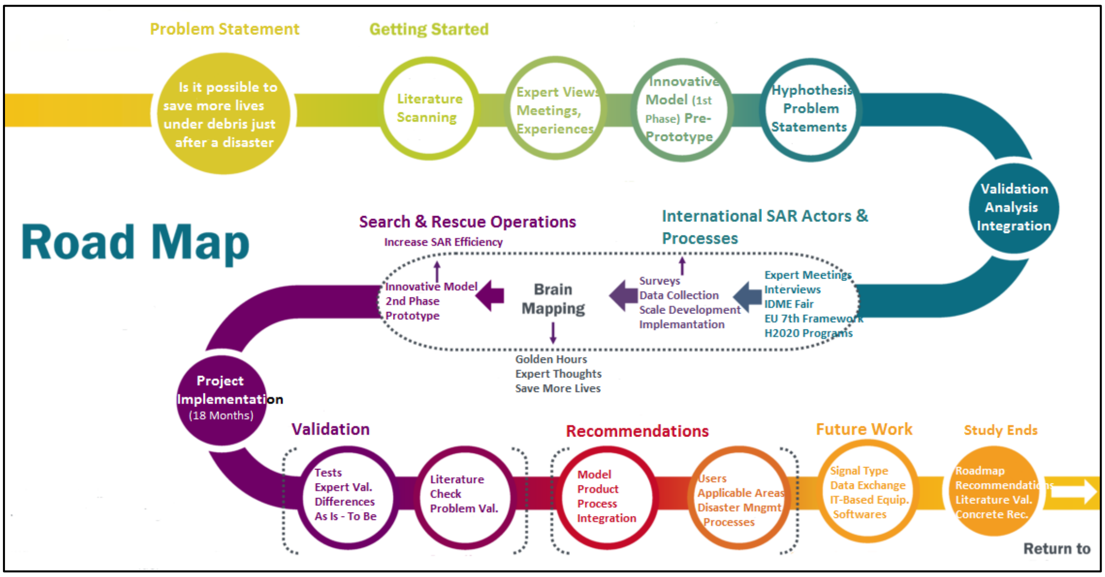

Figure 3 Road Map of Study

These studies are:

- ✓ A literature scanning to find disasters and types of disasters, disaster management systems in Turkey and in the world, disaster and risk management systems, search and rescue activities in disaster management, parameters in search and rescue activities, and aspects regarding the technological application and research for shortening the period of search and rescue of alive victims. During this scanning, international sources especially considered. In the scanning, similar or different aspects of the applications in Turkey and abroad considered. These studies are explained in first and second chapters with details.
- ✓ Face to face interviews with the people of officially or unofficially assigned for search and rescue activities, between the years 2013 and 2014. During these studies, information sharing regarding experience of these teams, training subjects, lessons and example applications are made. These activities during search and rescue, other studies in literature and details of necessary information took part at third chapter of the study.
- ✓ In the field study that is made to confirm the studies before and examine the details of experts opinions, an evaluation of current situation in Turkey, a survey that includes efficient search and rescue suggestions is made. Survey questions are enhanced after taking the views of an expert of survey application, and final implementation is started on web (www.anket.vairosoft.com) address during 2014 to gather necessary data. Survey study is implemented to personnel who have expertise on search and rescue and worked in field regarding this subject in Turkey. Detailed explanations regarding survey results can be found in forth chapter of this study.
- ✓ With the result from literature scanning and interviews/surveys, a technological device is developed to reduce the time of searching alive victims during search and rescue; and these developments are supported financially by the TUBITAK (Scientific and technological research council of Turkey) TEYDEB Department as a research and development program number 7150684. Project is conducted during 2016 and 2017 and finished succesfully in December, 2017. The project is intended for developing a technological device prototype which is planned for increasing the effectiveness of search and rescue teams and decreasing time of search alive victims

under wreckage. And also an innovative search model/procedure is proposed with this device in the Project. The aspects related to this study is included in fifth chapter of this thesis with details.

✓ All the results and lessons learned gathered at the last sixth chapter and some suggestions and a roadmap for disaster management processes regarding to search and rescue activities in Turkey are listed in this chapter.

1.4. Planning and Management of the Study

Theoretical works regarding field of study is investigated by literature scanning. As a field study, some interviews and a survey is made with different personnel from the organizations that are included to the disaster management system such as AFAD (central and country organizations), AKUT (Ankara and country organizations), Civil Defense Search and Rescue Units, GEA Search and Rescue Organization, AKA Search and Rescue Research Association, Çanakkale Onsekiz Mart University (ÇOMÜ) Emergency and Disaster Management Department, Dumlupınar University Material Science and Engineering Department, Department of Mining Engineering, Yıldız Technical University Civil Engineering Department, Pamukkale University Health Care Vocational School for Higher Education, Eskişehir Anatolian University Health Institution Business Management Department, Akdeniz University Institute of Science and Technology Geological Engineering Department, and Antalya Metropolitan Municipality Fire Department. Besides these interviews, a booth is installed by participating into the IDME 3rd International Disaster Management Fair and Conference which held in Ankara between the dates of 27-29th November 2014. In this event, the meetings with experts continued (Figure 4). The knowledge and documents that are obtained were conveyed to this study; these information is held as the base of the survey implementation and application that is developed.

Figure 4 Face to Face Interviews with Experts in Ankara

To determine existed Turkish Disaster Management System, publications, laws, regulations and circulars of public institution and organizations including AFAD are examined.

The study which is made to determine the effect of the reaching time to the victims on the search and rescue activities are divided into six chapters in this study. At the first chapter of the study, the objective, importance, scope and provisions regarding the methods of the thesis are mentioned. At the second chapter, concept of disaster, types of disasters and their effects, disaster and emergency management systems, disaster management units in Turkey and all around the world, steps and organizations of the managements and existed technologies that in use are mentioned. At third chapter, special processes, techniques and technologies that are used, and important parameters of search and rescue activities in the action of disaster and risk management are mentioned. At the fourth chapter, an analysis of the survey that is used to experts is made to determine the effects of reducing time of search and rescue of alive victims on the search and rescue activities. At the fifth chapter, Emergency Help And Detection System (EHDS) which is an application to reduce the time of finding alive victims during search and rescue activities is explained with details. Also an innovative search model is proposed with this system. At the sixth and last chapter, the technology policies regarding to the search and rescue operations, analysis and the studies related with policies, the lessons that are taken, results and suggestions for later studies are included.

1.5. Main Contributions of The Thesis

The major contributions of this thesis can be summarized as:

✓ Disaster management systems and organizations in Turkey is reviewed, the literature about disaster management systems is scanned and summarized.

✓ Search and rescue processes, tools and techniques at SAR processes in Turkey are listed and defined in detail regarding to the interviews and face to face meetings with professionals.

✓ Informations needs at SAR processes, information systems and robotic systems that are used at SAR processes are examined. Information requirements of SAR teams when they arrived at disaster area are derived and listed.

✓ A valuable data gathered from the experts about the aspects of SAR operations, factors affecting the activities and belief about the tools and technologies used.

✓ A local victim detection system is developed with a signal generator and mobile detection unit. Existing works in the literature have focused on the GSM or GPS based centralized systems. However centralized systems are not used in the developed system in order to minimize the search and rescue time to save more lifes. It is an innovative model proposal for search and rescue processes in Turkey.

✓ A short, mid and long term roadmaps for the search and rescue units in Turkey at disaster management are listed.

CHAPTER 2

DISASTER MANAGEMENT

2.1. Concepts and Definitions

2.1.1. Concept of Disaster

Disaster is the name of the event that causes loss of live and property, that requires coordinated work of many different organizations to cope with, and that stops the normal life and human activities with the state of nature, technological and human made (AFAD, 2014b). These events are called as “natural hazard” if they are happened during the life span of the nature itself. These events are called “technological disaster” if they are happened because of manmade systems. To gain the name “disaster” these hazards should happen in a large scale to cause loss of life and property, social environments and societies.

Figure 5 Distribution of World Population Into Urban and Rural Areas (Works & UNU-EHS, 2014)

In Turkish, disaster is called “afet”. The word “afet” is originated from Arabic and it means devastating events in the nature (tdk.gov.tr).

According to the World Risk Report (Works & UNU-EHS, 2014), in 1950s, 2/3 of general population were living in rural areas however that number has changed to 1/2 in 2007; and it is also expected to change to 2/3 of general population will live in cities (Figure 5). This situation reveals a bigger calamity in our country than in worldwide. Correspondingly to these expectations, it is known that due to the living in more intense and risky places with many other people, natural and manmade disasters will create immense effects on people and societal living.

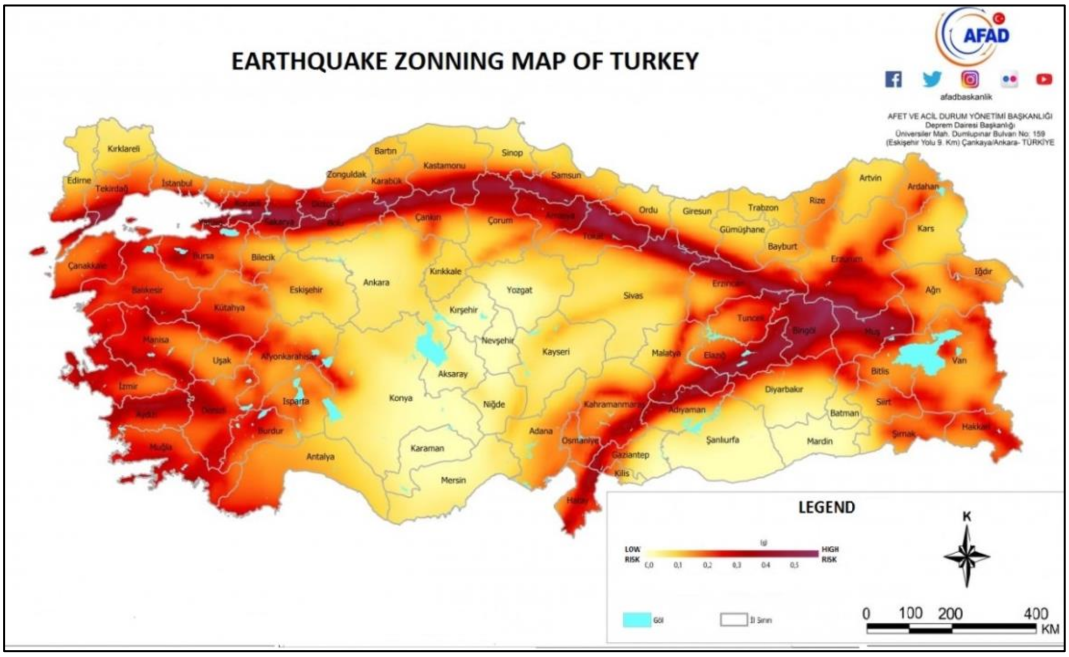

Figure 6 Map of Earthquake Regions (AFAD, 2018)

More than 90% of Turkey is under the risk of earthquake and the 95% of the population is living under the high seismic risk (Figure 6). In 20th century, the most devastating event in Turkey is happened in 1999 around Marmara and it caused damages around 250.000 buildings in different levels (Albayrak, Canbaz, & Albayrak, 2015). There are many different studies in the literature regarding the building structure as an important factor that affects the destructions and disasters alongside with the earthquake risks in our country. In one of these studies, as a small example, for creating a database and increasing the speed of search and rescue teams' work for preparation before disasters is made by Albayrak et al. (2015) in Eskişehir with the method of recording 1.643 buildings that reevaluated according to the parameters. Because of these evaluations, 218 buildings (13,2% of all buildings) are recorded in high risk category and 492 buildings (29,9% of all buildings) are recorded in low risk category. As a result of building evaluations, 43% of the buildings are in risk and any big earthquake can destroy them easily. The studies related to risky buildings have gained a movement in 2018. According to an announcement made by AFAD, right after a similar study related to this topic (Erdem, 2009), 65.377 buildings in 23 districts of Istanbul are confirmed as risky and demolishing of 48.609 of those buildings have conducted immediately. Similarly, in İzmir, eight different risky zones have been established with 918 hectare surface in six district. In İzmir, the number of risky buildings were confirmed as 17.905 and demolishing of 14.429 of those buildings have conducted immediately. Same year, according to the statement of Murat Kurum, Environment and Urbanization Minister, it is confirmed that there are 7.5 million risky buildings for urban transformation in Turkey (Hürriyet, 2019). These numbers are challenging, according to the urgency and importance of disaster related actions as a reality of Turkey.

Even though the technological level is getting higher every day, mankind is still vulnerable to natural events such as earthquake, drought, volcanic eruption and storms, and other international events like terrorism, wage gaps, conflicts. The capability to stop these events does not exist with mankind. The most important action to take against these disasters is researching, planning and applying the studies regarding effects of disasters to societal order.

Despite all actions that are developed and increased in Turkey and in the world, number of disaster victims who rescued alive after the disaster is lower than the casualties (Bartels et al., 2010; Mizuno, 2001). On the other hand, downfall, crashing and smashing events (such as in Iran 2003 Earthquake, Indonesia 2004 Earthquake, Italy 2009 Earthquake, Haiti 2010 Earthquake, Japan 2011 Earthquake, Indonesia 2018 Earthquake), and manmade technological disasters or accidents (such as in The Netherlands 2000 Airplane Crash, Indonesia 2002 Airplane Crash, Russia 2009 Hydroelectric Power Plant Explosion, Canada 2013 Airplane Crash, Turkey/Soma 2014 Mining, Egypt 2015 flood, Turkey/Ankara 2015 Explosion) and the numbers of casualties are growing (AFAD, 2014a). In a place that the risk of disaster and the casualty possibilities is high, there is a need for increasing number of research to cope with rescuing people alive after disasters and gain necessary measurements against disasters.

2.1.2. Natural Disasters

Natural disasters are events that cause shutting or slowing down the social life and they occur with the effects of nature itself. These events are defined as the events that caused by the geological or atmospheric factors (Akyel, 2007). The most well-known of the disasters is earthquake which can affect the whole life by its existence after the movement of earth’s crust. Avalanche is a disaster that causes casualties or loss of properties by the movement of snow that includes soil or rock pieces in it from higher places to lower grounds (Ayuso, Cuchí, Lera, & Villarroel, 2015). Volcanoes are funnels that magma comes to the surface of the earth and they threat the environment with lava and/or clouds. Tsunami is defined as oceanic waves that has an immense wave number that can be caused by the earthquakes (Wright et al., 2015; Wex, Schryen, Feuerriegel, & Neumann, 2014). Tornadoes are swirls that occur after the weather's powerful revelation. Landslides are the change of location of big soil/rock pieces due to the gravitation or excessive precipitation. Floods are causing loss due to the increasing level of excessive precipitation or melted snow. Storms and fires are disasters that are most common natural disasters. Fogs are also accepted as a natural disaster due to its power over societal life and its effect to accidents.

2.1.3. Technological Disasters

Technological disasters are also known as manmade disasters. These disasters are the disasters that are occurred from manmade systems with an effect from nature directly or indirectly. Akyel (2007) evaluated the flight or automobile accidents, war, terrorism, fires, chemical accidents (Phalkey, Ranzinger, & Marx, 2004) or sabotages as technological disasters, while Kenar & Karayılanoğlu (2004) added nuclear accidents and attacks as technological disasters.

Table 3 Natural and Technological Disaster Relation (Phalkey, Ranzinger, & Marx, 2004)

Natural Disasters	**Technological Disasters (Man-made)**
Geo-physical Avalanches/landslides, earthquake, volcano	Industrial Accidents Chemical spills, collapses of industrial infrastructure, explosions, fires, gas leaks, poisoning and radiation
Meteorological Storms, cyclone	Transport Accidents By air, rail, road or water means of transport
Hydrological Flood	Miscellaneous Accidents Collapses of domestic/non-industrial structures, explosions and fires
Climatological Extreme temperature (heat/cold wave), drought, wildfire	
Biological Epidemics, insect infestations	

Integrated structure of technological disasters with natural disasters and the sphere of influence already surpassed the national borders. Both natural and technological disasters can trigger one and other (Table 3), and require the cooperation (Figure 7) and coordination (Table 4) between countries/ institutions/organizations that are affected.

Figure 7 Disaster Management Actors in Turkey (AFAD, 2014a)

2.1.4. Effects of the Disasters

Disasters can cause different effects according to their nascence. While earthquakes cause damage on infrastructures and buildings, tornado and hurricanes cause damage on vehicles, equipment of daily life and buildings. Floods and landslides are more likely affecting the rural areas (Arslan, 2009). According to the records of last 60 years, direct or indirect loss of properties and damages reached to the 3% of Gross National Product (AFAD, 2012a).

Along with the physical effects of disasters, psycho-social effects that affect human and societal lives are also existed (Figure 8). Arslan (2009) indicated that there can be predictions regarding different societal actions, however not every person can show such an action in each stage. Generally, right after the disaster, people have a tendency of rescuing and protecting others than themselves during courage stage. Actions of saving lives and materials happen during this stage. At the second stage, the expectation regarding surviving together and public opinion and attention to the event and assistance to the victims becomes more important.

Table 4 Cooperation and Coordination for Technological Disasters (AFAD, 2014a)

Technological Disaster	Relevant and Responsible Institutions and Organizations
Large Scale Industrial Accidents	* Ministry of Science, Industry and Technology * Ministry of Labor and Social Security * Ministry of Environment and Urbanization
Accidents that Affect Marine Pollution	* Ministry of Transport, Maritime Affairs and Communications * Ministry of Environment and Urbanization * Coast Guard Command
Disasters Related to Climate Change	* Ministry of Environment and Urbanization * Ministry of Food, Agriculture and Livestock * Ministry of Forestry and Water Affairs * Ministry of Health
Bio-security of Genetically Modified Organisms	* Ministry of Environment and Urbanization * Ministry of Food, Agriculture and Livestock * Ministry of Forestry and Water Affairs * Ministry of Health
Accidents of Mine and Mine Tailing Ponds	* Ministry of Science, Industry and Technology * Ministry of Labor and Social Security * Ministry of Environment and Urbanization * Ministry of Food, Agriculture and Livestock * Ministry of Transport, Maritime Affairs and Communications * Ministry of the Interior * Turkish Atomic Energy Authority Directorate * Turkish Scientific Technology and Research Department * Nongovernmental Organizations
Accidents of Hazardous Substance Transportation	* Ministry of Science, Industry and Technology * Ministry of Environment and Urbanization * Ministry of Energy and Natural Resources * Energy Market Regulatory Authority * Ministry of the Interior * Ministry of Transport, Maritime Affairs and Communications

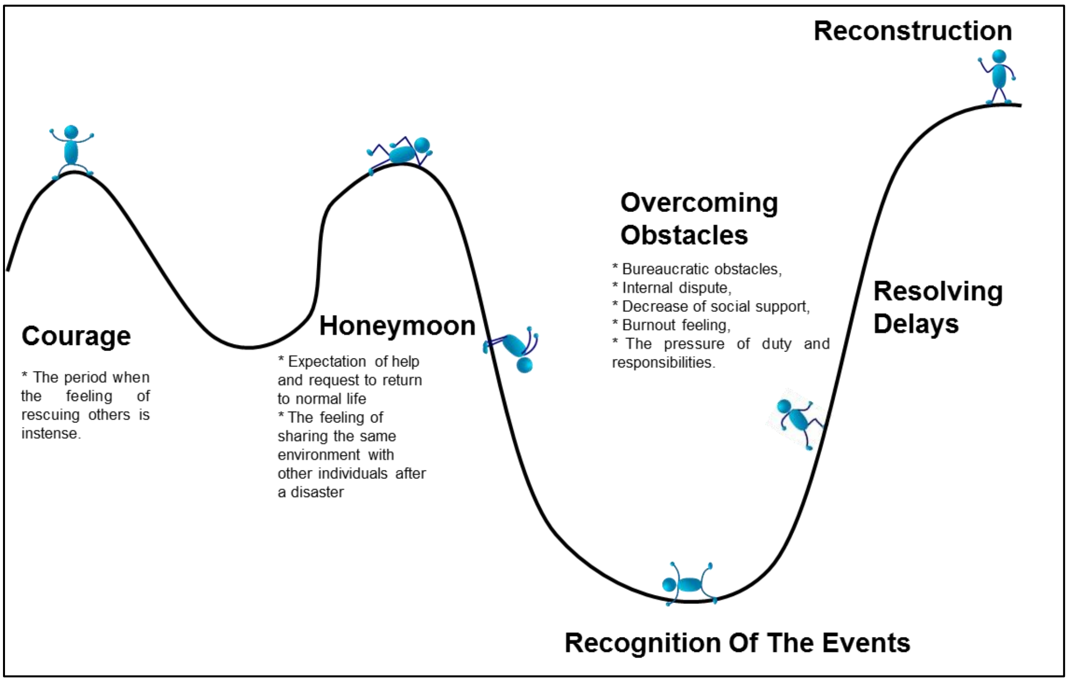

Figure 8 Psycho-Social Stages of Disasters (Arslan, 2009)

After the second stage, people live a disappointment due to the lack of helps, bureaucratic obstacles and losing attention of public. Later, with the recovery actions, solving difficulties regarding assistances, creating a psychological stability, reconstruction stage starts. Regarding physical and psycho-social aspects of reconstruction, dependence to the ground due to the traumatic effect after earthquake, environmental adaptation and mental mapping concepts, Arslan (2009) carried out a study. The most important point of this study is related to rescue activities by the people in disaster zone who gained their confidence, right after the first shock. The tool that is developed as innovative model and is suggested in this study is a device for common people who are not search and rescue professionals to conduct rescuing actions for survivors right after the disaster.

Another example for the effects of disasters is avalanche incidents. Casualties after avalanches are increasing each year. Especially in mountain regions, between local population, mountaineers, passengers, road or electricity infrastructure workers, military personnel and athletes, avalanche incidents happen frequently. Each year, average of 200 avalanche incidents end with casualties. In avalanche incidents, period of staying under snow, snow depth and type of avalanche are the most important factors to survive under the snow. Possibility of surviving under avalanche decreases after 8 minutes of staying under snow, greatly. Snow depth caused by the avalanche is another important factor. In the depth of more than 2 meters, due to the difficulty to elevation, the possibility to survive is quite low (Ayuso et al., 2015). This study too, reveals the importance of first 72 hours and even minutes. Survival rate after disaster rapidly decreases. Hence the participation of local people for rescuing and survivor detection activities may save many lives.

Search dogs and harmonic radars are being used for search and rescue operations in avalanche incidents. However, due to the inverse proportion of surviving chance and staying under snow period, it is better for victims to being rescued by their friends at the area immediately than to wait for search and rescue teams' arrival. Avalanche rescue transmitters are the most valid technologies regarding the incidents. These tools can be used as a receiver and a transmitter with solenoid antennas. In normal conditions, these transmitters emit 457 kHz bandwidth signal. In the circumstance of a person involved in an avalanche incident, rest of the tools turn into a receiver and search for the signal of transmitter (Ayuso et al., 2015).

Since the invention of avalanche rescue transmitters, there were many studies regarding catching signal, signal direction, searching optimization techniques and detection of the victim. Ayuso et al. (2015) studied the subjects regarding magnetic field emanating from transmitter and the way of perceive of this field by the receiver, and the effects of snow and soil to the signal. Avalanche rescue transmitters carry some similar features with the application that is subjected to this thesis.

Except the cold regions with avalanches, mountain activities gain more attention each day. Especially mountain climbing, rock climbing, ski, race, backpacking, horse riding on mountain, and mushrooming are the activities with great attention from public. Even though there is a great attention for these activities, the attention for working difficulties and risks on the area and their awareness about these are not receiving great attention. In the interviews with the survivors, is has been seen that inexperience is the biggest issue. However, rescuing operations are dangerous even for search and rescue teams and especially around difficult terrains, the difficulty level can be increased according to the summer or winter seasons. Regarding this issue, informing about accident aspects and early education are extremely important to reduce the risks and accident costs (Ciesa, Grigolato, & Cavalli, 2015).

2.2. Disaster Management Systems

2.2.1. Disaster Management

The subject of disaster management differs from country to country in terms of management, organizational structure or operation methods. However, at the same time, since because disaster management does not require any borders, creating of standards in especially international operations provides features such as partnership and mutual activities.

Although the information and technological levels are higher than before, the abilities of human kind against disasters are considerably limited. Due to the inescapable nature of the disasters that causes fatal destructions, making a preparation before disaster and putting it into the force is carrying a crucial impact to prevent the effects of the disaster to the public. Since Turkey is recorded as one of the most death occurrences (Figure 9) at last century, it is more important to make researches regarding this subject in here.

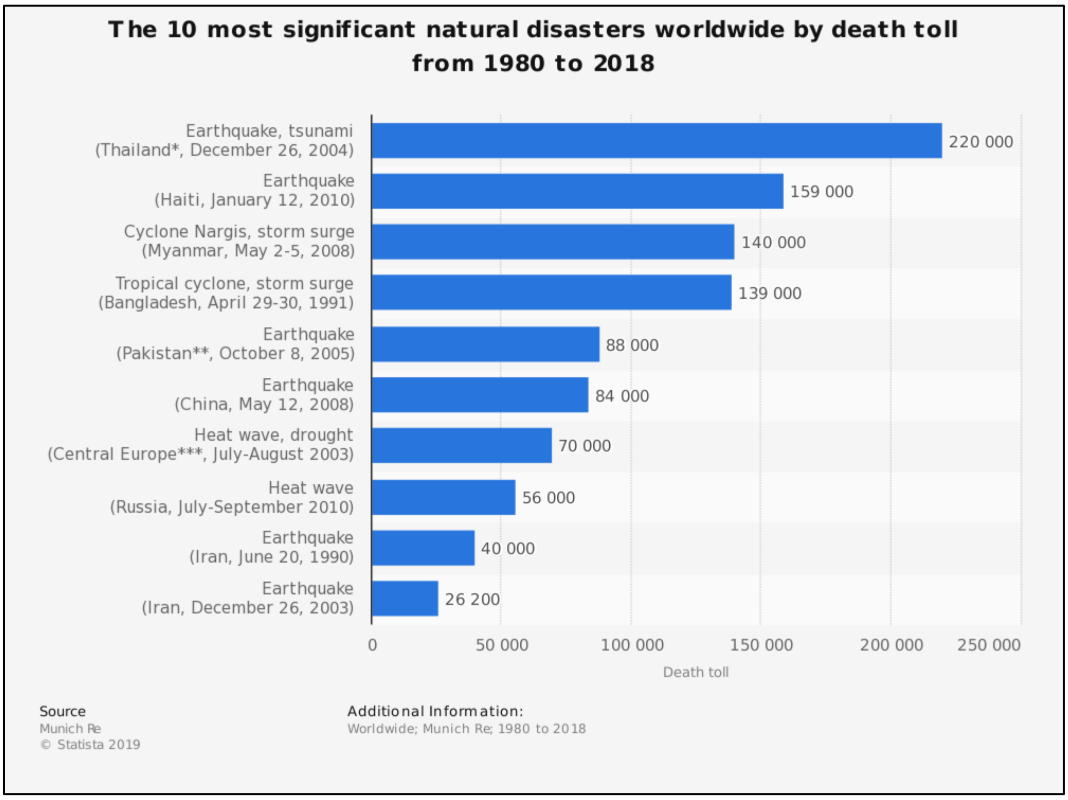

Figure 9 The 10 Most Significant Natural Disasters (Statista.com, 2018)

To the studies and exercises to introduce disasters to people and inform people about the subject, and decrease the effects of such disasters in recurrence are called "Disaster Management". In literature, there are many different definitions existed for disaster management. (JICA, 2008) takes the studies regarding understanding disasters, early warning, preparation and prediction before disaster, under the title of "Risk Management". Activities such as impact analysis after disaster, interference, improvement, reconstruction is considered under the title "Crisis Management".

Erkal & Değerliyurt (2009) defined the "Contemporary Disaster Management" as an activity that requires the knowledge of risks for these disasters, taking preventive actions and if it is possible resolving the risks for good and decreasing the impacts to eliminate the harms of these disasters. In this struggle, the main elements include the planning of an active disaster, providing an organization to prevent authority crisis, taking example from developed countries, and actively using the information technologies and geographical information systems in disaster managements.

Aktel (2010) considered the disaster management as the all exercises that apply to the whole public for eliminating negativities of public life and losses after the disaster. He also said that these exercises should cover the planning, inducement, coordination and institutional formations, and usage of existed resources in an effectual and productive way. Nowadays disaster management covers the studies and exercises of preparation before disasters and taking necessary measures to prevent the damages, decreasing the levels of uncertainties, and returning to the normal life as fast as possible (Horita, de Albuquerque, Marchezini, & Mendiondo, 2017; Anson, Watson, Wadhwa, & Metz, 2017).

During the recent years, along with the natural disasters, technological disasters that affect social life and environment, global and local economy, human and public health, started to occur more often. Technological disasters include transportation accidents, misuse of information and communication technologies, industrial accidents, nuclear accidents, mining accidents, wastes in the sea and environmental pollution. To prevent these disasters there are many necessities and general measurements like written below:

✓ Informing related institution regarding usage, transportation or storage of dangerous substances, and establishing the support systems regarding these issues,

✓ Preparing, reviewing, and testing of preliminary plan to prevent accidents for dangerous substances or industrial infrastructures,

✓ Determining the domino effects,

✓ Preparing and testing the risk assessment and accident scenarios,

✓ Establishing an infrastructure of information technologies that increases speed between parties, in case of a partnership between institutions, and usage of mutual sources and information sharing,

✓ Renewing the related regulation, making the organizational changes. (AFAD, 2014a).

To provide an effective disaster management in Turkey, a nationwide policy related to the topic should be executed as well as the disaster management culture should be implemented with each level of the society. When the studies and operations after the implementation of the law no. 5902 and subsequent works are taken to account, it is seen that, in Turkey, there must be more works to be accomplished for this subject. When the force of disaster and disaster management is taken as a continuously improving and enhancing progress, it also should be taken as a fact in our lives as a loop with never ending results.

2.3. Disaster and Emergency Management in Turkey

Turkey is one of the countries that encounter with numerous disasters that cause high numbers of casualties and loss of property, due to its climatic, geological and topographical structure (Figure 10). When the past disasters are considered, it is known that big scale disasters and casualties may occur in the future. When we examine the statistics of disasters that cause casualties and loss of property in Turkey for last 60 years, 62% of damage is occurred due to the earthquakes (Limoncu & Bayülgen, 2005). Therefore, when disasters are discussed, earthquake comes at first place in Turkey.

Due to its unpredictability of disasters, being ready for all time is a crucial step. During and after disaster, fast intervention is one of the most important factors to rescue people. Being ready for each kind of help after a disaster can only be possible with a good planning.

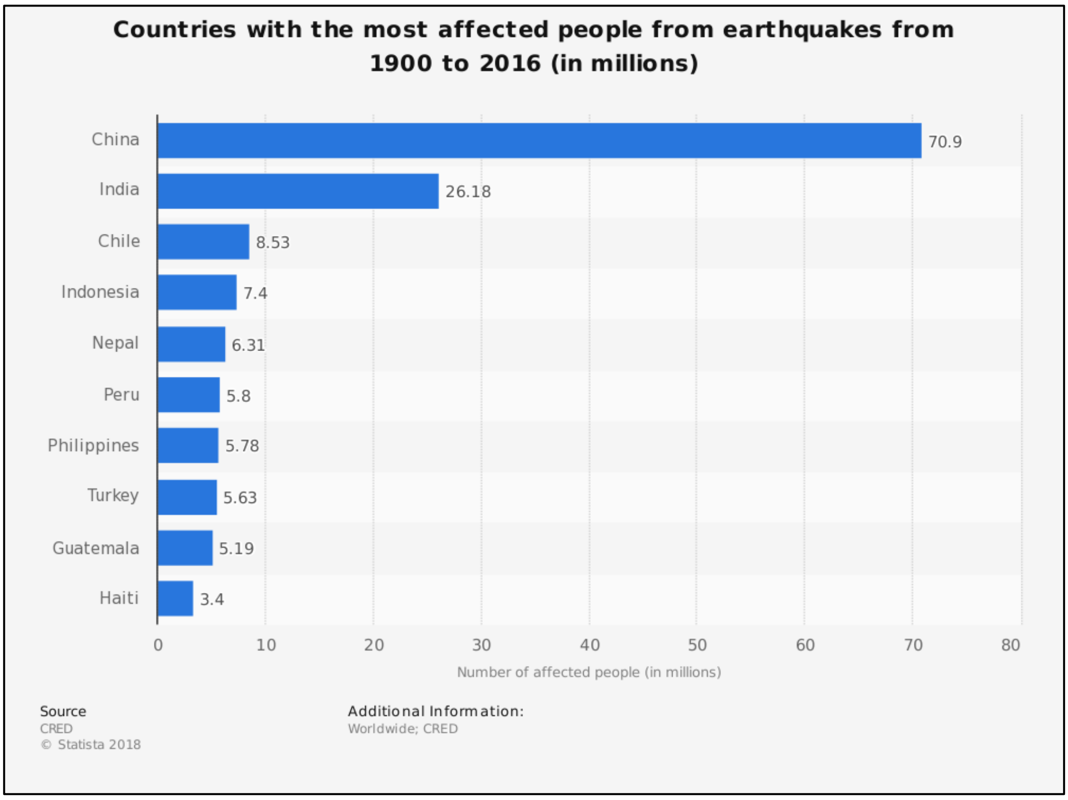

Figure 10 Countries With the Most Affected People From Earthquakes (Statista.com, 2019)

In literature, disaster management is identified as two-phased action. “Risk Management” that includes the analysis of risks until the event of disaster, preparation and reducing those risks; “Crisis Management” includes the activities that start after the disaster and consist of improvement and returning to normal lives (Kutluk, 2011; JICA, 2008)

After 1939 Erzincan Earthquake in Turkey, policies regarding natural disasters started to be prepared. With the events that happened at the same time with 1939 Erzincan Earthquake such as Niksar-Erbaa, Adapazarı-Hendek, Tosya-Ladik and Bolu-Gerede Earthquakes that caused 43.000 casualties and 200.000 buildings are severely damaged or razed, it is understood that different kinds of studies should be made to decrease the numbers of casualties and losses instead of helping people after disasters and a law no 4623 “Law Regarding the Measures To Take Before and After the Earthquake” is established in 18th July 1944. The actual works and studies regarding decreasing the damages of disasters are started with this law (afad.gov.tr). In the world, only Japan, USA and Italy had almost the same law in that time. In 1945, to comply with this law, Earthquake Areas of Turkey, Regulation of Disaster Area Actions and Regulation of Earthquake Area Structure in Turkey is published.

With the “Civil Defense Law” with the number of 7126 which came into force during 1959, rescue and first aid actions during disaster is arranged and grounds of General Directorate of Civil Defense is established.

In 15th May 1959, “Law of Measures and Actions for Disasters that Affect Public Life” with the number of 7269 is established to involve settlements that can be affected to earthquakes, avalanches or floods, while the grounds of General Directorate of Natural Disasters are founded. The law mentioned above is the main law that is in force regarding the actions to be taken for sake of disaster survivors and the activities of disaster area in general. Recently, in 2014, regarding helping to the victims and their families who are affected by the mine accident in Soma, Manisa, some improvements on the law have been made.

In Turkey, regarding disaster management, engineers have great part for solving problems regarding construction and geological dynamics for many years (Leblebici, 2014). Emergency Management System is considered sufficient for small scale disasters until 1999 Marmara Earthquake. However, in the disastrous 1999 Marmara Earthquake which led too many to great suffering showed that existed disaster management system in Turkey is not sufficient enough. With this earthquake, the deficiencies in disaster management process showed themselves immensely. Both not developing an awareness for importance of being ready for disasters and the devastating effects of earthquakes increased the ravages of disaster (Kundak & Kadıoğlu, 2011).

Different institutions with different responsibilities regarding disaster management in Turkey caused some troubles in activities of disaster managements, however especially after 1999 Marmara Earthquake, a need of disaster and emergency management in single hand is risen. Firstly, Turkish Emergency Management General Directorate is established in 2000. However, in this 10 years of time, Turkish Emergency Management General Directorate, Natural Disasters General Directorate and Civil Defense Head Office in different ministries for same duty caused coordination difficulties. Until 2009, many different studies regarding acceleration of central coordination and improving local movements after the past disasters are made. In 2009, with a law with number of 5902, Disaster and Emergency Management Directorate of Prime Ministry is founded for gathering all duties and authorization (afad.gov.tr). Therefore, General Directorate of Emergency in Turkey, General Directorate of Natural Disasters and Civil Defense Department is closed.

Crisis Management Directorate of Prime Ministry which served for a short time in Turkey for defense and crisis is the most ranked decision making and coordination central. By the Official Gazette with the number of 22872 and date of 09th January 1997, the main duty of Crisis Management Directorate of Prime Ministry is to provide eluding the disaster with the least damage and to direct the activities of preparation regarding this eluding of disaster according to the national interests. Between the related ministry, institution and organizations in this process, providing coordination, collaboration, speed and sufficiency is another duty of the Directorate (Taşkın, 2012).

Disaster and Emergency Management Directorate of Prime Ministry in Turkey is conducting studies and preparations for decreasing the damages of disasters and for being ready. Disaster and Emergency Management Directorate in central, Provincial Disaster and Emergency Management Directorate and Civil Defense Directorate in rural areas are established. Provincial Disaster and Emergency Management

Directorates are giving the training of search and rescue to the technical personnel and running in concordance with civil defense logic in 1950s.

In Turkey, until AFAD started to work, institutions could not provide a good service due to the collapsed infrastructure during disaster search and rescue activities. But organizations which lose its effectiveness by the earthquake's devastating effects, people who lost their conscious with the shock or pain comes after the disaster, and problems regarding transportation and communication caused more difficulty in these activities. Disconnection between search and rescue teams and false or imperfect data can cause the becoming distant to alive and wounded victims.

There was a radical change in Turkey regarding understanding and organization of disaster management with the 5902 law "Law of Disaster and Emergency Management Directorate Organizational Duties" which came into force 2009. With this law, the responsible actors for disaster managements are gathered into a single organization under the name of Disaster and Emergency Management Directorate (AFAD) which will work under Prime Ministry. With this law Emergency Immediate Support units, Turkish Armed Forces Search and Rescue units, National Medical Rescue Teams, Fire Departments of Municipality are assigned to operate under Provinciaal Disaster and Emergency Management Directorate (Caymaz et al., 2013). With this organization, providing coordination between institutions and organizations before disaster and effective disaster management structure were aimed (Caymaz et al., 2013). Before 5902 law, there were also some studies in this literature regarding disaster management, organizations, responsibilities and regulations (Aktel, 2010).

Increasing the efficiency in disaster management, involving local authorities, non-governmental organizations, volunteering institutions and universities are the mentioned obligations. Taşkın (2012) especially mentioned that local authorities and fire departments should work efficiently in search and rescue operations due to their technical tools and trainings, along with fire extinguishing actions.

Disaster management model in Turkey is shaped by seven policies such as risk-driven, community involvement, local administration, integrity with sustainable development, constant development, flexibility and nationalism which are mentioned to be in a process of on-going enhancement in the Strategy Papers of Disaster Management in Turkey (AFAD, 2018).

In all stages, preventing and decreasing the risk takes the grant place. The existed and potential disaster risks will be defined, prevented or decreased; the risk transfer will be provided, and preparatory work will be made. Intervention and recovery take a place with the understanding of preventing or decreasing the risks of the disaster. This understanding carries utmost caution in every aspects of life by all partners. Preventing and decreasing risk brought the disaster information systems in life. Disaster Information System is defined as "an integrated and technological system with easy change on a virtual network which can provide each data and information with coordination to prevent and/or decrease loss of lives or economical assets during each stages of disasters" (AFAD, 2014b). The actors of disaster information systems are users and decision makers, meanwhile the parts of the systems are hardware and communication substructure, and data which is gathered or in use with coordination.

Even though the disaster management starts with individuals, community participation is a crucial point. With increasing the awareness and encouraging the participation, partners take more responsibilities and play important roles in decision making. Participation of the people to search and rescue activities may be crucial with the coordination of strength of big numbers of people with experiences of professional teams. Right after the disaster in the local areas, before the professionals' intervention, the first aid and search and rescue can be executed by local survivors who works as volunteers. Especially in a mass disaster such as earthquakes, with a necessary leadership and administration features may break the difficulties of the chaos and save time for search and rescue activities in disaster areas.

Local administration is grounded on disaster managements. Planning and activities should be executed locally considering local needs and aspects. In this view, local administration should be enhanced regarding the capacity and resources.

Increasing the effectiveness in disaster management requires the involvement of the local administrations, NGOs, volunteered institutions and universities to disaster management. In McConnell et al., (2010) and Taşkın's study (2012) it is stated the importance of involvement of especially the fire departments of local administrations to search and rescue activities with necessary training and technical tools along with their first duty of extinguishing fire.

Disasters suspend the development processes; development processes that do not care for disaster risks increase the risks of a disaster. Therefore, the integrity and alignment between disaster management and sustainable development carry a great importance. Disaster management enhances according to the new risks and needs by updating itself. In enhancement process, global trends and local dynamics are taken into consideration. If it is necessary, disaster management activities can be executed by adapting to different conditions. By force of this policy, local and cultural differences, needs of vulnerable groups and their sensitivity should be taken into consideration.

Every kind of system, material, tools and equipment that will be developed for disaster management, it is supported that usage and enhancement of national technologies.

2.3.1. Central Organization

After the law 5902 came into force Disaster and Emergency Management Directorate is established. In the structure of directorate, units as committees (such as Disaster and Emergency High Committee, Disaster and Emergency Coordination Committee, and Earthquake Consultative Committee) to involve other ministries into disaster management.

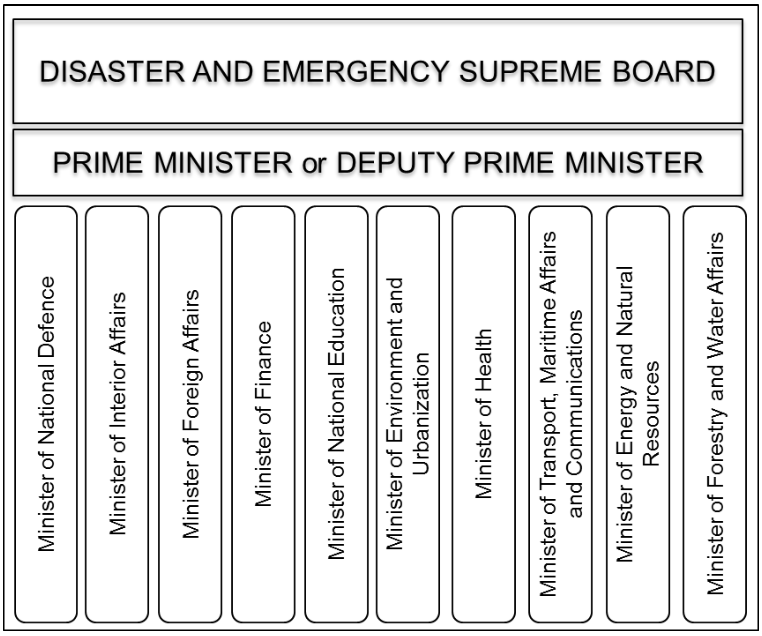

Figure 11 Disaster and Emergency Supreme Board

Disaster and Emergency Supreme Board is a committee that gathers under the chairmanship of Prime Minister or Prime Minister Deputy after the related ministries are charged. Committee is a supreme board that confirm plans, reports and programs related to disaster and emergency situations (Figure 11).

Disaster and Emergency Coordination Board gathers under the chairman of Prime Minister Undersecretary. It consists of high level authorities. It is responsible for coordination and application of the provisions that is given to Supreme Board (Figure 12).

Figure 12 Disaster and Emergency Coordination Board

Earthquake Advisory Board gathers with the participation of related bureaucrats under the chairman of President and works to determine suggestions and policies in activities for reducing the loss and protecting from earthquakes (Figure 13). In the scope of regulations about Presidential Government System, Disaster and Emergency Management System is to conduct services under The Ministry of Interior with the Presidential Enactment No.4 on the date of 15th of July 2018.

Figure 13 Earthquake Advisory Board

Boards within the institution are abolished, except the Disaster and Emergency Consultative Committee. The duties of Consultative Committee involve the protection from disaster and emergency situations, reducing disaster and emergency situations risks, providing suggestions related to the activities after disaster and emergency situations, and specify politics and priorities. This Committee is going to be gathered under the presidency of the Committee President or representative Vice President, and include one representative at a level of department head from the Ministry of Interior, the Foreign Office, Boğaziçi University Kandilli Observatory and Earthquake Research Institute, General Directorate of Mineral Research and Exploration, Turkish Scientific and Technological Research Institution, and Turkish Red Crescent along with five (5) members selected by the President from ten (10) university lecturers named by Higher Educational Council due to their disaster and emergency situation studies, and three (3) members selected by the President from accredited non-governmental organizations. Committee is to be gathered at least two times a year. Also, as may be required, Committee is to hold an emergency meeting with the request of President. Presidency is to conduct secretariat of the Committee (www.afad.gov.tr).

2.3.2. Disaster and Emergency Management Directorate

After the law 5902 came into force Disaster and Emergency Management Directorate is established in Ankara. Directorate consisted of 6 departments first (such as Planning and Damage Reduction Department, Intervention Department, Improvement Department, Civil Defense Department, Earthquake Department, and Management Services Department). In 2011, due to the necessities, 2 departments (such as Strategy Development Authority and Information Systems and Communications Authority) and a Legal Consultancy Department established (afad.gov.tr).

In the scope of regulations about Presidential Government System, the framework of the Disaster and Emergency Management System is also reshaped with the Presidential Enactment No.4 on the date of 15th of July 2018. Department of Personnel and Support Services for personnel and personnel affairs, Department of Training for training services, Department of International Affairs and International Humanitarian Aid for international activities, Department of Voluntary and Benefactor Affairs for donation responsibilities, a Department of Inspection Services for the control of conducted activities are also established in this sense. Details of duties and responsibilities of Disaster and Emergency Management Directorate is included to Aktel (2009)’s study and official web site of organization. Due to the focus on intervention stage of disaster management system in the scope of this thesis, only Intervention Department Directorate’s duties and responsibilities are explained in detail.

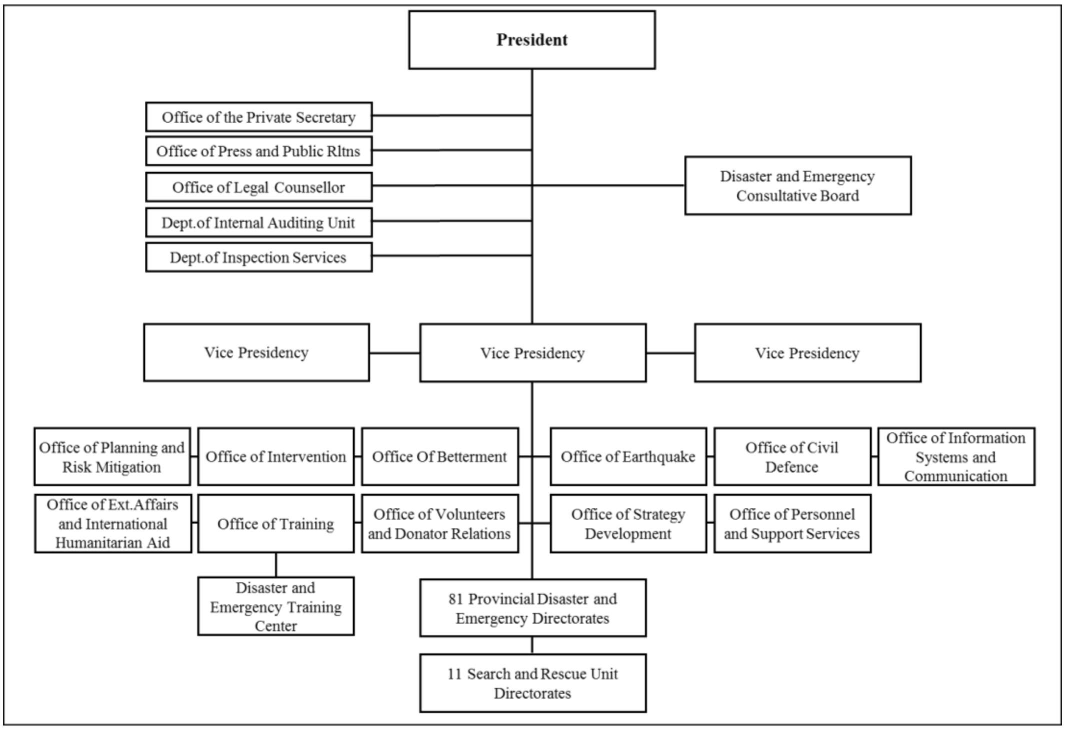

Figure 14 AFAD Organization (afad.gov.tr, 2019)

2.3.3. Intervention Department Directorate

Intervention Department Directorate organized to work in efficiency during and after the disaster. Also, it is responsible for regulating and supervising the search and rescue services of fire departments and volunteering organizations that are under the authority of local governments. One of the duties of Intervention Department Directorate is planning and executing the protective and rescuing activities.

According to the statement on the AFAD official website, the duties of Intervention Department are as follows:

✓ Conducting intervention activities to eliminate the affects of disaster or emergency situations by utilizing all kind of resources belong to public, private sector and non-governmental organizations, along with foreign public and institutions.

- ✓ Managing disaster and emergency situation management center under the presidency.
- ✓ Establishing and managing disaster and emergency situation management centers in provinces with public institute and organizations.
- ✓ Determining search and rescue service standards of fire department.
- ✓ Cooperating with fire department and institute and organizations of search and rescue services.
- ✓ Planning and conducting protective and rescuing actions.
- ✓ Performing disaster and emergency situation tasks that are determined by the agreements.
- ✓ Conducting collaborations with foreign states and task related organizations.

Refugee Influx subject that turned into an important issue for our country is also among with the duties of AFAD Intervention Department, even though it is not considered as a disaster or emergency situation at first.

2.3.4. Country Organization

Rural organization of Disaster and Emergency Management Directorate includes Provincial Disaster and Emergency Management Directorates and Civil Defense Search and Rescue Units Directorates.

In provinces, Provincial Disaster and Emergency Management Directorates that works under Governor in Special Provincial Directorate of Administration. Governors work as chief superior in Provincial Disaster and Emergency Management Directorates in rural organizations of AFAD.

As a special situation for rural organization, Civil Defense Search and Rescue Units Department can be named. These departments started to work in 2001. Their duties are including decreasing casualties and loss of property to the least and reconstructing normal life as fast as possible during mobilization or warfare and natural disasters. Unit departments are founded in Afyon, Adana, Ankara, Bursa, Diyarbakır, Erzurum, İstanbul, İzmir, Sakarya, Samsun and Van, and became responsible for nearby provinces. Provincial Defense Departments' duties which were already existing before 5902 law came into effect, are transferred to Special Provincial Directorates of Administration along with all special tools and equipment after the foundation of Disaster and Emergency Management Directorate. In his study, Aydoğdu (2010) supported the aspect of necessity of these units' collaboration with AFAD with the poll he applied to Civil Defense Search and Rescue Unit personnel with the result of 77,6% rate. This situation shows that this organization is adopted by the units. After the law 5902 came into force, Civil Defense Search and Rescue Unit Department started to work under Provincial Disaster and Emergency Management Directorates. These units are continuing to work until a new regulation come into force.

Disaster and Emergency Management Directorate works with the Civil Defense Search and Rescue Units Departments which are in 11 cities as a part of Provincial Disaster and Emergency Management Directorates. In the scope of regulations about Presidential Government System, the existed eleven (11) Search and Rescue Unit Directorates will be regulated to be limited to at most twenty (20) directorate with the Presidential Enactment No.4 on the date of 15th of July 2018.

2.3.5. Volunteers and Non-Governmental Organizations

In Turkey, especially after 1999 Marmara Earthquake, many different awareness and participation progress have occurred, and regarding disaster management, many training, direct rescue or awareness raising organizations started to work. Among with these, Neighborhood Disaster Support Project (MADP) backed by Switzerland Development and Cooperation Department and Governorship of Istanbul continues for 15 years to provide awareness raising actions for public (Kutluk, 2011). In this scope, Neighborhood Disaster Volunteers (MAG) raised 5008 volunteers in 109 neighborhoods (mag.org.tr, 2019). Another organization AKUT, which is established in 1996, is extending the search and rescue activities with sufficient participation (akut.org.tr, 2019). Preparation for Disasters and Earthquake Training Association (AHDER) which started to work in 1999 after Marmara Earthquake and became an association in 2003 is still continuing preparation and training actions for this purpose (ahder.org, 2019). Except these organizations, there are many different institutions that provides activities for awareness raising, training and planning for disaster management. As an example, METU Disaster Management Implementation and Research Center (DMC-dmc.metu.edu.tr) and Istanbul Technical University Center of Excellence of Disaster Management (http://www.aym.itu.edu.tr/), GEA Search and Rescue Team (gea.org.tr) can be given.

There are many studies regarding the sufficient structuring of volunteering and Non-Governmental Organizations too. National Earthquake Strategy and Action Plan which is prepared with the AFAD coordination consist of three main axis in 2012-2023 (UDSEP) report (AFAD, 2012b). These are;

- ✓ Learning about earthquakes,
- ✓ Safe habitation and structuring,
- ✓ Coping with the effects of the earthquake.

The first goal of the third main axis (Axis C) “Coping with the effects of the earthquake” is Target C.1. “Activity development for training and awareness raising regarding earthquakes and other disasters”. One of the strategies that are planned for this goal is identified as Strategy C.1.4.“Establishing a disaster volunteering system”. In the same way, goals related to the framework of local intervention system with volunteers for more effective intervention system are set in Target C.3 sub articles. This strategic document has an importance that address to necessity and vitality of volunteering and NGO actions.

Axis A: Learning about earthquakes

Axis B: Safe habitation and structuring

Axis C: Coping with the effects of the earthquake

- ✓ Goal C.1: Enhancing the Activities for Training and Raising Awareness of People related to Earthquakes and Other Disasters

  * Strategy C.1.1. A consensus for the Administrators of Disaster and Emergency Situation management will be provided.

  * Strategy C.1.2. A development of training for disaster management and the enhancement of the numbers of expert disaster managers will be provided.

  * Strategy C.1.3 Establishment of earthquake museums in the provinces with big earthquake pasts will be provided.

  * Strategy C.1.4 Disaster Volunteering System will be established.

- ✓ Goal C.2: Regulating the Legislative Arrangements for More Integrative and Active Earthquake Strategy

- ✓ Goal C.3: Procuring a Faster and More Active Intervention in Time to Earthquakes and to the Other Disasters

  * Strategy C.3.1 Enhancement of intervention system after disaster will be provided.

    - Action C.3.1.1. Transportation systems for emergency intervention and aids along with substructure of communications, emergency call and informatics system at local and central level will be enhanced.

    - Action C.3.1.2. Studies related to determination of the health facilities and social equipments in emergency situations will be made.

  * Strategy C.3.2. Health organization in disasters will be procured.

    - Action C.3.2.1. Preparing and updating the disaster plans for the hospitals in all provinces will be provided.

    - Action C.3.2.2. Provincial health plans for fast and efficient intervention in time for the health issues caused by disasters will be procured in all provinces.

    - Action C.3.2.3. Mobile emergency intervention and transportation units will be launched.

  * Strategy C.3.3. Information sharing and collaboration for damage assessment will be launched.

Similarly, in the 2013-2017 strategic planning of AFAD, which is still in effect, “Starting a campaign for education to be prepared in disasters” is another objective. The first step of this objective is “increasing the social awareness nation-wide for 50% each year”. According to this objective, there are many projects such as project of disaster-ready families, project of disaster-ready schools, project of disaster-ready work place, project of volunteering youth for disasters (afad.gov.tr). These projects started to work in 2013; and until 2015 December, 5.500 instructors are trained and around 5 million student, teacher, housewife and worker got the training for disaster (AFAD, 2012a).

2.4. Stages of Disaster Management Process

Disaster management process includes the time from the starting of a disaster to the another one and preparation phase from intervention to improvement, from decreasing the number of losses to another preparation for another disaster. These stages are known to be complex and integrated, and each one of them is providing an added-value to another and work as a loop (Figure 15).

Emergency is defined as “All state and conditions that are big-scale however can be dealt with local instruments, and require urgent intervention activities” (AFAD, 2014b). In 5902 law, it is defined as “State and condition that stops or slows down the normal life actions in a part or whole of society and the crisis state that comes with it, and requires immediate intervention”.

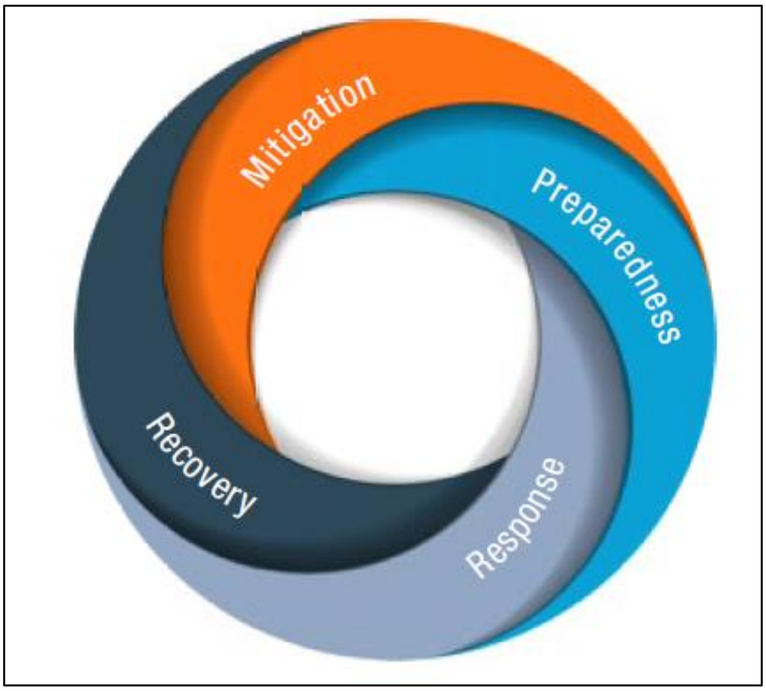

Figure 15 Disaster Management Loop (AFAD, 2014a)

At the same document, Emergency Management is defined as “Management process which aims to provide fast and effective actions to help for all kinds of needs of affected societies from the beginning of the emergency”. From this definition, it is clear to say that this management system starts to work right after the emergency and ends with the elimination of the emergency. However, intervention and improving stages after the emergency are also included into this management system. AFAD (2014) mentioned that “an effective emergency management requires to be planned, prepared and coordinated and involves deviant opportunity, source and authority, different than normal managements”.

At the same document, Disaster and Emergency Service is defined as “the services of announcing the disaster and emergency situation, impact analysis, communication, security, health, traffic, search and rescue, evacuation, fires and secondary disasters, infrastructures, transportation infrastructure, energy, burial, habitation, nutrition, wreck removal, damage and loss assessment, in cash and kind donations, international support and coordination, decontamination of hazardous substances, hosting, and psychological and social supports".

Disaster and Emergency Management is "planning, guiding, coordinating, supporting and implementing of necessary actions before, during and after the disaster by the institutions and organizations for the sake of common objectives" (AFAD, 2014b). This process is a complex, dynamic, multi-disciplined, multilateral and versatile management process.

In Turkey, Integrated Disaster Management System is taken as the ground of disaster management. The foundation objective of the AFAD is determined as providing the best national/international coordination by using this system effectively. As a preparation, intervention and improving of the process, AFAD brings the responsibilities such as:

- ✓ Planning, guiding, coordinating and cooperating,
- ✓ Research and development, and training,
- ✓ Taking protective and preventive measures.

Integrated Disaster Management System that AFAD adopted in Turkey consist of four different stages: Damage reduction, preparation, intervention and improving (AFAD, 2014a). These four stages bring the disaster management loop and it is not right or possible to separate one stage from another. In such cases these stages should be implemented simultaneously. With the latest changes that are made in 2018, organizational framework of AFAD is shaped according to these four stages.

2.4.1. Damage Reduction

Damage Reduction is defined as "complete actions of structural or nonstructural nature before, during and after the disaster for preventing or reducing environmental damages in natural, technological or manmade situations" (AFAD, 2014b).

The activities of decreasing the violence or possibility of emergence of damages with the way of risk evaluation before disaster are included in this stage. For this objective, raising awareness of public, creating regulation and institution, determining research and development policies after risk assessments are also included in this stage.

Before a great disaster, providing a strong warning and notice systems, alerting the people who can be affected by the disaster in a short time, gaining time for getting necessary measures for escape and protection involves great importance. There are some researches that provides the information regarding 11th September 2001 New York World Trading Centers terrorist attack that due to late alert to people about fire, many casualties occurred (McConnell et al., 2010). Moreover, it is determined that the period of decision making before warning can be longer than escape period before the disaster. In this study, after the analysis of database of past disasters, only 10% of disaster victims are evacuated at the first moment of disaster; however at least 45% of disaster victims should be evacuated at first moments of disaster.

In this stage, the results of the actions that will be executed are:

- ✓ Planning for reducing damage and risk management that will be used for disasters in Turkey,
- ✓ National Disaster Management Strategy and Action Plan,
- ✓ Determining the probable disaster areas with risk assessment,
- ✓ Public works aspects of probable damaged area after disaster,
- ✓ Evaluation and information reports of disasters,
- ✓ Aspects of humanitarian aid,
- ✓ International information sharing,
- ✓ Regulations regarding trainings, raising awareness and informing in scope of disaster preparation (AFAD, 2012a).

2.4.2. Preparation

Due to its unpredictable nature of disasters, preparation for them carries a great importance. During and after the disaster, chaos and uncertainty become more common. In this situation, the easiest way to reduce the damage to the least is including the actions such as detailed planning before disasters, designating the authority and responsibility, risk assessments, planning and sharing support sources and preparing drills. Starting from personal ground, having public measures, these preparations carry a great importance. Again, in this process, stocking for basic needs like health, sheltering and food, keeping available distribution channels and establishing organizations for these, are the main activities.

Preparation process includes the studies for preventing damages of disaster by sufficient organization and intervention. This stage contains the activities of training and preparation for intervention with coordination of whole population and institutions. Maintaining the equipment and tools, usage of early warning systems, education and other activities should be updated regularly. It is a must for people to have a plan for organizing during the disaster and providing basic needs. In disaster management, effective administration of sources is crucial. In this stage, the results of the actions that will be executed are:

- ✓ Informing whole population, raising awareness and training during disaster and emergency preparation,
- ✓ Information, communication, early warning and prediction systems,
- ✓ Risk maps,
- ✓ Immediate aid and logistic plans,
- ✓ Research and development, and project designing,
- ✓ Training and drills of intervention units,
- ✓ International cooperation and coordination,
- ✓ Suitability of disaster and emergency management centers' mutual communication and information systems.

Research and development actions of decreasing the time of reaching alive victims during intervention process which is the scope of this thesis should be evaluated in this stage. Also, information, communication, early warning and prediction systems regarding this problem should be executed in this stage (AFAD, 2012a).

2.4.3. Intervention

Intervention is defined as "actions for life and property protection, health, food, quarter, security, property and environment protection, social and psychological support systems during disaster and emergency situations" (AFAD, 2014b). Intervention consist of activities such as fast evaluation of developments after disaster, establishing of versatile communication and coordination, warning people, management of personnel, evacuation of people (Özerdem & Jacoby, 2006), preparation of knowledge-communication network (Kutluk, 2011), damage assessment, dangerous wreck removals (Ramezankhani & Najafiyazdi, 2008), arrival to disaster area steadily, immediate aid services and support team works (Akyel, 2007). Works that will be executed in this stage include the providing basic needs such as catering, sheltering and heating of the disaster victims who lost their homes, treatment of injured people, search and rescue actions for alive people due to saving as many lives as possible. These needs can be extended with the subjects as communication and transportation, first aid, treatment, evacuation, sheltering, providing food, security, preventive medicine, and securing dangerous wreck. Prominent aspects in this phase are:

- ✓ Communication,
- ✓ Transportation,
- ✓ Search and Rescue,
- ✓ Safety and traffic,
- ✓ Protection from fire and hazardous substances,
- ✓ Damage assessment,
- ✓ Urgent sheltering,
- ✓ Nourishment,

- ✓ Burial,
- ✓ Information management.

At the ground of disaster studies in Turkey history, there was almost only “search and rescue” logic and therefore the intervention stage was not sufficient enough. The number of loss of life and wounded people in 1999 Marmara Earthquake shows difference regarding search and rescue works. However, in the earthquake of 7.0 magnitude in Van-Erciş on 23rd October 2011 and 5.7 magnitude in Van-Edremit on 9th November 2011 despite of 644 casualties, with the search and rescue work of 2522 personnel, 252 people from 1966 rescued alive (AFAD, 2014c). At the success of these rescues along with search and rescue units, awareness and communication factors were important too (Chenji, Zhang, Won, Stoleru, & Arnett, 2012). The rate of disaster survivors and casualties are shown at Figure 16.

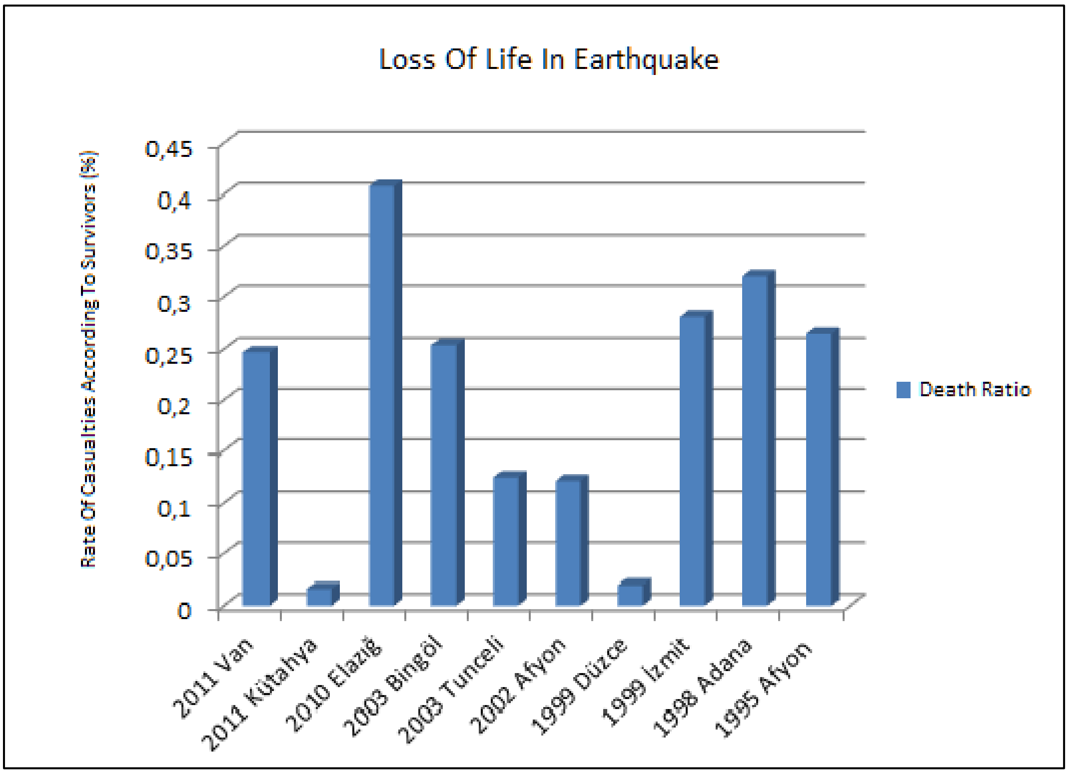

Figure 16 Rate of Casualties to Survivors in Last 20 Years

Detailed information regarding intervention stage shall be included in next chapter.

2.4.4. Improving

At the stage of improving, the activities to provide at least minimum level of basic needs for intercommunication (Luna & Pennock, 2018), transportation, water, power, education, long term temporary sheltering, economic and social activities (Güzel, 2013).

Damage reduction and preparation activities before disaster are included into risk management, intervention and improving activities after disaster are included into crisis management. This model which is also named as “Integrated Disaster Management System” aims for execution of determining risks in early stage, preventing disaster damages, good intervention and improving activities after disaster in an integrated scope.

The activities that involve the works for returning to normal life or to a better life after disaster are:

- ✓ Selection of a safe place,
- ✓ Construction of disaster homes,
- ✓ Public works, planning and project development of disaster areas,
- ✓ Rerouting of development and disaster risk reduction sectors.

Improving stage is the stage that contains the works of binding up the wounds, prevention from repetition, and turning to a normal life after the disaster.

2.5. Examples of Disaster Management Systems/Projects in Turkey

Disaster management systems and applications of the past revealed a complicated structure for legal and organizational regulations in Turkey. It can be seen that many of the systems that are tried to be activated before 2000 have failed due to multiheaded organizational structure. When the Turkish Disaster Management Systems are investigated, taking the law No 5902 which regulated the establishment of AFAD in 2009 as the start will be more correct. At the following years of the establishment of AFAD, institutional structure is enhanced and new projects along with the systems are started to be procured (AFAD, 2012a).

Turkey launched a program which is called National Earthquake Research Program for the period between 2012-2023 to support the researches in general and studies of project design and creating solutions for disaster management (afad.gov.tr). This program aims to produce projects in the scope of the program, gather new information, execute scientific researches to provide applicable projects for the needs of disaster management with the usage of national sources sufficiently and effectively.

Because of the studies which is led by AFAD, a Disaster Management and Decision Support System (AYDES) is developed to work as a base for disaster management. This project, is a general management system which consist of decision support mechanisms and risk management stages with simulation support and estimation-modeling, and with an early warning opportunity which is integrated to geographical information system infrastructures until 2017. In this context, Incident Command System (OKS) which ensured the management of resources during disaster, Disaster Temporary Urban Management System (AFKEN) module which manages shelters that are used for various reasons, Electronic Help Disbursement System (EYDAS) module which organizes the aids, and Spatial Information System module which manages geographical data are completed (afad.gov.tr). These studies are continuing with a plan for increasing disaster management efficiency as it is planned. The most gratifying aspect of this subject is that umbrella programs such as National Earthquake Research Programme UDAP which supports the programs that improves disaster management by AFAD is implemented. In the scope of these supports, it is a well-known fact that disaster management activities in various subjects will gain a momentum.

Except the central projects, there are other small or local projects that are executed for commercial or academical scope.

“Designing and Making a Prototype of Self-Propelled Robotic Snake for Earthquake Wreck Scanning” is a project that works for detection of alive victims. This project is related to share the local knowledge (such as buildings, institutions, infrastructure services and inhabitant of a neighborhood) which is kept before earthquake to the search and rescue teams (Topal, 2011; Pehlevan et al., 2009). The objective of the project is organizing the activities of data collecting for search and rescue teams’ readiness.

“Is Anyone There?” application which is developed by AveaLabs in Turkey is detecting the location of the user and the data of earthquakes around the world by using 3G for rescuing the people under wreck. In the cases of the earthquake is dangerous enough for the user, the application sends a message to the user to check his/her safety. When the confirmation from the user is not sent, the system changes into a state of alarm based upon the user is under a wreck (http://avea.pclabs.com.tr, 2012). Despite that it is one of the best applications made in Turkey, especially some of the cell towers can be damaged due to the disaster and lose the effect and work of this system. Also, with the signaling of hundreds/thousands of phones (lack of confirmation due to the dead users) around the earthquake area, search and rescue teams’ works will be divided into different places where dead disaster victims are and not the alive victims. Warning signal of many phones can cause an obstacle to search and rescue works.

On the other hand, the application which is developed by AVEA is updated in 2014 August; and with the Panic Button on the new interface new functions as sending location on social media and asking help during a disaster even if it is not in the disaster region are gained. Moreover, due to the importance of the subject and social necessity, the application became available worldwide along with the AVEA. The application is calibrated to give a voice signal in each 15 minutes to make sure the battery usage is optimum.

For the goal of providing emergency communication needs right after disasters, Turkcell, another telecom operator in Turkey, developed a “Emergency Communication System”. A system that works as a small GSM network consist of 1 mini switchboard, 3 radio base stations, mobile stations, 1 communications center, and Internet connected computers with fixed and satellite phones. In the first stage, special cards for 5000 search and rescue professionals are designed, and a mobile GSM network with the structure of working ability in disaster area in 6 hours is incorporated. As intended for this system UNDP and Turkey’s UN Permanent Representation held a meeting in New York on 4th April 2013 regarding disasters and gave successful examples; and by the UNDP representatives, the importance of information sharing steadily right after disaster and this application’s usage as an example by other countries is mentioned. Turkcell developed another emergency commonication system as “DroneCell”, which is designed small portable base stations on the drones for first responders at 2018.

As an another example, İstanbul Provincial Disaster and Emergency Directorate is suggesting to everyone to fill an Emergency Information Card before disaster for sharing with search and rescue teams after earthquake. Despite its usefulness for raising awareness, each individual needs to carry this card with themselves 24/7, however it can be used after search and rescue teams reach to the victims (JICA, 2008).

Again, with the project called “Mobile Device Use for Disaster Management” which became available in 2014 by Istanbul Provincial Disaster and Emergency Directorate, increasing the existed capacity for disaster preparation is aimed. With a simple, informative and directive mobile software, the opportunity to reach to the practical information of survival after the disasters and getting ready before the disasters is given. The benefit of the application is irrefutable, however, it should be available for each province, instead of focusing on Istanbul.

AFAD Inventory Information System is a web-based application to provide benefits to decision makers, to work with map bases, to follow the units which will work after disaster with inventory information by the personnel, communication and equipment with geographical information system technological infrastructure (Güzel, 2013).

2.6. Disaster and Risk Management in the World

History of the world and human kind is filled with the monuments of abnormal events and their effects. For centuries, human kind created civilizations of societal living and rules of common life, they suffered from destructions came with the disaster, and then lived a learning process regarding taking measurements from those past events. This process caused creation of many monuments, and the results of the events that affected humans and societal life deeply are transferred from society to another for centuries. In Turkey and in the world, 13^{th} October of each year is celebrated as International Day for Disaster Reduction for the sake of the effects of the disasters and the measures to be taken (http://www.un.org /en/events/disasterreductionday, 2019).

Disaster management of each country is based on the past experiences regarding disasters. This situation caused to take more measures on some certain disasters (Erkal & Değerliyurt, 2009). If a generalization is to be made, each country took the protective measures for the disasters they suffered most. Disaster managements of some of the countries are explained briefly below.

With developed organizations at disaster management United States of America started to its disaster management from a central organization that provides local qualifications at first implementation. Federal Emergency Management Agency (FEMA) is founded due to the need of integrated organization which coordinate disaster management (Wong & Robinson, 2004; Federal Emergency Management Agency (FEMA), 2003; Leblebici, 2014). Emergency Management in force is called Integrated Emergency Management System (IEMS). This system gathers the whole existed sources together. Along with the local sources, volunteering institutions and commercial sources are also in use. IEMS addresses to four stage in disaster management which evaluates the all disasters. Also, from local municipalities to national government, all government levels come together with the private sector. Implementation of the plan for disaster in USA requires at least 24 hours, and it is seen that surviving chance of the victims under wreck decreases to 50% (JICA, 2008).

Japan is another country that live with the disaster. Disaster management programs in Japan are based on the Law of Disaster Countermeasures. Providing the effective disaster improving and reconstructing actions and promoting the scientific and technological researches are constituting the basic policy of the government. In Japan, disaster management is implemented in three stages (Özerdem & Jacoby, 2006). National, regional and local level of disaster management councils are working for implementation of measures to their regions. In the disaster management of Japan, Fire and Disaster Management Agency (FDMA) works as the lead group. Along with this institution whole state organizations and volunteering institutions are tasked with details in disasters (Emin, 2011).

Another developed country, in Italy, national civil protection service is established with a law in 1992 to promote an institutional framework for all kinds of civil protection actions around the country. Emergency management and rescuing action coordination, is made by municipality, state, regional and national operation centers (Ciesa et al., 2015; Gülkan et al., 2003).

2.7. International Institutions Regarding Disasters

There are many different international organizations which work for disaster management all around the world. The biggest organization regarding participation and activities from all of those is United Nation Developing Program (UNDP) (Development, Fund, & Services, 2018).This organization is working to organize the actions of by working as an umbrella institution which gathers the proficient organizations under itself. Organizations such as OCHA, WHO, WFP, UNICEF providing help in various ways to the disaster regions under the umbrella of UN (Development et al., 2018; Gülkan et al., 2003).

International Search and Rescue Advisory Group (INSARAG) is another organization which provides similar international actions (INSARAG, 2006). Unlike others, this organization has a structure of non-official global network. The purpose of INSARAG is providing a platform to countries and institutions for the goal of developing standards and coordination methodology in intervention and aiding in earthquakes that require international help. INSARAG is operating actions with the participation of more than 80 countries within the UN umbrella. INSARAG is working for the subjects related search and rescue activities with international coordination of minimum standards at the earthquake related disasters which UN explained in 2002. After the earthquake series in 1999 at Turkey, Taiwan and Greece, a web based emergency information management system which is called OSOCC (www.unocha.org) is developed. Essentials of INSARAG (INSARAG, 2012) are also defining the responsibilities of supported country. These responsibilities are including the subjects like helping for migration and custom procedures for search and rescue teams, and providing services like transportation, map, translator, drinking water, gas and compressed gas. Search and Rescue (SAR) teams which comply with the standards of INSARAG is recorded in INSARAG SAR list. In this guide, AKA Search and Rescue Association, AKUT, Ankara AFAD Search and Rescue Teams, Istanbul AFAD Search and Rescue Team, Istanbul Metropolitan Municipality Disaster Coordination Center Urban Search and Rescue

Team, Istanbul University Natural Disasters Search and Rescue Team, NESAR National Emergency Search and Rescue Association, SAR Search and Rescue Association, GEA Search and Rescue Team from Turkey are also listed (https://vosocc.unocha.org/USAR_Directory/USARTeamsByCountry.asp, 2019) (Akyel, 2007).

2.8. Disaster Management in EU

The base for cooperation regarding disaster protection in EU is established in Rome during 1985 inter-ministerial meeting. From that day, in the cases of a disaster event in a member state, responsibilities became clear for preparations of responsible institutions for disaster management. Also, the studies of taking various measurements for being ready in private sector at the member states were also made. After 9/11 in US which occurred in 2001, new regulations for evaluation of risks, warnings and interventions and recording these information were also made (AFAD, 2014a). These regulations can be listed as being ready for disasters by supporting the national, regional and local works, developing cooperation between countries and institutions, increasing information of personal safety of citizens, conducting a framework for coordination and cooperation in a fast and effective way (Seppänen & Virrantaus, 2015).

CHAPTER 3

SEARCH AND RESCUE ACTIONS IN DISASTER

3.1. Search and Rescue Actions

Search is defined as the activities for finding alive victims under wreck during disaster and emergency situations. Search and rescue, however is defined as “searching, finding and rescuing activities by official and private teams who are educated and well-equipped for helping people who are suffering from effects of disaster” (AFAD, 2014b) (INSARAG, 2012).

Search and rescue actions are critical and a detailed planning is a must for fast rescuing operation. In this planning, determining the places with higher chance of finding disaster victims should be included. Also, categorization of making the damage assessment for collapsed buildings in a fast manner should be included into this planning too. Technologies that provides a rescue of alive victims under the wreck in personal basis, and planning that focus on techniques that can help the rescue actions constitute the main theme of the event.

Search and rescue actions are the services which can be executed in a plan and coordination with well-educated and equipped professionals with modern and appropriate tools and information who can also work in time pressure (Aydoğdu, 2010). Search and rescue activities are consisted of search, rescue and survival skills.

Search skills are divided into sub-sections like on non-marine, in marine, on air, planning and search dogs. Rescue skills are varied according to the field of rescuing like mountain, marine and urban. Surviving skills are divided into sub-sections like surviving in nature, navigation, improvisation, and communication (Aydoğdu, 2010).

According to Wong & Robinson (2004) "The Search Team is responsible for locating victims trapped in rubble, wreckage, collapsed buildings, or other dangerous situations. The team's capabilities include electronic (visual imaging, acoustic/seismic, and thermal imaging), canine, and physical search. These strategies and techniques may be applied separately or in combination, depending on the situation".

After disasters, teams of intervention make a small analysis on determining damage and loss and raising awareness around the field. This analysis is called "Impact Analysis" (Kutluk, 2011). Before intervention, with this analysis, first information and existed sources regarding alive victims, situation of loss, places or sections that are still in danger and what happened in the field can be evaluated. The type of the disaster and the time can change the profile of affected people. For example, an earthquake that happens during the night can catch many people in their beds; in the meantime, an earthquake that happens during the day, affected people will be in schools, shopping malls or official institutions that contain the biggest number of people. Therefore, impact analysis after disaster carry an importance due to provide right guidance of search and rescue activities. Evaluation which includes what is needed when, and how to distribute these sources, measurements that will be taken and priorities in general after the impact analysis is called "Need Analysis" (Kutluk, 2011). Basic aspects of search and rescue in these analysis is shown at Figure 17 (Statheropoulos et al., 2015b).

At the SWOT Analysis in 2013-2017 Strategic Plan of AFAD, the subjects like "Late Intervention", "Insufficient Intervention and Action Plan", "Not Taking Necessary Measures for Vulnerable Groups (such as women, children and disabled)" took place in the beginning of Estimation and Early Warning Systems. At the opportunity section of the same analysis, the subjects like "Decreasing Loss with Gaining Time for Disaster prevention" and "Providing Fast and Right Intervention" took place. These aspects are referring to the importance of search and rescue process, the time shortage in this process, and actions for decreasing loss of lives (AFAD, 2012a).

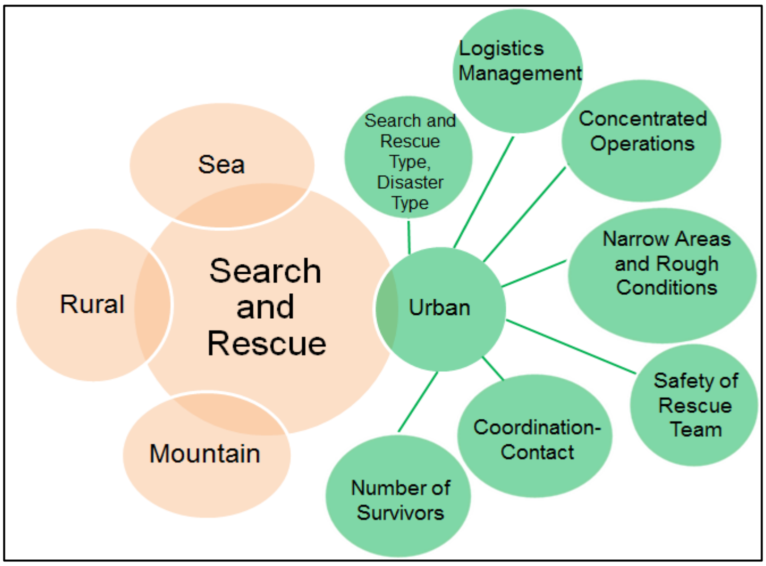

Figure 17 Basic Aspects of Search and Rescue Operations (Statheropoulos et al., 2015b)

Disaster intervention team is defined as “the group of people with special education who took responsibility for disaster and immediate aid actions and work for official and private institutions and organizations” (AFAD, 2014b). Another definition according to Wong & Robinson, (2004) “The Rescue Team is responsible for evaluating incident areas for hazards, stabilizing damaged or collapsed structures, breaching, site reconnaissance, victim extrication, and heavy equipment and rigging”. AFAD is the responsible name for preparing educational policies and the coordination of disaster and emergency services in Turkey (AFAD, 2013). In this field, Disaster Intervention Plan of Turkey (TAMP) entered into force in 2013. The objectives of this plan include:

- ✓ Saving lives,
- ✓ Reviving life and interrupted activities back to normal as soon as possible,
- ✓ Executing the intervention processes as fast and planned,
- ✓ Maintaining public health care,
- ✓ Protecting property, environment and cultural heritage,
- ✓ Decreasing economic and social losses,
- ✓ Reducing or preventing the effects of secondary disasters.

Table 5 Service Groups to be Assigned at a Disaster

DISASTER TYPE	SERVICE GROUPS TO BE ASSIGNED
Flood	Communications, Transportation Infrastructure, Security and Traffic, Search and Rescue, Transportation, Health, Evacuation Positioning and Planning, Substructure, Energy, Sheltering, Damage Assessment, Wreck Removal, Food Agriculture and Livestock, Technical Support, Loss Determination
Forest Fire	Communications, Transportation Infrastructure, Security and Traffic, Search and Rescue, Transportation, Health, Evacuation Positioning and Planning, Substructure, Energy, Sheltering, Damage Assessment, Fire, Wreck Removal, Food Agriculture and Livestock, Technical Support, Loss Determination
Industrial Fire	Communications, Transportation Infrastructure, Security and Traffic, Search and Rescue, Transportation, Health, Evacuation Positioning and Planning, Substructure, Energy, Sheltering, Damage Assessment, Fire, Wreck Removal, Technical Support, CBRN
Mass Population Movements	Communications, Safety and Traffic, Transportation, Health, Evacuation Positioning and Planning, Energy, Sheltering, Nutrition, Fire, Damage Assessment
Cyber Attack	Technical Support, Safety and Traffic, Communications, Energy, Damage Assessment
Chemical	Communications, Transportation Infrastructure, Security and Traffic, Search and Rescue, CBRN, Transportation, Health, Evacuation Positioning and Planning, Substructure, Energy, Sheltering, Damage Assessment, Fire, Wreck Removal, Technical Support, Food Agriculture and Livestock, Loss Determination
Biological Disasters and Epidemics	Communications, Transportation Infrastructure, Security and Traffic, Search and Rescue, CBRN, Transportation, Health, Evacuation Positioning and Planning, Substructure, Energy, Sheltering, Damage Assessment, Fire, Wreck Removal, Technical Support, Food Agriculture and Livestock, Loss Determination
Radiological and Nuclear Accidents	Communications, Security and Traffic, Search and Rescue, CBRN, Transportation, Health, Evacuation Positioning and Planning, Energy, Sheltering, Nutrition, Food Agriculture and Livestock, Loss Determination
Earthquake	All the service groups
Transportation Accidents	Communications, Transportation Infrastructure, Security and Traffic, Search and Rescue, Transportation, Health, Energy, Wreck Removal, Technical Support, Damage Assessment

Like the other plans and preparations, at the top of the TAMP goals, "rescuing lives" can be seen. Rescuing more lives at the areas affected by the disaster will be possible with fast and operative intervention by utilizing the first 72 hours which are defined as the Golden hours.

TAMP identifies the responsibilities and roles of service groups and coordination units during intervention activities prepared with tactical approach. TAMP defines the service groups that should take a place in these scenarios as follows (Table 5).

3.1.1. Search and Rescue Processes, Relations

Disaster are continuously happening in Turkey and in the World. After these disasters, search and rescue teams work in first 72 hours which are called "Golden Hours" for rescuing alive disasters under wreck. Ochoa & Santos (2015) gave the survival rates against the time during search and rescue actions which also include Turkey's data (30 October 1983 Erzurum Earthquake 6,9 magnitude, 1.155 loss, 537 wounded, 3.241 heavily, 3 thousand medium and 4 thousand as lightly damaged buildings and more than 30 thousand dead animals) with four earthquake data (Figure 18).

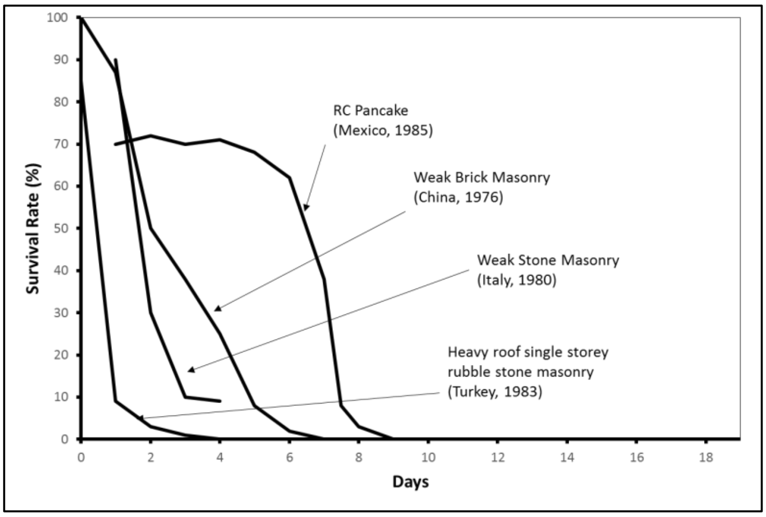

Figure 18 Real Survival Rate After Disasters (Ochoa & Santos, 2015).

Researches show that the survival rates in each disaster differ from another, however, “First 72 Hours” are called the most critical period all around the World. Fiedrich et al., (2000) suggested a model to predict these rates and they figured out that first 72 hours’ importance at the end of this research (Ochoa & Santos, 2015) (Figure 19).

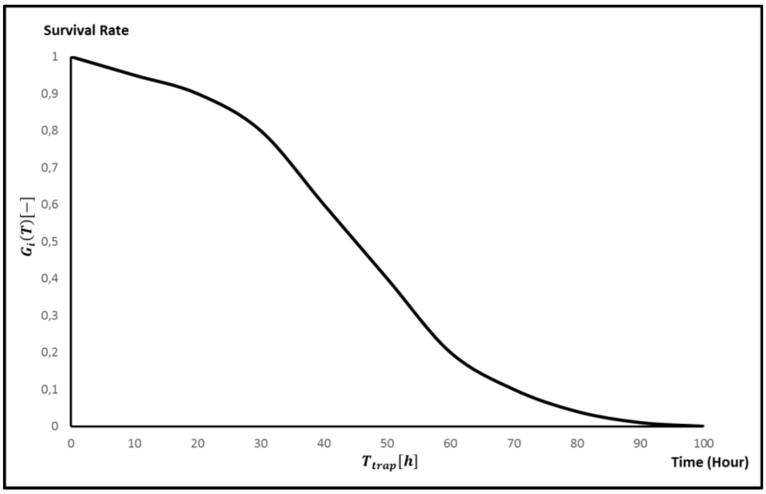

Figure 19 Predicted Survival Rates After Disasters (Ochoa & Santos, 2015)

It is known that, after the big-scale disasters, the arrival of first official intervention team can take 24 hours after necessary preparation and transportation (Wong & Robinson, 2004; INSARAG, 2012). However these first 24 hours are defined as the most important period of time for highest survivor rates during the Golden hours. According to Leblebici (2014), first intervention comes from relatives, survivors and local sources as collectively. The reason of this action is the late arrival of official intervention teams to affected areas. Leblebici (2014) mentioned that the importance of time and importance of raising awareness and abilities of local people.

Among with the effects of the disaster, explosions, fires, other risks that carry bigger risk and can be triggered right after the disaster are also on the way of search and rescue teams. Making an intervention and risk assessment to these after incidents as fast as possible is one of the actions that are made against the time.

At the operations of search and rescue, although the search and analyses (for natural, technological disasters or incidents) are increasing, casualty numbers are also increasing exponentially. Getting rid of this situation, decreasing the loss and casualties to the lowest level, and increasing the speed of search and rescue actions require the standardization of all stages of these activities. These stages do not include a standard timing. According to INSARAG definition, search and rescue times and relations are included in Figure 20.

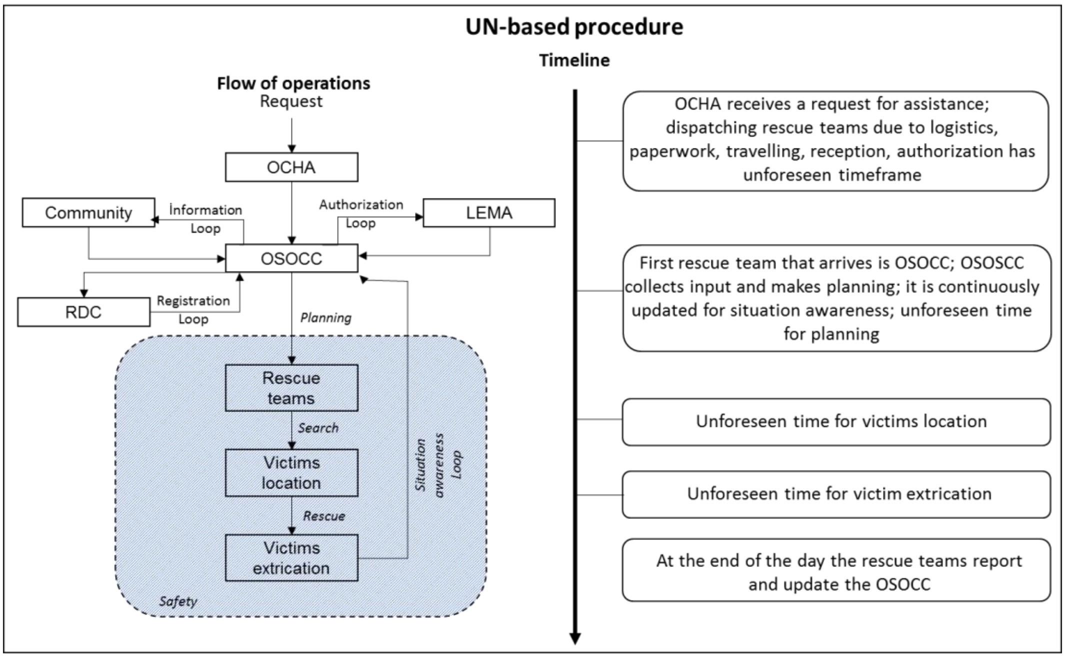

Figure 20 INSARAG Search and Rescue Processes, Relations

The shaded area of this definition includes the regional search and rescue teams' survival detection, localization detection and rescuing action as a loop. This loop continues to the end of the activities until there is no chance of finding and rescuing any survivors under wrecks. In the figure, there are operated function analysis on the right. The time to determine the victims and their location is predicted as "unpredictable". This point is crucial that shows the importance of reaching time of the knowledge of survivors even in the UN based studies.

3.1.2. Stages of Search and Rescue Processes, Responsibilities

Effective disaster management consist of three stages such as preparation, intervention and pre-recovery (AFAD, 2013). Preparatory works include:

- ✓ Determining existed resources,
- ✓ Planning,
- ✓ Organizing,
- ✓ Preparing tools, equipment and devices,
- ✓ Enhancing the capacity,
- ✓ Benefiting from new technologies,
- ✓ Preparing, developing and testing the early warning systems,
- ✓ Regulating trainings and simulated accidents, and
- ✓ Evaluating processes.

Table 6 Intervention Levels

Level	**Effect**	**Support Situation According To Disaster Type And Scale**
Q1	Local opportunities are enough.	Provincial Disaster and Emergency Management Directorate
Q2	There is need for support from near provinces.	Provincial Disaster and Emergency Management Directorate, Related Disaster Coordination Unit 1St Group Cities Support from near provinces
Q3	There is need for nationwide support.	1St and 2nd group cities support from near provinces + national capacity
Q4	There is need for international support.	1St and 2nd group cities support from near provinces + national capacity + international support

TAMP explains intervention management system in local and national levels. Recovery works divided into two as pre-recovery and long-term recovery works. At this point, intervention process and recovery stage of disaster management relate to each other. According to TAMP, intervention levels are divided into four groups in Turkey (Table 6)

Provincial Disaster and Emergency Management Directorate which is mentioned here works under the directorate of deputy governor who is assigned by the Governor in provinces for 24/7 workload.

At international level, according to INSARAG Guidelines, the Urban Search and Rescue Response Framework contains all levels of responses (Figure 21). It extends from a daily local accident response to a more complex international response with an USAR team.

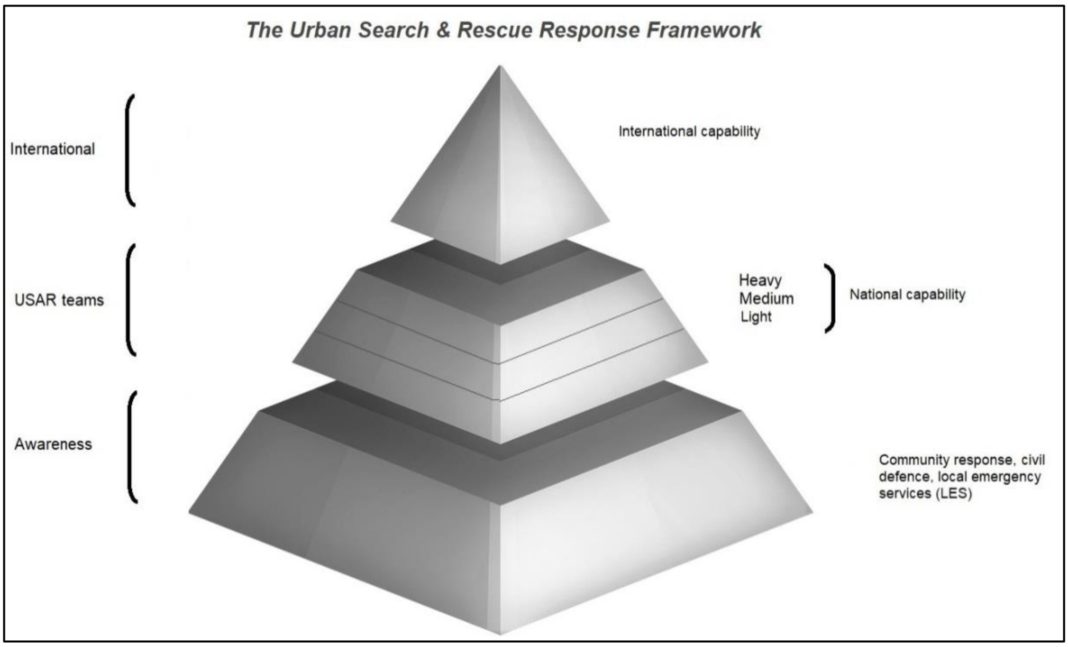

Figure 21 The Urban Search and Rescue Response Framework

The USAR teams has three levels of organization. Light, Medium and Heavy USAR teams have the same capabilities with different levels of equipment and size. But all the teams are well organized and have a predefined management structure, high level of preparedness and mobilization. According to INSARAG protocols, minimum personnel requirement for a heavy USAR team is at Table 7.

Table 7 Minimum Personnel Requirement for a Heavy USAR Team

Component	Tasks	Minimum Staff	
Management	Command Liaison / Coordination Planning / Follow up Media / Reporting Assessment / Analysis Safety / Security	Team Leader/Deputy Liaison Officer / Deputy Structural Engineer	2 2 1
Search	Technical Search Canine Search Hazmat Assessment	Technical Search Dog Handler	2 4
Rescue	Breaking & Breaching Cutting Lifting & Moving Shoring Technical Rope	Rescue Team Leader Rescue Technicians	4 24
Medical	Team Care (Personnel & Search Dogs) Victim Care	Medical Doctor Paramedics / Nurses	1 2
Logistics	Base of Operations Water supply Food supply Transport capacity Fuel supply Communicaions HAZMAT isolation	Logistics Team Leader HAZMAT Specialists Logisticians / water Base Manager Transport specialist	1 1 1 2 1
TOTAL		**48**	

According to the international search and rescue protocol (INSARAG, 2012), search and rescue actions are being executed by teams. Each team has a leader and this leader works for coordination of task force commander and team actions, and distributing the assignments between personnel. Generally, first intervention team is being police and fire department, and these actions are being coordinated by those teams. First search and rescue action that is held by these teams are executed in four stages:
Task force commander of search and rescue, design a field for search and rescue at first. This field is designed as 2x2 or 3x3 block/street size. This field cannot be designed bigger than that to reduce the communication problems.

Later, the commander designates the operations center. This area is a secure place that is inside or nearby the search location. Every member of the team knows the location of this center for coordination.

Task force commander divides the teams into two as search and rescue teams. Generally, search team includes 3-4 people and the task of this team is related to detection of alive victims who are under the wreck in the search area. Rescue team's task is related to rescuing these alive people safely.

Search and rescue actions work in a parallel run. Search actions and the results of search teams are given to the center constantly, and in the light of these information, rescue teams work on the locations of alive people.

Table 8 USA Disaster Management Core Competencies

Prevention	**Protection**	**Mitigation**	**Response**	**Recovery**
Planning				
Public Information and Warning				
Operational Coordination				
Forensics and Attribution	Access Control and Identity Verification	Community Resilience	Critical Transportation	Economic Recovery
Intelligence and Information Sharing	Cybersecurity	Long-term Vulnerability Reduction	Environmental Response-Health and Safety	Health and Social Services
Interdiction and Disruption	Intelligence and Information Sharing	Threats and Hazard Identification	Fatality Management Services	Housing
Screen, Search and Detection	Interdiction and Disruption	Risk and Disaster Resilience Assessment	Infrastructure Systems	Infrastructure Systems
	Physical Protective Measures		Public and Private Services and Resources	Natural and Cultural Resources
	Screen, Search and Detection		Mass Search and Rescue Operations	
	Risk Management for Protection Programs and Activities		Operational Communications	
	Supply Chain Integrity and Security		Mass Care Services	
			Public Health and Medical Services	
			Situational Assessment	

After disasters, for coordination of actions in the disaster location and the fields that are affected, gaining time and effective work, there are many suggested systems in the literature. In almost all of these suggested systems include distinctive limitations. The reason for this can be explained as the insufficient of one single tactic in search and rescue actions to make a full search. To not to restrict the actions in disaster area, USA Homeland Security (DHS, 2011) defined the core competencies by preparing documents that explains the network and necessities for software and hardware that will be used in first intervention by the units right after the disasters (Table 8).

USA Homeland Security drove forward the articles regarding usage of local public and survivors as much as possible for rescuing more people in shortest period while listing the action points in search and rescue actions (Table 9).

In these documents that belong to USA Disaster Management concept, rescuing as many survivor as possible at the shortest amount of time from the disaster zone is given as the primary goal. One of the riveting subjects were the suggestion of utilization of asymmetrical search techniques along with traditional ones. Also, employing local search units in an active position is given as important subjects in these documents.

Table 9 Search and Rescue Operation Action Points (DHS, 2011)

Response Mission Area Capabilities and Preliminary Targets	
Mass Search and Rescue Operations	Deliver traditional and atypical search and rescue capabilities, including personnel, services, animals and assests to survivors in need, with the goal of saving the greatest number of endangered lives in the shortest time possible.
1. Conduct search and rescue operations to locate and rescue persons in distress, based on the requirements of state and local authorities.	
2. Initiate community-based search and rescue support operations across a wide geographically dispersed area.	
3. Ensure the synchronized deployment of local, regional, national and international teams to reinforce ongoing search and rescue efforts and transition to recovery.	

Table 10 Situational Awareness Action Points (DHS, 2011)

Situational Awareness Action Points	
Situational Assessment	Provide all decision makers with decision-relevant information regarding the nature and extent of the hazard, any cascading effects, and the status of the response.
1. Deliver information sufficient to inform decision making regarding immediate lifesaving and life-sustaining activities and engage governmental, private and civic sector resources within and outside of the affected are to meet basic human needs and stabilize the incident.	
2. Deliver enhanced information to reinforce ongoing lifesaving and life-sustaining activities, and engage governmental, private, and civic sector resources within and outside of the affected area to meet basic human needs, stabilize the incident and transition to recovery.	

Likewise, in the action points that are listed for situational awareness, points related to raising awareness and sharing information to whole actors in the disaster management are also listed (Table 10).

3.2. Tools & Techniques at Search and Rescue Operations

3.2.1. Rescue Technology

Search and rescue activities are inseparable in disaster management. Rescuing survivors under the wreckage without causing any other danger to their health right after the detection is similarly important as dissolving the chaotic situation after the disaster, increasing awareness along with detection of survivors as fast as possible. Rescuing teams are conducting their actions against time at the locations that are detected by search teams. Developed loss/casualty prediction optimization, screening and rescue tools are at the priority list regarding rescue technology. Right equipment for right work is shortening the necessary time for evacuation of wounded people under wreck. Especially the progress of construction technology and tools are providing immense benefits to search and rescue teams during their operations to protect the strength of them (Federal Emergency Management Agency (FEMA), 2018). Search and rescue work areas are dangerous, demolished, ruinous, corrupted and fractured areas that harden the work of rescue and need great efforts. Technological tools that are developed to work on these areas should be produced as practical and light that will be able to force the weight limitation, design and functionality. Tools and equipment that will work under wreck which need to be short, light and strong, able to evaluate the toxic gas from exhaust pipe if they have motors, power source from batteries and accumulators can be provided these days. Especially there are many powerful devices to move, cut or bend the heavy columns and materials under wreck, and they are providing opportunity to gain time as much as needed to save and rescue wounded people. Also, newly developed laser technology equipment, high water pressure systems, small and smooth blasting equipments, and automatic stabilization providers help to save time and search and rescue operations in general (Wong & Robinson, 2004). A list of materials that are being used during search and rescue operations in Turkey which are determined during face to face meetings or interviews is included in Table 11. This list includes the materials that are used at least once, however there are many other materials and tools can be used. US Federal Emergency Management Agency which is called FEMA supports 28 task forces nationwide. In each task force, there are fire extinguishing expert, doctor and health personnel, construction engineers, dog experts, heavy construction equipment operators along with the heavy and light equipment for search and rescue teams. Chen & Miller-Hooks (2012) indicated in their study that these equipment include cranes, earth movers, trucks, support tools, generators, boats, helicopters, cutting tools, dog teams, robots, infrared detection tools, heat censors, sonar, drilling tools, microphones, fiber optical cameras that are remote controlled and medical aid materials. Detailed authorized list of these materials by FEMA (Federal Emergency Management Agency (2018) is on their own sources.

Table 11 Tools and Systems Used in Search and Rescue Operations in Turkey

- ✓ Wreckage Search Dog,
- ✓ Wreckage Alive Sound Locater,
- ✓ Wreckage Alive Imaging Devices,
- ✓ Sensor Systems,
- ✓ Geographical Information Systems,
- ✓ Seismic Meter / Acoustic Meter,
- ✓ Excavation Tools (Pickaxes, Shovel, Rope, Sledgehammer, Idlers etc.),
- ✓ Megaphones,
- ✓ Communication Technologies, GPS,
- ✓ Emergency Flashcard / Information Card,
- ✓ Night Vision Glasses,
- ✓ Hydraulic Cutting/Dismantling Set,
- ✓ Field Illumination System,
- ✓ Airbag Set.

Developments that are made with classical methods regarding technological tools and equipment which are important parameters that affect search and rescue actions are on construction engineering. However, since because there are no borders in disaster and their effects in the geography, re-evaluation of the technologies and tools should be done to modernize them. Statheropoulos et al. (2015b) proposed the priorities for next generation rescue tooll and Technologies at their study (Table 12).

As a small comparison, examples of regular tools and equipment which are being utilized by US Federal Emergency Management Agency (FEMA) (2018) are given in Table 13.

Table 12 Priorities for Next Generation Rescue Tools and Technologies

- ✓ Implementation of standardized rescue techniques,
- ✓ Providing quality assurance of rescue equipment,
- ✓ Providing quality assurance of utilization of equipment by the rescue personnel in training,
- ✓ Establishing networks and rescue team groups to provide determination of user needs in a proper way,
- ✓ Modulating all rescue equipment as lighter,
- ✓ Preventing vibration from hand/arm,
- ✓ Keeping the exhaust outlets out of wreckage and extension of power chords of motors which are going to work under wreckage,
- ✓ Production of light equipment without exhaust which can work with battery or accumulator,
- ✓ Preventing rescue teams from harming the victims, by subtracting water and dust,
- ✓ Improving abilities of equipment as cutting, breaking and clipping under wreck and gaining time for rescue,
- ✓ Decreasing the noise of equipment under wreck and providing opportunity of intercommunication of team,
- ✓ Developing an equipment which is small and light that can decrease the manual work under wreck,
- ✓ Producing equipment that can provide light from itself which can work under wreck.

Table 13 US Federal Emergency Management Agency (FEMA) Search and Rescue Material Examples (FEMA, 2018)

✓ CBRN Mask,
✓ Seismic and Acoustic Monitoring System,
✓ Face, Hand and Feet Protection Mask,
✓ Personal Alarm Security System (PASS),
✓ Personal Mental State Monitoring Sensor,
✓ CBRN Detection Robot and Equipment,
✓ Thermal Screening System,
✓ Various-Purposed Robotic Systems (Explosive detection, search and rescue, hazardous material detection, surveillance),
✓ Small Unmanned Air Vehicle (Drone),
✓ Search Cameras,
✓ Risk Management Softwares,
✓ Command, Control and Decision Support Softwares,
✓ Operational Field Virtual Imagining Softwares,
✓ Cloud Systems Compatibility Softwares,
✓ Traffic Circulation and Modeling Softwares,
✓ Material Following and Inventory Softwares,
✓ Public Warning and Alarm Systems,
✓ Wide Range Field Linked Hand-held Computer, Tablet, Phone,
✓ Mobile Computer (Search, communication, cyber security, logistical support),
✓ Mobile Data Computers (Mounted to vehicle, makes information sharing to databases),
✓ Barcode scanner and Writer with Wi-Fi Support,
✓ Infrared Camera,
✓ Network Installation and Tracking Softwares,
✓ Ciphering Softwares,
✓ Personal Security Wall Softwares.

When the materials above are evaluated, too many technological softwares and hardwares for utilization by FEMA teams among with classical material and tools are taking the attention. To remove fast as possible the dangers from the nature of search and rescue tasks, to provide the security of teams and utilization of these systems for receiving information of alive people under wreck as fast as possible are important aspects that need attention.

Table 14 Turkish Disaster and Emergency Agency (AFAD) Material Examples (AFAD, 2014)

No.	**Material / Item**	**Amount**
1.	Personal Computer	3713
2.	Notebook	1111
3.	Tablet PC	184
4.	Toughbook	46
5.	Printer	1495
6.	Scanner	340
7.	Photocopier	206
8.	Faximile	176
9.	Camera	185
10.	Plotter	21
11.	Server	96
12.	Phone	2924
13.	Projector	205
14.	Switch	133

3.2.2. Search and Rescue Methods

There are mainly three types of search methods (Wong & Robinson, 2004):

- ✓ Physical Search – consisting site search, visual search with voice,
- ✓ Canine Search – using trained special dogs,
- ✓ Electronic Search – using various electronic devices and systems.

The most common technique to physical search is to make a detection of a victim is yelling the sentence of “Can anybody hear me?”. This technique can be used with under wreck sound locater tool. Listening quietly under wreck is another common technique. This technique can be used by people with no training or tool, however the situation can be dangerous. People who lost conscious due to their wounds cannot be detected by this technique. Within the bounds of the possibility, search actions can be made by using a camera under wreck. Simple usage of cameras, records of video or photographs, and remote viewing can create great advantageous. However, this technique is not common as others due to the limited battery power, size and costs. Also, infrared or thermal cameras and electronic sound locater tools are other tools that are being used. Infrared and thermal cameras are very useful in big and dark open spaces, dusty or smoky areas. Electronic sound locater tools can detect the breathings and hence location of victims in great areas with special techniques like triangulation (Wong & Robinson, 2004). In the cases of any signal that belongs to an alive victim under wreck, the removal of wreck starts from right or left side in 1.5 - 2 meters and then rescue actions start (Özdemir, Karabıyık, Çalışkan, & Bülükçulcu, 2012). The biggest disadvantages of these tools and techniques are limited scanning area, need to silence background voice and low capability to detect unconscious victims. In search actions, special trained dogs can also be used. In cases of scanning great scale area in a short time, dogs are very useful. Dogs can also detect unconscious alive victims. However, number of search and rescue dogs are very scarce, and the performance of the dogs can be limited, and they need to get rest for a long time after a very short period of work. Also, in the places of dead bodies, they can lose their senses.

The other methods apart from techniques that are explained above, are usage of microwave systems, autonomous camera based tools (Dandoulaki & Andritsos, 2007) and search robots, electric visual detecting devices, endoscopic detectors, fibre-optic detectors, infrared goggles, thermal detectors, underwater imaging devices, geophones, ultrasonic detectors. Also, usage of tools or dogs to detect volatile organic compounds (VOCS) of alive people under wreck is another method (Agapiou, Amann, Mochalski, Statheropoulos, & Thomas, 2015).

It is known that even if the search and rescue studies are gaining attention, the actions are not considered as effective in Turkey. After disaster, mostly driller or breaker tools are being used for wreck removal. In the base of the studies, the speed of reaching to the information of regional structure, buildings that will be searched and alive victims under wreck is laying. However, studies that are made are not applicable enough yet (Erkal & Değerliyurt, 2009).

AKUT, a volunteer organization for search and rescue, is using the vehicle or person tracking system for search and rescue activities. From a center, a surveillance can be made to the AKUT and volunteering teams in the field to see the exact location of them by using the map and a direction can be made by these information. Searched areas and existing situation of the teams can be seen to make a direction accordingly. Alive detection cannot be made with this device and only in search and rescue actions it can be used for learning the location of teams and direction of teams (Arvento, 2009).

3.2.3 Roles of Dogs in Search and Rescue Operations

Throughout humankind history, dogs were essential for search and rescue actions due to their senses of smell. Especially from World War 1, dogs are started to be used in an organizational way and records regarding dogs started to be kept. Particularly in the subjects of detecting unconscious soldiers due to usage of tobacco or drugs, and contact with explosives, SAR dogs are used and will continue to be used.

With those aspects, dogs became irreplaceable for search and rescue teams too. Due to the time limitation after disasters, in the cases of victims underground cannot be heard, weak or unconscious, dogs become one of the most important assets for searching and detecting the locations (Greatbatch, Gosling, & Allen, 2015). Dogs which take these tasks are not mechanical tools and therefore it is hard to expect the same success all the time. Greatbatch, Gosling, & Allen (2015) who decided to measure the effectiveness and success of the dogs especially in search and rescue actions on flat areas, made 25 tests with 14 dogs in England in 2014 and evaluated the results. A GPS tool is mounted to each dog to follow the route, and external factors such as temperature, humidity, and wind are also recorded. The dogs that are subjected to the tests are expert on smell and positioned on a flat area to start the search and direct to the location of the victim after they are triggered with the smell of them. Success rate of the dogs are calculated with the division of victim number they located to total victim number. Success rate is recorded as 76,4%. The efficiency of dogs is calculated as the degree of success in this task; the division of victim number they located to the addition of wrong detection number to total victim number gave the result of the efficiency. The efficiency rate is recorded as 62,9%. It is also mentioned that the difference between success and efficiency rates of search and rescue dogs are not directly related to the environmental effects, and tests should be repeated after the enrichment of dogs and tests. In Turkey, along with search and rescue teams, dogs are also take tasks for search and rescue operations and there is no similar study in literature on performances of dogs. In the Dog Search Team Task Competence Examination on November 2015 which is executed by AFAD, 17 of 35 dogs achieved to success and awarded with medals; and in the ceremony, Dr. Fuat Oktay the President of AFAD said “When we look at the numbers of search with dogs, it is the fastest technique.” According to the information of this news, the time of finding victims under wreck of search teams with dogs’ changes between 3 to 7 minutes which is an achievement and progress when seismic search tools' time of finding victims is compared to this technique (AFAD, 2015).

When we look at to the utilization of the dogs and their efficiency in Turkey, unfortunately, we cannot see a good picture. Marmara Earthquake caused grave sorrow in Turkey (Mizuno, 2001). According to the detections, 15.135 confirmed dead, more than 20.000 injured, 200.000 people were made homeless. 46 Countries provided asistence with 2.276 SAR team members, 224 dogs, 23 ambulances and 709 medical personnel. After Marmara Earthquake Mizuno (2001) defined search and rescue activies "slow and unorganized" as a result of lack of command and control activities, loss of communication, shortage of appropriate equipment and absence of disaster responce training. Although after each disaster that occurred in Turkey, the tools of search and rescue actions and disaster management started to show some level of progress, in Van Earthquake in 2011 which is still being considered as a new disaster, search and rescue actions could not be effective and many lives are lost in this incident.

3.2.4 Alive Detecting Radar Systems

Alive Detecting Radar System is a system that can detect the indications of an alive person (such as breathing, heart rhythm (Chuang et al., 2012), pulse etc.) from a long distance from behind of concrete or brick walls (Hu, 2012). In this system, signals are being sent to the alive disaster victim. Indicators like breathing and pulsation turns into parameters. Technical limitations of the device (detecting the movement to only 12m and the breathing to only 10 m, 13 kg weight, short battery duration, the necessity of usage on wreck due to its ability to detect only in narrow and vertical band etc.), make the usage of this device difficult.

Despite the difficulties at usage of these devices, Alive Detecting Radar Systems are providing great advantages due to their durability to external factors such as temperature, humidity, and noise, the high level of detection, resistance to derangement, sensibility and the ability of penetrating to deep surfaces. However, there are also some disadvantages such as low success rate of detecting more than one body, and exposure to radiation. As a response to the limitation of usage that is mentioned above, the system that is developed in this study is aimed to work in all wrecks as independently and work with different devices.

3.2.5. Optical Alive Detecting Systems

Optical Alive Detecting Systems are working with the technique that allows to drill holes on wreck and extend the optical device to figure out the location and health condition of the victim. These systems are generally consisting of sensors, optical correction mirror, round objective glasses, a beam light based shaft mounted with a light source, headphones and microphone. The disadvantage of these systems is the low image quality in darkness under the wreck. Also, there are other disadvantages of this device such as the compulsion of extending the optical source to the location of the alive victim and the working challenges with objective glasses and a long shaft under wreck (Hu, 2012).

3.2.6. Acoustic Alive Detecting Systems

Acoustic Alive Detecting Systems consist of acoustic sensors, data collecting system and a computer processing unit. Acoustic systems are working with collecting vibration signals that caused from the screams, movements or hitting at the wall from the victim. Naturally, these alive detecting systems are very fragile due to their exposure to many different vibrations that are coming from activities above the wreck, and they need to be extended to the depths of the wreck. Especially after earthquakes, the aftershocks, quakes from building's lifting or collapsing, insensible movements from people who are excited and distracted above the wreck, voices of the teams and vehicles who arrived at the disaster area make the usage of these sensors very difficult (Hu, 2012).

3.2.7. Infrared Alive Detection Systems

Infrared Alive Detection Systems are established on spreading a different kind of infrared than the objects around the human body. Infrared radiation is a longer electromagnetic radiation than a visible light however shorter from microwaves. Color of red is the color that has the longest wave length of visible light. Infra means “down below” in Latin and infrared means down below from red. A human body spreads 10 micrometer radiation in a normal human temperature. Especially in the dark areas of the wreck after earthquakes, these systems are creating advantages to detect alive bodies under fog especially (Hu, 2012).

3.3. Information Systems at SAR Operations

In these days, the systems for gathering the data, creating knowledge, accessing, reserving and sharing the knowledge are in a progress at an unprecedented pace. The increasing pace of communication medium, astronomical growth of data processing capacities, and expanding and/or lifting boundaries make the world a little village with people who are affected by each other. The share of information systems in this change is a fact that cannot be irrefutable. Internet of Things which is expected to be entered in our lives in near future and Smart City concepts will be built on Information Systems. Naturally, a subvertical part of Smart Cities will be Smart Disaster Management System.

In the Smart Disaster Management Systems, production, interpretation, and gathering the data along with sharing it with the partners intra vires are main subjects. Also, providing those data to be utilized by the Disaster Management Actors, reporting and gaining ability for fast movement during disaster chaos are also counted as main subjects for those systems.

3.3.1. Priorities of Information Systems at Disaster Management

Recognition, data gathering, managing different data sources and common planning and turning into information to create situational awareness are important aspects for Information Systems at Disaster Management. Each decision and application in each stage of search and rescue operations should come consecutively. These decisions are taken by the decision maker in the light of information and situational awareness experiences and most of the times these decisions are affecting the safety of teams.

Table 15 Priorities of Information Systems of Professional Teams

- ✓ Fast detection of victim's location under wreckage,
- ✓ Utilization of a situational awareness model such as Endlsey (data, info, decision)(Endsley, 1995)
- ✓ Providing the satellite imaging that can be bought at its location,
- ✓ Normal area analysis with helicopter or plane,
- ✓ Utilization of balloon with video camera,
- ✓ Real time data transfer with drones and cameras,
- ✓ Continuous monitoring means,
- ✓ Recognition of structural informational systems,
- ✓ Monitoring of collapsed buildings,
- ✓ Utilization of mobile phones of victims under wreckage,
- ✓ Information combination and fusion

Therefore, gathering information in disaster area carries great importance. The most common situation regarding information gathering even in international area is gathering information and making detailed observation from firsthand regarding disaster victims, survivors and relatives. While team leaders are gathering information in such situation, they also try to make right deductions from those information due to the important risks and mistakes cause security problems. Along with the information gathering in this way, the application that works to provide chemical detections and knowledge acquisition above the wreckage, application that works with database in wide area, and data regarding the security of wreckage are evaluated together. Statheropoulos et al. (2015) listed the priorities of information systems of search and rescue teams (Table 15).

3.3.2. Disaster and Risk Management Information Systems

At last ten years, after the law 5902 established, studies regarding the protection from disasters and disaster management in Turkey increased immensely. This situation creates an advantage for Turkey, however the great number of studies mostly include the structure and soil structure. Whereas disaster management that starts from preparation for disasters is a crucial subject that requires synchronization and participation of all organizations in the country, and importance of long term planning and coordination that enhances the period for years from the beginning of all preparation. Prediction and warning systems, meeting the need of basic information technologies such as communication and correspondence during intervention stage, right before the disasters should provide the increasing situational awareness, and right and fast information acquisition.

Search and rescue dogs are called old technologies of search and rescue operations that are using the voices or vibrations of people. These technologies are the ones that are being used in cases of the arrival of experts to disaster area directly, and to use these technologies man power and time is required. Whereas the developments of sensor technologies, wireless technologies, robots and voice-image technologies in recent years provided great improvements to detect alive victims under wreckage. None of these technologies are not sufficient enough to work by itself and they are being used in different areas according to the most advantageous features they have.

In Turkey and in the world, there is a need for water, food, sheltering, protection and medical service during intervention stage after disasters. These helps are being distributed unevenly and manually due to the emergency of the situation at the first place. Later in the day, these helps are being distributed more coordinated and orderly by the measures that are taken. At the same time, during intervention stage, the search and rescue actions for finding alive people under wreck are also being conducted. However, these actions are time consuming. These works are in a nature that requires too many efforts of search and rescue teams along with the time of their work. Therefore the utilization of information technologies in search and rescue activities effectively is a need for search and rescue processes (Endsley, 1995; Fujiwara & Watanabe, 2005; Hu, 2012; Statheropoulos et al., 2015b).

The unpredictable nature of disasters makes people vulnerable and unprepared against them. Even though that many nation call it differently, the networking that is established during intervention and improving stages right after disasters are called Disaster Relief Network (Lakshmi Narayanan & Ibe, 2012). These networks are the networks for lifesavings. These networking are established to serve to the teams and alive people under wreck. Lakshmi Narayanan & Ibe (2012) indicated the value of these networks are higher for official organizations. EHDS project that is suggested in 5th chapter of this thesis is an example work of networks studies that save lives.

According to the AFAD Dictionary; Disaster Information System is a system that is defined as “a technological and integrated system that provides an easy networking for information that is required in a coordination and data related the subject to be used to decrease the casualties and economical loss during each stage of the disaster” (AFAD, 2014b) Actors of disaster information systems are users and decision makers, meanwhile their department requires the actors such as hardware, communication, software infrastructure that is stored or used simultaneously.

To decrease the disaster damages, networking that will be established during intervention stage should be independent from statically networking before disaster. The reason for that the collapse of the networking systems gradually or wholly in infrastructure during disaster. Accordingly, these networking shall not be very useful to be used as a base for intervention related applications. Intervention networks should be easy to be established, moved or worked. These networks should be easy to learn in a short time especially by their users. The networking that can ease these features are wireless networking. There are many wireless networks that can be used easily such as GSM networking topology, wireless local networks, wireless mesh networks, regional networks, however these networks are not in an easy in use situation because they are not designed as intervention to disaster network directly. Whereas the service of these networks during disaster carries great importance. Especially in cases of becoming unusable of the GSM networking which are called "Infrastructure Based Networks" due to the disasters, people cannot use their mobile devices (phones, tablets etc.) which obtain many technological abilities even though they carry these devices with them constantly. In such cases, establishing an alternative way for people to get in touch with local search and rescue teams provides a help signal spread without a need for going to foreign fields.

Çeri (2014) made a hardware change on Android devices by using the wireless feature of theirs to start ad-hoc mode, and made a study regarding creation of a communication via ad-hoc network between themselves in cases of no GSM networks in mobile devices with an open source coded frame with the name of "MANET Manager" that uses OLSR (Optimized Link Source Routing) guide protocol. This study is an important study that provides the benefits to search and rescue operations with the wireless features of mobile devices, even though there is no such model that can be used generally due to the requirement of hardware change. Also this study has cross points with our model that is explained at chapter five regarding to the local operational feature.

At another study in the literature, Lakshmi Narayanan & Ibe (2012) indicated the basic needs for establishing the intervention networks after disasters in their studies as below:

- ✓ Quick Response - Intervention networks that will be established after disaster should be in a nature of reacting swiftly according to the structural features of disasters.
- ✓ Life Expectancy - According to the devastation level of disaster, the intervention networking structure that will be established after the collapse of infrastructure should be able to provide service until the end of the search and rescue processes and even after the improving of normal infrastructure.
- ✓ Interoperability - When the variety and different infrastructure of disaster area teams are considered, the networks that will be established during intervention process should have the interface that provides a coordination with other networks.
- ✓ Free - If the sound systems in the intervention networking structures in disaster areas are going to be used, they should be provided for free.
- ✓ Coverage - Communication infrastructure after disaster could be divided into independent pieces. Network structures that are going to be established during intervention process should comply with and include these divided pieces.
- ✓ Heterogeneous Traffic - The network structures that are going to be established during intervention process should include three type of data; sound, image and data itself.
- ✓ Capacity - The network structures that are going to be established after disaster should provide access to the systems which will work as a normal infrastructure and should be compatible with the existed systems.
- ✓ Ease of Use - The network structures that are going to be established during intervention process should be easy to use and learn by large masses. If victims are going to purchase a device for these structures, these devices should be cheap and easy to buy.
- ✓ Indoor and Outdoor - The network structures that will be established should be proper for usage in and out of buildings.
- ✓ High Precision - The network structures that are going to be established during intervention process should be able to notify the locations with the acceptable accuracy level.

In literature, ad-hoc networks (Fujiwara & Watanabe, 2005), wireless mesh networks, satellite and sensor networks are the ones for intervention process. Many of these network structures can provide access to search and rescue teams to other team members. There are quite few examples that provide access from victim under wreckage to search and rescue teams (Lakshmi Narayanan & Ibe, 2012). Comparison situation of qualities that are mentioned above related to suggested EHDS of this thesis is given in details in 5th chapter.

3.3.3. Wireless Sensor Networks at Disaster Management

Due to their wireless and easy to use applications, wireless sensor networks are becoming more and more popular each day. Sensor networks can be used for detection of alive people under wreckage along with the usage of data collection from different applications.

Wireless sensor networks are not a full solution when they are used by themselves. They are subsidiary factors of network structures that are established during intervention process. In this manner, the scalability, fault tolerances, network structures, power consumption and power current in network structures to be established should be planned in detail. In a typical sensor network there are receiver, transmitter, power supply and sensor. In literature, a wireless sensor network that is designed for search and rescue by the name of SENDROM (Çayırcı & Coplu, 2007). In this study, the method of keeping such sensors in all houses before disaster and using these sensors for locating users after disaster is explained. Although the configuration of this system and having a sensor at each house may be costly, it is still considered as an alternative view to intervention stage systems at the literature. The Project suggested at the 5th Chapter is also very likely to be considered as an alternative.

In a similar study, A. Y. Chen, Peña-Mora, Plans, Mehta, & Aziz (2012), indicated that at the first intervention teams there are fire departments and construction engineers that works to coordinate the next intervention teams along with defining the damaged buildings and their situation. The integrity, structural defection and secondary effects of the damages of the buildings that are under the security of search and rescue teams are greatly important. Also, the priority is defining the structural situation, access time, danger of collapse, alive victims, known victims, inhabitant in the buildings for search and rescue operations. In traditional methods, the first teams arrive make the first examination and gather the information afterwards for keeping them available for other teams by marking the buildings with international orange colored spray paintings. In this study, a structure called Mobile Temporary Network Using Urban Disaster Preparation and Emergency Response (SUPER-MAN) is proposed. This system work for defining methods, ways and manners of work of intervention teams according to the grow of structural damages. In this system, the information that are marked will be written to the RIFD tags on the buildings, and the access of these information from network or electronic inquiry shall be made by the teams that arrive later.

Ochoa & Santos (2015) who studied on the same subject indicated that the first teams arrive that include health personnel, policemen, and soldiers together can decrease the speed and efficiency of whole search and rescue operations by their lack of communication and coordination. Especially the public officers are using WHF/UHF radio for communication in this process which are trustworthy and simple systems can be used after infrastructural collapse, however these systems are highly limited. Particularly in the cases that the units at first intervention should wait for establishment of a system to provide communication and coordination, it is seen that they can waste the Golden Hours for this issue and they start to improve according to their experiences.

The common points of the studies are fast access to the information (such as search and rescue area features, maps, building structures, inhabitants, special buildings/apartments, infrastructure features, ground structure, chemical/nuclear substances around the area etc.) that can speed up by providing easiness for work of search and rescue operations by the first arriving teams. Even though there are differences in each country, there is no locally access to those information by search and rescue teams in Turkey easily. This situation cause difficulties for search and rescue works such as misleading actions that causes the decrease the efficiency, and difficulties that cause the endangering the search and rescue teams and victims all together. Avdan (2011) developed a system that provides the receiving the information at the search and rescue area by the teams with modeling the necessary information at disaster area by search and rescue teams. With this system, a model is established to provide opportunity to process the information in a central database in the disaster area by mobile devices and storing with wireless sensor technology and RFID after the determination of the information before the disaster. This study which is conducted by Avdan (2011) is another version of the study of A.Y. Chen et al. (2012) for providing it before the disaster.

3.3.4. Robotic Search and Rescue Systems

Victims are many times being stuck between wreckage after disaster. It is not an easy job for victims to be rescued from those wreckage. Especially the disasters such as earthquakes that continue consecutively are highly dangerous for search and rescue teams on the wreckage due to the dangers of falling, hitting, and cutting which are the nature of wreckage, or gas explosion or electrifying due to the damaged energy infrastructure that are not stabilized yet.

Whereas robots are very convenient devices for detecting alive people under wreckage and their usage requires low cost. Generally, robots are designed to provide information to search and rescue teams. Robots are informing the situation via communication with search and rescue teams when they face an alive person. Robots are also being used for the chase and controls of the teams that are working on search and rescue subjects at the same time. Also, robots are impressive helpers in cases of the chemicals or nuclear dangers for people in general. Robots should be in a state with basic features that can transfer the images after visual specification of the environment, detect the locations, able to move in search and rescue areas for the works of search and rescue. With the increase of the importance of human lives, and with the improvement on the studies regarding increasing the intervention process time and capacity after disasters, there are many studies made regarding the robots' usage for search and rescue activities. Tokuda, Yagi, Kinugasa, & Miwa (2010) in their study of a robot design with 6 arms and jump feature modeled with consecutive jumps, detected that these round robots which separate to random areas of disaster area are serving for rescuing more alive people and gaining more time to search and rescue teams by data collection and exceeding obstacles.

Robot surveillance systems consist of a reference vital points and robots connected to an empty point before disaster. With the movement of robot to forward, empty points send requests to reference vital points with ZigBee interface protocol and reference vital points informs the location. Especially with RSSI (Received Signal Strength Indicator) values, robots can calculate the exact locations and move forward accordingly. The difficulties of this system are the planned distribution of reference sensors before and possibility of confusing the RSSI signals with other signals.

Çakmak (2014) in his study developed a wheeled robot platform with differential drive that is designed to be used for search and rescue operations. The main features in these robots are the features of autonomous navigation, mapping, location and state estimation, and movement pattern of the robot. Also, these features need to the detectors such as inertia sensor, imaging systems and laser distance measuring sensors.

Topal (2011) suggested in his study that a goal-oriented primary search method with exudation modeled multiple robots to save time and energy in search and rescue operations. In this model, multiple robots are structured to compound the maps of the areas they scanned by the map assembly method after the right searching and scanning the areas that they can detect the most alive people with the exudation modeled at different locations of the wreckage. With this method, the mapping of the area in the shortest period possible and detection of the wounded victim can be provided.

Robots are extremely advantageous to be used at the disaster locations that endangers the human health and life. Except disasters, these robots are taking the place of the people in many places that endanger the human lives because of the bad working conditions. Mines are included into these kind of work areas, however, due to the nature of the mines, the limitation on movement, characteristic aspects of underground, the deployment of the robots to those areas are not common yet. Reddy, Kalyan, & Murthy (2015) indicated that the situation in the mines after disasters that happens there can be deadly for search and rescue teams and miners who are stuck underground, and search and rescue operations are nearly impossible. After such incidents, generally the area fills with dangerous gases such as carbon dioxide, carbon monoxide, and methane. Also, all galleries are being filled with water or with dust and some. In such situations visibility is totally lost. Underground mines are divided into two such as coal mines and others. Especially coal mines are the mines with the most danger which close to the ground and with soft surfaces, and this situation makes these mines more dangerous.

Due to the dangers that are listed above, on 13th May 2014 due to a fire in a mine in Soma Manisa, 301 miners lost their lives. This incident is recorded as the worst mine incident due to the number of casualties in Republic of Turkey. At the same year, a flood occurred in a coal mine that is close to Pamuklu village which is attached to Ermenek Karaman on 28th October 2014 and it caused 18 miners death. In those two incidents due to the dust, smoke and water, the intervention could not be made for a long time. In such cases, the importance of robotic systems is increasing more and more.

The biggest problems while working underground are lack of space, high temperature and humidity, suffocation atmosphere and limited illumination. In cases of disasters, these conditions worsen and make it very difficult for search and rescue teams' work. Reddy et al. (2015) divides the search robots into four main group:

- ✓ Unmanned Ground Vehicles - These devices are helping to the search and rescue teams at dangerous areas by moving on ground.
- ✓ Unmanned Surface Vehicles - These devices can search by moving on the surface of water.
- ✓ Unmanned Underwater Vehicles - These devices can search and examination by moving under the surface of water.
- ✓ Unmanned Aerial Vehicles - These devices can help by finding victims and transportation of health aids without descending to the ground.

Lin Chen et al. (2011) designed a robot system that is covered with a long and lean steel armor to detect alive people under wreck that cannot allow search and rescue teams' entrance to the ground. The robot that is designed in this study has 40 mm diameter, 3 m height and 3,5 kg weight, with a flexible structure and a CCD camera system on the head. With this structure, this flexible and long robot can provide some benefits for gaining time and increasing the efficiency of search and rescue teams by detection of people with entrance from small holes that people cannot enter.

There are a lot of robotic systems that are designed especially for hazardous areas and disaster zones in the literature. It is very clear that the benefits of robotic systems are extremely important and the utilization of those systems will be increased in the future. EHDS system which is suggested in this project can be seen as a complementary tool for robotic systems. At the detection of help signal of EHDS, instead of mobile tools, robots can be used under the wreckage.

3.3.5. Health Disaster Information Systems

During the intervention process of disaster management, the main goal is the rescuing people who stuck under wreckage alive and well and providing emergency health services to decrease the effects of disaster. In these works, especially the removing the negative effects on the health of victims after disaster and providing emergency health needs as fast as possible are carrying great importance. Therefore, providing fast and coordinated emergency health application to alive victims as much as rescuing them alive is a most necessary actions to be carried. In these days, referring a patient according to his/her triage after disaster to the proper hospital, recording necessary information of referring, tagging and information sharing are being made with the paper based recording systems. Whereas due to the nature of disaster, these services should be made urgently and correctly with a high coordination. In Turkey, especially İzmir Disaster Information Management System (İZAYBİS) and İstanbul Municipality based Disaster Coordination Center (AKOM) are the health information systems that provide examples in this subject. It is clear that there is a need for progress in health management systems in Turkey, as well as the existed disaster management systems. Hence, there are a lot of duties to be established in both fields that require progress.

In literature, there are many studies regarding disaster management system that include health information systems applications. Some of the examples that are required during intervention process for health information system of these studies are listed below:

- ✓ Search and rescue team information, intervened victim information, material and energy stock situations, last location information,
- ✓ The situations, coordination and communications of health personnel and organizations,
- ✓ Triage codes, locations, medical interventions of victims, and information of people who made these interventions,

- ✓ Referring information of referred patients to another health organization from same or different regions, last location information,
- ✓ Morgue, tent city, hospital station, empty bed numbers of local hospitals, distribution of patients to the hospitals and units.

Health information systems, information technologies in hospitals, durability of health information systems to disasters and subjects related to work continuity should be evaluated in the scope of disaster information systems. Ada (2013) made a study regarding the subject that includes the availability of necessary talents and operability of hospital information systems during disasters. According to the results of this study it is seen that hospitals are ready and able to use their systems in normal terms; however, these systems are not usable during disasters due to the lack of operability, and there is a need for study for these subjects. Huang, Kwan, Ku, Hung, & Wang (2002) developed a system for utilization of sources efficiently and time saving for disaster management by usage of mobile devices and wireless networks with the semantic operation management mechanism to be used for mobile emergency health services. In the system that they developed, rescued alive people and their health situation information are delivered to a central health database by mobile devices and wireless networks around search and rescue personnel. For this delivery, the limited sources of mobile devices are modeled to provide an optimum performance.

3.3.6. Geographical Information Systems

Even though the disaster history started with the existence of human kind, information related to disasters and their effects were very limited until the progress of information and communication technologies in recent history. Due to the lack of information and research, there were many inadequate studies made for disaster recovery and measurements. Today, thanks to the progress in information and communication technologies, great scale of information gathering, processing, storing, analyzing and re-using is possible.

Especially when the unpredictable nature of disasters is considered, the best options to do are decreasing the effects of these disasters, decreasing the effects on human and societal health, doing research and investigation on these subjects, preparing plans, preparing and applying all these preparations. Geographical Information Systems include the extracting each kind of information to computers by creating time and space relation, processing these information, categorization, storage, analyzing and using as visual figures. Geographical Information Systems are providing great benefits to constitution of disaster risk maps with the means of processing the great number of data very swiftly along with the all the other information systems' advantages.

Because of these features, Geographical Information Systems become the irreplaceable features of disaster management information system infrastructure. From location detection of victims in disaster areas to the service of logistical factors to the area, transportation and coordination of the teams, feeding the public, and all the other processes until wreck removal, geographical information systems are providing numerous benefits. In the applications that will be developed with these aspects, Geographical Information Systems integration should also be considered.

3.4. Factors that Affect Search and Rescue

3.4.1. Aspects that Extend the Time of Search and Rescue

Statheropoulos et al., (2015) listed the aspects that extend the time of search and rescue operations in settlements in Table 15. These aspects are observed clearly in Port Au Prince/Haiti (2010) and L'Aquila/Italy (2009) earthquakes. In this subject, a clarification should be made to one aspect. Each search and rescue operation, due to its nature includes a preparation period and different stages.

Table 16 Aspects that Extends The Time of Urban Search and Rescue Operations

- ✓ Especially the mobilization of the teams that came from another country and transportation of these teams,
- ✓ Authorization and permits,
- ✓ Logistic activity of operations,
- ✓ General situational awareness, risk assessments and security evaluations,
- ✓ Planning and assignment of the teams with security briefing,
- ✓ Second search at the same building after the wreck removal,
- ✓ Actions of drilling and lifting heavy weights,
- ✓ Communication with teams from different nationalities,
- ✓ Safety and stabilization of buildings and wreck,
- ✓ Evaluation of prioritization of operations,
- ✓ Human resource and material limitation,

Therefore, it can be said that these aspects are not applicable in a standard, however the effects of these aspects can be effective. Another aspect of this subject is the role of public that is affected from disaster. If the disaster is in a scale that can affect big and large number of places and people - like 1999 Gölcük Earthquake-, there is a possibility of the public started to search and rescue operations before the official teams' arrival for the sake of volunteering and helping to their own relatives. In such cases, same aspects are available yet their effects can be different. For example, even after many days from 1999 Gölcük earthquake, transportation and traffic remained stuck due to the publics flow into the area and this situation caused great delays in transportation of help. However, at the same time, these same volunteers helped to remove the heavy wreck to sake of helping wounded people without any tools or vehicles. This is why, search and rescue volunteers who works unofficially may carry positive and negative effects to search and rescue operations.

3.4.2. Important Parameters and Needs in Search and Rescue Operations

For the disaster victims under wreck, “four rule” is valid. A disaster victim can survive 4 minutes without air, 4 days without water, and 4 weeks without food (Agapiou et al., 2015); therefore, search and rescue operations end after 72 hours or change the priorities afterwards. However, despite all the disasters that happened before, it is possible to see miracle survivors from longer than this time. In literature, there are many studies regarding disasters and disaster management systems, and in these studies, the correct information that will be provided to actors during intervention after disaster includes great importance. Seppänen & Virrantaus (2015) indicated in their studies that the actions during intervention should be fast and coordinated due to their vital importance. They suggested a method for the Shared Situational Awareness (SSA) in disaster response.

It is evaluated that gathering information in a short time and the high level of correction possibility can cause sufficient actions during chaos or on the contrary more chaos and damage. Disaster area requires a high level of situational awareness such as war zone which shows similarity to itself. Wickens (2008) described the situational awareness as the projection of future events and existed meanings of materials around in a time or place framework. At the same subject, Dilo & Zlatanova (2011), said that situational awareness is a situational information which is defined with “what is happening where” and due to this information’s dependency with time and location, usage of this information plays a critical role. They suggested a spatiotemporal model to handle operational and situational information in emergency response.

In disaster management process, the most critical part that is related to time in intervention stage is the search and rescue stage (Seppänen & Virrantaus, 2015). This stage takes place with the management from center that is established as a control center/operation center of search and rescue operations. This center works to manage the whole actors and resources related to search and rescue actions. When the time is critical, the operation/control center should own the information to provide the most extensive situational awareness (Seppänen & Virrantaus, 2015). Duties in control/operational center are clarified before, time is in the critical state and the only objective is decreasing the damage of disaster or rescuing more people. The search and rescue units which work in such situation are generally institutional state organizations. Search and rescue units of such organizations are ready for similar scenarios with drills and trainings; and these units took long term trainings related to this subject. Similarly, in “critical time” duties the existed information is scarce and there is no time to gather or analyze new information. According to the scale of the disaster, the actors which will work in the area can grow from tens to thousands. Organizations which will work are state official organizations, volunteers or nongovernmental organizations; and sharing information between each other in a common language with or without cooperation is a must due to the scarce time that cannot be spend in disagreements or misunderstandings. Seppänen & Virrantaus (2015) suggested the implementation of a portal application for information retrieval and share in such cases.

Another process that continues at the same time with search and rescue after disaster, without reducing the efficiency of these teams is the process of recognition of diseased victims. This process is a stage that should be executed in a fast pace due to the too many casualties, lack of places to keep these bodies, psychological and social reactions. Regarding this process there are many suggestions and studies in the literature (Brough, Morgan, & Rutty, 2015) (Ibrion, Parsizadeh, Naeini, Mokhtari, & Nadim, 2015).

During intervention stage after a disaster, although it is not time critical, another critical activity is wreck management and removal problem. Wreck removal, transportation and cleaning which are planned for improving and reconstructing stage in disaster management, are also problems of intervention stage. Clearing the roads of the most important points such as hospitals, schools and bridges from wreck after disaster to provide fast transportation is another aspect to be recognized in the intervention stage. In Haiti earthquake in 2010, humanitarian aid could not be transported to the area due to the limited space in airport and limited fuel. Similarly, at Japan earthquake in 2011, there were too many blanket and clothing donated and these donations turned into a wreck after Joplin tornado and slowed down the arrival of new aids. When disaster management is not conducted well after disasters, this situation may cause bigger problems. After Haiti earthquake, the 98% of wreck did not removed before 6 months and due to this problem, transportation was almost impossible (Berktaş, 2014). The amount of wreck after disaster is in a scale that cannot be underestimated.

Table 17 Amount of Wreck After Disasters (Berktaş, 2014)

Year	**Incident / Disaster**	**Amount of Wreck**
2011	Earthquake and Tsunami in Japan	250 Million Ton
2008	Wenchuan Earthquake in China	380 Million Ton
2005	Hurricane Katrina, USA	76 Million Cubic Meter
2004	The Indian Ocean Tsunami	10 Million Cubic Meter
2004	Hurricane Charley, USA	14 Million Cubic Meter
1999	Marmara Earthquake in Turkey	13 Million Ton

Removal of the wreck is a must due to the physical and psychological health of disaster victims. While in intervention stage the removal of only the wreck that require emergent action (that prevents any food or medicinal aid or emergency health services), in improving stage, the removal of all the rest can be done. Berktaş et al. (2016) suggested the removal of the wreck should be done during intervention stage. Coordination authority of wreck removal in Turkey is under the control of Prime Ministry Disaster and Emergency Management Directorate (AFAD). Subsidiary ministries which help to AFAD for removal of wreck are Ministry of Transport, Maritime Affairs and Communications and Ministry of Environment and Urbanization.

Preparation of search and rescue activities, keeping the records and working in a coordination are the prominent aspects. To provide this coordination, records of search and rescue incidents should be categorised in seperate designated groups. For example, these groups can be called as injured (at the end of the incident, victims need medical attention for injuries), non-injured (victim rescued does not need medical attention), disease or pain (medical attention for diseases that are not coming from trauma of the event), dead and unknown. Recording these information in same data types and sharing them provide a great benefit for supplying those necessary information.

Along with the great sensibility of search and rescue teams, the sensibility for being damaged due to the usage of dogs should be considered. Dogs need to get rest and be fed after a period of work time. Usage of dogs can be easily done on the wreck. Dogs should be trained for long time because their reaction to humans can be lower. (Agapiou et al., 2015) suggested a generator that simulates metabolic gases/scents that disaster victims release under the wreck for training of the dogs to decrease these sensibilities. In this study, Agapiou et al. (2015) explained that gas/scent released from human metabolism can be detected until around 6 hours under the wreck, carbon dioxide, ammoniac, acetone and urine. Agapiou et al. (2015) suggested three different situation under wreck for victims. These situations are:

- ✓ People who are in great panic even if they are wounded or not,
- ✓ People who are wounded severally and under great stress,
- ✓ Dead victims.

These three groups are also divided into sub-groups as under the wreck less than 24 hours and under the wreck more than 24 hours. In this study, it is said that the releases of human gas/scent might not indicate the victim under the wreck. Especially the food under wreck, bad foods, chemicals, dead bodies are also able to release such gas/scents in a similar way. Blood, skin and sweat that are apart from above were included into studies for detection of victims under wreck, however, at the end of these studies, no patterns are determined with a significant aspect. Interaction of bodies with the grounds and materials, effects of temperature and humidity, gas/scent interactions from animals and plants, health issues and medicines of victims under wreck are also the subjects that are needed to be studied.

A lot of victims stuck under wreck in disasters and only a few of them can be rescued alive. Only in Sichuan state of China in 2008, 70.000 people and after Yushu earthquake in 2010 with magnitude of 7.1, 2.000 people were stuck under wreck. However only a few of them rescued alive from these incidents. Searches are showing that 80% of victims who are closer to surface can be rescued by other people (Lin Chen et al., 2011). Notwithstanding, only 20% of alive people can be rescued due to the immobility of their status under wreckage. Search and rescue teams cannot detect those victims who are stuck under very narrow surfaces in Golden Hours.

Victims after great scale disasters are generally stuck between wrecks from big buildings and in need of immediate aid and rescue. In such cases, generally local sources and even national sources are remaining incapable, and help from international rescue teams are needed. In 1999 Gölcük earthquake and in 2008 Wenchuan/China earthquake, 75% of the buildings on epicenter are damaged. Thousands of people on this epicenter are predicted to be under wreck (Lichun Chen & Miller-Hooks, 2012). In 2010 Haiti/Port-au-Prince earthquake, more than 10.000 buildings with 225.000 population is collapsed or seriously damaged (UNITAR, 2010). In 2011 Tohoku/Japan earthquake and the tsunami that happened afterwards destroyed 59.806 buildings, and damaged 190.000 buildings in general (Lichun Chen & Miller-Hooks, 2012). After this earthquate, different search and rescue teams from 23 countries arrived to help to Japanese teams.

For a sufficient search and rescue action, creation of intervention means in a short time of period brings a great importance. For example, in 2003 Bam/Iran earthquake, hundreds of national team, 44 international aid agencies, UN and other non-governmental organizations arrived for the rescue actions. Due to the lack of coordination and communication, most of the search and rescue teams could not intervene in a fast pace (Ramezankhani & Najafiyazdi, 2008). Yet, decisions against time should be made in time and place due to the chaos after disaster. For example, in 1976 Tangshan/China earthquake, the survival rate decreased from 81% to 7,47% from the first day to fifth day (Olson & Olson, 1987). Especially if the number of teams which will perform search and rescue actions in disaster area is low, they may focus on the places with more people and leave the other areas for later. And this situation decreases the rate of alive people.

Lichun Chen & Miller-Hooks (2012) tried to reveal the information of search and rescue teams that are tasked in a disaster area such as the distributions of work and areas that teams need to work, environment of search and rescue they need to follow the evaluation from a program dynamically of geographical areas and their abilities. In this study, different kind of works are done on the tests, simulations and modal suggestions on many subjects such as the detection of geographical area of each team, determination of the roads to be used, time that will be spend on the roads, distribution of the sources, utilization of tools and vehicles in a proper performance. The main goal in these studies is optimizing the rescuing victims in a maximum number and shortening the time of starting the operations of search and rescue.

Wex, Schryen, Feuerriegel, & Neumann (2014), suggested a decision support system for determining the work areas and locations of search and rescue teams which are indicated as scarce in the literature to decrease the economic losses and the damages of disasters. In this study, the main goal is shortening the time of first intervention, receiving the information of alive people under wreck, and determining the schedule and geographical work areas of search and rescue teams to provide the best alive rescue numbers. In the studies they conducted as example, they achieved the values that can calculate less than a second of 40 search and rescue teams' optimizations in 40 disaster areas. The solutions they achieved is seen as a helper to solve the complicated problems of decisions makers under especially time pressure with right results.

In disaster areas, an awareness can be formed by gathering time-wise and spatial data together. However, in the association and processing of these data, the network topologies can be inadequate.

3.4.3. Participation of Public to Search and Rescue Operations

The combination of public and expert teams for search and rescue operations can be very important. In classical search and rescue operations, planning, search and rescue stages can be intertwined however these stages are not consecutive; different stages for situation and operations can be used.

Before the arrival of professional teams for first aid and search and rescue, local public who are affected from disaster make the first intervention as volunteers. Especially in disasters such as earthquakes that brings great scale of destruction, if the necessary leadership/management features are shown properly, it is possible to gain time for search and rescue actions by getting over problems of chaos of disaster area. In such cases emergency first aid implications can be made. Rescuing people who are under wreck can be made with simple actions and rough surface scanning. Logistic support can be reinstated and providing basic food products can be made. Information that has direct effect or support the security concerns in search and rescue can be gathered. Main intelligence information for search and rescue actions can be provided to professional teams after their arrival.

Support of local public matters greatly in search and rescue actions. Professionals who are going to work as leaders should understand the cultural and moral values of public to collect the support of public. Statheropoulos et al. (2015) listed the features of public after disasters in their articles as a table (Table 18).

Table 18 Features of Public After Disasters (Statheropoulos et al., 2015b)

Already Owns	**Needs**	**Asks for**
Information	Help and Solidarity	Disruptive or Constructive Communication with search and rescue teams
Motivation to help	Management	Independent work
Sources	Information	Keeping up after recovery
Abilities	Psycho-social support	Turning into their own inner world if there is no support

After disaster, the distribution on non-professional, simple and low technological tools should be made to public as fast as possible. After the arrival of professional search and rescue teams, they should lead and coordinate people, and gather information. To work swiftly in cultural subjects, a search and rescue protocol that is interiorized should be used.

3.4.4. Information Requirements in the Period of Search and Rescue

In Turkish Disaster Management processes, Disaster and Management Directorates are providing coordination between public institutions, private organizations and nongovernmental organizations in a province during a disaster for the sake of prevention of casualties by intervening as fast as possible. After disaster, special educated, professional search and rescue teams start to search and rescue actions along with trained teams from volunteering institutions regarding search and rescue. The objective of these teams is rescuing as much as victims alive in a shortest period.

Search and rescue teams have a little knowledge about general situation when they first arrive to the area. They might not know where to go, how to start and who to speak and communicate with. The first questions these teams asking are: Where are we? What do we know about the situation? What is the extent of damage? In which locations the other search and rescue teams are working? Where are alive victims? And others (Gökdemir, 2011) (Table 19)

Table 19 The First Questions Of Search and Rescue Teams (Gökdemir, 2011)

- ✓ Where are we?
- ✓ What do we know about the situation?
- ✓ What is the extent of damage?
- ✓ Who are we?
- ✓ What is our duty?
- ✓ Is there any other team at our area?
- ✓ What are the collaboration needs?
- ✓ What is the time plan?

After the first visual exploration in disaster area, search and rescue teams try to clarify the situation by talking with people and other teams in the area and gaining more information about up-to-date situation. The action plan is developed before the start of the teams' work; and all the actions should comply with this plan. In the action plan, there are some notifications that should be clarified and necessities to be filled after risk and disaster.

Gökdemir, (2011) explained the matters that carry great importance that is detected after disaster for information necessity in her study (Table 20):

Table 20 Importance of Information Necessity (Gökdemir, 2011)

✓ Providing the necessary accurate information as fast as possible decreases the casualties and economical losses of disaster.
✓ Especially the decisions taken in the search and rescue actions against natural disasters, "time" is the most important basis.
✓ The information that will be provided to teams after disaster should be in a format that can be understood by all potential users.
✓ If there are more than one source of information and if there is a doubt of these information, the possibility of casualties will be increased.

Search and rescue team which arrives to the disaster area to provide security, fast pace and effective intervention requires various information at first. These information consist of the information regarding survivors under wreck, building, floor plans, purpose of use, locations of stairs and emergency exits, inhabitants, dangerous areas and substances. Lack or mistake of these information decreases the efficiency of search and rescue actions and increases the risk of the events which ends with more number of casualties (Gökdemir, 2011). Search and rescue teams are conducting evaluations after disaster. These evaluations consist of steps such as:

- ✓ Gathering data,
- ✓ Determining the damage in the building,
- ✓ Identification of sources,
- ✓ Determining the rescuing priorities,
- ✓ Developing a rescue plan,
- ✓ Implementing the recovery process,
- ✓ Making a general evaluation at the end.

Reflectional activities after disaster in the disaster area can be shaped by the works of search and rescue teams, volunteers, expert institutions, official organizations which works for infrastructure of the country (Figure 22).

Figure 22 First Reactions in Search and Rescue Process (INSARAG, 2012)

Search and rescue teams communicate with local public to provide information at their first arrival. However, the information that gathered from this event requires a long time and tends to be not accurate. People who are living in the area can be in shock due to the trauma that is caused by losing their relatives and friends and/or effect of disaster by itself. The possibility of misleading is high in these information. Therefore, right after they receive the information, search and rescue teams should confirm these information too. This situation causes losing more time for the teams who are ready for search and rescue. Whereas, Gökdemir (2011) indicated in his study the importance of the time by giving the rates of survival after earthquake (Table 21).

Table 21 Survival Rates After Earthquake (Gökdemir, 2011)

Time	Percentage of Survival
First 30 Minutes	93%
First Day	81%
Second Day	36%
Third Day	19%
Fifth Day	7%
After the Fifth Day	2%

After this stage, search and rescue actions that are planned is being executed by the stages as mentioned above. In search actions, the location of the victim will be detected and search techniques that are appropriate for operation will be used. In rescue actions, first, the safe rescue area will be created, and then earthquake victims will be gathered in this area and wounded victims will be transferred to the hospitals.

Generally, after disaster, the first intervention is being made by the people around with the simple tools or bare hands. Search and rescue teams can arrive at least 1-2 hours later to the disaster area. Firstly, search and rescue teams prepare a safe area and take citizens away from wreck and put them in this safe area. After implementing safety, search and rescue responsible personnel determines the area that will be searched for, with the knowledge of building plan and locations of rooms and taking the disaster time zone as a base. In this stage, search and rescue teams gathers the necessary information from their leader. Gökdemir (2011) modeled these information under the name of Building Information Modeling (BIM). In this study, the necessary information is categorized as Static Information (unchanging information that is prepared before disaster) and Dynamic (Real-Time) Information

(information gathered after disaster). The necessary information in this study is categorized under six section:

- ✓ Information related to building/structure,
- ✓ Information related to building inhabitants,
- ✓ Information related to disaster,
- ✓ Information related to transportation to the area,
- ✓ Information related to environmental factors,
- ✓ Information related to CBRN (Chemical, Biological, Radioactive and Nuclear) material.

3.5. Fast Search and Fast Rescue

3.5.1. Priorities at Fast Search and Rescue

There are many factors that affect the search and rescue activities' speed such as fast reaction, alternative applications, detailed planning and high level of performance, from the moment of disaster to the first 72 hours period which is called "Golden Hours". Because the disaster zones are under a multivariate chaotic situation, with confusion, pain and tension, mostly where the national and international coordination needs required. In such cases, intervention can only be made with detailed planning, modern equipment, high level of information sharing and situational awareness.

Due to the immediate happenings of disasters and chaotic events afterwards, political decision should be made parallel to strategical planning, and in right time regarding disaster preparation and intervention phases. Late decision making of the countries may cause the late arrival of help, delayed intervention and increased number of loss and casualties at the end.

At the list of priorities that Statheropoulos et al. (2015) suggested, the first place goes to alive detection and localization. A listing that can be used to verification and international honoring of this thesis consist of a high level of importance due to its existence in 7th Framework Program of European union and the time zone similarity.

Priority list in a fast search and rescue operation which is constituted by Statheropoulos et al. (2015) is included in Table 22.

Table 22 Priority List in a Fast Search and Rescue Operation (Statheropoulos et al., 2015b)

- ✓ Providing a politically right decision (what happened in the disaster, scale of disaster, available sources in the country and need of help).
- ✓ Making early detection and localization of alive disaster victims under wreck.
- ✓ Providing the security of search and rescue teams.
- ✓ Providing good conditioned concrete cutter tools.
- ✓ Providing better logistic support (detailed material and tool list that are needed).
- ✓ Providing better information and preparing a planning.
- ✓ Detection of tools that can be distributed easily.
- ✓ Providing satellite support.
- ✓ Providing cooperation between international search teams.
- ✓ Providing the compatibility of tools and materials to the disaster.
- ✓ Providing fast transportation of search and rescue teams to disaster zone.
- ✓ Raising situational awareness.
- ✓ Detection of right scale of disaster.
- ✓ Utilization of existed technologies and methods in a better way.
- ✓ Providing better trainings.
- ✓ Providing information from media.

When the list above is examined, technologically developed tools for information system and rescue which provides right and updated constant information sharing, and developed technologies to make early detection of alive people took very important place.

3.5.2. Integration of Technology to Traditional Methods

The development of technologies of search and rescue should be made for the integration of technology subject. Even though there are several tools and technologies that are developed for disasters and intervention stages, there are only a few technologies that tested and proved their ability which can enter to the wreckage. Providing these features will be possible with integration of those technologies in a single platform. Technologies that are going to be developed in this way will provide the opportunity to detection of alive people in shortest time possible, increase accuracy of location and sensibility of sensors, decreasing mistakes regarding detection of location, gaining the chance of making more than one detection, showing reactions based on technology with the information provided from public. Statheropoulos et al. (2015) listed the technologies that are expected to be integrated during search and rescue actions.

Some part of the list above is being used for disaster management in Turkey, yet some part of the list is not being used. Technologies that are being used and will be developed are detailed in the survey results in forth chapter with the expert opinions. Integration of functions of technological tools as far as possible and integration of them to support each other are other important aspects. To gain new talents for search and rescue operations, integrated usage of these technological tools should be considered.

Table 23 New Technologies Expected To Be Integrated

✓ 3D scanners,
✓ Video signals,
✓ Sound signals,
✓ Chemical signals,
✓ Hyper spectral monitoring,
✓ Radar through the wall,
✓ Radar through the soil,
✓ Intelligence with video,
✓ Satellite imaging,
✓ Accelerometer based methods,
✓ Radio/Wireless technologies,
✓ Drones and robots,
✓ Smart Phones,
✓ Mobile phones (location and identification)

Regarding Crisis Management, implementation of compatible and scalable management systems to life takes a great importance. Each disaster brings its own composition and they occur different than each other. The only common subject related to them is the great chaos and crisis. Disasters nature of being independent from location and time, without recognition of border, causing great loss and casualties, causing the loss of cultural and intellectual values are increasing this crisis level more and more. Under these chaotic conditions in especially great-scaled disasters, the location and position of search and rescue teams and their priorities affect the usage of technological tools (Statheropoulos et al., 2015a). More importantly, disasters are affecting the accuracy, quantity, coordination and type of intelligence and information that are gained related the occurrences.

3.5.3. Experiences and Lessons Learned

Even though intervention stage of disaster management seems to have the field activities only, preparation for this stage as well as other stages are carrying a great importance. It can be seen in many studies of the literature that search and rescue activities is considered as a race against time and as a dangerous process at the same time. Since because this process can rescue lives directly, a need for detailed study and the importance of the subject can be seen clearly. Even though there must be other continuing training, informing and preparation progresses that are created by the data from old disasters, after each disaster, a new study process must be started.

The information of analysis from studies and researches that include the experiences and lessons learned from old disasters are evaluated. At the evaluation of old disasters, it is possible to take lessons for how to conduct an operation which will shorten the search time and fast rescuing operations. In this subject, with the Turkish Disaster Data Bank (TABB) of AFAD Turkey, Earthquake Service and Database Service, all information regarding disasters started to be provided from one single point. In international area, the information sharing can be made in OFDA/CRED International Disaster Database, UNISDR United Nations International Strategy for Disaster Reduction Office (http://www.unisdr.org/we/inform), Canada Disaster Database (http://www.publicsafety.gc.ca/cnt/rsrcs/cndn-dsstr-dtbs/index-eng.aspx), USA Homeland Security (USDHS, 2011) database and NASA Disaster Mapping Portal (https://data.nasa.gov/Earth-Science/NASA-Disasters-Mapping-Portal/vyzu-gm3d). Even though these sources include great number of information, a sharing tool for internationally systematic base is not developed yet. However, the clues of fast search and rescue can be gathered from previous disaster evaluations. Even though the objective of analyzing these subjects is conducting a fast search and rescue operation; starting point should include a team that can provide constant information to search and rescue teams regarding the situation of wreck and observe the security parameters, which is equipped with technological tools. Later, the operation can be shaped according to the priority list that starts from security.

Details of face to face meetings and interviews of this thesis study and the survey implementation in forth chapter share a great number of similarity. Raising situational awareness to provide security of search and rescue teams, providing standard working places with national and international information sharing, and the importance of experience and training for technological tools utilization to save time are the aspects that requires most attention.

3.6. Chapter Summary

According to the information which is gathered from face to face interviews and the other studies of the literature, timing of search and rescue activities are critical and a detailed planning should be executed with search and rescue activities (AFAD, 2014b; INSARAG, 2012). The most important purpose of search and rescue activities is about "rescuing lives". For this purpose, along with the rescuing survivors from wreckage by the teams, there are other duties such as carrying out an impact analysis at the area, carrying out an analysis for hazardous materials, and stabilizing damaged buildings that can provide shelter (Wong & Robinson, 2004).

After the disaster, an intervention should be conducted as soon as possible, the first “72 Golden Hours" should be used effectively and a continuous information sharing mechanism should be established. Situational awareness should be considered as equally important for local teams and national and international actors. For the coordination of the activities and effective conducting, there must be a reliable and continuous information should be established. Also, there must be researches and studies related to increasing the situational awareness for all actors in the field.

To provide the reflection of Turkey from the scanning of the literature, 2013-2017 Strategic Plan of AFAD SWOT analysis carries a great importance. In the Threats section of this analysis:

- ✓ Delaying the intervention,
- ✓ Not being able to conduct intervention and action plans effectively,

- ✓ Not taking necessary precautions for vulnerable groups (women, children, disabled, etc.),

are taken into consideration as top priorities (AFAD, 2012a). At the same report, in the Opportunities section:

- ✓ Reducing the number of casualties by saving time for disaster prevention,
- ✓ Providing fast and correct intervention activities,

are taken into consideration. Also, in the Disaster Intervention Plan of Turkey (TAMP) of AFAD:

- ✓ Saving lives,
- ✓ Executing the intervention processes as fast and planned,

are taken into consideration as main goals.

It is important to have a matched detections from literature and from this thesis due to affirm the strategic plans with international and academically studies, from the viewpoint of Turkey.

Another reality that is accepted in international literature is about the aspect that the arrivals of first responder teams to the area and start of their activities take 24 hours (INSARAG, 2012). Standardization of all activities of these teams, training and coordination before the disaster and preparing these standards for stages are also other important aspects. Estimated time of the survival detection, localization detection and rescuing action from all of these standard processes are defined as indefinite. Extension of the time of this process decreases the survivor rates. Studies and the suggested system of this thesis are recommended to shorten the amount of time that is defined above. This situation carries an importance to provide a contribution of this thesis to internationally defined and confirmed studies.

Search and rescue work areas are dangerous, demolished, ruinous, corrupted and fractured areas that harden the work of rescue and need great efforts. Technological tools that are developed to work on these areas should be produced as practical and light that will be able to force the weight limitation, design and functionality (Federal

Emergency Management Agency (FEMA), 2018). The system that is suggested in this project is a system that can be used with mobile tools. It is a system that provides an easy and wireless utilization thanks to its practicality and lightness. This system can be used by professionals as well as the disaster survivors who are working as first responders, due to its ease of handling with the aspects that are specified in the international definitions.

When the three search method which is described in the literature (Wong & Robinson) is taken into consideration, the system that is suggested in this thesis gain an importance for increasing the physical search method efficiency along with electronic search method efficiency.

In the Smart Disaster Management Systems, production, interpretation, and gathering the data along with sharing it with the partners intra vires are main subjects. Also, providing those data to be utilized by the Disaster Management Actors, reporting and gaining ability for fast movement during disaster chaos are also counted as main subjects for those systems. These subjects under the concepts of Smart Cities are taken as primary research subjects in Turkey; and the research of these subjects are supported. Studies and the suggested system in this thesis are also carrying an importance for being under Smart City concepts.

At another study in the literature, Lakshmi Narayanan & Ibe (2012) indicated the basic needs for establishing the intervention networks after disasters in their studies. The countervail situation of suggested EHDS system in this thesis with the qualities that are mentioned above, is given in details in the 5th chapter. The system that is produced after the studies in this thesis carries a great importance for validation by bringing a huge part of the described qualities in international literature.

Robots are taking up an incontrovertible place for disaster management studies that are being executed in the world. It is clear that utilization of robots in this field will be increasing for expediting the wreckage activities and advantages in general. The suggested system after the studies of this thesis is also important for completing the robot efficiency and working on the robots as well as mobile tools. Even though there is a lack of tests in the scope of this study, coactivation of the systems by skill-building for search and rescue robots with a few adjustments.

Turkish Disaster Data Bank (TABB) of AFAD, Earthquake Service and Database Service sections that are prepared for disaster management systems in Turkey are also other important developments for right and in time data share. Establishing information sharing mechanisms for increasing situational awareness and coordination is also crucial. Addition of the studies related to technologies of near future that are listed in Table 23 for search and rescue activities to these information sharing mechanisms will also gain favor.

CHAPTER 4

A RESEARCH METHOD REGARDING SEARCH AND RESCUE ACTIONS OF DISASTER MANAGEMENT IN TURKEY

4.1. Face to Face Meetings and Interviews with Search and Rescue Experts and Derivations

In the studies that are conducted before, it is defined that after a disaster such as earthquake or fire, the arrival of the search and rescue teams in a short period of time, gaining information regarding disaster area, and rescuing alive victims under wreck are the most important parameters of the search and rescue success (Pehlevan et al., 2009) (Özerdem & Jacoby, 2006). For these findings, in meetings and surveys that are made with search and rescue expert teams, it is determined that the period of detection of alive people can be improved and shortened to produce a better search and rescue process.

In the scope of this study, between 2013 and 2014, several interviews, face to face meetings are done with technical personnel who worked/works for search and rescue operations directly. As a field study, several interviews and a survey is made with different personnel from the organizations that are included to the disaster management system such as AFAD (central and country organizations), AKUT (Ankara and country organizations), Civil Defense Search and Rescue Unit Managements, GEA Search and Rescue, AKA Search and Rescue Research Association, Çanakkale Eighteenth of March University (COMU) Emergency and Disaster Management Department, Dumlupınar University Material Science and Engineering Department, Department of Mining Engineering, Yıldız Technical University Civil Engineering Department, Pamukkale Univeristy Health Care Vocational School for Higher Education, Eskişehir Anatolian University Health

Institution Business Management Department, Akdeniz University Institute of Science and Technology Geological Engineering Department, and Antalya Metropolitan Municipality Fire Department.

The meetings and interviews are made with 32 experts . The meetings are conducted with the experts by giving them information of the research and asked for an interview with them as face to face or via phone. The method of the interview is explained as a dechiperation of the notes that are taken during the interviews. The information that is taken from those notes are used in this thesis with the subject of "The Effects of Period of Time For Search and Rescue Units to Get the Survivors' Status Under the Wreckage on Search and Rescue Operations At Disaster and Emergency Management"

The questions that are drawn up before is asked to the participants and the information related to their own experiences are recorded. The questions that are asked to the participants consist of 3 stages. At the first stage, the general questions regarding disasters and search and rescue actions with the experience telling took place. At the second stage, the questions regarding the information and sources that are needed during search and rescue actions took place. At the last stage, the questions regarding the evaluation of the utilization of new technological tools and devices for search and rescue actions in their own experience took place. Each interview took about 10 minutes. The questions that are asked to the participants included in Appendix A. According to the information gathered from the SAR experts interviews and literature surveys, the SAR teams information needs about victims are listed (Table 24).

Table 24 Information of Alive Victims that Search Teams Need

- ✓ Is there any person under the wreck?
- ✓ Is there any alive person under the wreck?
- ✓ Is this alive person conscious or unconscious?
- ✓ Is this alive person wounded or not?
- ✓ Is it possible to contact with this alive person?
- ✓ How deep is this alive person from upper ground?
- ✓ Is this person is stuck or not?
- ✓ Where exactly is this alive person located?
- ✓ Is there any alive animal under the wreck?

In this doctoral thesis, the focus is on the effects of reaching the information of survivors under wreck from the factors that affects the search and rescue time during these actions (Table 26).

Table 25 Expert Profiles

- ✓ 28 Male (M), 4 Female (F),
- ✓ All of them participated at least one search and rescue operation,
- ✓ 4 of them are at age between 20-25, 12 of them are at age between 26-30, 12 of them are at age 31-35, 4 of them are at age 36+,
- ✓ 4 of them are graduated from high school, rest of them are graduated from university or more,
- ✓ 20 of them are a member of AFAD, 8 of them are a member of AKUT and 4 of them are a member of the others,
- ✓ 4 of them are expert on avalanches SAR, 12 of them are expert on urban SAR, 32 of them are expert on earthquakes SAR.

Face to face meetings held with 32 search and rescue expert personnel in different places and different times. 29 questions are asked to the participants and their opinions regarding the subject are also recorded. The distribution of the answers is included in Appendix B. The profiles regarding to the 32 face to face meeting experts are listed at Table 25.

According to the results that are taken from face to face meetings, rescuing alive victims under wreck (concrete, steel columns, cement blocks, glass, wood or stone) after disaster takes long time. Therefore, there is a need for the researches regarding the factors that are going to save time for search and rescue actions after big disasters.

Table 26 Important Aspects Detected From Face to Face Meetings

✓ In disaster recovery, preparation is important.
✓ Information necessity for search and rescue actions are too much, each right information saves time.
✓ Along with technological tools, training is another important aspect.
✓ 3 key aspects: Trained personnel - right equipment - right and timely information.
✓ Reaching to disaster area and task sharing are time-consuming.
✓ Training and informing for new technology is a must for personnel.
✓ Light mobile devices speed up the actions in disaster area and make the actions long-running.
✓ Shortening the search time also shortens the rescue time.
✓ Early alive detecting increases the possibility of alive rescuing.
✓ Team spirit and power are musts for the security of the actions.

These results are confirmed by the search and rescue experts who participated to "IDME 3rd International Disaster Management Fair and Conference" which held in Ankara on 27-20 November 2014, at a booth for this research. According to the results that are taken and confirmed, the important factors that are detected for search and rescue actions (Table 26) can be summarized as disaster preparation, need for right information at right time, early detection and rescue, education and technology, and fast reaction. These detections are carrying great importance for being based upon opinions of the experts in Turkey and for being a new knowledge for the literature.

The results from face to face meetings and interviews show that the necessity of a re-evaluation of the information that are recorded from implementation regarding technological tool developing by experts. In this scope, this thesis is re-organized with new problem statement and hypothesis after the consideration of all the information and the criteria. The reorganized problem statement and the hypothesis are included into Appendix C. In this direction, a survey is prepared and published in web address of www.anket.vairosoft.com between March 2015 and November 2015. This survey is also published in a tangible form and distributed. The results regarding this survey is included in the fourth chapter.

After this stage, it is determined to make an application that researches the aspects that carry importance and promoting efficiency in search and rescue operations, detecting any deficient aspects and suggesting new tools and technologies instead. In 2015 a project plan is prepared to shorten the reaching the alive person information that influences search and rescue actions, for the subject of this thesis. The project that is prepared is submitted to TÜBİTAK TEYDEB Directorate for evaluation for scientific criteria and support. The project that is supported to TEYDEB Directorate gained the financial support in research and development encouragements with the number 7150684. This project is finished successfully at 31th December 2017, after a process between July 2016 and December 2017. The results of the project and the prototype that is developed is used in the tests of evaluation of this thesis. Detailed information regarding the project is included into the fifth chapter. There are numerous studies in the literature regarding natural and technological disasters, surface texture, building texture and their effects, and yet in our detection this research is one of the first studies in Turkey about shortening information reaching time for alive people in search and rescue actions.

Apart from this thesis, Statheropoulos et al. (2015) conducted a study regarding determination of the basic aspects which affect the timing and search and rescue actions in urban areas. Similarly, to this thesis, Statheropoulos et al. (2015) determined some aspects that are detected for their importance or priority which affect the search and rescue actions.

Statheropoulos et al. (2015) developed a prototype for several technological tools and devices for increasing the efficiency of search and rescue activities after disasters in their project that is supported by 7th Framework Program of EU (FP7/2007-13 - Second Generator for Urban Search and Rescue Operations). In the study that includes generally chemical, sound and image detection tools and prototypes, the aspects that affect the search and rescue actions are written below.

4.2. A Survey on Tools and Techniques to Get Survivor Data at SAR Operations

Alongside with the fact of the inevitable nature of the disasters, Turkey is also under the risk of natural or technological disasters due to its geographical location. In the world, it is a fact that effective disaster management performing and necessary preparations cause decreased number of disaster effects. Turkey, right after the big scale disasters that faced in the past, worked for reconstruction of its disaster management policies, institutions and methods with re-evaluation and constructive criticism (Akyel, 2007). This situation is not only applicable for Turkey. In the literature, there were many re-evaluation of studies that are conducted right after disasters for providing suggestions to solve problems. The main goal of the preparation of this thesis is related to contribute to the process of searching and rescuing of the survivors with the change of being rescued from the wreckage after the disaster especially for search and rescue activities during disaster management processes in Turkey. In this part of the thesis a survey study is conducted to benefit from information and experiences of search and rescue actors, to detect the aspects that triggers this process, and to provide problem-solving suggestions by considering the reforming some aspects that requires a change.

According to the information which is gathered from face to face interviews and the other studies of the literature, timing of search and rescue activities are critical and a detailed planning should be executed with search and rescue activities (AFAD, 2014b; INSARAG, 2012). With this purpose, intervention must be conducted as soon as possible; the first 72 "Golden Hours" should be used most efficiently; and a continuous information sharing mechanism should be established. A survey study has been conducted to understand how the search and rescue activities in Turkey embraced the defined aspects in the literature; the effects of the technologies and tools in use along with the timing and accuracy of the survivor information to search and rescue activities; and to reveal the thoughts and experiences of search and rescue experts.

At this research specifically, a survey study is conducted to measure the impact of survivor data under the wreckage and its validity to search and rescue actions, to interpret the existed technology efficiency, to determine the aspects which affect the period of search during search and rescue actions right after the disaster.

Research is conducted with the people of experience on search and rescue actions under any institutions or as individual initiative. In the research, a survey is made to determine the remarks of professionals regarding the issue with the questions that are asked by experts of the field. In the survey study, to verify the hypotheses, questions of the expertise were also included into the survey questions, along with the other questions related to demographic data.

4.3. Research Objective

Detecting problems related to search and rescue activities during intervention stage of disaster management of Turkey, providing solutions for these problems related to search and rescue activities, and benefiting to disaster management of Turkey which is considered as a risky country for disasters are included as goals of this study.

This research included the specific parameters, aspects that affect search and rescue actions in disaster management system, usage of informatics and technologies in search and rescue actions and methods and effects of reaching to the data of survivors. Research objective is related to measuring the feelings and thoughts of experts that are specified below with the developed scale from interviews with field experts before (Table 27). Within the scope of this thesis, interviews with the experts who actively participated to search and rescue processes in Turkey, are being held between the years of 2013 and 2014. As a result of these interviews, a survey has been prepared which consist of the aspects that are verified by the experts as below. The prepared survey and the questions that are asked for implementation are showing parallelism with the findings of international literature. This thesis carries a great importance for consisting findings related to efficiency of search and rescue activities during intervention stage of disaster management in Turkey.

Table 27 Subjects Related to Research Objective

- ✓ The pace of rescuing actions from wreckage in order to save lifes,
- ✓ Technological sufficiency of tools for activities,
- ✓ Accuracy of information about survivors under wreckage,
- ✓ Certainty of survivor information under wreckage,
- ✓ Effects of using survivor detection tools with technological ground,
- ✓ Effects of changing the tools and devices in existed phases with more informatic tools and devices regarding the detection of survivors under wreckage,

4.4. Scope of Research and Limitations

Detection of search and rescue efficiency during intervention stage of disaster management in Turkey is limited with the place and population that is considered with study survey questions with the aim of providing solutions for problems in this field. For the detection of search and rescue activity problems in Turkey and the solutions for these problems, search and rescue technicians are considered as targeted audience. At the main organization of the institution of AFAD, there is no search and rescue technician staff by year 2013. There were only 1044 Search and Rescue Technician staff within Disaster and Emergency Directorates under Special Provincial Directorate of Admissions of provinces in Turkey. 900 of the these personnel positions are already taken. With the 35th article of the Law No.6525, from the date of 20/02/2014, directorates of Provincial Special Administrators are nullified; Provincial Disaster and Emergency Directorates are established as AFAD Provincial Organization, and passage transactions to new cadres are executed during all of 2014. The second part of 2013 which consist of the execution of these progress and the time until March 2014, search and rescue technicians who are not included in AFAD Institution started to be incorporated to AFAD. Population of the research has the limitation of 900 newly incorporated search and rescue staff who work in 81 provinces. From the survey population, 251 participants are being reached.

As the result of the interviews with the experts, aspects that effect the pace of search and which also carry importance for search and rescue activities have been detected. The detected aspects are including the effect of reaching to victim information period by the teams to search and rescue activities. Also, studies have been made to understand which parts of the search and rescue activities are affected by them. Questions/subjects that are re-evaluated and enhanced with the expert opinions created the major axis for preparing the survey after this study.

Scope of research includes the effects of the methods and period of reaching to the data of survivors by the search and rescue teams during intervention period after the disaster. Questions asked to gather the answers related to field study as below.

Table 28 Question Topics Related to Research Objective

- ✓ What are the aspects that affect the period of search and rescue actions regarding determination of survivor under wreckage during these search and rescue period? Is it possible to increase the speed of this step?
- ✓ Does it have an importance for validity/certainty of survivor data under wreckage during search and rescue activities? If it is yes, how it can be provided?
- ✓ Are technical tools and materials that are used for search and rescue activities technologically sufficient enough in Turkey?
- ✓ Can the existence of the information of survivor under wreckage affect the speed of search and rescue in general?
- ✓ Can tools and materials with technological development of search and rescue activities increase the efficiency of search and rescue actions in general?
- ✓ Are there any positive effect of usage of modern tools in search and rescue actions?
- ✓ Can the usage of technological informatics in search and rescue activities increase the efficiency of whole actions?

The effects of speed of the reaching to the information of survivor under the wreckage, which is seen as cognitive information under second and third chapter, to the actual search and rescue actions is given under 4.7 with hypotheses. These hypotheses are tested with a field study.

Participant features such as gender, age and educational background, regional variations, and experiences are considered to not affect the answers of this survey.

General situation of the demographic features of search experts who participated to survey is considered to provide a positive contribution to effectiveness of the research.

4.5. Pilot Study / Developing the Scale

Expert remarks and literature is taken as a ground to determine the important aspects that affect the search and rescue actions of disaster management in Turkey, use of important parameters, knowledge and informatics in search and rescue actions, and the methods of reaching to the data of survivors under wreckage and effects of these methods. Before the main implementations in the study made, a pilot study is conducted with 32 people (SAR experts) to create survey forms on June 2013. Many differences are made in the study according to these preliminary findings and data analysis. The differences in implementation tools and survey methods are as below:

- ✓ Reducing the numbers of survey questions,
- ✓ Taking out the personal development questions,
- ✓ Accepting the rescuing more lives during intervention stage as a different stage, even though there is a loop between search and rescue stages and even though the search and rescue activities are considered as a whole general subject,
- ✓ Limiting the questions of the survey with only the disaster location actions and intervention stage,
- ✓ Taking out the questions of the regulations,

The literature is scanned regarding the search and rescue activities during disaster management and important aspects related to the subject are tried to be detected. Face to face interviews with the experts of the subject are made and a communion related to their experiences, existed implementations, abroad experiences and trainings are made. In this part of the study, there was no grouping or sortation is made regarding to their institutions. The Information is gathered from experiences of the experts who attended to any search and rescue activity.

In total, 32 questions/subjects are selected and answers for these questions are gathered. With the results and answers, these questions are validated by the experts and at the end a survey with 29 questions is created with revised hypotheses. Face to face interviews are made with 32 search and rescue personnel in different times and places. These 29 questions are gathered under three main groups. The first group, (Questions 1-12) included the general questions related to search and rescue actions, disasters and experiences related to these subjects. At the second group (Questions 13-24) questions related to information and tools during search and rescue activities are asked. At the last group (Questions 25-29) the questions related to the evaluation of search and rescue activity experiences with the informatics or new technological tools' usage are asked.

Table 29 Important Aspects from Face to Face Interviews

- ✓ Preparation is crucial in disaster management.
- ✓ In search and rescue activities, necessity of information is high and each valid information saves time.
- ✓ Along with the technological tools, training is also an important aspect.
- ✓ Trained personnel, proper equipment, valid and punctual information are important.
- ✓ Reaching to the disaster location and task sharing are time consuming.
- ✓ Training and informing the personnel for adaptation to new technologies are crucial.
- ✓ Light mobile devices speed up the activities and make the activities long-running in disaster areas.
- ✓ Shortening the search period can also shortens the period of rescuing.
- ✓ Early survivor detection increases the possibility of rescuing the person alive.
- ✓ Team spirit and power are important for the security of the activities.

With the results of face to face interviews and meetings, the need of research of the survivor information during search and rescue from the wreckage and usage of this information to the activities in general along with the necessity of modern technological tools and devices that are being used is observed. These revised results are listed in Table 29.

These results are validated with search and rescue experts. According to the results that are taken and validated, the important aspects that are detected for search and rescue activities can be sum up to preparation to disaster, need for valid and punctual information, early detection and rescue, training and technology, and fast reaction.

This research which enlightens the existed situation in search and rescue actions and carrying those services to another level in Turkey, evaluation of the collected results carries great deal of importance for the effects of reaching to the information of survivors' search and rescue actions and detection of the needs.

4.6. Population of the Research and Sample Choice

Population of the research includes search operations professionals who work in official and unofficial institutions in Turkey. The whole search experts at AFAD in 2014 is about 450 and search and rescue experts governed together as their replacement to each other (Resmi Gazete, 2009) and the other organizations that have search experts ignored. Study group consist of 251 people who worked in search and rescue activities in different times under many organizations or who worked individually in Turkey. Search operation professionals who work in Turkey provided more answers than the quarter of total numbers. As quantitative approach, the survey is considered as suffice. 96,4% of the study group (242 people) are male, meanwhile 3,6% (9 people) of the group are female. Average age of the participants is 36,8.

The survey is conducted face to face with people who gathered in outdoor/indoor areas, as well as with remote access through an online website. Participants are informed for the reason and the people behind this survey. This is why, it is seen that the answers of this survey are conveyed in a sincere, natural and factual way. Evaluation of search experts who conduct the direct search activities and work as operators of disaster management in province and districts and suggestions of those experts are considered crucial. The data taken from 251 Search expert is considered efficient enough to test the hypotheses of this research.

In this study, the demographic variants such as “Gender”, “Age”, “Educational Attainment”, “Position in the Organization”, “Experience Years in the Organization” and “Quality of the Assignment” are defined as independent variant.

Along with the demographical variants, questions which include five-point Likert scale within 19 closed ended questions are asked.

As a data gathering tool, printed forms designed and distributed as well as online questionnaire is designed and sent to the participants as a link.

In this study, a survey with 19 vocational/technical questions and 8 demographic questions which are developed with the reviews of the experts due to the detected aspects from face to face interviews are asked. Survey application which is used is in Appendix D.

The prepared survey is sent to the personnel’s official e-mails of such institutions like AFAD (central and field service), AKUT (Ankara and field service), Civil Defense Search and Rescue Association Directorate, GEA Search and Rescue, etc. Due to the request of the mass personnel locations, surveys are sent as printed form. Moreover, regarding this study, information exchange between Provincial Disaster and Emergency Directorates of 57 provinces are made via e-mails and phone calls.

4.7. Application of the Survey

This research included the specific parameters, aspects that affect search and rescue actions in disaster management system, usage of informatics and technologies in search and rescue actions and methods and effects of reaching to the data of survivors. For the sake of the research, it is asked to be reached to gather the thoughts and feelings of search and rescue experts from face to face interviews.

The first group questions of the survey (1-8) are the questions related to socio-demographic conduct of search and rescue experts.

Second group question package includes 19 questions for this survey. In this part, 2^{nd}, 3^{rd} and 9^{th} questions are multiple choice, meanwhile 13^{th} and 14^{th} questions are multiple choice belief and opinion questions. 4^{th},5^{th},10^{th},12^{th},15^{th},16^{th},18^{th} and 19^{th} questions are belief and opinion questions with five-point Likert scale. Rest of the questions are combined belief and opinion questions. At the second group of question package, only the question number 8 is open ended text question. The rest of the questions are all closed-ended questions.

At the scope of the validity and reliability analysis of the survey, item analysis is made for the beginning. Item analysis study is conducted with SPSS20.0 package program. With the scope of the survey, significance level in all statistical calculations is taken as 0,05. All the results that are gathered controlled bi-directionally. Statistical model in use is based upon mean, standard deviation, t test and correlation techniques. For the reliability analysis of data related to scale testing, "alpha cronbach" is used. Data of the survey is transferred to a computer and the analysis of numeric data is made this through computer.

The questions that are prepared according to the data from face to face interviews are implemented between the dates from January 2014 to April 2014 via a website survey as well as printed form survey. Total number of the participants to the survey is 251. Printed survey number was 384 and yet 99 of them are answered. Meanwhile the online survey number is 152. Survey results are gathered from different provinces and locations. It was clear to the participants of this survey that the scope and reason of this survey as well as the owner of the research. Therefore, these answers that are gathered are observed to be sincere and valid. The data from the survey concluded as sufficient to test the hypotheses of this research.

4.8. Hypotheses of the Research

Efficient and fast intervention right after the disaster is crucial for saving lives. For this aim, detection of the problems related to the efficiency and the pace of intervention stage of search and rescue activities in disaster management of Turkey should be made. Also proper solutions for these problems should be determined. With this reason, with the survey that is conducted in this thesis, the suggestions related to the efficiency of search and rescue methods, equipments and systems to Turkish disaster management are gathered. In the scope of this thesis, according to the results of the data that is considered to be gathered by the survey, an evaluation and testing is made for the hypotheses that are listed below.

Hypothesis

H_1: Reducing the time to reach to the information regarding survivor under wreckage increases the efficiency of SAR Teams for search and rescue.

(This hypothesis is related and extracted from these studies in literature like O choa & Santos, 2015; Lichun Chen & Miller-Hooks, 2012; Statheropoulos et al., 2015a; INSARAG, 2012; Lakshmi Narayanan & Ibe, 2012).

H_2: Using Information Technology Based equipment in search and rescue teams during intervention period, creates more efficient rescue activity in disaster management search and rescue activities.

(This hypothesis is related and extracted from these studies in literature like O choa & Santos, 2015; Lichun Chen & Miller-Hooks, 2012; Statheropoulos et al., 2015a; INSARAG, 2012; Lakshmi Narayanan & Ibe, 2012).

4.9. Data Analysis

At the analysis of the data comes from the survey; the hypothesis tests and descriptive statistics are used from Analysis and Evaluation of Techniques and Processes of Search and Rescue Activities and the resulted data is analyzed with IBM SPSS 20.0 Package Program.

Theoretical framework of the search and rescue processes in disaster management systems and the literature related to some countries with successful applications are analyzed. On the other hand, search and rescue equipments and technological systems in use for FEMA organization of United States of America which is a country with many disaster stories, are also examined. The fundamentals of search and rescue were also included as questions in this survey. From both reviewing of the literature and the country applications, scales are developed to provide important aspects during an efficient search and rescue process. Moreover, before the conducting the survey, these scales that are developed are verified by the subject experts. Likewise, different scales are produced with main search and rescue terminology which is accepted for the expertise of search and rescue professionals, that is partaking in their field, and being screened on training programs.

For the analysis and the detection of problems of the existed situation of search and rescue activities in Turkey, 29 scales are identified. Every decision statement is asked with five point Likert scale (I ABSOLUTELY do not Agree, I Do not Agree, Neutral, I Agree, I ABSOLUTELY Agree). Five point Likert scale is chosen to make the decision statements more explicit. Also, it is detected that five point Likert scale is chosen for subject evaluation surveys quite often. It should not be overlooked that this study is also including an evaluation survey. The suggestions of the participants are also tried to be gathered with an open ended question related to this subject.

Gathered suggestions are going to be categorized according to main subjects. In this content, the questions for testing the hypotheses are defined according the results of the data which is planned to be gathered with the survey study of this thesis.

4.10. The Descriptive and Demographical Structure of the Study

The number of the participants to our study is 251. A great majority of the participants are male. 96,4& Male and 3,6% Female participants are questioned (Appendix D, Table 30). Average age of the participants is 36,8. Average age of female participants is 27,2 and male participants is 37,1 (Appendix D, Table 31, Table 32, Figure 23). Youngest participant is 25 years old, meanwhile eldest is recorded as 48 years old. The standard deviation of the age variant is seen as sd= 5,835.

When the educational attainment of the participants observed, it is clear to see a 73,3% of bachelor’s degree in total. 18,3% of associate degree and 4,8% of high school degree can be seen (Appendix D, Table 33).

A great majority of the participants with 45,8% are graduated from Anadolu University with a formal education. Afterwards, 14,3% of participants are graduated from Anadolu University Distance Education; 10,8% of participants are graduated from Gazi University, and 8% of participants from Vocational High Schools (Appendix D, Table 34).

Another demographic variable that is asked to be determined by the participants’ latest relation with search and rescue organizations; and 94% of the participants worked with AFAD field service, 3,2% with AFAD central quarters,0,8% with NGOs like AKUT/Kimse Yok mu etc., and 0,8% with Fire Authorities. 1,2% of the participants specified that they did not work with any organizations for search and rescue (Appendix D, Table 35).

At the D6 question which specifies the which directorate under AFAD did the participants worked, 93,6% of the participants marked AFAD Field Service (AFAD Provincial Directorates) (Appendix D, Table 36).

It is stated that the total period of work time in this organization is 10,7 years. Female participants have the average of 2,2 years, meanwhile male participants have 11 years (Appendix D, Table 37).

The last demographic variable of our study is related to the participants' assignments in the organizations and which category they fall under. In total, 90,8% of the participants worked under "Search and Rescue Mission", 3,2% worked under "Planning and Administrative Duties" and "Technical Services", 2% worked under "Administration Assignments", and 0,8% worked under "Other" category (Appendix D, Table 38)

After the examination of all demographic variables, participant profile is male with average 36,7 years old who owns a bachelor's Degree and works for AFAD Field Service under the category of Search and Rescue Missions with average working period of 10,7 years.

4.11. Research Reliability Analysis

With the method of reliability analysis, it is aimed that to increase the internal consistency of the scale by definition and the elimination of variables that does not share the desired and aimed value from the survey equally. In reliability analysis, the reliability values which are generally accepted for the studies under the research of a subject (Cronbach, 1951) are being calculated. Qualification of prepared survey question for evaluation of any subject is revealed with this method. After the analysis, if there are some scale items that don't fulfill the goal, they can be excluded from the survey. Alpha (Cronbach), Splithalf, Guttman, Parallel, Strict Parallel models are included in reliability analysis methods. Reliability of the scales that are being used in this study are evaluated by the utilization of the value of Alpha (Cronbach) model. Alpha (Cronbach) model is an internal consistency measure based on the correlation mean between scale items. The reliability analysis information of related variables of scale reliability is shown in Table 39. Scale reliability of this study is considered sufficient. Reliability analysis of open ended questions of this survey are not being executed for being non-applicable.

After the reliability analysis which is made to “Analysis and Evaluation of Techniques in Search and Rescue Activities”, standardized Cronbach’s Alpha value is calculated as equal to 0,817 which means 81,7% (Table 39). When it is looked to the value, it is clear and easy to define that the reliability of the survey is high level.

Table 39 Reliability Analysis

Cronbach's Alpha[a]	Cronbach's Alpha Based on Standardized Items	N of Items
-3,351	,817	66
a. The value is negative due to a negative average covariance among items. This violates reliability model assumptions.		

The interpretation of the Cronbach’s Alpha test which is used to determine the internal consistency of the questions of the survey is to be found below. Significant value after Reliability Analysis test can be interpreted as:

- ✓ Scale is not reliable if $0.00 < p < 0.40$
- ✓ Scale is low reliable if $0.40 < p < 0.60$
- ✓ Scale is reliable if $0.60 < p < 0.80$
- ✓ Scale is very reliable if $0.80 < p < 1.00$

The Alpha value of our sample is p= 0,817. Since because scale reliability is 0.80 < p = 0,817 < 1.00, the scale is very reliable. With high level of reliability shows the correlation between the questions.

At the end of the reliability analysis which is conducted without the multi answers, mean values of variables of the analysis (Mean), Standard Deviation (SD) and Prevalent Total Participant Number (N) SPSS results are used and given in the Table 36 (Appendix D, Table 40).

4.12. Findings

At the section for findings, 19 variables of search and rescue activities with the vocational and technical nature in our survey are included.

✓ *Q1. Did you take an active role for search and rescue activities?*

94,8% of the participants took an active role in search and rescue, meanwhile 5,25% of the participants specified they did not take any active part in search and rescue activities. (Table 41)

✓ *Q2. Please check the trainings you took for search and rescue.*

Participants indicated that 21,2% of them took “First Aid Training”, 16,1% of them took “Search Training with Classical Approach” and “Evacuation from Wreckage”, 15,6% of them took “Search and Rescue Training on Mountains/Out of City”, 7,3% of them took “Wreckage Informatics/Database Trainings”, 54,5% of them took “Other Search and Rescue Trainings". The other trainings are included in the table with the order. The existence of information of the participants general knowledge of search and rescue is shown in Q1 and Q2 with net results. (Table 42)

✓ *Q3. Please put the search and rescue action phases in order, according to their importance level.*

The most iterative statement is recorded as “Information Gathering of Location and Structures Before the Search” with the percentage of 32,7%.
The second most iterative statement is recorded as “Reaching to the information of survivor within 10 Minutes” with the percentage of 25,5%.
The third most iterative statement is recorded as “Rough Surface Scanning, Superficial Wreckage Search” with the percentage of 19,9%.
The fourth most iterative statement is recorded as “Research of All Space, Detailed Wreckage Research” with the percentage of 29,1.
The fifth most iterative statement is recorded as “Rough Surface Scanning, Superficial Wreckage Search” with the percentage of 19,9%.
The sixth most iterative statement is recorded as “Creating an Access Way to Survivor” with the percentage of 30,7%.
The seventh most iterative statement is recorded with the 50,2% in total as “Continuing the Research until there is no dead or alive left under the wreckage”. (Table 43)
In the Index calculation, statistical proportional alterations of observation values show differences according to the time and location. At the end of index calculation of concatenated statements, the statement with 18,7% which includes “Reaching to the information of survivor within 10 Minutes” takes the first place. The other statements are included with their order below. (Table 44)

- ✓ *Q4. Please mark each search and rescue components according to their importance level.*

Statement of “Time” is sorted as Important + Most Important with 98,4%,
Statement of “Trained Search Teams” is sorted as Important + Most Important with 99,2%,
Statement of “Reaching to the information of survivor within 10 Minutes” is sorted as Important + Most Important with 89,2,
Statement of “Existence of Support Team and Volunteers” is sorted as Important + Most Important with 58,2%,

Statement of “Conducting the Wreckage Search Activities with Technological Tools” is sorted as Important + Most Important with 94,4%,

Statement of “Technological Competency of Tools” is sorted as Important + Most Important with 96,4%,

Statement of “Technological Sufficiency of Tools for Activities” is sorted as Important + Most Important with 90,8%,

Statement of “The Pace of Rescuing Actions from Wreckage” is sorted as Important + Most Important with 89,6%,

Statement of “Accuracy of Survivor Information is sorted as Important + Most Important with 94,4%. (Table 45)

- ✓ *Q5. What is the importance of the phrases, when you consider the survivor “Search and Rescue Activities” under wreckage?*

Statement of “Early/Fast Transportation with Vehicles to the Location” is sorted as Important + Most Important with 96,4%,

Statement of “Wreckage Construction Features” is sorted as Important + Most Important with 80,1%,

Statement of “Rescue Teams with Knowledge of Disaster Zone / Building” is sorted as Important / Most Important with 77,3%,

Statement of “Reaching to the information of survivor within 10 Minutes” is sorted as Important + Most Important with 89,2% in the general calculation,

Statement of “Sufficient Number of Technical Devices” is sorted as Important + Most Important with 98,0%,

Statement of “Interfering with Trained Teams” is sorted as Important + Most Important with 97,6%,

Statement of “Overload of Trained Search Teams” is sorted as Important + Most Important with 55,0%,

Statement of “Accuracy of and Confirmed Survivor Information under Wreckage” is sorted as Important + Most Important with 93,2%,

Statement of “Sufficient Number of Wreckage Search Methods” is sorted as Important + Most Important with 68,9%, Statement of “Features of Wrecked Building” is sorted as Important + Most Important with 56,2%. (Table 46)

- ✓ *Q6. According to your experiences, how would you divide 100 points to Search and Rescue works' importance?*

Female participants placed importance to Search activities with 46,7%, meanwhile male participants number is recorded as 53,9%. In total, participation to Search Activities is recorded as 53,6%. Female participants placed importance to Rescue activities with 53,3%, meanwhile male participants number is recorded as 46,1%. In total, participation to Rescue Activities recorded as 46,4%. (Table 47)

- ✓ *Q7. When you consider your experiences in search and rescue in general, how would you divide 100 points to the time that is spent to search and rescue activities?*

With this question, the percentage evaluation of time of spared for search and rescue activities is asked. According to the experiences of the participants, the total time ratio for rescue activities is 57,2%, meanwhile the search time is 42,8%. (Table 48)

- ✓ *Q8. What is the crucial point of a successful search and rescue activity?*

The answers for this open-ended question that is asked to participants are gathered under 12 topics. After the evaluation of the results, 25,5% of “Equipment and Hardware”, 16,6% of “Training”, 12% of “Personnel”, 9,8% of “Pace/Speed” and 9,1% “Experience” became first five titles. (Table 49)

- ✓ *Q9. Please mark the technical/systems/tools or devices that you used for search and rescue under wreckage.*

All the techniques that are used, with 24,7% “Survivor Listening Tools under Wreck”, with 20,6% “Search Dog Under Wreck”, with 20,2% “Survivor Scanning Tools Under Wreck” are indicated. It is also stated that another technique with high percentage is “Sensor Systems” with 13,7%. (Table 50)

- ✓ *Q10. According to your experiences, please put the search and rescue methods in order from the weakest to the strongest.*

When it is looked to the possibilities for rescuing survivors under wreck, “Wreckage Search, Decision Making Support Systems/Software” statement is recorded as powerful + most powerful with 27,5%,

The statement of “Wreckage Search Dog” is recorded as powerful + most powerful with 56,6%,

The statement of “Wreckage Survivor Listening Tools” is recorded as powerful + most powerful with 72,5%,

The statement of “Wreckage Survivor Screening Tools” is recorded as powerful + most powerful with 59,4%,

The statement of “Remote Research Motors” is recorded as powerful + most powerful with 41%,

The statement of “Mobile Phones with Search Application” is recorded as powerful + most powerful with 25,9%,

The statement of “Wireless Devices (Tablets, computers, special hardware etc.)” is recorded as powerful + most powerful with 32,3%,

The statement of “Geographical Information Systems” is recorded as powerful + most powerful with 41,8%,

The statement of “Sensor Systems” is recorded as powerful + most powerful with 63,7%,

The statement of “Networks such as Facebook/Twitter” is recorded as powerful + most powerful with 5,2%,

The statement of “Survivor Detection Radar” is recorded as powerful + most powerful with 55,4%,

The statement of “Vests with Wearable Computers” is recorded as powerful + most powerful with 23,1%. (Table 51)

- ✓ *Q11. Please put the wreckage construction type in order from the MOST EFFECTIVE TO SAVE A SURVIVOR to LEAST EFFECTIVE in search and rescue methods after your consideration of the evaluation of existed technical* *for each type of wreckage construction. (1 IS THE MOST SUCCESSFUL, 5 IS THE WEAKEST)*

The first statement is recorded as “Steel” with 65,3%.

The second statement is recorded as “Ferro-concrete” with 42,6%.

The third statement is recorded as “Wooden” with 48,2%.

The fourth statement is recorded as “Masonry” with 76,9%. (Table 52)

- ✓ *Q12. How do you describe the evaluation of effectiveness of existed technologies in search and rescue activities?*

When it is asked to participants “How do you describe the evaluation of effectiveness of existed technologies in search and rescue activities”, the recorded answers are 39,0% of “Effective”, 19,9% of “Moderately Effective”, 36,7% of “Not Effective”and 0,4% of “Very Ineffective”. (Table 53)

- ✓ *Q13. What are the situations that existed technologies are effective?*

When it is asked to participants “What are the situations that existed technologies are effective?”, the recorded answers are “Our country has a strong search and rescue organizations” with 38,5%, “Search and rescue tools are very powerful at our organization” with 28,6%, “Searching and rescuing the alive underground does not require highly technological gadgets” with 11,5% and “Search and rescue system is the one with informatics based automatic system” with 5,2%. (Table 54)

- ✓ *Q14. What are the situations that existed technologies are not effective?*

When it is asked to participants “What are the situations that existed technologies are not effective?”, the recorded answers are “Search and rescue under wreck requires high technological devices” with 23,1%, “many disasters occur in our country and existed technologies are insufficient” with 11,4%. (Table 55)

- ✓ *Q15. Please put an “X” to the options regarding to existed technological features of tools that are used in general search and rescue actions which are effective, after you consider your experiences.*

When it is asked to participants “Please indicate the proper one between the related subjects regarding technological tools for search and rescue actions, according to your experiences”;

The answer “Search and rescue activity tools are expensive” is recorded as I Agree + I Absolutely Agree with 72,5%,

The answer “Tools are in use are imported” is recorded as I Agree + I Absolutely Agree with 88,8%,

The answer “It is hard to supply of tools are in use” is recorded as I Agree + I Absolutely Agree with 43,8%,

The answer “There are no domestic tools or domestic tools are of poor quality” is recorded as I Agree + I Absolutely Agree with 40,2%,

The answer “Trusting to domestic tools are difficult” is recorded as I Agree + I Absolutely Agree with 37,5%,

The answer “There are no sufficient or experiment personnel for tool maintenance” is recorded as I Agree + I Absolutely Agree with 50,2%. (Table 56)

- ✓ *Q16. If you give an importance level degree to the all factors below, how would you consider?*

The answer of “The existence of information regarding survivors under wreckage” is recorded as important + very important with 97,6%,

The answer of “The fast pace of reaching the information of survivors” is recorded as important + very important with 98,8%,

The answer of “Information of the numbers of survivors under wreckage” is recorded as important + very important with 86,1%,

The answer of “Territorial Ground Structure” is recorded as important + very important with 61,4%,

The answer of “Survivor Detection Tools with Technological ground” is recorded as important + very important with 87,3%,

The answer of “Search Method in Use” is recorded as important + very important with 90,0%,

The answer of “Experience of Search Teams” is recorded as important + very important with 90,4%,
The answer of “Number/Density of Search and Rescue Teams” is recorded as important + very important with 59,0%,
The answer of “Certainty of Survivor Information” is recorded as important + very important with 92,0%,
The answer of “Content/Details of Survivor Information” is recorded as important + very important with 75,7%. (Table 57)

- ✓ *Q17. Could you indicate the sufficiency levels of techniques/tools and devices of search and rescue activities suggested below?*

When it is asked “could you indicate the sufficiency levels of tools and devices of search and rescue activities”,
Participants’ answers are recorded as “not applicable/ not sufficient” for “Search and Rescue Robots” with 88,8%, meanwhile 94,0% of “enough/ needs development” for “Digging Tools”. (Table 58)

- ✓ *Q18. How would the changing the existed tools and devices with modern tools of informatics effect the search and rescue phases?*

When it is asked to participants “How would the changing existed tools and devices with modern tools of informatics effect the search and rescue phases”, the answer of “It absolutely enhance them” is recorded with 74,1%, meanwhile there is no such an answer for “It absolutely deteriorates” from any participants. (Table 59)

- ✓ *Q19. Does changing the tools and devices in existed phases with more informatic tools and devices provide a progress regarding the detection of survivors under wreckage in those existed phases?*

When it is asked to participants “does changing the tools and devices in existed phases with more informatic tools and devices provide a progress regarding the detection of survivors under wreckage in those existed phases”, the answer of “It absolutely enhance them” is recorded with 71,3%, meanwhile there is no such an answer for “It absolutely deteriorates” from any participants. (Table 60)

4.13. Chapter Summary

According to the information which is gathered from face to face interviews and the other studies of the literature, timing of search and rescue activities are critical and a detailed planning should be executed with search and rescue activities (AFAD, 2014b; INSARAG, 2012). The most important purpose of search and rescue activities is about "rescuing lives" (Wong & Robinson, 2004).

Expert opinions that are gathered by the interviews during the preparation of this thesis to contribute to the international literature are collected to provide a toll and system list under the Table 11. These tools and systems are the ones that are used at least once for search and rescue activities in Turkey. Listing of these tools and systems are carrying a great importance to be in the required features and to provide for the needs that are defined in the literature. Especially, when the material lists (Table 13) of Federal Emergency Management Agency (FEMA) (2018) is taken into consideration for comparison, lack of sensor systems, embedded information systems and software in the tools and systems that are being used in Turkey draws a negative attention. When the material lists of FEMA is examined thoroughly, there are a lot of information technology based systems that are increasing the effectiveness of teams, and that are standardizing, easing and expediting the search and rescue activities. The system which is suggested in this thesis is also important for the potential of providing the qualities related to search and rescue activities in Turkey that are listed above.

In disaster management process, the most critical part that is related to time in intervention stage is the search and rescue stage (Seppänen & Virrantaus, 2015). To detect the important aspects of this stage for Turkey, and to compare these aspects with international literature, opinions of the experts has been asked. There were many interviews that are made in different times and different places with the experts of their own field who worked actively for search and rescue activities. Data from these interviews are re-evaluated and provided to same experts for verification. With all of these efforts, a list is established under the name of Important Aspects of Search and Rescue Activities in Turkey. This list carries an importance for showing parallelism with international literature as well as being one of a few studies that are conducted in near past about this field in Turkey. Within the results that are taken from the study are as listed below:

✓ Survivor detection under the wreckage in a short amount of time increases the efficiency of search and rescue.

✓ The shortening the search timing also means the shortening the timing of rescue activities.

✓ there are three important aspects as trained personnel, right equipment and gathering the correct information in time.

With the direct association, the information about survivors that is required by search and rescue teams is also tried to be gathered (Table 19). This data is used in questionnaire in 4th and 5th chapter and in the project.

Data from the survey results of this thesis are giving important clues related to search and rescue activities. The important aspects that are gathered from the evaluations of expert interviews and the survey are listed below.

✓ Majority of the participants of search and rescue activities are male. Number of female workers in health support even though there are no participation to survey are high; however due to the physically heavy work, male dominance in this field is accepted as normal. However, the aspects that can be faced at disaster zones requires the existence of female search and rescue experts for the search and rescue activities for women and children. This subject carries a great nature of potential for future researches.

- ✓ Average age of the search and rescue expertise field which is recorded as 36,7 is a very high number. This situation which can affect the search and rescue activities' efficiency brings another aspect which need a study on itself even though it is not included in this thesis. According to AFAD Regulations (Official Newspaper No.29871 of the date 28.10.2016), people above 50 years old require a permission for search and rescue activities in an active role. There must be a homogeneous structure in the consideration of the age distribution in new personnel employments. With the Law No.6525 that is legislated in 2014 and the regulation came afterwards, conditions to become search and rescue technicians are reformed. Even though there is an increasing age average during the upcoming years, there will be a new inclination towards young generation with these regulations and with aspects of employment by exams.

- ✓ 95% of the participants of the survey had the experience for search and rescue, and 90% of them are still working in a related field. This situation creates a reliability increasing factor for the results of the study.

- ✓ When the trainings of the participants are taken into consideration, it is clear to see that majority of them have the standard trainings, however the number of the participants who had the training for new technologies, information technologies and sensor systems is very low. This situation brings the necessity of training related to new technologies, and information systems for search and rescue activities. Especially trainings and awareness for sensor technologies, Internet of Things, robotic technologies and mobile technologies should be increased. According to the regulations of Search and Rescue Technicians (Official Newspaper No.29871 of the date 28.10.2016), the rudiments of assignments to cadres, remaining at the office and promotion are defined and started to be applied at the end of 2016. With these new applications, it is clear that there will be an increase of quality of personnel and training implementations.

- ✓ More than half of the participants listed the having information related to survivor under wreckage as the number one priority. This situation puts the importance of the information related to the survivor. This situation is also supporting the Hyphothesis and some resources at literature ((Statheropoulos et al., 2015b)).

✓ 90% of the same participants listed time, trained personnel and survivor information in prioritization for search and rescue components. This result puts the importance of survivor information as well as the well-trained team for search and rescue in dangerous disaster areas against the time. The importance of reaching to the survivor information in a very short period shows another important aspect for increasing the efficiency of search and rescue activities. The results that are taken from this article show parallelism with the studies in the literature (Statheropoulos et al., 2015b).

✓ When the separate evaluation is made for search and rescue activities by the participants, no significant differences are recorded. Rescuing actions are taking more time than searching actions.

✓ To the open ended question of "what is the crucial aspect of search and rescue activities", participants answered with right equipments, tools and trainings. The results that are taken from here show consistency with the studies in literature (Statheropoulos et al., 2015b), along with the results of face to face interviews with the experts before the survey (Table 15, Table 24).

✓ According to the opinions of the participants, the most powerful tools are wreckage listening and scanning, and sensor systems. When it is considered that these are the active systems that are in use by the participants, parallel results may be seen as normal. Also these systems are similar to the systems at FEMA Equipment list (Federal Emergency Management Agency (FEMA), 2018).

✓ In the search and rescue activities, the sorting related to building structure from the best to the worst is resulted as steel, ferroconcrete, wooden, and masonry. In this part, only the experiences of the participants related to search and rescue activities are taken into consideration. There is no study for building and ground structure.

- ✓ To the question of “could you evaluate the efficiency of existed technologies”, participants answered as 40% inefficient, and 43% efficient. 65% of the people who answered as “Efficient”, are also gave the answer of “our organization is strong and has abundance of tools”. People who answered as “Inefficient” also said “search and rescue activities requires advanced technological tools/systems” and “if the existed technologies are sufficient enough, more lives can be saved” as equally. It can be said that people who gave the answer of "technologies that are used in here are efficient" show a protective approach and psychology for the institution they work under and they believe there are no need for improvements.

- ✓ Participants are almost like minded for the subject of the prices for tools of search and rescue activities are too high. This subject is one of the topics that experts mutually agree, and it should be evaluated for localisation and domestic production.

- ✓ In the part that participants evaluated the significance level, reaching to the information of survivors under wreckage and validation of this information in a short period of time is considered as important with 90%. This situation confirms the hypotheses. The experts mutually agreed on the importance of this subject in reaction to a consistent result provided by the questions of the survey and the main subject titles from the expert opinions.

CHAPTER 5

EHDS – A SYSTEM THAT HELPS TO REDUCE THE TIME NEEDED FOR SEARCH AND RESCUE TEAMS TO LOCATE SURVIVORS UNDER THE WRECKAGE

5.1. Problem, Purpose and Scope

In many studies of the literature, there are many aspects related to the race against time (Dandoulaki & Andritsos, 2007; Huang et al., 2002) to save people and the importance of search and rescue activities right after the disasters. To be more efficient in search and rescue activities and save more lives, planning of actions in intervention stage before, training and drills, and the decreasing the effects of a chaotic (A. Y. Chen et al., 2012) environment are needed. Especially after the earthquakes with full scale disasters, transportation to the location of professional intervention teams may take hours (Wong & Robinson, 2004) or even days.

Within the scope of this research, a survey application and face to face interviews with the search and rescue experts are executed between the years of 2013 and 2014. The results that are taken from the interviews and the survey are gathered under specific topics (Table 26) as important aspects during search and rescue processes:

- ✓ Preparation is crucial in disaster management.
- ✓ In search and rescue activities, necessity of information is high and each valid information saves time.
- ✓ Along with the technological tools, training is also an important aspect.
- ✓ Trained personnel, proper equipment, valid and punctual information are important.
- ✓ Reaching to the disaster location and task sharing are time consuming.

- ✓ Training and informing the personnel for adaptation to new technologies are crucial.
- ✓ Light mobile devices speed up the activities and make the activities long-running in disaster areas.
- ✓ Shortening the search period can also shortens the period of rescuing.
- ✓ Early survivor detection increases the possibility of rescuing the person alive.
- ✓ Team spirit and power are important for the security of the activities.

There were studies that are conducted for the aspects that are gathered under these topics, along with their utilization for existed search and rescue processes and how it can be improved. During these studies, it is seen that tools and systems that are used in existed search and rescue techniques are heavily based on the rescuing process. There is no other search technique which is being heavily used for the process, except trying to hear any voices after shouting for the victims, listening with sensitive microphones and dogs (Table 11). These techniques are the ones that can be difficult and time consuming, and can be used by only experts (people who cannot reach to the area in 24 hours in some occasions). However in the past, in Turkey, there were many disasters that caused destructions in great scale and locally. During these disasters, establishing search and rescue activities in first 24 hours by the professional experts became almost impossible due to the too many numbers of destructed buildings. Foreign units who came as international support had to leave the country due the lack of coordination and without providing proper help (AFAD, 2014c; Ramezankhani & Najafiyazdi, 2008). In these cases, the efforts of volunteers who are also survivors from disaster and local people couldn't being used effectively due to the lack of preparation. Search process is an ambiguous phase that repeats itself until reaching to the survivors under wreckage (INSARAG, 2012). Extending the time of this process can be concluded as more loss of lives. In this project, it is aimed to provide efficiency to search activities by the local volunteers right after the disasters as well as to increase of professional teams' search pace.

As a result of these evaluations, a project is conducted to provide support to survey hypotheses, and provide benefits that are written in articles below, such as:

- ✓ To provide preparation for disasters by the usage of the product in preparation phase of the disasters,
- ✓ To provide right information to search and rescue teams right after the disasters,
- ✓ To have an easy, local and wireless utilization,
- ✓ To provide time to search teams and volunteers,
- ✓ To provide easy use and training,
- ✓ To provide convenience to search and rescue teams over the wreck with light and mobile usage,
- ✓ To shorten time of rescue time by shortening the time of search,
- ✓ To provide rescuing more people alive.

This project is prepared to save or help more victims under wreckage by the people who survived and can work around the disaster area until the professional teams' arrival to save valuable Golden Hours, in such cases. This project can be used by the professionals after their arrival to the area as well.

The project is especially planned for the cause of detection of any survivors under wreckage who are sending the help signal under the wreckage via mobile devices by the first responders. Even thought the power and the range of the signal can show differences due to the general differences of disaster areas, it is possible to reach to the survivor information in a very short time (under a minute) and detect them with mobile tools above the wreckage that can catch the signal.

Main purpose of this project is about the designing of a survivor detection system with necessary wireless tools as well as signal emitter units which has communication opportunities that can be located into accessories such as watches, necklaces and bracelets to inform rescue units about the help call from survivors under wreckage and then producing a prototype that can appropriate for the market.

With the developed system, search and rescue teams will be informed by the surviving targets under wreckage with the actual health condition information promptly, search and rescue actions' effectiveness will be increased, wreckage survivors will have more chance to stay alive regarding to search and rescue issues.

With this system, the person who stucks under wreckage due to an accident or a disaster, will be able to emit the emergency signal by using help button of the device, and the information regarding the alive and/or injured survivors in a specific building of a specific region promptly. It will be wise to remember the Golden Hours which mean the first 72 hours after the disaster carry a great importance for survivors who are trying to stay alive, and the priority of this situation relates to the activities of search and rescue of those who stuck under wreckage. Due to this reason, with the system which is developed in this project, the chance of reaching to the survivors who can emit a help signal will be increased. There is no such wireless device or appliance developed for this cause in use in emergency management systems in Turkey.

5.2. Methodology

The system that is designed in this project includes many similar features with intervention network features which can be prepared and used right after the disasters in a short time. At another study in the literature, Lakshmi Narayanan & Ibe (2012) indicated the basic needs for establishing the intervention networks after disasters in their studies as below:

✓ Quick Response - Intervention networks that will be established after disaster should be in a nature of reacting swiftly according to the structural features of disasters. The system of this project can be operationalized with the usage of mobile application by the search teams and the signal generators on the victim.

✓ Life Expectancy - According to the devastation level of disaster, the intervention networking structure that will be established after the collapse of infrastructure should be able to provide service until the end of the search and rescue processes and even after the improving of normal infrastructure. The signal generator on the victim which is suggested in this project is limited with the battery life on itself. However, with the optimization of the battery life of the application for at least 36 hours, a signal that can be generated and lasted for 72 hours can be provided based on the battery life. On the other side of the application, the battery life of the mobile tools of search teams who use this mobile application limits the timing of this usage. However, mobile energy generators at the professional search teams can charge the tools in use for longer time of usage.

✓ Interoperability - When the variety and different infrastructure of disaster area teams are considered, the networks that will be established during intervention process should have the interface that provides a coordination with other networks. The system that is suggested in this project provides a communication with standard WiFi protocol, and it is compatible with all tools that use the same protocol. Practicality at the disaster zones are provided especially with mobile applications and tools.

✓ Free - If the sound systems in the intervention networking structures in disaster areas are going to be used, they should be provided for free. The system which is suggested in this project will be used unrestrainedly by the all people who have mobile tools.

✓ Coverage - Communication infrastructure after disaster could be divided into independent pieces. Network structures that are going to be established during intervention process should comply with and include these divided pieces. The system which is suggested in this project is not designed for national or regional usage; it is designed for local applications only. For providing an easy usage by the volunteers and with the consideration of power limitations, the system is planned locally.

✓ Heterogeneous Traffic - The network structures that are going to be established during intervention process should include three type of data; sound, image and data itself. In this system which is suggested in this project, the data transfer is planned only.

- ✓ Capacity - The network structures that are going to be established after disaster should provide access to the systems which will work as a normal infrastructure and should be compatible with the existed systems. In the system which is suggested in this project, there is an application which is limited with the power needs of the tool on the victim under the wreck.
- ✓ Ease of Use - The network structures that are going to be established during intervention process should be easy to use and learn by large masses. If victims are going to purchase a device for these structures, these devices should be cheap and easy to buy. The system which is suggested in the project can be used with almost all of the mobile tools with ease.
- ✓ Indoor and Outdoor - The network structures that will be established should be proper for usage in and out of buildings. Penetration tests are made for field testing of this system that is suggested in this project. The system is limited with the test gauges.
- ✓ High Precision - The network structures that are going to be established during intervention process should be able to notify the locations with the acceptable accuracy level. In the system that is suggested in this project, there is no location estimate.

In literature, ad-hoc networks (Fujiwara & Watanabe, 2005), wireless mesh networks, satellite and sensor networks are the ones for intervention process. Many of these network structures can provide access to search and rescue teams to other team members. There are quite few examples that provide access from victim under wreckage to search and rescue teams (Lakshmi Narayanan & Ibe, 2012).

To make this project going, Project plan, sub-units of the project, work packages of those sub-units and schedules of these sub-units are determined. Project consist of two main sub units:

- ✓ Emergency Help Unit (EHU), and
- ✓ Emergency Help Detection Unit (EHDU).

Emergency Help Unit (EHU) is designed to emit the help signal that will show the existence of survivor which works as a battery-operated signal circuit. EHDU, on the other hand is a computer software which is designed to point out the signal with an application on devices such as laptops, tablets, phones or other mobiles through this signal. Since because disasters have a nature of lack of estimation, people who live on a disaster area must carry an EHU on them. With this scope, EHU which is developed in this project is aimed to be located within bracelets, necklaces or wristwatches to be carried with no trouble to the carrier.

Project is divided into systematic and applicable work packages to proceed with successful usage. The project is divided into 6 work packages such as

- ✓ Work Package-1: Examination and design of the product features,
- ✓ Work Package-2: Developing a signal circuit,
- ✓ Work Package-3: Developing and controlling of software application,
- ✓ Work Package-4: Implementation and integration,
- ✓ Work Package-5: System testing and integration,
- ✓ Work Package-6: Proceeding to the final form of the product.

In the work package (WP-1) related to the examination of the product; the other studies and researches regarding the subject is analyzed; and such analyze is used to compose a determination of software needs and creation of the signal circuit design as well as it is used to make the description of needs of the work at upmost level to adapt the planned system properly.

In the work package (WP-2) related to developing a signal circuit; determination of the signal frequency as well as the determination of the designed signal emission frequency's horizontal or vertical direction, determination of network components before the design, preparation of an appropriate circuit design to be established, drawing the circuit board and having the output, establishing the necessary controls for a work of the circuit at the requested level, and design and production of the tooling for mobile usages on people is made.

In the work package (WP-3) of developing the software application; the analyze of the application to be prepared, design of the software which has a finished analyzing process, coding after analyzing and designing of the software, and the establishing the tests of output software application is made.

In the work package (WP-4) of application and integration; EHU and EHDU units are activated, and the eliminating the shortcomings that occurred during application is made.

System testing and integration work package (WP-5) includes the studies regarding the elimination of problems during integration system and making all the testing the EHU and EHDU components as a whole system. In this process, penetration tests over the wreckage is made with the horizontal plane tests.

Preparation of the product for serial production and completion of the project work package (WP-6) includes the efforts for ending shortcomings of the project to create an output product from the project after the system testing.

In 2015 a project plan is prepared to shorten the reaching the alive person information that influences search and rescue actions, for the subject of this thesis. The project that is prepared is submitted to TÜBİTAK TEYDEB Directorate for evaluation for scientific criteria and support. The project that is proposed to TEYDEB Directorate gained the financial support in research and development encouragements with the number 7150684. This project is finished successfully at 31th December 2017, after a process between July 2016 and December 2017. The results of the project and the prototype that is developed is used in the tests of evaluation of this thesis. There are numerous studies in the literature regarding natural and technological disasters, surface texture, building texture and their effects, and yet in our detection this research is one of the first studies in Turkey about gathering and shortening the victim information reaching time for alive people in search and rescue actions.

5.3. Code of Practice

Emergency Help Unit (EHU), is a device with a duplexer and a battery that creates a help signal is located on a wristwatch or necklace. EHU device which disaster survivors can carry easily is providing the determination of the location of survivor under the wreckage by the people over the wreckage via an emitter signal at certain intervals. When the survivors under the wreckage press the power button of EHU (a button or a switch) on their necklace or watches, EHU will emit a signal as an access point. The Emergency Help Detection Unit (EHDU) device on the rescue teams or first responders around the wreckage will be able to receive the signals from EHU. With this process, the power level of signals that are received from EHU, the location of the survivor, and the comments related to the distances can be made easily.

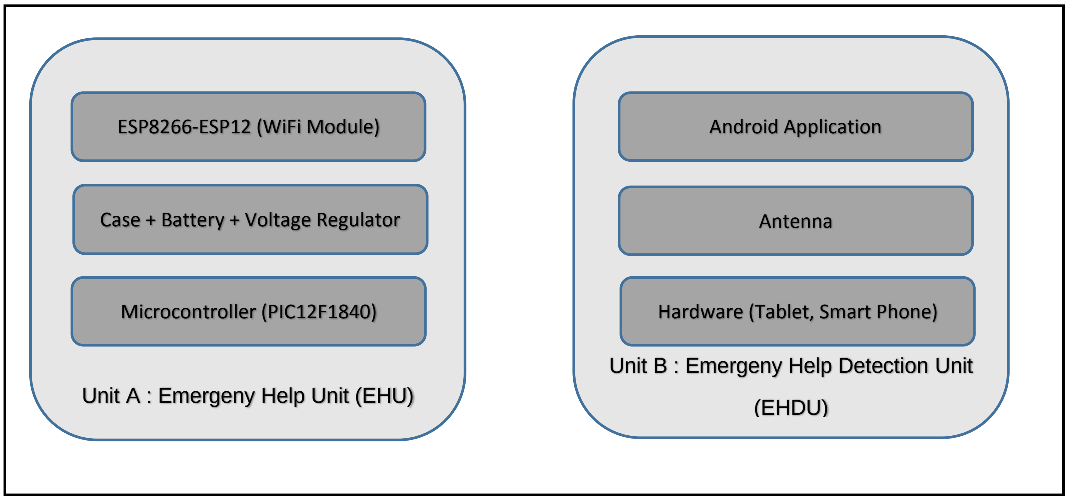

Figure 24 EHU and EHDU Unit Components

One of the main purposes of this project is related to the design of the product to be user friendly and practical for everybody. There are many practices to design the product to be small and chic for users to be used as an accessory on the body.

5.4. Objectives of the Design Stage of the Project

Before starting the Project, five success criteria listed below are defined as the confirmation of Project:

- ✓ To Have a Low Volume Wearable Device: To carry the EHU on the body, the measurements of the device should be in a reasonable level. Especially the EHU that is thought as an accessory, it is decided to be designed as a necklace or a watch with 3 cm diameter.
- ✓ Duration of Transmitting Signals: One of the main features of the EHU is related to its duration of transmitting signals for at least 48 hours. The major problem of this situation is about the small size of the battery to keep EHU small to carry on a body. To solve this problem, it is decided that EHU will take itself into sleep mode periodically.
- ✓ Working Conditions of the Device: The operating range in temperature of the integratings used during production of EHU fits to the range between -25/+50 C temperature.
- ✓ Signal Transmittance Performance: At the open field tests of EHU, the maximum signal range is reached to 130 meters. At the beginning of the project, the minimum signal range is aimed to be 50 meters.
- ✓ Power Consumption of Signal Transmittance: At the beginning of the project, the objective was related to increase signal transmittance duration with a little power consumption; however, the lesser power consumption of signal transmittance means lesser signal range for EHU. Therefore, instead of decreasing the power consumption for signal transmittance, it is decided that EHU will take itself into sleep mode periodically. Signal transmittance power of EHU is 19 dBm (80mW).

5.5. Emergency Help Unit (EHU) and Emergency Help Detection Unit (EHDU)

5.5.1. Emergency Help Unit (EHU)

The studies regarding the signal frequency bands that can be used on EHU during designing process show the result of 2.4 GHz frequency is providing most effective usage. The reasons of choosing this frequency are:

✓ Related to the smart phones that are using WiFi and Bluetooth protocols that are developed by IEEE (Institute of Electrical and Electronic Engineers),

✓ Related to the continuity of data communication of EHU by using different bandwidths even though there are different transmissions with the usage of these protocols in data communication.

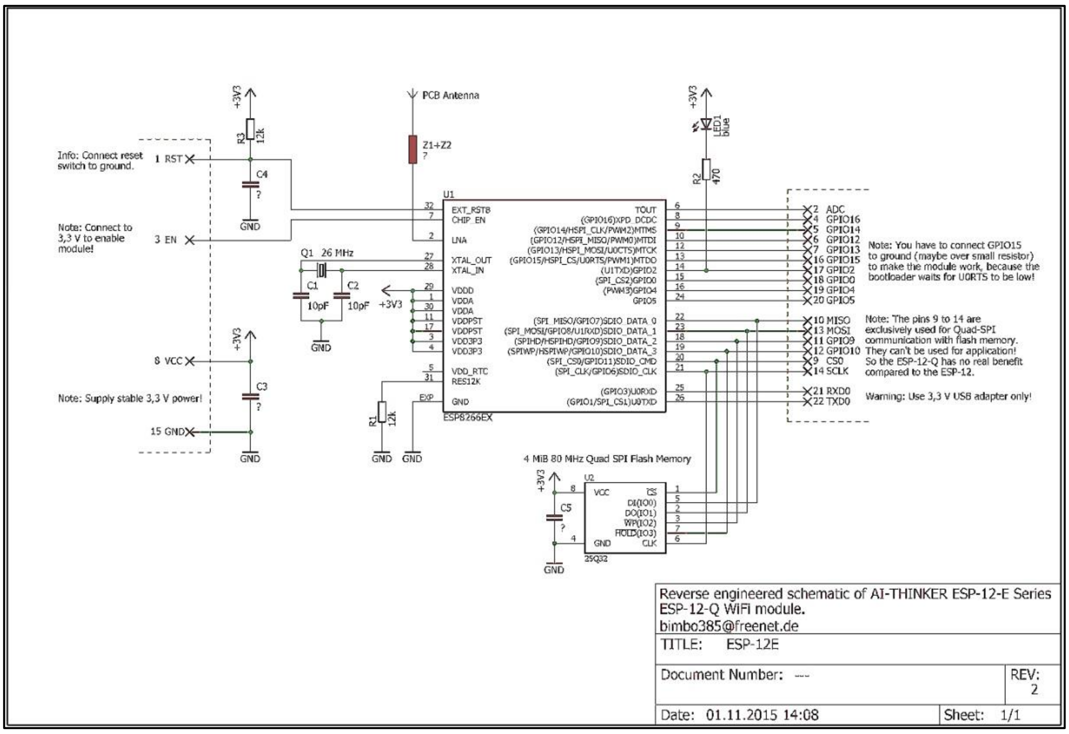

Figure 25 ESP8266 ESP-12 Module Schematic

During the process of designing of EHU it is decided to have the usage of WiFi protocol. Therewith, the existed WiFi modules on the market are investigated and ESP8266-ESP12 module is chosen to be used in the project. On the ESP8266-ESP12 module, there are:

- ✓ ESP8266EX chipset,
- ✓ Quad SPI flash memory (25Q32),
- ✓ 26 MHz Cristal, and
- ✓ Antenna (PCB Mounted).

There is a module circuit schematic of ESP8266-ESP12 below (Figure 26).

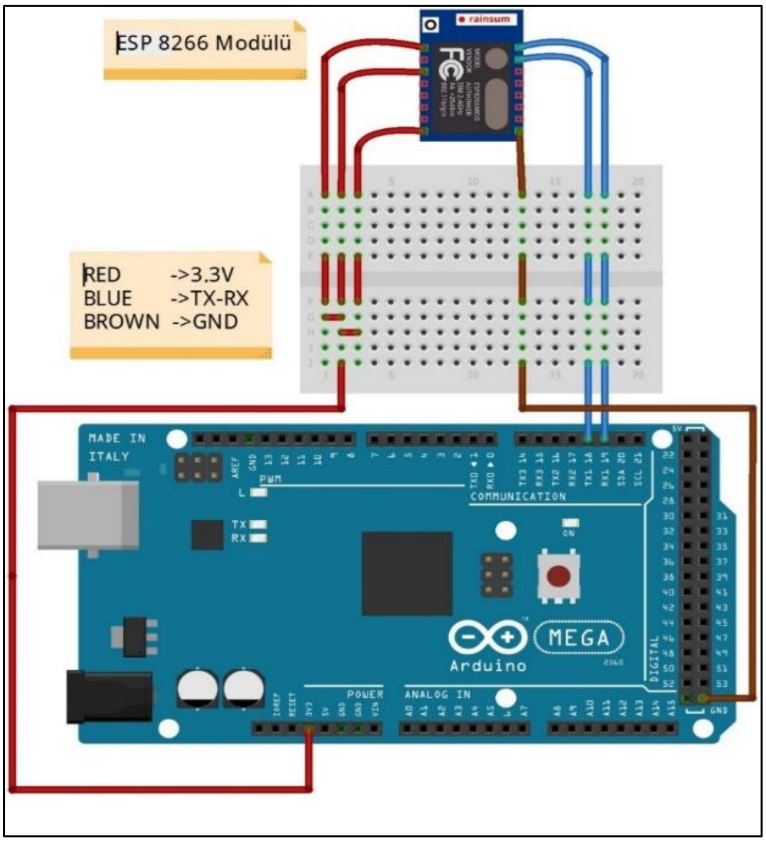

Figure 26 ESP Module And Arduino Mega Connection

After the decision of which WiFi module to be used, for the circuit design, Ardiuno test cards are used (Figure 27).

The module and circuit integration tests that are to be used to proceed with prototype design are made on the readymade cards.

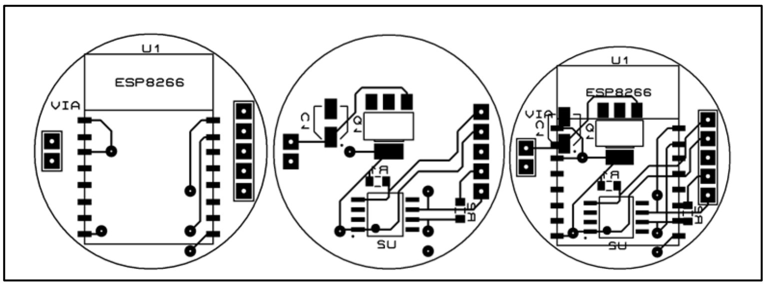

Figure 27 All PCB Outlook From Above And Below

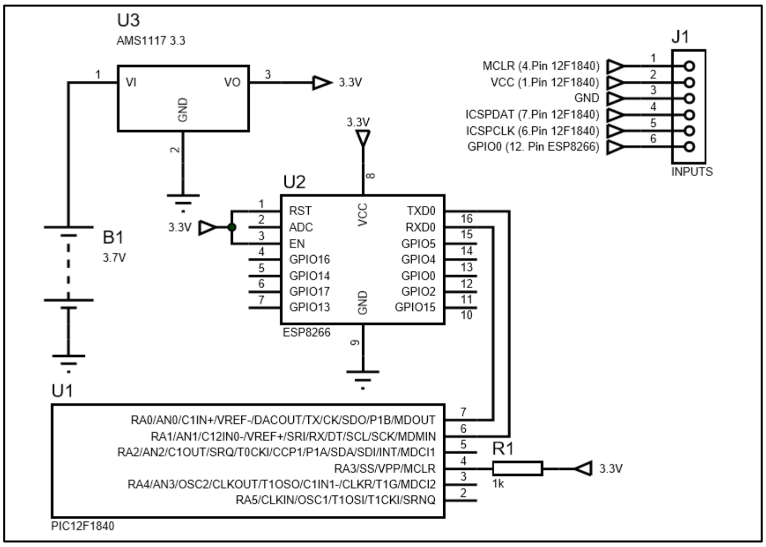

Figure 28 EHU Design

After the system operation, designing EHU device is started. During the designing process, a watch template design is also prepared. For this purpose, at the design of the electrical parts, a circular circuit design is found appropriate for usage. There is the designed circuit scheme and connections figure as above (Figure 28).

EHU consist of 4 hardware pieces in general terms (Figure 28 EHU Design):

✓ WiFi signal generator ESP8266-ESP12 Module,

✓ Microcontroller (PIC12F1840) that provides sleep mode of WiFi signal module,

✓ AMS1117 3.3 Regulator that regulates the voltage of module and microcontroller, and

✓ Power supply battery.

As the EHU system design, a wristwatch design is selected as an example to show the usage on men and women. Since because the triggering the button or switch is necessary to start the system, these apparatuses should be easily accessible. Therefore, the wristwatches are thought the best option. The watch system of EHU is shown at the figure below (Figure 29). The design of the watch model is detailed as follows:

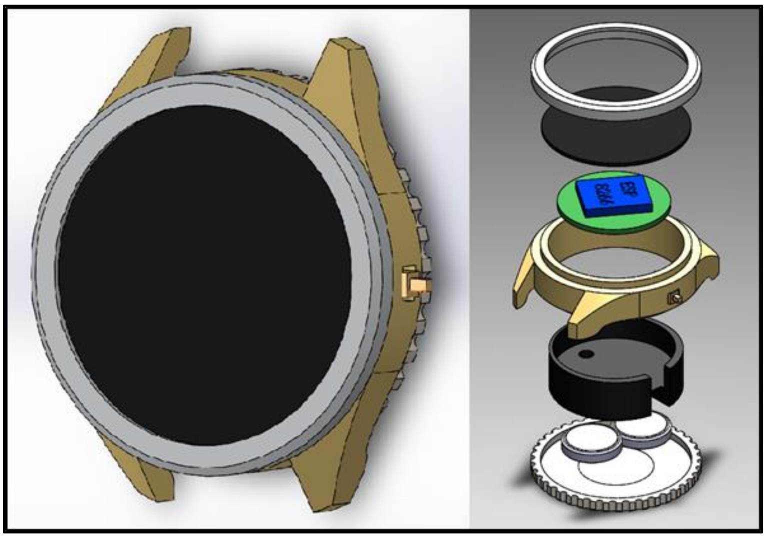

Figure 29 EHU's Template's Detailed Outlook (From Below to Above: Lower Case, 2 Batteries, Battery And Circuit Sockets (intermodulation), Main Component, Circuit (EHU), Glass and Upper Case)

Template design consist of 4 parts. These are:

- ✓ Parent frame,
- ✓ Main component,
- ✓ Intermodulation, and
- ✓ Lower lid.

Parent frame is used to stabilize the glass that is used for the design. Lower lid is designed to provide stabilization of main component of electronic part and batteries. Main component provides the connection of button and cordon part of the design. In general terms, the main point of the design is required to be simple and solid.

5.5.2. Emergency Help Detection Unit (EHDU)

EHDU (Emergency Help Detection Unit) system is planned to procure a mobile application software. One of the main reasons to use mobile software is the ease of handling of light devices that provides easy usage over wreckage with no energy dependence for practicality by the disaster management units specifically in Turkey. Another reason related to this issue is about providing friendly usage to the people who are not professional rescue teams on the disaster area that are needed due to the lack of number of professionals in great scale disasters to work as first responders to gain time. Also, in the locations which has lack of energy substructure and limited communication opportunities, the usage of this system is thought as easy use for local perimeters and as a provider of another search opportunity.

At below, there are interface and outlook of the design for EHDU for mobile applications. EHDU mobile application source codes can be found at Appendix E.

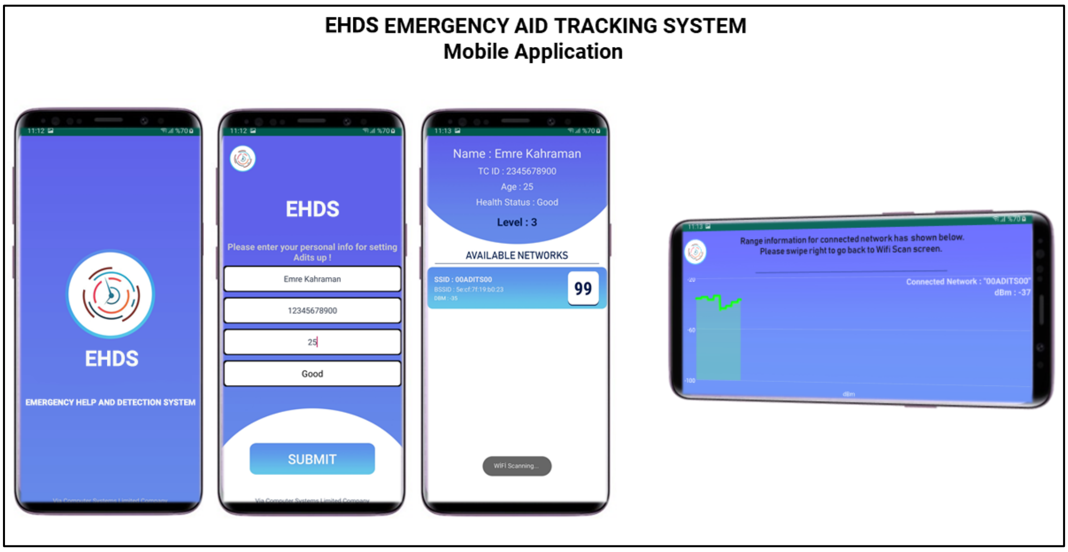

Figure 30 EHDU Opening Screen, Menu, WiFi List

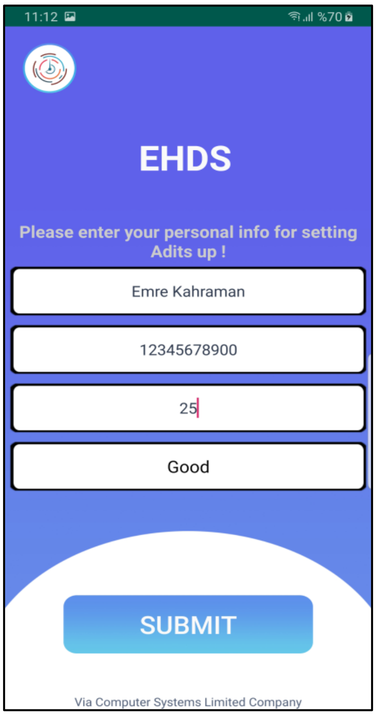

Figure 31 EHDU Port Connection on Client Mode and Access Points

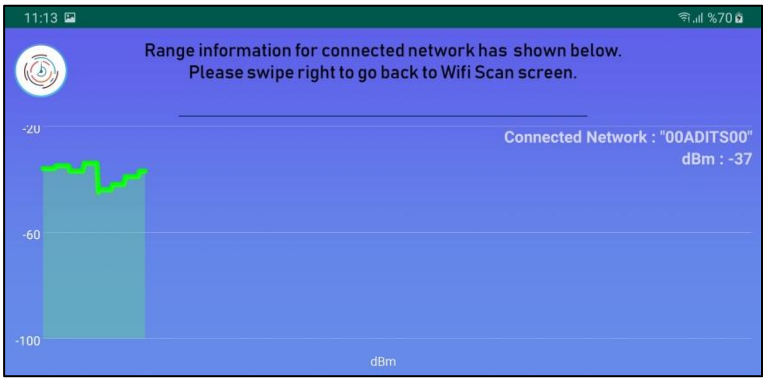

Figure 32 EHDU Range Tab

The most critical feature of EHDU is the tab of Range. This tab can print the information from access points that smart phone is connected and therefore the distance to the attachment point can be guessed by the graphics on the screen. EHDU module is coded on Android operating system. EHDU application works on all smart phones and devices that have Android 4.0 to Android 8.0 versions.

5.6. Field Tests

EHU and EHDU modules that are developed on this project is tested on labs to begin with. In these tests, operability controls, signal powers, energy consumption and applicability requirement analysis are calculated. Lab tests are made at the offices that are located on the address of Bilkent University Ankara Technology Development Zone Cyberpark Block A, No. A707, Bilkent, Çankaya, Ankara. In the lab tests, system is controlled to be exposed to external effects, energy lines, wireless service areas. After that, modules are tested on the filed as an integrated system. Field tests are made in two different category such as distance tests and penetration tests. Both field tests are made without exposed to any external effects or away from wireless connections or energy lines for at least 100 meters.

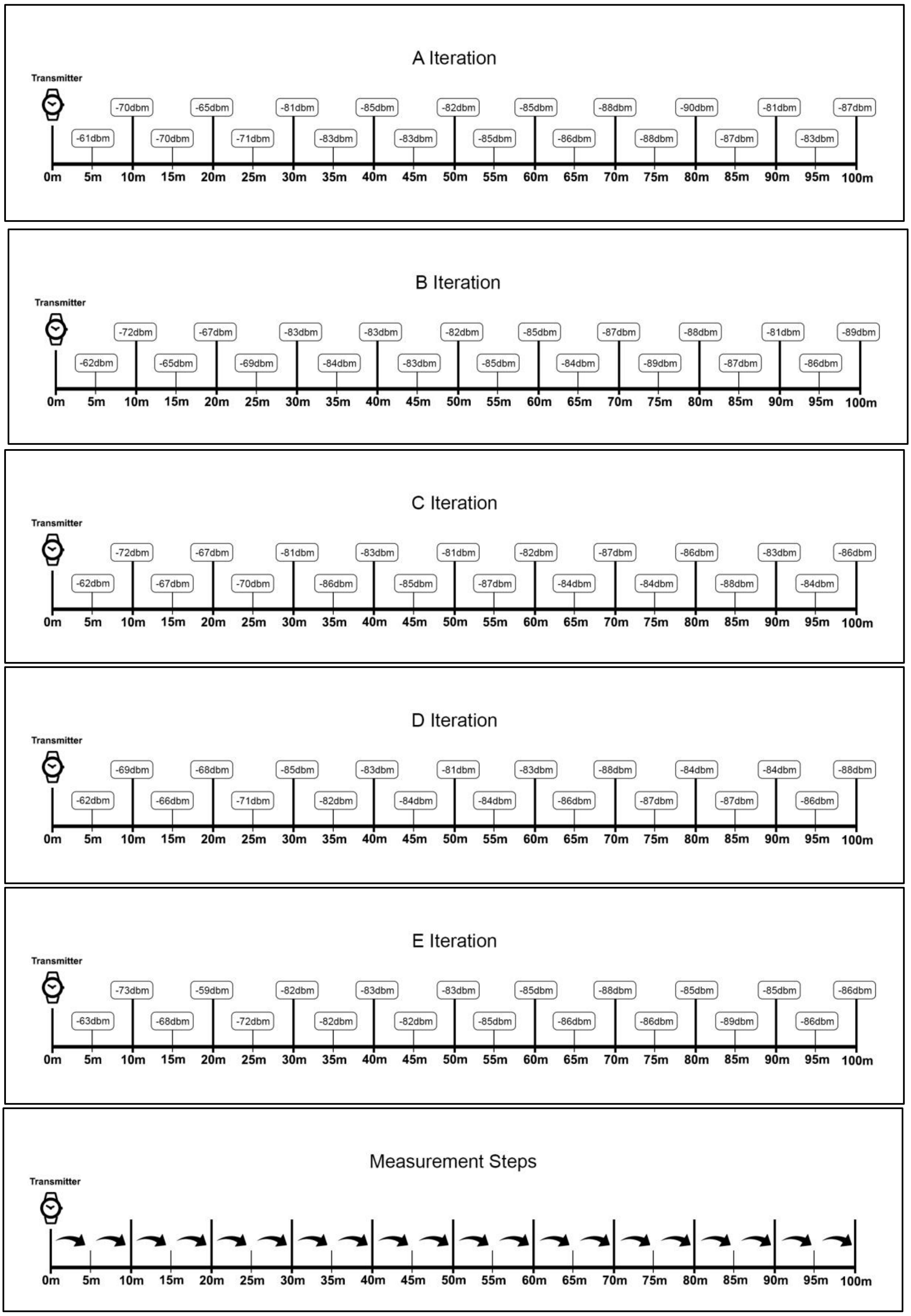

Figure 33 Distance Test Iterations For EHDU

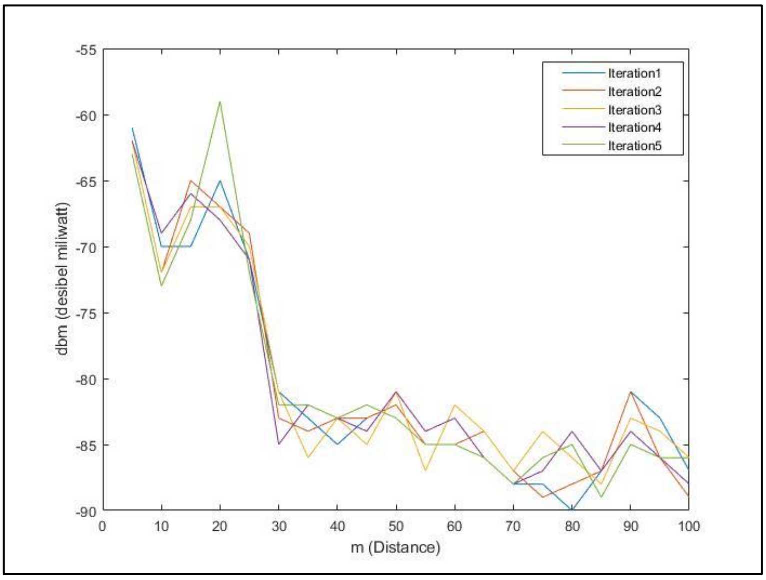

Figure 34 The Values Received From EHU to EHDU (5 iteration)

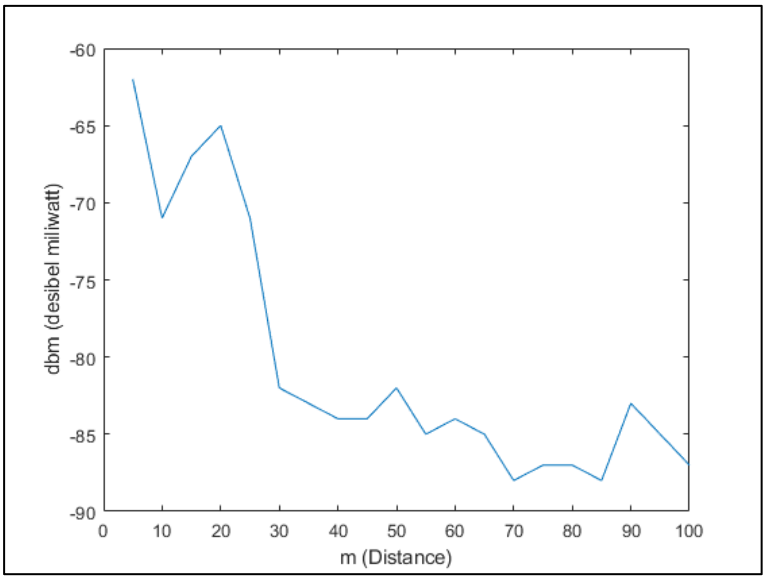

Figure 35 The (Average) Values Received From EHU to EHDU According to the Distance

Figure 36 Open Field Test Scene

5.6.1. Distance Tests

The distance tests of EHU and EHDU modules are made on an open field at the location of 39°52'07.4"N 32°45'09.8"E, between Faculty of Education and Faculty of Music and Stage Arts at the central campus of Bilkent University. Distance tests are calculated with 5 meters of spaces in the range between 0 to 100 meters via 5 iterations. Distance tests are made during midday with 20C degree temperature.

EHU module's signal emitting power to the access point according to the distance is shown at the table above as a graphic.

According to the results of the tests that are used, dbm and distance show a change with an inverse proportion. These computations came from testing show information that provides an opportunity to guess the distance. Even though it is not possible to point a certain location with the signal power, it is possible to point a certain range of near distance. The reason for this kind of a result is that signal provider and signal receiver in the project that is created is the only example of their own design.

5.6.2. Penetration Tests

After the production of application and hardware designs, under wreckage testing, one of the main testing of the project is conducted at the destruction field with the coordinates of 39°54'33.7"N 32°47'17.3"E, during the destruction process of Çankaya Anatolian Agriculture and Vocational High School.

Figure 37 Çankaya Anatolian Agriculture and Vocational High School (From South to North)

For the test, two EHU devices are used to represent two survivors under the wreckage. EHU devices are located to the certain points of the wreckage and the power of the signals from those devices are recorded. When the testing is on conduct, horizontal distances to the devices are recorded with laser meter, along with the signal power. Penetration tests are made during afternoon around the 8C degree temperature.

Figure 38 Çankaya Anatolian Agriculture and Vocational High School (From West to East)

Figure 39 Placement of EHU in the wreckage (Device I)

Figure 40 Placement of EHU In The Wreckage (Device II)

Figure 41 Outlook of the Building Before Destruction (From West to East)

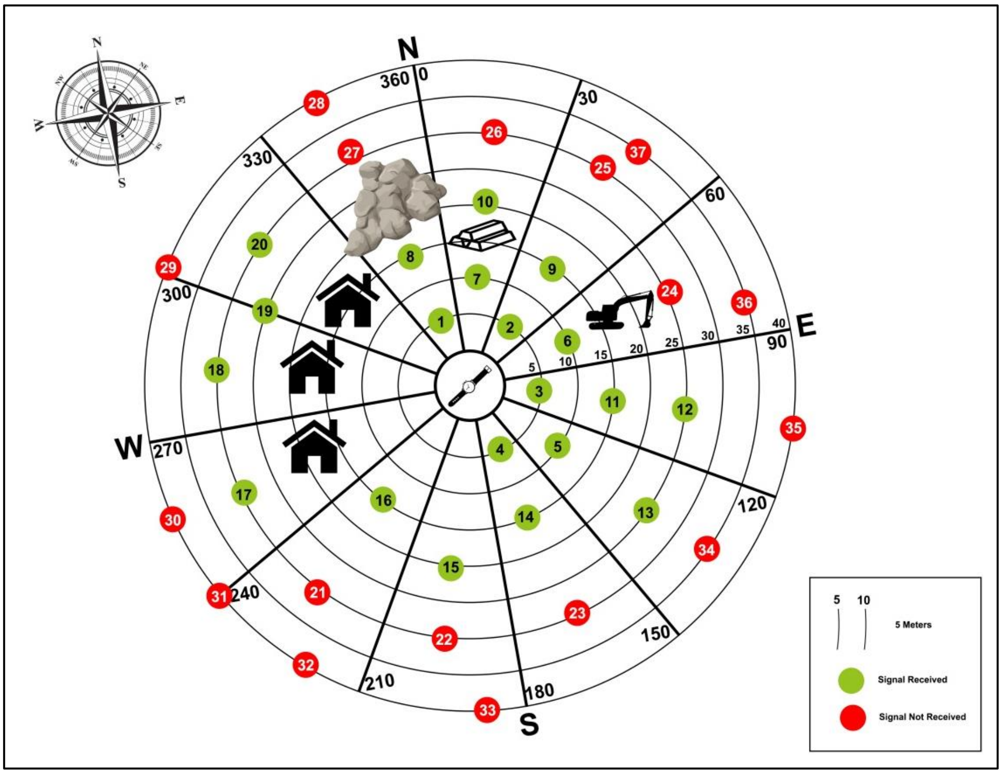

Figure 42 Signal Power From EHU Located in Wreckage (Device I)

Table 61 Values Obtained From The Device-1 According To The Signal Analysis

Measuring Point	Angle (Degree)	Distance (Meter)	Signal Value (dbm)
1	345	5	-60
2	40	5	-59
3	95	5	- 50
4	170	5	-55
5	130	10	-79
6	80	10	-75
7	10	10	-80

Table 61 (continued)

8	340	15	-82
9	45	15	-76
10	20	20	-85
11	95	15	-81
12	100	25	-80
13	130	25	-85
14	160	15	-75
15	195	20	-80
16	225	15	-79
17	250	30	-84
18	290	30	-83
19	300	25	-87
20	315	30	-86
21	220	30	N/A
22	190	30	N/A
23	160	30	N/A
24	70	25	N/A
25	40	30	N/A
26	15	30	N/A
27	345	30	N/A
28	340	40	N/A
29	300	40	N/A
30	280	40	N/A
31	240	40	N/A
32	220	40	N/A
33	185	40	N/A
34	135	35	N/A
35	110	40	N/A
36	85	35	N/A
37	45	35	N/A

Data on the table are written according to the measurements that are recorded in radar system.

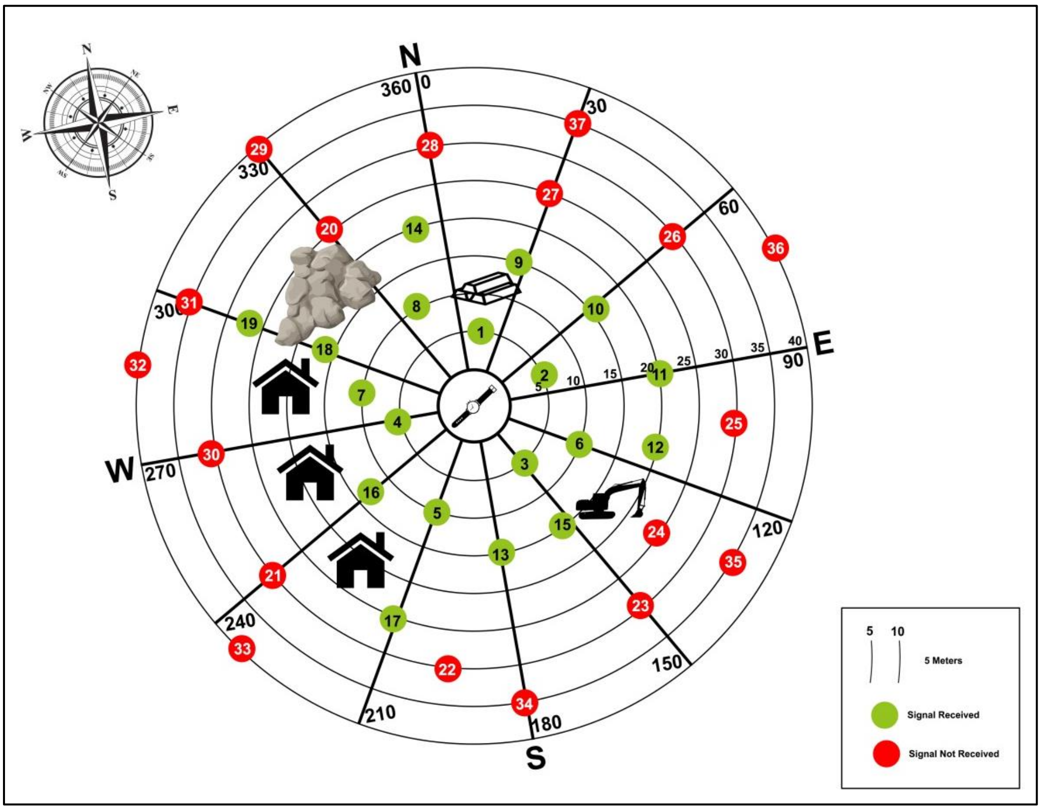

Figure 43 Signal Power From EHU Located in Wreckage (Device II)

Table 62 Values Obtained From The Device-2 According To The Signal Analysis

Measuring Point	Angle (Degree)	Distance (Meter)	Signal Value (dbm)
1	20	5	-59
2	65	5	-61
3	150	5	-58
4	270	5	-55
5	210	10	-68
6	120	10	-71

Table 62 (continued)

7	285	10	-75
8	335	10	-80
9	25	15	-79
10	60	15	-81
11	90	20	-84
12	110	20	-82
13	180	15	-79
14	350	20	-89
15	160	15	-88
16	240	13	-74
17	210	25	-88
18	300	16	-85
19	300	28	-90
20	330	25	N/A
21	240	30	N/A
22	195	30	N/A
23	150	35	N/A
24	135	25	N/A
25	115	30	N/A
26	60	30	N/A
27	30	25	N/A
28	0	30	N/A
29	330	40	N/A
30	270	30	N/A
31	300	35	N/A
32	285	40	N/A
33	230	40	N/A
34	180	30	N/A
35	130	35	N/A
36	70	40	N/A

Data on the table are written according to the measurements that are recorded in radar system.

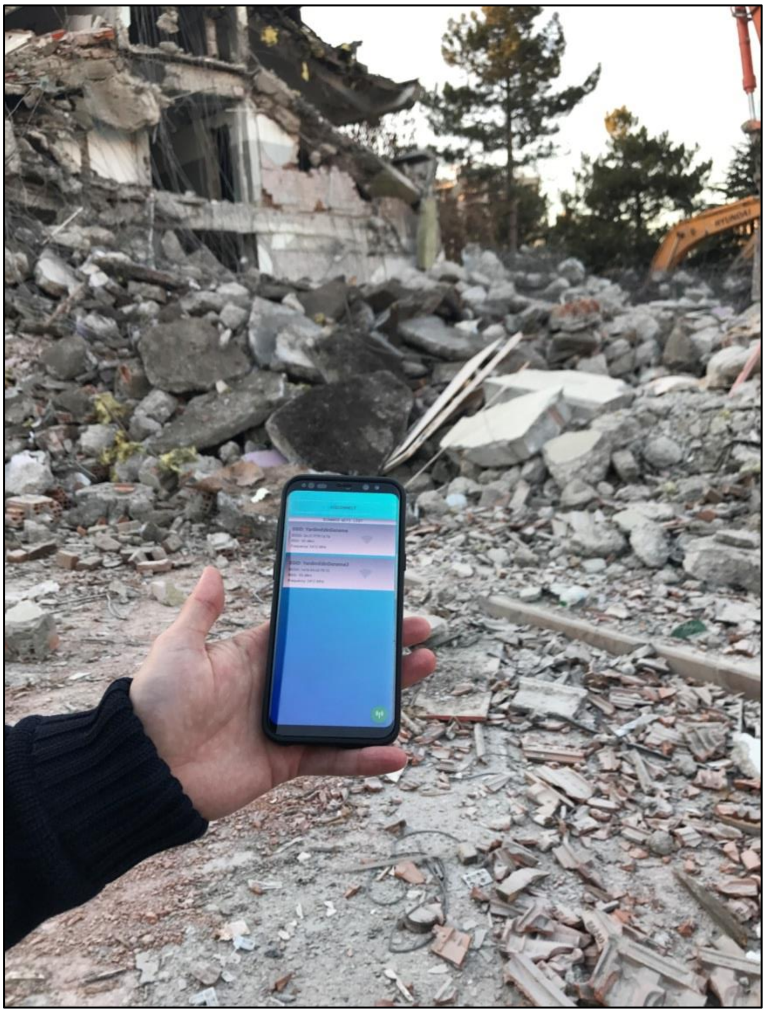

Figure 44 Recognition of 2 EHU Devices Under Wreckage By EHDU

Decibel (dB) is the term which explains the signal power; and it is a comparison between input and output power on a circuit (dB= log(P1/P2) (P1 =Input power, P2= Output power)). This term is generally used for circuit gain or loss. To measure the signal power, decibel milliwatt (dbm) term is used. (dbm = 10log(P/1mW) (P = Input power)) (2).

Table 63 DBM and MW relation

dbm	mW
10dbm	10mW
3dbm	2mW
0dbm	1mW
- 3dbm	0.5mW
- 10dbm	0.1mW
- 20dbm	0.01mW
- 30dbm	0.001mW
- 40dbm	0.0001mW
- 50dbm	0.00001mW
- 60dbm	0.000001mW
- 70dbm	0.0000001mW

Generally, transmission distance of a signal related to many different factors. However, we can call the main factors as:

- ✓ Transmitter Power,
- ✓ Loss of wires between transmitter and antenna,
- ✓ Antenna gain of transmitter,
- ✓ Locations of two antennas (length between, obstacles),
- ✓ Received antenna power,
- ✓ Loss of wires between receiver and antenna,
- ✓ Receiver Sensitivity.

At the table below, the average declination values of signals with certain obstacles are given.

Table 64 Amounts of Average Declination of The Signal Due To The Obstacles in Wireless Networks

Inhibitor Type	Declination
Gypsum Wall	3db
Brick Wall	4db
Glass Wall with Metal Frame	6db
Glass Frame	3db
Metal Door	6db

At the schemes of signal analyses (Figure 42 and Figure 43) from the testing, it is clear to see that there is a declination due to the obstacles of wreckage with high metal density as well as a normal declination. In the open field testing that are conducted to 100 meters, detection of EHU is being decreased during this distance due to the obstacles (with high metal density).

5.7. Limitations and Asumptions

In the testing to the modules that are developed in this project, the steps are taken after the acceptance of certain limitations and asumptions.

✓ During the process of EHU's design, the paradox between signal frequency and antenna length caused a limitation. Watch mold in the design (a circle with around 3 cm diameter) created a maximum size for antenna.

✓ During the testing and designing of EHU and EHDU, it is decided to use a WiFi protocol and a work of 2.4 GHz frequency due to the effectiveness.

✓ It is decided to use a short antenna on the device design to make a wearable effect, and 2.4 GHz frequency which embedded into the designed circuit (PCB mounted antenna) is used.

✓ Most people are using smart phones and tools that are providing Bluetooth and WiFi protocols which are developed by IEEE (Institute of Electrical and Electronics Engineers). These protocols work on 2.4 GHz frequency. Thanks to the ease of application, WiFi protocol is chosen for first responders' usage.

✓ Especially EHU can show differences on signal frequencies according to the wreckage they are located. The main reason of this situation is related to the differences of metal density of walls and beams of each building. The signal which hits the metal leaves a little power of itself on that metal by absorption. High frequency and metal density around causes EHU signal's loss of transportation distance.

✓ EHU that will be used should have strong signal antenna output to reach longer distances. Therefore ESP8622-ESP12 module which has a strong output power is selected to be used.

✓ ESP8266-ESP12's antenna gain is 19 dB. (Approx. 80mAh). With this gain, on the open field, signal can be detected until 130 meters range; however, in this situation high energy consumption has happened.

✓ At the results of the test with 9V batteries for the EHU's continuing work during Golden Hours, it is seen that there was a perpetual signal transmittance for 48 hours by having at intervals of 7 seconds that consist of 1 second of signal transmit and 6 seconds of stand-by mode.

✓ At the design phase, 2 CR1632 batteries connected with series thus they provided power to EHU. The capacities of CR1632 batteries are 3V - 130mAh. At the end of this process, the continuous work period of EHU is increased to 1.5 hours. To increase this time, EHU will change its mode into sleep mode, regularly.

5.8. Chapter Summary

As indicated at the beginning of this chapter, a project is conducted to provide support to survey hypotheses, and provide benefits that are written in articles below, such as:

- ✓ To provide preparation for disasters by the usage of the product in preparation phase of the disasters,
- ✓ To provide right information to search and rescue teams right after the disasters,
- ✓ To have an easy, local and wireless utilization,
- ✓ To provide time to search teams and volunteers,
- ✓ To provide easy use and training,
- ✓ To provide convenience to search and rescue teams over the wreck with light and mobile usage,
- ✓ To shorten time of rescue time by shortening the time of search,
- ✓ To provide rescuing more people alive.

This project is prepared to save or help more victims under wreckage especially by the people who survived and can work around the disaster area until the professional teams' arrival to save valuable Golden Hours, in such cases. This project can be used by the professionals after their arrival to the area as well.

With the prototype that is prepared with the application of this project, the achievements below are gathered:

- ✓ A new tool and a new process example to be used in intervention phase are provided for the Disaster Management concept of Turkey. This prototype tool and the process can be used in search and rescue activities as defined in route map which is included in the next Chapter. With this route, a new method will be included to the existed tools and technologies of search and rescue activities, and with this addition to the activities, the efficiency of the teams will be increased.
- ✓ The prototype which is prepared in this project will ensure an opportunity to increase the work pace of the search teams during intervention stage. This situation will provide a possibility for more effective utilization of First 72 Golden Hours in the great scale disasters especially, thanks to its ability to do more search in shorter period of time. Thanks to directing the search teams to the victims, the possibility to save more lives will be increased.

- ✓ The prototype of this project will provide an easy work for search teams over the wreckage. Since because this tool is light to carry, teams will not be tired easily and they will be able to work swiftly.
- ✓ The need of power for usage of tools will be decreased with the prototype of this project. Also, this prototype will provide an easiness for search activities due to its dynamic and flexible usage of the mobile tools.
- ✓ The prototype of this project will be used by first responders who do not have a training and the survivors of the wreckages.
- ✓ The prototype of this project will provide more search activities in First 72 Golden Hours by the search and rescue teams as well as the volunteers.
- ✓ The prototype of this project will provide easiness thanks to its ability to work locally and wirelessly. This prototype will not need an energy infrastructure. There will be no need for integration to national systems.
- ✓ The prototype of this project will provide right and in time information sharing to search and rescue teams. With the researches of this project, along with the information related to the existence of a survivor, the identity and the health information of the survivor was able to be served. This situation will provide an opportunity to gather more information related to survivor before the rescuing activities, by turning information to data and the validation of the data.
- ✓ The prototype of this project will provide an opportunity to be ready for disasters by people's usage of similar tools during preparation stage before disasters. Thanks to this, there will be an opportunity to provide training of similar tools in ease to huge masses during preparation stages. This prototype will be able to contribute to the situation with the scope of decreasing the effects of the disaster.

CHAPTER 6

CONCLUSION AND FUTURE WORK

6.1. Conclusions

The inevitableness of disasters and the effects of them to the human lives are the reminders of potential disasters every day. In disaster recovery, even though disaster types, number of affected people, affected locations, and types of the effects show differences, the processes and steps of disaster management, and the reality of the disaster management's continuous nature are almost same in all societies.

Differences between countries related to disaster recovery brings different results in disaster effects as well. For disaster recoveries, in the countries like Japan which suffered and learned many things from disasters and got use to live with the disasters, the effects of great disasters may be resulted with a very little numbers of economic and social loss. This situation indicates that the disaster recovery in Turkey with the majority of the population live in first and second degree seismic zone should be developed with techniques and methods that are in use, as well as training and informing actions. Even though in the World Risk Report, the risk point of Turkey is lower than World Risk Index; Lack of Coping Capabilities (%69,11), Lack Of Adaptive Capabilities (%38,79) and Vulnerability (%42,44) percentages are high. Therefore, the effects of a disaster will be great and devastating, even though the risk capacity is low. The calculation of the disaster risk has been performed for 180 states worldwide and is based on four components (Radtke, 2019):

- ✓ Exposure to earthquakes, cyclones, floods, drought, and sea-level rise,
- ✓ Susceptibility depending on infrastructure, food supply, and economic framework conditions,

- ✓ Coping capacities depending on governance, healthcare, social and material security,
- ✓ Adaptive capacities related to coming natural events, climate change, and other challenges.

In Turkey, the studies related to disaster management and disaster prevention works are shown a great improvement recently. This situation is very affirmative for Turkey; however, the biggest part of the work is related to building and ground structure. Whereas disaster management starts with preparation before disaster and continues with the years after disaster as a long-term process which requires a high-level importance for coordination and planning and participation from all organizations in the country with full synchronization. Search and rescue activities in disaster management subject includes the necessary usage of information technologies for effective search and rescue activities which can speed the process up and save time. In search and rescue activities, pace and time mean more people that are saved and secured. The detection of this necessity and quantitative / qualitative researches with the details of the system that is developed for this necessity is explained in this doctoral thesis. According to our findings, reducing the time to reaching the survivors under wreckage during search and rescue activities carry a great effect that can increase the efficiency of the whole processes.

When we look to disaster management and disaster term in Turkey, disaster management includes a complicated structure with many actors which can cause a fear due to the confusion and chaos after any disaster. In such complicated location, national and local volunteered search and rescue teams are carrying a great deal of importance for efficiency of time. In the search and rescue activities which is conducted against time, the good use of first 72 Golden Hours implies a crucial importance for the sake of activities.

In this thesis, activities, needs, and important parameters related to intervention stage of disaster management are evaluated. The aspects from literature search, 32 experts who worked in search and rescue activities with great knowledge relating the issue and important aspects are tried to be determined by face to face meetings. In this scale, the needs, and important parameters are listed for search and rescue activities by gathering of all information from those meetings and surveys.

The aspects that evaluated after this study, as a validation of important parameters of suggested system, a survey with 8 demographical and 19 technical/vocational question is prepared for the experts of the field. In this survey, as well as the demographic variables, 19 closed ended questions with 5 points Likert scale methods. The survey is applied to 251 search and rescue experts in total. The population of the survey include search and rescue experts who are assigned in search and rescue organizations in Turkey. According to the results of the survey, all the hypotheses related to problem sentences are validated.

With the evaluation of the survey result, reducing the time of detect the survivors under wreckage by the search and rescue experts, efficiency of tools in use, and experienced personnel are the most important subjects. Also, the question of "How would the changing the existed tools and devices with modern tools of informatics effect the search and rescue phases" is answered with 25% of "enhances", and 74% of "absolutely enhances". These answers put the importance of modern tool usage to reduce the search and rescue process.

Thereafter, in the light of the information that is gathered together, a technological tool application which can reduce the time for detection of survivors under wreckage is designed. To put this technological tool prototype into practice, applications to TÜBİTAK supports are made and with the support, 18 months of project between the years 2016-2017 is conducted. The system prototype after this project is a system that can provide more valid and extensive information to detect the survivors under wreckage, with a long duration energy consumption that can work under deep wreckage especially with spaces, that has the usage without any dependency to time and location and completes other data gathering processes and techniques; and after all, decreases the time and loss during search and rescue progress. In the tests with system prototype, performance tests with Wi-Fi 2.4 Ghz frequency is at the promising level for the usage in search and rescue activities.

In this thesis, a study is executed related to disaster management and search and rescue actions in general along with especially natural disasters such as earthquakes which can cause great number of devastating effects. In such disasters, the scenarios relating to the insufficient numbers of organizationally established official search and rescue teams, lack of intervention teams except the local first responders during the first hours of disaster, the existence of full-scale disasters and the aid teams from abroad cannot reach to the disaster area took important place. Moreover, only focus was the search and rescue actions and the subjects like logistic, ground and building structures, CBRN and hazardous substances which affect the disaster management were not taken into consideration for the research. Search and rescue activities taken into consideration as an integrated step with recovery stage and they did not considered as search and rescue activities as themselves.

In this study, the aspects that are defined as goals are as below:

✓ Investigation of search and rescue activities during intervention at disaster management in Turkey,

✓ Determining the parameters that affect the search and rescue activities,

✓ Determining the factors that affect the rescuing the victim alive during search and rescue activities,

✓ Having a confirmation of information that can be used to speed up and making more efficient of the search and rescue activities from the experts of search and rescue team by conducting a poll.

✓ Proposing an application that provides benefits to duty security and situational awareness and planning by shortening the information of victims underground during search and rescue.

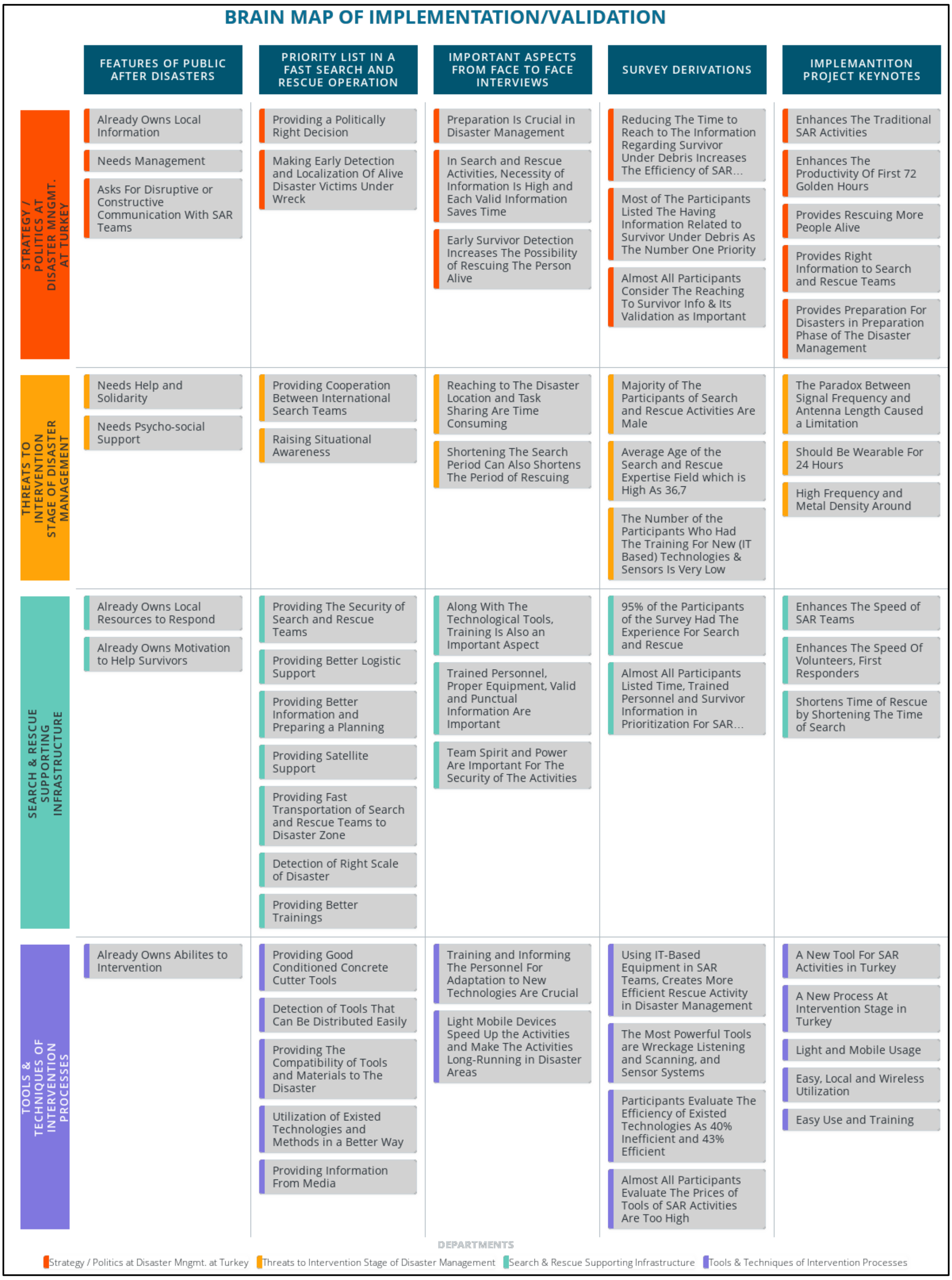

Figure 45 Brain Map of Implementation / Validation

Providing an effective and efficient search and rescue activities, more disaster victims can be rescued alive (Avdan, 2011; Chenji et al., 2012; Statheropoulos et al., 2015b; Wong & Robinson, 2004). With the consideration of factors that reduce the time of search and rescue activities, efficiency of search and rescue teams can be increased, searching times can be decreased, a better planning can be made, and especially in international duties (INSARAG, 2012), field operations can be prepared more efficiently.

Within the results of the literature scanning, expert interviews and the survey for this thesis, it is seen that there are 4 (four) horizontal axis of conducted study for intervention stage of disaster management:

✓ Strategy / Politics at Disaster Management at Turkey (applied policies and strategies, reformed resources, aspects that affect the all stages, integrated aspects of other Institutions/Ministries/NGOs etc for disaster management at Turkey),

✓ Threats to Intervention Stage of Disaster Management (Constraints, threats, dependencies, inadequacies, and other critical aspects that requires work which take place at disaster management),

✓ Search & Rescue Supporting Infrastructure (Common infrastructure that is in use during search and rescue stages of disaster management, institutional infrastructures, important aspects that affects the processes, the aspects which are expected to be ready before disaster for disaster management, etc),

✓ Tools & Techniques of Intervention Process (Tools, devices and materials, technologies, systems, operations, and general usages of search and rescue stages of disaster management),

After the definition of horizontal axis, the subjects that provides validation to this thesis and the ones that are referred for search and rescue field during the literature scanning are presented as 5(five) vertical axis. These axis are presented as follows:

✓ The Situation of People After the Disaster (Societal detections that affect search and rescue stages of disaster managements, needs and capacities of people after disasters, contributions of public for search and rescue stages, etc),

- ✓ Priorities of an Expeditious Search and Rescue Operation (Priorities lists of international literature, important and primary aspects of search and rescue activities for horizontal axis, etc),
- ✓ Important Aspects Gathered From Face to Face Interviews With the Experts (Important aspects gathered from the data of the interviews with the search and rescue experts of Turkey that also correlate with horizontal axis, etc),
- ✓ Survey Deductions (Evaluations of the results from the survey on the basis of horizontal axis, etc),
- ✓ Important Notes from Application Project (Evaluations of the information gathered from this thesis and application project as a result of literature studies on the basis of horizontal axis, etc).

When the 4 (four) horizontal and 5(five) vertical axis are evaluated together, it comes into the sight that the results of application project, applied survey, interviews with the experts regarding the aspects of literature are in a consistency. In accordance with this situation, a route map on five vertical axis is prepared for the four horizontal axis as below:

- ✓ Current State (Existing situation of disaster management of Turkey, existing systems, tools, techniques, processes and infrastructural situation, etc),
- ✓ Initiatives (Ventures, campaigns, important aspects, main actors, etc),
- ✓ Prioritization (Priorities, constraints, key notes, important aspects, etc),
- ✓ Responsible (Responsible people, responsibilities, authorized institution or people, actors, etc),
- ✓ End Point (Final situation that is aimed after the route map, goal, purpose, etc),

All of the aspects that appear in the created route map are divided into three groups with a categorization as short, medium and long term goals. The route map which is created and directed for technological policies of disaster management at Turkey is converted to short-middle and long term concrete steps on the four horizontal axis, and it is explained in details as below.

Figure 46 Roadmap to Technology Policies at Disaster Management in Turkey

6.2. Suggestions and Road Map

6.2.1. Strategy / Politics at Disaster Management at Turkey

This part is related with applied policies and strategies, reformed resources, aspects that affect the all stages, integrated aspects of other Institutions/Ministries/NGOs etc for disaster management at Turkey.

There are many striking statistics in the literature. Nowadays, when it is considered that most of the population live in cities with high density, great losses will be caused by the natural and technological disasters in near future. Also, a possible earthquake in Marmara zone in near future is considered as granted by the experts of the field. With all these actual information, the strategical planning and actions should be developed for disaster recovery against any natural and technological disasters. In this research, the results and suggestions are organized as concrete suggestions.

Disaster management is a process that requires great coordination and collaboration. Due to the different scales and types of the disasters, a sphere of influence emerges that exceeds province or country borders; and this situation creates an increasing complication between partners and work relations exponentially. To be effective in a such complicated and chaotic situation, the main key is related to preparation, planning and training. In Turkey, AFAD Directorate which is established with the law no 5902 related to Disaster and Emergency Management Directorate Organization and Functions has a great role in this subject. Many strategical studies, regulation, plans and coordination methods related to the subject are excluded from this research. However, the results and suggestions related to planning, strategy, training and projects o f search and rescue studies along with the aspects of the field are listed below.

Table 65 Suggestions Regarding To Strategy / Politics at Disaster Management at Turkey

No.	Term	Responsible Unit / Initiative / Sub Units	Main Topic	Suggestions in Detail
1	**Short Term (0-6 Months)**	AFAD Directorate	AFAD Strategic Plan (Current)	An evaluation regarding to the SWOT analysis in 2013-2017 AFAD Strategical plan should be made. There must be a concentration on the aspects which are planned in this analysis and yet not executed, and emergency measurements for the execution of these aspects should be taken.
2	**Short Term (0-6 Months)**	AFAD Directorate	AFAD Strategic Plan (Current)	AFAD Strategic Planning for 2013-2017 is published. However, 2018-2022 planning are not yet published. A new strategic plan which consist of 2018 and after should be published. In this new plan, SWOT analysis should be compared to the previous one. Analyses, reports and actions plans are also interrupted due to the lack of expected publishing of the new plan. This situation is in a nature that cause hindering the mission and vision evaluations. This situation also causes interruptions at institution strategy.
3	**Short Term (0-6 Months)**	AFAD Directorate	AFAD Strategic Plan (Current)	2nd Goal in existed plan: Establishing an Integrated Disaster Management System Focused on Risks, Goal 2.6: Until the end of 2017, the goal of Developing the Disaster Management Support System is not completed. In the support system which is developed for this aspect, there should be projects related to detection of disaster victim in search and rescue actions. Starting to these projects related to rescuing victims under wreckage after the potential disasters and making studies related to this field should be made.
4	**Short Term (0-6 Months)**	AFAD Directorate	AFAD Strategic Plan (Current)	Especially the subjects like “Late Intervention”, “Insufficient Intervention and Action Plan”, “Not Taking Necessary Measures for Vulnerable Groups (such as women, children and disabled)” which are located in Estimation and Early Warning should be reevaluated. In this matter, what are made and what did not make should be reevaluated.

Table 65 (continued)

5	**Short Term (0-6 Months)**	AFAD Directorate AFAD Provincial Directorates Fire Brigades AKUT etc. NGOs Ministries Local Administrations	Tools & Techniques	Lists of all materials that are in use or will be used for search and rescue actions should be prepared and published. Number of the actions related to direct and encourage to the technologies related to search and rescue activities should be increased.
6	**Short Term (0-6 Months)**	AFAD Directorate	Turkey Disaster Management Strategic Paper and Action Plan	Turkey Disaster Management Strategic Paper and Action Plan is a document with long history of study. Preparation works are continuing since 2015. The paper should be completed and published in the short term. In this paper, strategical actions should be planned with the high consideration level of search and rescue activities for a sufficient intervention.
7	**Short Term (0-6 Months)**	AFAD Directorate AFAD Provincial Directorates Fire Brigades AKUT etc. NGOs Ministries Local Administrations	Coordination	Management of disaster and emergency situation coordination is not a short term and simple task. On the other hand, measurements related to the topic should be taken for short term as well. This subject is multivariate and has many actors. The coordination between those actors and units is a subject that requires studies and practices. There are many studies that are conducted by AFAD regarding emergency situation coordination. However, it is difficult to except that those studies are enough. There must be coordination mechanisms that are supported especially by the volunteers, and consist of ministries and local authorities. Especially for disaster management, there must be measurements for coordination of preparation work related to disasters along with refugee problems that absorb the greatest part of AFAD's energy in general.
8	**Medium Term (7-36 Months)**	AFAD Directorate	AFAD Strategic Plan (Current)	At the opportunity section of the same analysis, the subjects like “Decreasing Loss with Gaining Time for Disaster prevention” and “Providing Fast and Right Intervention” should be reevaluated.

Table 65 (continued)

9	**Medium Term (7-36 Months)**	AFAD Directorate AFAD Provincial Directorates Fire Brigades AKUT etc. NGOs Ministries Local Administrations	Late Intervention	Theoretical and practical works related to the problem of "Late Intervention" should be made. New mechanisms that will save time and pace the intervention stage should be established. In this sense, new projects that provides solutions should be prepared.
10	**Medium Term (7-36 Months)**	AFAD Directorate AFAD Provincial Directorates Fire Brigades AKUT etc. NGOs Ministries Local Administrations	Integrated Disaster Management System	The understanding of disaster management in Turkey is based upon the Integrated Disaster Management System. There must be new studies regarding the involvement of all actors and processes of the applications that is based upon to this infrastructure. Especially local resources, neighborhood units, volunteer mechanisms should be integrated to AYDES Disaster Management Systems.
11	**Medium Term (7-36 Months)**	AFAD Directorate AFAD Provincial Directorates Fire Brigades AKUT etc. NGOs Ministries Local Administrations	Interoperability With International SAR Teams	New protocols should be prepared within the framework of INSARAG and international cooperation all around the world, by embracing the problems related to cooperation of previous disasters. The numbers of practices should be increased regarding the application of those protocols. Standard plans related to the arrival, employment, transportation and coordinations of foreign intervention teams who will arrive to Turkey right after great scale disasters should be prepared.
12	**Medium Term (7-36 Months)**	AFAD Directorate Ministries AKUT etc. NGOs AFAD Provincial Directorates	AYDES With Search Planning &Tracking Functions	Organization of search and rescue teams, search planning and tracking functions should be added to AYDES modules. Parts related to search and rescue teams on AYDES should be enriched. Preparation of teams, tools and devices of use, trainings, assignments, and specialties should be shared with AFAD Provincial Directorates and private NGOs on the AYDES modules.

Table 65 (continued)

13	**Medium Term (7-36 Months)**	AFAD Directorate Ministries AKUT etc. NGOs AFAD Provincial Directorates	Situational Awareness by Public	Big scale disasters that happened in Turkey had some influences on increasing the situational awareness and sensitivities over public. However, in time, those sensitivities decreased along with the awareness rates. Whereas this subject is accepted clearly and cannot be seen as a debate topic. There must be new projects related to increase the awareness of public related to disasters. Especially, new studies that are related to utilization of local information and people resources should be made. Neighborhood Volunteer System should be put into practice and invigorated for Turkey in general.
14	**Long Term (36+ Months)**	AFAD Directorate Ministries	Disaster Management Information Systems	Disaster management information system substructure should be prepared on the basis of provinces. Local knowledge related to disasters should be gathered, prepared and shared. Disaster Management Information System projects in R&D works within TUBITAK should be supported.
15	**Long Term (36+ Months)**	AFAD Directorate Ministries TÜBİTAK	R&D Efforts	Disaster Management Systems should be added and supported to the primary fields of R&D works within TUBITAK. These systems should focus on the search and rescue processes.
16	**Long Term (36+ Months)**	AFAD Directorate Ministries AKUT etc. NGOs AFAD Provincial Directorates Local Administrations	AYDES With Local Information Source Integration	Especially in AYDES Disaster Management and Decision Support System which is executed should be able to create an integration of local information related to search and rescue activities. Integration of AYDES with neighborhood units, municipalities and NGOs for access and utilization of local information by volunteers as well as expert teams in particular. There must be authorization for local users.
17	**Long Term (36+ Months)**	AFAD Directorate Ministries AKUT etc. NGOs AFAD Provincial Directorates Local Administrations	Smart Diaster Management at Smart Cities	Smart Cities concept is emerging into our lives swiftly. One of the main fields of this concept is related to the tools regarding the increasing the situational awareness, guidance and information sharing tools, and the tools that provides a quick informing after the social events. Resources of information technologies should be provided to the usage of Smart Disaster Management for rescuing more lives. In this sense, new research & development works should be conducted. New project should be prepared for creating an increase of the speed for the intervention stage. New Smart Home Tools should be developed for organization of local information resources and volunteers. Information sharing mechanisms in neighborhoods should be established.

6.2.2. Threats to Intervention Stage of Disaster Management

This part is related with constraints, threats, dependencies, inadequacies, and other critical aspects that requires work which take place at disaster management.

Disasters are the events that come to the forefront with their unexpected nature which causes great chaos, and with the immense effects that damage the social order. From the nature of the globe that we live on to malevolent actions of people, there are many reasons of disasters. Interruption of socio-economical life and disruptions of social life can cause after-effects as well. Even though the inevitable nature of the disaster had and acceptance from the life, works that are made especially during the preparation and an effective intervention help people to go back to their lives by diminishing the effects of the chaos. There are many studies that are conducted in Turkey from 1999 earthquake to now. Especially, the situation that emerged after the Syrian crisis, the biggest migration wave and refugee influx caused to make Turkey to have some measurements for this technological disaster which burst in an unusual way that other countries are not familiar, as well. For the threats, constraints, dependencies, inadequacies, and other critical aspects that requires work that emerge during preparation stages of both natural disasters and technological disasters, there must be new efforts. There are a route map and suggestions that address to second horizontal axis of this thesis project, as below.

Table 66 Suggestions Regarding To Threats to Intervention Stage of Disaster Management

No.	Term	Responsible Unit / Initiative / Sub Units	Main Topic	Suggestions in Detail
1	**Short Term (0-6 Months)**	AFAD Directorate AKUT etc. NGOs Local Administrations	Local First Responders	People who create the local power that provides first respond and support the local activities for disasters should be organized, trained and informed. Volunteering mechanisms should be strengthened. The existing Neighborhood Disaster Volunteers (MAG) organizations should be enriched.
2	**Short Term (0-6 Months)**	AFAD Directorate	Local First Responders	Projects related to speed the search and rescue activities up should be supported with R&D budgets. Basic tools and equipments to be used in search and rescue activities should be stored to distribution to the people as fast as possible.
3	**Medium Term (7-36 Months)**	Local Administrations	SAR Plans & Practices For Critical Infrastructures Like Airports	Measurements should be taken to increase the volunteering, situational awareness, search and rescue especially at airports and malls in Turkey. Information screens of these places should be able to work in disaster mode. Early warning systems' controlling and development in the fields like shopping malls, stadiums and theaters that creates dense traffic for people in megalopolis against the high technological disaster risk should be made.

Table 66 (continued)

4	**Medium Term (7-36 Months)**	TÜBİTAK Directorate	Research & Development of SAR Tools & Techniques	Research and development projects regarding to enrichment of tools and systems that are used for search and rescue activities in Turkey should be started. For this cause, Disaster Management subjects especially, the projects that are related to information technologies along with robotic Technologies, should be added to Priority Areas under the presidency of TUBITAK TEYDEB. Investments related to Internet of Things (IoT) and smart cities should be developed as well as the robotic systems and sensor technologies for disaster management.
5	**Medium Term (7-36 Months)**	AFAD Directorate Ministries AKUT etc. NGOs AFAD Provincial Directorates Local Administrations	Mutual Working & Synchronization	There is a need for coordination and synchronization of almost all units for search and rescue activities. In existing systems, communication and synchronization between the units are being conducted very slowly. During the preparation stage, these units should make search and rescue preparations with mutual practices and drills. Work mechanisms for disaster mode should be conducted for local, regional and national scale. Information sharing with search and rescue expert institutions in Turkey and abroad, mutual drills and experience sharing mechanisms should be developed. Coordination points with partners in the country related to the logistics, coordination and planning in search and rescue development for disasters should be enhanced. Planning abilities to use the international intervention abilities effectively should be developed.

Table 66 (continued)

6	**Medium Term (7-36 Months)**	AFAD Directorate Ministry of Education AKUT etc. NGOs AFAD Provincial Directorates Local Administrations	Situational Awareness at All Levels	In the high schools, situational awareness should be increased by focusing on volunteering for search and rescue activities. Information screens that show the importance of first 72 Golden Hours of disasters should be kept updated consistently. Works and studies related to create resources and raising the awareness of the public should be concentrated on.
7	**Long Term (36+ Months)**	AFAD Directorate Ministries AKUT etc. NGOs AFAD Provincial Directorates Local Administrations	Long Term Training	Training, drill and planning of conducted activities during intervention stage should be enriched. There must be participation of volunteers that are trained by AFAD as well. The participation of local governments should be ensured. Trainings related to the coordination of fire department and AFAD units should be planned especially.
8	**Long Term (36+ Months)**	Ministry of Energy Local Administrations Ministry of Family, Labor and Social Services	New SAR Systems to Especially High Risk Work Fields Like Mines	Lessons should be taken from Soma disaster in our country and new systems that provides early warning, alarm, search and rescue in high risk work fields in each provinces should be configured and projectized. Disaster management systems that can use the mobile technologies and communication substructure advantages should be established.

6.2.3. Search & Rescue Supporting Infrastructure

This part is related with common infrastructure that is in use during search and rescue stages of disaster management, institutional infrastructures, important aspects that affects the processes, the aspects which are expected to be ready before disaster for disaster management, etc.

When we examine the statistics of disasters that cause casualties and loss of property in Turkey for last 60 years, 62% of damage is occurred due to the earthquakes (Limoncu & Bayülgen, 2005). Therefore, when disasters are discussed, earthquake comes at first place in Turkey.

Especially, after the great scale disasters, psycho-social effects can be seen on people (Arslan, 2009). At the stage of “courage” right after the disasters, people who are affected by the disaster, volunteer to save survivors under wreckage. People who survived and volunteered for rescuing other survivors under wreckage right after the disaster and before the professional teams’ arrival to the disaster area carry a great importance.

Wrong and incomplete actions after earthquakes that happened in near past were too many. After 1999 Marmara Earthquake, a part of foreign intervention teams that arrived to Turkey were obliged to leave the country due to the lack of organizations. The other parts of disaster management processes are excluded from this research, and the suggestions related to disaster management systems, specific to search and rescue are listed below.

In this horizontal axis, infrastructural aspects that support search and rescue activities are evaluated, and suggestions regarding to these aspects are prepared. At the base of problems and deficiencies that are exposed in literature, there are infrastructural troubles. The only aim of the race against the time right after the disaster is related to rescuing more lives and returning the lives back in order. The efficiency of these activities are directly bonded to infrastructural preparations before the disasters. In this chapter, the suggestions that are made for detected aspects during this thesis.

Table 67 Suggestions Regarding To Search & Rescue Supporting Infrastructure

No.	Term	Responsible Unit / Initiative / Sub Units	Main Topic	Suggestions in Detail
1	**Short Term (0-6 Months)**	AFAD Directorate	SAR Tools & Systems	Basic tools that can be easy to use by everyone which can make light searches should be developed. These tools should be distributed by the volunteers and necessary trainings should be given. First intervention trainings related to search and rescue actions in great scale disasters should be increased in every level (Arslan, 2009). Neighborhood volunteering works should continue.
2	**Short Term (0-6 Months)**	AFAD Directorate AFAD Provincial Directorates	SAR Tools & Systems	Trainings related to light searches should be increased. Developing drills and scenarios should be executed continuously. Simple search tools should be developed to support these trainings.
3	**Medium Term (7-36 Months)**	AFAD Directorate GSM Operators	Mobile Infrastructure	GSM infrastructure of Turkey is in a more advance level than other countries' infrastructure. There are mobile base stations (such as Dronecell) to use for the period of time to retrieve the infrastructure to its regular order after the disaster. The other operators should develop similar projects for this purpose. GSM infrastructures are providing serious benefits to search and rescue activities after disaster.

Table 67 (continued)

4	**Medium Term (7-36 Months)**	AFAD Directorate Ministry of Justice	Early Detection & Localization	The similar project to the one in this thesis should be made by using RFID technology. Also search and rescue priorities should be made by using tags for people who should be kept in closed areas. Abilities of Disaster Management Information Systems such as AYDES, OKS, AKFEN, and EYDAS should be increased. There should be an integrated structure with local applications. Volunteers and NGOs should be able to use specific modules.
5	**Medium Term (7-36 Months)**	AFAD Directorate Ministry of Education AKUT etc. NGOs AFAD Provincial Directorates Local Administrations	Cooperation & Coordination	Coordination and cooperation channels should be increased for intervention teams. Along with the intstitution based developing activities, cooperation with NGOs and volunteering organizations should be executed. Authority confusion and frictions may occur between official and private intervention teams during disasters. There should be a new structure which allows the official and private intervention teams' cooperation with a task sharing nature. Province based applications such as mobile disaster application by Istanbul Province Directorate in 2014 should be rendered to use nationwide.
6	**Medium Term (7-36 Months)**	AFAD Directorate	AFAD Information & Communication Systems	Communication infrastructure that AFAD created for nationwide is in an advance level and being used actively. There must be an integration of neighborhood units and volunteer systems to this system. Systems that can speed up and make the search and rescue activities easy should be provided as well as the data structures with data transfer mechanisms.

Table 67 (continued)

7	**Medium Term (7-36 Months)**	AFAD Directorate Ministry of Education AKUT etc. NGOs AFAD Provincial Directorates Local Administrations	Better Logistic Support	Logistics is an important infrastructure. It is an invariable part and factor of disaster management. All enhancements related to the usage of logistic systems in disaster management are directly affecting the efficiency of search and rescue activities. There must be enriched studies regarding the gathering, distribution of materials, arrivals, alimentations and sheltering of search and rescue units (official and volunteering). Even though its nature of not being striking and not sudden, there should be organizational structures for refugee problems. In disaster management, strategic documents should be produced for refugees. Objectives should be determined.
8	**Long Term (36+ Months)**	AFAD Directorate TURKSAT Satellite Corp.	Satellite Support	There must be transition preparations to disaster modes that provides broadband satellite broadcasting, sound and data services that supports the search and rescue activities should be made with the coordination of TÜRKSAT Corp. and AFAD.
9	**Long Term (36+ Months)**	AFAD Directorate AKUT etc. NGOs AFAD Provincial Directorates Local Administrations	Disaster Management Support System Including Victim Detection Projects	New evaluations for Disaster Management Mechanisms before the establishment of AFAD in 2009 in Turkey should be made and necessary lessons should be learned. Awareness of the people should be raised regarding the past experiences and training scopes for institutions should be prepared.

6.2.4. Tools & Techniques of Intervention Process

This part is related with tools, devices and materials, technologies, systems, operations, and general usages of search and rescue stages of disaster management.

According to the gathered data in this thesis and the opinions of the experts, it is clearly seen that the levels of tools and devices that are used in search and rescue activities in Turkey are in basic level. When it is considered that AFAD is established in 2009, the institution itself established its restructuring fully, and conducted the stages of preparation and execution of strategic projects in 10 years. In these 10 years, AFAD, naturally faced many disasters. When AFAD was working on the improvements of its systems for just 2 years, the institution had to face Syrian crisis. Refugee influx caused more damage than many natural disasters and affected the structure of social lives. The scope of the troubles of the refugee influx had more extensive effects than disasters. In this case, AFAD had to channel the biggest part of its resources to this crisis. This situation is a fact in Turkey. Without recognizing the Syrian crisis, it will not be correct to evaluate the search and rescue activities and systems of AFAD. In the light of this information, it is also clear that having more effectiveness, rapidness and coordination of search and rescue activities that are being conducted against the time during intervention stages after disasters. When the tools and systems that are used by the search and rescue teams are evaluated, it can be seen that units can only conduct basic search and rescue activities with existed equipment. Especially, when the survivor detection under the wreckage is evaluated, the main method can be seen as the utilization of the dogs. Hence, under the light of improvements of informatics technologies, the effect of efficiency improvement of the usage of new technologies along with conventional search techniques, especially informatics-based technological tools and systems is the main hypothesis of this thesis. As a result of the studies that are conducted with the experts, this hypotheses is supported. In this chapter, suggestions related to search and rescue systems for the sake of this goal are listed.

Table 68 Suggestions Regarding To Tools & Techniques of Intervention Process

No.	Term	Responsible Unit / Initiative / Sub Units	Main Topic	Suggestions in Detail
1	**Short Term (0-6 Months)**	AFAD Directorate	Basic Tools For Volunteers	Basic tools that can be easy to use by everyone which can make light searches should be developed. These tools should be distributed by the volunteers and necessary trainings should be given. These tools should be stocked at disaster gathering zones that are defined by the municipalities and kept ready for usage during disasters.
2	**Medium Term (7-36 Months)**	Neighborhood Administrations Local Administrations	Projects/Systems That Can Ease The Reach to The Survivors	Electronic recordings of building population should be updated and completed. Electronic records of people who live in the building that are kept in municipalities should be updated and completed.
3	**Medium Term (7-36 Months)**	AFAD Directorate	Data Gathering & Recognition	There must be a Victim Information System application that can provide simple usage by the actors for information gathering during search and rescue activities. This system should be integrated on AYDES.
4	**Medium Term (7-36 Months)**	AFAD Directorate	Situational Awareness	A Tool Management application should be made to provide the following tools and systems, resource allocation and management of disaster area. The situational awareness should be increased by providing information of placements of tools and systems that are needed to volunteers and search and management units in disaster area.

Table 68 (continued)

5	**Medium Term (7-36 Months)**	AFAD Directorate	Light, Mobile Devices At SAR	All of the tools and systems developed for search and rescue should be compatible with mobile systems. These tools should be used without assembled with power tools and devices.
6	**Medium Term (7-36 Months)**	Neighborhood Administrations Local Administrations	Projects/Systems That Can Ease The Reach to The Survivors	Systems that can share the existed information of people who reside in damaged buildings during disasters with search and rescue teams should be developed.
7	**Long Term (36+ Months)**	Neighborhood Administrations Local Administrations Fire Brigages AFAD Provincial Directorates	Neighborhood Disaster Databases	A database that include the information of the people in the buildings in the neighborhoods to share with assigned teams through neighborhood administrations during disasters should be developed.
8	**Long Term (36+ Months)**	TÜBİTAK Directorate	Projects/Systems That Can Ease The Reach to The Survivors SAR Robotics Projects	Systems that expediting gathering information of victim such as the application of this thesis should be designed and supported primarily by the Research and Development contributions. Robotic systems should take the primary place for these designs. Providing the security of search and rescue teams should also be aimed for.
9	**Long Term (36+ Months)**	Neighborhood Administrations Local Administrations	Disaster Informing Screens	Big screens that are being used for advertisements and information in neighborhoods and towns should be able to work under Disaster Mode in cases of disasters. Guidance messages that are prepared before should be broadcasted on these screens.

Table 68 (continued)

10	**Long Term (36+ Months)**	AFAD Directorate TÜBİTAK Directorate	RFID Detection Tools	In the application chapter of this thesis, a research based on Wi-Fi technologies is made. Projects and simple tools that use RFID technologies which are used commonly for the same goal should also be produced.

6.3. Future Work

Search and rescue process is a complicated process with many different actors and variables even though it is a little part of the disaster management. In this process, there is a need for research and examination for every aspects of the increasing of efficiency.

In the studies of developing, these researches and studies that are conducted until today should not be seen enough; new research subjects like gathering data from different sensors and providing developed systems to help search and rescue teams with meaningful results should be taken into consideration.

At the new researches that will be developed after this project, reformed prototype tool will be able to select the different signals, also will be able to detect the survivors under wreckage with the valid information related to survivor by the identification of survivor with T.R. Identity number. Another subject which is related to the search and rescue teams' efforts to find the continuous signal of the tool that survivors carry even though the survivor is no longer alive. This situation will cause the search and rescue teams to reach alive disaster victims by misleading them. When these subjects are taken into consideration, new configurations that can provide a disconnection of the signal when there is no pulse or body temperature (when the victim is no longer alive) may be executed. When the battery life of the device is taken into consideration, to increase the lifetime of the battery, the signal from the device can be given periodically. New studies related to reduce the signal transmittance period and increasing the battery duration may be executed.

Also, there is a need for increasing the studies related to finding a solution and validation for other aspects that affect the search and rescue activities.

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APPENDICES

APPENDIX A: Interview Questions

Item No	Meeting Statement / Survey Question / Question of Debate	Explanation
1	I participated / have experience in search and rescue activities even for just once.	1st Group
2	Do you have technical training and skills for search and rescue activities? / I am.	1st Group
3	Do you think that your training that you received for your work assignment is enough to save lives? / I do.	1st Group
4	Are there training and individual development opportunities provided for your work related to search and rescue in the unit that you work) / There are.	1st Group
5	Do you think that tools and equipment in your unit are efficient enough? / I do.	1st Group
6	Do you think that you act according to a well-organized plan for search and rescue activities? / I do.	1st Group
7	Are you taking advantage of the best technological opportunities for search activities under wreckage? / I do.	1st Group
8	Do you believe that more lives can be saved with the effective usage of technology in search and rescue activities? / I do.	1st Group
9	Time is crucial for search and rescue activities. / It is crucial.	1st Group
10	Training is crucial for search and rescue activities. / It is crucial.	1st Group
11	Existence of volunteers is crucial for search and rescue activities. / It is crucial.	1st Group
12	Materials are crucial for search and rescue activities. / They are crucial.	1st Group
13	Do you think that the existed technical devices are efficient enough for determining rescuing strategies and fast decision making in after natural disasters and destructions? / I do.	2nd Group
14	Large number of search teams is crucial for search and rescue teams. / It is crucial.	2nd Group
15	Do you think that technical tools are effective enough to reduce the time loss during search and rescue activities? / I do.	2nd Group
16	Do you think that your success rate can be increased with technical support in search and rescue activities? / I do.	2nd Group

17	Does a system that can provides information (help signal) from disaster victims under wreckage during search and rescue make your work easier? / It does.	2^{nd} Group
18	Does the detection of help signal from disaster victims by the tablet PCs during search and rescue activities affect the works in a positive way? / It does.	2^{nd} Group
19	Do you think that explorations of the teams in disaster locations can be analyzed better with the help signals from disaster victims? / I do	2^{nd} Group
20	Search activities in search and rescue works are crucial.	2^{nd} Group
21	Rescue activities in search and rescue works are crucial.	2^{nd} Group
22	Is it possible to reach more victims in a shorter duration thanks to the help signals from disaster victims? / It is.	2^{nd} Group
23	Do you believe that thanks to the help signals from disaster victims under wreckage in disaster locations, teams can be organized more effectively? / I do.	2^{nd} Group
24	The most efficient method in search and rescue activities are canine search.	2^{nd} Group
25	Do you think that using mobile tools and software during search and rescue activities under wreckage can increase the efficiency? / I do	3^{rd} Group
26	Do you think there is a delay and malfunction in supply chain during search and rescue activities after disaster, in the current situation? / I do	3^{rd} Group
27	There is no need for information systems in search and rescue activities. Do you think the classical methods are efficient enough? / They are.	3^{rd} Group
28	Is there a frequent change in duties and assignments related to disasters of the local administrations, in the scope of regulation and institutional changes for after disasters? / There is.	3^{rd} Group
29	Do you believe that group work, coordination and efficient communication can increase the success rate in search and rescue activities? /I do believe.	3^{rd} Group

APPENDIX B: Interview Answers

Transmittance of Help Signals from Disaster Victims to Rescue Teams with Wireless Technologies in Disaster and Emergency Management – Interview Practice

Q. No.	Statement	I ABSOLUTELY do not Agree	I Do not Agree	Neutral	I Agree	I ABSOLUTELY Agree
1	I participated / have experience in search and rescue activities even for just once.	**0**	**0**	**0**	**2**	**30**
2	I have the technical training and skills for search and rescue activities.	**0**	**0**	**0**	**23**	**9**
3	I think that my training that I received for my work assignment is enough to save lives.	**0**	**0**	**0**	**23**	**9**
4	There are training, and individual development opportunities provided for my work related to search and rescue in the unit that I work.	**0**	**0**	**0**	**6**	**26**
5	I think that tools and equipment in my unit are efficient enough.	**0**	**0**	**4**	**8**	**20**
6	I think that we act according to a well-organized plan for search and rescue activities.	**0**	**0**	**2**	**9**	**21**
7	We are taking advantage of the best technological opportunities for search activities under wreckage.	**0**	**0**	**6**	**15**	**11**
8	I believe that more lives can be saved with the effective usage of technology in search and rescue activities.	**0**	**0**	**0**	**6**	**26**
9	Time is crucial for search and rescue activities. / It is crucial.	**0**	**0**	**0**	**6**	**26**

10	Training is crucial for search and rescue activities. / It is crucial.	**0**	**0**	**0**	**12**	**20**
11	Existence of volunteers is crucial for search and rescue activities. / It is crucial.	**0**	**0**	**0**	**15**	**17**
12	Materials are crucial for search and rescue activities. / They are crucial.	**0**	**0**	**5**	**18**	**9**
13	I think that the existed technical devices are efficient enough for determining better rescuing strategies and fast decision making in after natural disaster.	**0**	**0**	**0**	**24**	**8**
14	Large number of search teams is crucial for search and rescue teams. / It is crucial.	**0**	**0**	**5**	**20**	**7**
15	I think that technical tools are effective devices enough to reduce the time loss during search and rescue activities.	**0**	**0**	**3**	**7**	**22**
16	I think that my success rate can be increased with technical support in search and rescue.	**0**	**0**	**3**	**11**	**18**
17	A system that can provides information (help signal) from disaster victims under wreckage during search and rescue make our work easier.	**0**	**0**	**0**	**3**	**29**
18	The detection of help signals from disaster victims by the tablet PCs during search and rescue activities affect our works in a positive way.	**0**	**0**	**3**	**7**	**22**
19	I think that explorations of the teams in disaster locations can be analyzed better with the help signals from disaster victims.	**0**	**0**	**0**	**11**	**21**
20	Search activities in search and rescue works are crucial.	**0**	**0**	**0**	**5**	**27**
21	Rescue activities in search and rescue works are crucial.	**0**	**0**	**0**	**6**	**26**
22	It is possible for us to reach more victims in a shorter duration thanks to the help signals from disaster victims.	**0**	**0**	**3**	**6**	**23**
23	I believe that thanks to the help signals from disaster victims under wreckage in disaster locations, our teams can be organized more effectively.	**0**	**0**	**4**	**15**	**13**
24	The most efficient method in search and rescue activities are canine search.	**0**	**0**	**2**	**12**	**18**
25	I think that using mobile tools and software during search and rescue activities under wreckage can increase our efficiency.	**0**	**0**	**6**	**4**	**22**

26	I do not think there is a delay and malfunction in supply chain during search and rescue activities after disaster, in the current situation.	**0**	**3**	**17**	**8**	**4**
27	There is no need for information systems in search and rescue activities. Existed classical methods are efficient.	**18**	**10**	**2**	**1**	**0**
28	There is a frequent change in duties and assignments related to disasters of the local administrations, in the scope of regulation and institutional changes for after disasters.	**0**	**0**	**19**	**9**	**4**
29	I believe that group work, coordination and efficient communication can increase the success rate in search and rescue.	**0**	**0**	**0**	**1**	**31**

APPENDIX C: Problem, Hyphothesis and Sub-Questions

Problem Statement

It is possible to reduce the time for search and rescue and to reach to the information regarding survivor under wreckage and create more efficient rescue activity by using a information technology based equipment during intervention stage of disaster management.

Hyphothesis

H_1: Reducing the time to reach to the information status regarding survivor under wreckage increases the efficiency of SAR Teams for search and rescue.

H_2: Using IT Based equipment in search and rescue teams during rescue operations, creates more efficient rescue activity in disaster management at search and rescue activities.

Sub-Questions

Question No.1 Is there any meaningful relation between people who answered “important, very important” to the statement of “Technological Efficiency of Materials” and people who answered “important, very important” to the statement of “Speed of Rescue from Wreckage Activities”?

Table 69 Question No 1. Chi-Square Test Results

Pearson Chi-Square Tests		
		Q4.g. Speed of Rescue from Wreckage Activities
Q4.e. Technological Efficiency of Materials	Chi-square	,525
	df	1
	Sig.	,469
*. The Chi-square statistic is significant at the ,05 level.		

At the end of the SPSS Chi-Square test, sig. value is 0,469. Since because Sig. $p=0{,}469>0{,}05$, it is accepted. There is a meaningful relation between people who answered “important, very important” to the statement of “Technological Efficiency of Materials” and people who answered “important, very important” to the statement of “Speed of Rescue from Wreckage Activities” and there is a statistic significance.

Question No.2 Is there any meaningful relation between people who answered “important, very important” to the statement of “Validity of Information Related to Survivor under Wreckage” and people who answered “important, very important” to the statement of “Technological Efficiency of Materials”?

Table 70 Question No.2 Chi-Square Test Results

Pearson Chi-Square Tests		
		Q4.g. Speed of Rescue from Wreckage Activities
Q5.ğ. Validation of Information Related to Survivor under Wreckage	Chi-square	6,385
	df	1
	Sig.	,072*
Results are based on nonempty rows and columns in each innermost subtable.		
*. The Chi-square statistic is significant at the ,05 level.		

At the end of the SPSS Chi-Square test, sig. value is 0,072. Since because Sig. p=0,072>0,05, it is accepted. There is a meaningful relation between people who answered “important, very important” to the statement of “Validity of Information Related to Survivor under Wreckage” and people who answered “important, very important” to the statement of “Technological Efficiency of Materials” and there is a statistic significance.

Question No.3 Is there any meaningful relation between people who answered “important, very important” to the statement of “Speed of Rescue from Wreckage Activities” and people who evaluated the existed technologies that are used in search and rescue activities as “non-sufficient”?

Table 71 Question No.3 Chi-Square Test Results

Pearson Chi-Square Tests		
		Q4.g. Speed of Rescue from Wreckage Activities
Q12. How do you describe the sufficiency of existed technologies in use of search and rescue activities?	Chi-square	3,695
	df	2
	Sig.	,158
*. The Chi-square statistic is significant at the ,05 level.		

At the end of the SPSS Chi-Square test, sig. value is 0,158. Since because Sig. p=0,158>0,05, it is is accepted. There is a meaningful relation between people who answered “important, very important” to the statement of “Speed of Rescue from Wreckage Activities” and people who evaluated the existed technologies that are used in search and rescue activities as “non-sufficient” and there is a statistic significance.

Question No.4 Is there any meaningful relation between people who answered “important, very important” to the statement of “Existence of Information of Survivor under Wreckage” and people who answered “important, very important” to the statement of “The Usage of Technological based Tools for Detection of Survivors”?

Table 72 Question No.4 Chi-Square Test Results

Pearson Chi-Square Tests		
		Q16.a. Existence of Information of Survivor under Wreckage
Q16.d. The Usage of Technological based Tools for Detection of Survivors	Chi-square	1,610
	df	1
	Sig.	,204
*. The Chi-square statistic is significant at the ,05 level.		

At the end of the SPSS Chi-Square test, sig. value is 0,204. Since because Sig. p=0,204>0,05, it is is accepted. There is a meaningful relation between people who answered “important, very important” to the statement of “Existence of Information of Survivor under Wreckage” and people who answered “important, very important” to the statement of “The Usage of Technological based Tools for Detection of Survivors” and there is a statistic significance.

Question No.5 Is there any meaningful relation between people who answered “important, very important” to the statement of “Certainty of the Survivor Information” and people who stated that technologies are sufficient/insufficient in Q17?

According to the SPSS Z-Test results:

There is a meaningful difference with 95% confidence interval between the people who answered with “Important + Very Important” and with “Not Important + Not Important at all” to Q16 and “N/A or Insufficient” for Seismic Apparatus.

There is a meaningful difference with 95% confidence interval between the people who answered with “Important + Very Important” and with Not Important + Not Important at all” to Q16 and “N/A or Insufficient” for Megaphones.

There is a meaningful difference with 95% confidence interval between the people who answered with “Important + Very Important” and with Not Important + Not Important at all” to Q16 and “N/A or Insufficient” for Cable/Wireless Information Technologies.

There is a meaningful difference with 95% confidence interval between the people who answered with “Important + Very Important” and with Not Important + Not Important at all” to Q16 and “N/A or Insufficient” for Wearable Technologies.

There is a meaningful difference with 95% confidence interval between the people who answered with “Important + Very Important” and with Not Important + Not Important at all” to Q16 and “N/A or Insufficient” for Search and Rescue Robots.

There is a meaningful difference with 95% confidence interval between the people who answered with “Important + Very Important” and with Not Important + Not Important at all” to Q16 and “N/A or Insufficient” for GPS Global Positioning Systems.

Table 73 Question No.5 Comparison Results

Comparisons of Column Proportions[a]			
		S16 - Certainty of the Survivor Information	
		Not Important + Not Important at all	Important + Very Important
		(A)	(B)
Q17 - Seismometer	Sufficient / Need to be developed		
	N/A / Insufficient	B	
Q17 - Wreckage Listening Tools	Sufficient / Need to be developed		
	N/A / Insufficient		
Q17 - Megaphones	Sufficient / Need to be developed		A
	N/A / Insufficient	B	
Q17 - Scrapers (Pickaxe, Shovel, Rope, Sledge, Pulleys, etc.)	Sufficient / Need to be developed		
	N/A / Insufficient		
Q17 - Dogs	Sufficient / Need to be developed		
	N/A / Insufficient		
Q17 - Cable / Wireless Information Technology	Sufficient / Need to be developed		A
	N/A / Insufficient	B	
Q17 - Mobile Technologies	Sufficient / Need to be developed		
	N/A / Insufficient		
Q17 - Usage of Data Fusion Techniques	Sufficient / Need to be developed		
	N/A / Insufficient		
Q17 - Wearable Technologies	Sufficient / Need to be developed		
	N/A / Insufficient	B	
Q17 - Search and Rescue Robots	Sufficient / Need to be developed	B	
	N/A / Insufficient		A

Table 73 (continued)

Q17 - Information Systems Software	Sufficient / Need to be developed		
	N/A / Insufficient		
Q17 - Geographical Information System Applications	Sufficient / Need to be developed		
	N/A / Insufficient		
Q17 - Communication Technologies	Sufficient / Need to be developed		
	N/A / Insufficient		
Q17 - GPS Global Positioning Systems	Sufficient / Need to be developed		
	N/A / Insufficient	B	

Question No.6 Can the change of existed tools and devices in search and rescue actions with information technological based modern tools enhance the search and rescue processes?

Table 74 Question No.18 Results

Q18. How does the change of existed tools and devices in search and rescue actions with information technological based modern tools affect the search and rescue processes?	**D1. Gender?**				**Total**	
	Female		**Male**			
	n	**%**	**n**	**%**	**n**	**%**
Absolutely Make it Worse	0	0,0%	0	0,0%	0	0,0%
Make it Worse	0	0,0%	2	0,8%	2	0,8%
Will not Affect	0	0,0%	0	0,0%	0	0,0%

Enhance	6	66,7%	57	23,6%	63	25,1%
Absolutely Enhance	3	33,3%	183	75,6%	186	74,1%

The answer of "Enhances + Absolutely Enhances" to this question is given with 99,2%.

Question No.7: Can the change/support of existed tools and devices in search and rescue actions with information technological based modern tools enhance the detection of survivors under wreckage?

The answer of "Enhances + Absolutely Enhances" to this question is given with 96,9%.

Table 75 Question No.19 Results

Q19. Can the change or support of existed tools and devices in search and rescue actions with information technological based modern tools enhance the detection of survivors under wreckage?	**D1. Gender**				**Total**	
	Female		**Male**			
	n	**%**	**n**	**%**	**n**	**%**
Absolutely Make it Worse	0	0,0%	0	0,0%	0	0,0%
Make it Worse	0	0,0%	4	1,7%	4	1,6%
Will not Affect	2	22,2%	1	0,4%	3	1,2%
Enhance	4	44,4%	61	25,2%	65	25,9%
Absolutely Enhance	3	33,3%	176	72,7%	179	71,3%

APPENDIX D: Survey and Results

Survey

A Survey of the Analysis on The Tools & Techniques of Search and Rescue Operations at Disaster Management in Turkey	Survey No :	
	Check	
	Coding Control	
	Data Control	

Responder Name & Surname (Optional): ______________________________

Adress: ______________________________

____

Telephone No: (__________) ______________________________ Date: __________

E-Mail: ______________________________@______________

Giriş

We're conducting research on the tools and techniques of search and rescue operations at disaster management. We'd love to hear from you about especially the effects of the time of reaching victim status under the wreckage and the techological attitude of you to the tools and techniques. This will help us make improvements to the existing tool and prioritize new features. The survey should only take 5 minutes, and your responses are completely anonymous.
You can only take the survey once, but you can edit your responses until the survey is closed on May 28, 2014. Questions marked with an asterisk (*) are required.
We really appreciate your input!

****** Please give your answers checking the appropriate answer in the box.***

Demographical Questions

D1. Your gender?

Woman	
Man	

D2. Your age ?: ________

D3. What is your educational status?

Middle School Graduate	
High School Graduate	
Associate Degree Graduate	
Bachelor’s Degree Graduate	
Post Graduate	
Other (Please indicate)	

D4. Last School You Graduated From.

School Name:	
Department:	

D5. Please mark the Search and Rescue organization that you've worked most recently.

AFAD Central Quarters	
AFAD Field Services	
AKUT etc. NGOs	
Never worked with Search and Rescue Organizations	
None	
Other *(Please indicate)*	

D6. Which AFAD directorate do you work under?

AFAD Field Service (AFAD Provincial Directorates)	
Planning Directorate	
Intervention Directorate	
Recovery Directorate	
Civil Defense Directorate	
Earthquake Directorate	
Information Systems and Communication Directorate	
Strategy Development Directorate	
Other *(Please indicate)*	

D7. How long did you work in this organization? **Year:** _____________

D8. When you consider the quality of your assignment and your responsibilities, which category fit you most?

Search and Rescue Missions	
Planning and Administrative Duties	
Technical Services	
Administrative Assignments	
Other	

Technical Part Questions

Q1. Did you participate in search and rescue actions actively?

Yes	
No	

Q2. Please check the trainings you took for search and rescue.

Basic Telecommunications Training	

Wreckage Informatics/Database Trainings	
Evacuation from Wreckage	
First Aid Training	
Search Training with Classical Approach	
Search and Rescue at Mines Training	
Search and Rescue Training on Mountains/Out of City	
Planning and Staff Training	
Administrative Training	
Other Search and Rescue Trainings	

Q3. Please put the search and rescue action phases in order, according to their importance level. *(1 Point is the MOST IMPORTANT, 7 Points is LEAST IMPORTANT)*

Statement	**Point**
Information Gathering of Location and Structures Before the Search	
Closing open valves and securing the wreckage	
Rough Surface Scanning, Superficial Wreckage Search	
Research of All Space, Detailed Wreckage Research	
Reaching to the information of survivors within 10 Minutes	
Creating an Access Way to Survivor	
Continuing the Research until there is no dead or alive left under the wreckage	

Q4. Please mark each search and rescue components according to their importance level.

	1- Not Important At All	**2-** Not Important	**3-** Wont Affect	**4-** Important	**5-** Most Important
Time					
Trained Search Teams					
Reaching to the information of survivor within 10 Minutes					
Existence of Support Team and Volunteers					
Conducting the Wreckage Search Activities with Technological Tools					
Technological Competency of Tools					
Technological Sufficiency of Tools for Activities					
The Pace of Rescuing Actions from Wreckage					
Accuracy of Survivor Information					

Q5. What is the importance of the phrases, when you consider the survivor "Search and Rescue Activities" under wreckage?

	1- Not Important At All	**2-** Not Important	**3-** Wont Affect	**4-** Important	**5-** Most Important
Early/Fast Transportation with Vehicles to the Location					
Wreckage Construction Features					
Rescue Teams with Knowledge of Disaster Zone / Building					
Reaching to the information of survivor within 10 Minutes					
Sufficient Number of Technical Devices					
Interfering with Trained Teams					
Overload of Trained Search Teams					
Accuracy of and Confirmed Survivor Information under Wreckage					
Sufficient Number of Wreckage Search Methods					
Features of Wrecked Building					

Q6. According to your experiences, how would you divide 100 points to Search and Rescue works' importance?

Search	%______
Rescue	%______

Q7. When you consider your experiences in search and rescue in general, how would you divide 100 points to the time that is spent to search and rescue activities?

Search	%______
Rescue	%______

Q8. What is the crucial point of a successful search and rescue activity?

Q9. Please mark the technical/systems/tools or devices that you used for search and rescue under wreckage

Search and Rescue Decision Support Systems	
Search Dog Under Wreck	
Survivor Listening Tools under Wreck	
Survivor Scanning Tools Under Wreck	
Remote Search Robots	
Mobile Phone With SAR Application	
Wireless Hardwares (Tablets, laptops except phones)	
Geographical Information Systems	
Sensor Systems	
Facebook/Twitter (Social Networks)	
Detection Radar	
Wearable Computer	
Diğer (Lütfen belirtiniz.)	

Q10. According to your experiences, please put the search and rescue methods in order from the weakest to the strongest.

	1- Weakest	**2-** Weak	**3-** Medium	**4-** Powerful	**5-** Most Powerful
Search and Rescue Decision Support Systems					
Search Dog Under Wreck					
Survivor Listening Tools under Wreck					
Survivor Scanning Tools Under Wreck					
Remote Search Robots					
Mobile Phone With SAR Application					
Wireless Hardwares (Tablets, laptops except phones)					
Geographical Information Systems					
Sensor Systems					
Facebook/Twitter (Social Networks)					
Detection Radar					
Wearable Computer					

Q11. Please put the wreckage construction type in order from the MOST EFFECTIVE TO SAVE A SURVIVOR to LEAST EFFECTIVE in search and rescue methods after your consideration of the evaluation of existed technical for each type of wreckage construction. (1 IS THE MOST SUCCESSFUL, 5 IS THE WEAKEST)

Construction Type	**Order**
Ferro-Concrete	
Masonry	
Wooden	
Steel	

Q12. How do you describe the evaluation of effectiveness of existed technologies in search and rescue activities?

Very Effective	
Effective	
Moderately Effective	
Not Effective	
Not Effective At All	

Q13. What are the situations that existed technologies are effective?

Our country has a strong search and rescue organizations	
Search and rescue tools are very powerful at our organization	
Search and rescue system is the one with informatics based automatic system	
Searching and rescuing the alive underground does not require highly technological gadgets	
Natural disasters rarely happen in our country, therefore existing technologies are sufficient.	
Only few people can be rescued from under wreckage, existing technologies are sufficient.	

Q14. What are the situations that existed technologies are not effective?

Turkey search and rescue organizations are not strong enough.	
Search and Rescue Tools are not powerful at our organization	
Search and rescue system is not supported by information systems	
Searching and rescuing the alive underground requires highly technological gadgets	
Natural disasters oftenly happen in our country, in addition to this existing technologies are not sufficient.	
A lot of people can be rescued from under wreckage, if the existing technologies are sufficient	

Q15. Please put an "X" to the options regarding to existed technological features of tools that are used in general search and rescue actions which are effective, after you consider your experiences.

Features of Existing Tools	**1-** I Absolutely Not Agree	**2-** Not Agree	**3-** Uncertain	**4-** I Agree	**5-** I Absolutely Agree

Search and rescue activity tools are expensive					
Tools are in use are imported					
It is hard to supply of tools are in use.					
There are no domestic tools or domestic tools are of poor quality					
Trusting to domestic tools are difficult					
There are no sufficient or expert personnel for tool maintenance.					

Q16. If you give an importance level degree to the all factors below, how would you consider?

	1- Not Importan t At All	**2-** Not Importan t	**3-** Wont Affect	**4-** Importan t	**5-** Most Importan t
The existence of information regarding survivors under wreckage					
The fast pace of reaching the information of survivors					
Information of the numbers of survivors under wreckage					
Territorial Ground Structure					
Survivor Detection Tools with Technological ground					
Search Method in Use					
Experience of Search Teams					
Number/Density of Search and Rescue Teams					
Certainty of Survivor Information					
Content/Details of Survivor Information					

Q17. Could you indicate the sufficiency levels of techniques/tools and devices of search and rescue activities suggested below?

Techniques / Tools	Not Applicable/ Not Sufficient	Enough/ Needs Development
Seismometer		
Survivor Listening Tools under Wreck		
Megaphones		
Digging Tools		
Dogs		
Wired/Wireless Information Systems		
Mobile Technologies		

Data Fusion		
Wearable Technologies		
Search and Rescue Robots		
Information Systems Softwares		
Geographical Information Systems		
Communitcation Technologies		
GPS		

Q18. How would the changing the existed tools and devices with modern tools of informatics effect the search and rescue phases?

It absolutely enhance them	
Enhance	
Wont Affect	
Deteriorates	
It absolutely deteriorates	

Q19. Does changing the tools and devices in existed phases with more informatic tools and devices provide a progress regarding the detection of survivors under wreckage in those existed phases?

It absolutely enhance them	
Enhance	
Wont Affect	
Deteriorates	
It absolutely deteriorates	

***** Thank you *****

Survey Results

The number of the participants to our study is 251. A great majority of the participants are male. 96,4& Male and 3,6% Female participants are questioned (Table 30).

Table 30 Gender Distribution

D1. Gender	n	%
Female	9	3,6
Male	242	96,4
Total	251	100,0

Average age of the participants is 36,8. Average age of female participants is 27,2 and male participants is 37,1 (Figure 23).

Table 31 Average Ages According to Gender

	D1. Gender		
	Female	Male	Total
D2. Average Age	27,2	37,1	36,8

Youngest participant is 25 years old, meanwhile eldest is recorded as 48 years old. The standard deviation of the age variant is seen as sd= 5,835.

Table 32 Age Distribution

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
D2	251	0	251	22,000	48,000	36,761	5,835

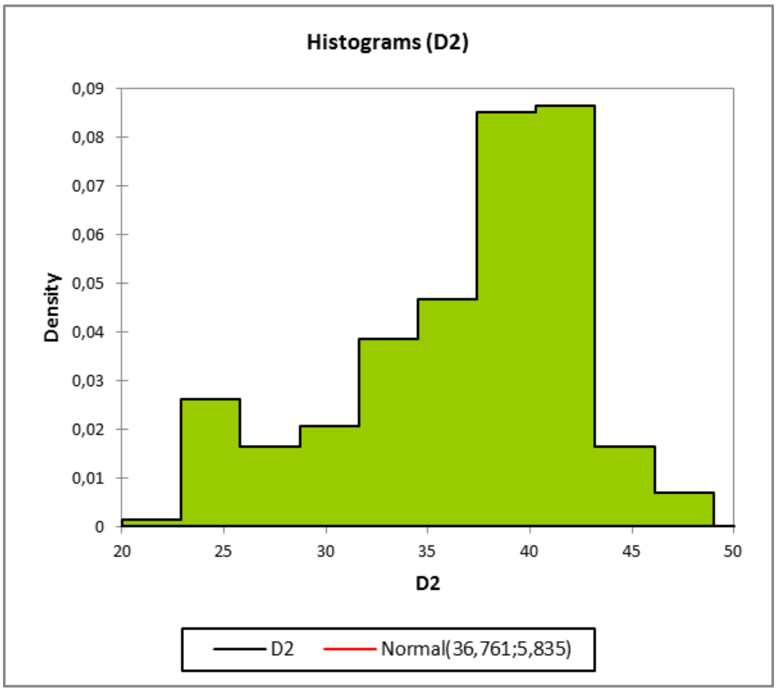

Figure 23 Age Distribution

When the educational attainment of the participants observed, it is clear to see a 73,3% of bachelor's degree in total. 18,3% of associate degree and 4,8% of high school degree can be seen (Appendix D, Table 33).

Table 33 Educational Attainment

D.3. What is your educational status?	D1. Gender				Total	
	Female		Male			
	n	%	n	%	n	%
Middle School Graduate	0	0,0%	2	0,8%	2	0,8%
High School Graduate	1	11,1%	11	4,5%	12	4,8%
Associate Degree Graduate	0	0,0%	46	19,0%	46	18,3%
Bachelor's Degree Graduate	8	88,9%	176	72,7%	184	73,3%
Post Graduate	0	0,0%	7	2,9%	7	2,8%

A great majority of the participants with 45,8% are graduated from Anadolu University with a formal education. Afterwards, 14,3% of participants are graduated from Anadolu University Distance Education; 10,8% of participants are graduated from Gazi University, and 8% of participants from Vocational High Schools (Table 34).

Table 34 Alma Mater

D.4. Last School You Graduated From	D1. Gender				Total	
	Female		Male			
	n	%	n	%	n	%
Anadolu University Formal Education	0	0,0%	115	47,5%	115	45,8%
Anadolu University Distance Education	3	33,3%	33	13,6%	36	14,3%
Afyon Kocatepe Uni.	0	0,0%	13	5,4%	13	5,2%

Table 34 (continued)

Ankara Uni.	0	0,0%	6	2,5%	6	2,4%
Bilkent Uni.	0	0,0%	1	,4%	1	0,4%
Celal Bayar Uni.	0	0,0%	2	,8%	2	0,8%
Çukurova Uni.	0	0,0%	1	,4%	1	0,4%
Industrial Vocational High School	1	11,1%	4	1,7%	5	2,0%
Osmangazi Uni.	0	0,0%	3	1,2%	3	1,2%
Gazi Uni.	3	33,3%	24	9,9%	27	10,8%
Hacettepe Uni.	0	0,0%	7	2,9%	7	2,8%
High School	0	0,0%	3	1,2%	3	1,2%
Karabük Uni.	0	0,0%	1	,4%	1	0,4%
Kocaeli Uni.	1	11,1%	1	,4%	2	0,8%
Vocational High School	0	0,0%	20	8,3%	20	8,0%
METU	0	0,0%	3	1,2%	3	1,2%
Sakarya Uni	0	0,0%	1	,4%	1	0,4%
Selçuk Uni.	0	0,0%	1	,4%	1	0,4%
Süleyman Demirel Uni.	0	0,0%	2	,8%	2	0,8%
Trakya Uni.	0	0,0%	1	,4%	1	0,4%
Yıldız Technical Uni.	1	11,1%	0	0,0%	1	0,4%

Another demographic variable that is asked to be determined by the participants' latest relation with search and rescue organizations; and 94% of the participants worked with AFAD field service, 3,2% with AFAD central quarters,0,8% with NGOs like AKUT/Kimse Yok mu etc., and 0,8% with Fire Authorities. 1,2% of the participants specified that they did not work with any organizations for search and rescue (Table 35).

Table 35 Participants' Organizations

D5. Please mark the Search and Rescue organization that you've worked most recently.	D1. Gender				Total	
	Female		Male			
	n	%	n	%	n	%
AFAD Central Quarters	0	0,0%	8	3,3%	8	3,2%
AFAD Field Services	6	66,7%	230	95,0%	236	94,0%
AKUT etc. NGOs	0	0,0%	2	0,8%	2	0,8%
Never worked with Search and Rescue Organizations	3	33,3%	0	0,0%	3	1,2%
Fire Authority	0	0,0%	2	0,8%	2	0,8%

At the D6 question which specifies the which directorate under AFAD did the participants worked, 93,6% of the participants marked AFAD Field Service (AFAD Provincial Directorates) (Table 36).

It is stated that the total period of work time in this organization is 10,7 years. Female participants have the average of 2,2 years, meanwhile male participants have 11 years (Table 37).

Table 36 Units of AFAD Workers

D6. Which AFAD directorate do you work under?	D1. Gender				Total	
	Female		Male			
	n	%	n	%	n	%
AFAD Field Service (AFAD Provincial Directorates)	4	44,4%	231	95,5%	235	93,6%
Information Systems and Communication Directorate	2	22,2%	0	0,0%	2	0,8%
Earthquake Directorate	0	0,0%	1	0,4%	1	0,4%
Recovery Directorate	0	0,0%	2	0,8%	2	0,8%
Intervention Directorate	0	0,0%	2	0,8%	2	0,8%
Civil Defense Directorate	0	0,0%	1	0,4%	1	0,4%
Strategy Development Directorate	0	0,0%	1	0,4%	1	0,4%
Other	3	33,3%	4	1,7%	7	2,8%

Table 37 Working Periods According to Gender

	D1. Gender		**Total**
	Female	**Male**	
	n	**n**	**n**
D7. How long did you work in this organization?	2,2	11,0	10,7

The last demographic variable of our study is related to the participants' assignments in the organizations and which category they fall under. In total, 90,8% of the participants worked under "Search and Rescue Mission", 3,2% worked under

“Planning and Administrative Duties” and “Technical Services”, 2% worked under “Administration Assignments”, and 0,8% worked under “Other” category (Appendix D, Table 38)

Table 38 Work Distribution

D8. When you consider the quality of your assignment and your responsibilities, which category fit you most?	D1. Gender				Total	
	Female		Male			
	n	%	n	%	n	%
Search and Rescue Missions	3	33,3%	225	93,0%	228	90,8%
Planning and Administrative Duties	3	33,3%	5	2,1%	8	3,2%
Technical Services	3	33,3%	5	2,1%	8	3,2%
Administrative Assignments	0	0,0%	5	2,1%	5	2,0%
Other	0	0,0%	2	0,8%	2	0,8%

At the end of the reliability analysis which is conducted without the multi answers, mean values of variables of the analysis (Mean), Standard Deviation (SD) and Prevalent Total Participant Number (N) SPSS results are used and given in the Table 40.

Table 40 Technical Part Questions Article Distribution

	Mean	SD	N
Q1. Did you participate in search and rescue actions actively?	1,05	,222	251
Q3. 1. Row	3,29	2,081	251
Q3. 2. Row	3,62	1,843	251
Q3. 3. Row	3,82	1,752	251
Q3. 4. Row	3,96	1,481	251
Q3. 5. Row	4,15	1,685	251
Q3. 6. Row	4,29	2,170	251
Q3. 7. Row	4,88	2,451	251
Q4. Time	4,78	,535	251
Q4. Trained Researchers	4,75	,489	251
Q4. Volunteered Teams / Individuals	4,42	,883	251
Q4. Technological Efficiency of Materials	3,61	,847	251
Q4. Suitability of Materials	4,31	,625	251
Q4. Pace of Search and Rescue Activities	4,36	,579	251
Q4. Briefness of Reaching to Survivor Information	4,35	,668	251
Q4. Pace of Rescue from Wreckage Activities	4,37	,792	251
Q4. Validation of Survivor Information	4,48	,665	251
Q5. Early / Fast Transportation to the Location with Vehicles	4,71	,601	251
Q5. Building Structure Features of the Wreckage	4,09	,759	251

Table 40 (continued)

Q5. Well Informed Teams About Disaster Location/Building	4,02	,764	251
Q5. Brief Time under 10 minutes for Reaching to Survivor Information under Wreckage	4,40	,872	251
Q5. Efficiency of Technical Equipment	4,51	,568	251
Q5. Intervention with Trained Team	4,67	,548	251
Q5. High Number of Search Teams	3,65	1,006	251
Q5. Validation of Information Related to Survivor under Wreckage	4,31	,643	251
Q5. High Number of Wreckage Search Techniques	3,82	,913	251
Q5. Features of Wreckage Soil Structure	3,66	,826	251
Q6. SEARCH Points	53,61	11,691	251
Q6. RESCUE Points	46,39	11,691	251
Q7. SEARCH Points	42,78	16,123	251
Q7. RESCUE Point	57,22	16,123	251
Q10. Wreckage Search Determination Support Systems / Software	2,83	1,015	251
Q10. Wreckage Search Dogs	3,63	1,092	251
Q10. Sound Locator under Wreckage	3,96	,816	251
Q10. Imaging Device under Wreckage	3,76	1,014	251
Q10. Remote Controlled Search Robots	3,16	1,213	251
Q10. Mobile Phones with Special Search Application	2,97	,923	251
Q10. Wireless Tools (Tablets, Computers, Special Hardware except Mobile Phones)	3,08	,849	251

Table 40 (continued)

Q10. Geographic Information Systems	3,26	,863	251
Q10. Sensor Systems	3,67	,847	251
Q10. Social Networks like Facebook /Twitter	1,66	,886	251
Q10. Survivor Detection Radars	3,55	,951	251
Q10. Vests with Wearable Computer	2,90	,878	251
Q11. Success rating according to the results of search and rescue activities in types of buildings - 1st ROW	1,55	,868	251
Q11. Success rating according to the results of search and rescue activities in types of buildings - 2nd ROW	2,36	,894	251
Q11. Success rating according to the results of search and rescue activities in types of buildings - 3rd ROW	2,55	,738	251
Q11. Success rating according to the results of search and rescue activities in types of buildings - 4th ROW	3,55	,938	251
Q.12. How do you evaluate the efficiency of existed search and rescue technologies?	3,10	,963	251
Q15. Materials that are used to search and rescue are very expensive.	3,75	1,297	251
Q15 - Materials that are used are coming from abroad.	4,35	,787	251
Q15. Supplying these materials that are used is difficult.	3,15	1,207	251
Q15. There are no local materials or local materials are not with high quality.	3,22	1,118	251
Q15. Domestic product is not reliable.	3,12	1,036	251
Q15. There are not enough number of sufficient and experienced personnel for material maintenance.	3,22	1,154	251
S16. Existence of Information of Survivor under Wreckage	4,59	,540	251
Q16. Briefness of the Rime to Reach to the Survivor Information	4,64	,506	251
Q16. Knowing the Number of Survivors under Wreckage	4,19	,727	251
Q16. Regional Soil Structure	3,64	,789	251

Table 40 (continued)

S16. The Usage of Technological based Tools for Detection of Survivors	4,19	,701	251
S16. Existed Search Method	4,23	,641	251
Q16. Experiences of Search and Rescue Teams	4,52	,689	251
Q16. Number/Density of Search and Rescue Teams	3,67	,888	251
Q16. Validity of Survivor Information	4,36	,639	251
Q16. Content / Details of Survivor Information	4,01	,839	251
Q18. How does the change of existed tools and devices in search and rescue actions with information technological based modern tools affect the search and rescue processes?	4,73	,498	251
Q19. Can the change/support of existed tools and devices in search and rescue actions with information technological based modern tools enhance the detection of survivors under wreckage?	4,67	,585	251

Q1. Did you participate in search and rescue actions actively?

Table 41 Q1. Answers

Q1. Did you participate in search and rescue actions actively?		
	n	%
Yes	238	94,8
No	13	5,2
Total	251	100,0

Q2. Please check the trainings you took for search and rescue.

Table 42 Q2. Answers

Q2. Please check the trainings you took for search and rescue.	D1. Gender?				Total	
	Women		Men			
	n	%	n	%	n	%
Basic Telecommunications Training	1	4,5%	116	11,2%	117	11,0%
Wreckage Informatics/Database Trainings	1	4,5%	76	7,3%	77	7,3%
Evacuation from Wreckage	3	13,6%	167	16,1%	170	16,1%
First Aid Training	4	18,2%	220	21,2%	224	21,2%
Search Training with Classical Approach	5	22,7%	166	16,0%	171	16,1%
Search and Rescue at Mines Training	1	4,5%	13	1,3%	14	1,3%
Search and Rescue Training on Mountains/Out of City	4	18,2%	161	15,5%	165	15,6%
Planning and Staff Training	2	9,1%	35	3,4%	37	3,5%
Administrative Training	1	4,5%	26	2,5%	27	2,5%
Other Search and Rescue Trainings	0	0,0%	57	5,5%	57	5,4%

Q3. Please put the search and rescue action phases in order, according to their importance level.

Table 43 Search and Rescue Action Phases

Line	Statement	D1. Gender?					
		Women		Men		Total	
		n	%	n	%	n	%

Table 43 (continued)

Q.3 Order 1	Information Gathering of Location and Structures Before the Search	3	33,3%	79	32,6%	82	32,7%
	Closing open valves and securing the wreckage	2	22,2%	22	9,1%	24	9,6%
	Rough Surface Scanning, Superficial Wreckage Search	2	22,2%	38	15,7%	40	15,9%
	Research of All Space, Detailed Wreckage Research	0	0,0%	9	3,7%	9	3,6%
	Reaching to the information of survivors within 10 Minutes	2	22,2%	60	24,8%	62	24,7%
	Creating an Access Way to Survivor	0	0,0%	7	2,9%	7	2,8%
	Continuing the Research until there is no dead or alive left under the wreckage	0	0,0%	27	11,2%	27	10,8%
Q.3 Order 2	Information Gathering of Location and Structures Before the Search	2	22,2%	35	14,5%	37	14,7%
	Closing open valves and securing the wreckage	2	22,2%	53	21,9%	55	21,9%
	Rough Surface Scanning, Superficial Wreckage Search	3	33,3%	34	14,0%	37	14,7%
	Research of All Space, Detailed Wreckage Research	0	0,0%	15	6,2%	15	6,0%
	Reaching to the information of survivors within 10 Minutes	1	11,1%	63	26,0%	64	25,5%
	Creating an Access Way to Survivor	1	11,1%	30	12,4%	31	12,4%
	Continuing the Research until there is no dead or alive left under the wreckage	0	0,0%	12	5,0%	12	4,8%
Q.3 Order 3	Information Gathering of Location and Structures Before the Search	4	44,4%	26	10,7%	30	12,0%
	Closing open valves and securing the wreckage	0	0,0%	34	14,0%	34	13,5%
	Rough Surface Scanning, Superficial Wreckage Search	1	11,1%	49	20,2%	50	19,9%
	Research of All Space, Detailed Wreckage Research	2	22,2%	38	15,7%	40	15,9%
	Reaching to the information of survivors within 10 Minutes	2	22,2%	44	18,2%	46	18,3%
	Creating an Access Way to Survivor	0	0,0%	37	15,3%	37	14,7%

Table 43 (continued)

	Continuing the Research until there is no dead or alive left under the wreckage	0	0,0%	14	5,8%	14	5,6%
Q.3 Order 4	Information Gathering of Location and Structures Before the Search	0	0,0%	18	7,4%	18	7,2%
	Closing open valves and securing the wreckage	0	0,0%	23	9,5%	23	9,2%
	Rough Surface Scanning, Superficial Wreckage Search	2	22,2%	46	19,0%	48	19,1%
	Research of All Space, Detailed Wreckage Research	3	33,3%	70	28,9%	73	29,1%
	Reaching to the information of survivors within 10 Minutes	2	22,2%	46	19,0%	48	19,1%
	Creating an Access Way to Survivor	2	22,2%	32	13,2%	34	13,5%
	Continuing the Research until there is no dead or alive left under the wreckage	0	0,0%	7	2,9%	7	2,8%
Q.3 Order 5	Information Gathering of Location and Structures Before the Search	0	0,0%	14	5,8%	14	5,6%
	Closing open valves and securing the wreckage	2	22,2%	27	11,2%	29	11,6%
	Rough Surface Scanning, Superficial Wreckage Search	0	0,0%	47	19,4%	47	18,7%
	Research of All Space, Detailed Wreckage Research	1	11,1%	72	29,8%	73	29,1%
	Reaching to the information of survivors within 10 Minutes	1	11,1%	16	6,6%	17	6,8%
	Creating an Access Way to Survivor	2	22,2%	44	18,2%	46	18,3%
	Continuing the Research until there is no dead or alive left under the wreckage	3	33,3%	22	9,1%	25	10,0%
Q.3 Order 6	Information Gathering of Location and Structures Before the Search	0	0,0%	33	13,6%	33	13,1%
	Closing open valves and securing the wreckage	3	33,3%	51	21,1%	54	21,5%
	Rough Surface Scanning, Superficial Wreckage Search	0	0,0%	6	2,5%	6	2,4%
	Research of All Space, Detailed Wreckage Research	2	22,2%	28	11,6%	30	12,0%
	Reaching to the information of survivors within 10 Minutes	1	11,1%	10	4,1%	11	4,4%

Table 43 (continued)

	Creating an Access Way to Survivor	0	0,0%	77	31,8%	77	30,7%
	Continuing the Research until there is no dead or alive left under the wreckage	3	33,3%	37	15,3%	40	15,9%
Q.3 Order 7	Information Gathering of Location and Structures Before the Search	0	0,0%	37	15,3%	37	14,7%
	Closing open valves and securing the wreckage	0	0,0%	32	13,2%	32	12,7%
	Rough Surface Scanning, Superficial Wreckage Search	1	11,1%	22	9,1%	23	9,2%
	Research of All Space, Detailed Wreckage Research	1	11,1%	10	4,1%	11	4,4%
	Reaching to the information of survivors within 10 Minutes	0	0,0%	3	1,2%	3	1,2%
	Creating an Access Way to Survivor	4	44,4%	15	6,2%	19	7,6%
	Continuing the Research until there is no dead or alive left under the wreckage	3	33,3%	123	50,8%	126	50,2%

Table 44 Index of Ordered Statements

Information Gathering of Location and Structures Before the Search	16,5%
Closing open valves and securing the wreckage	14,0%
Rough Surface Scanning, Superficial Wreckage Search	15,9%
Research of All Space, Detailed Wreckage Research	13,3%
Reaching to the information of survivors within 10 Minutes	18,7%
Creating an Access Way to Survivor	12,3%
Continuing the Research until there is no dead or alive left under the wreckage	9,1%

In the Index calculation, statistical proportional alterations of observation values show differences according to the time and location. At the end of index calculation of concatenated statements, the statement with 18,7% which includes “Reaching to the information of survivor within 10 Minutes” takes the first place. The other statements are included with their order below.

Q4. Please mark each search and rescue components according to their importance level.

Table 45 *Search and Rescue Components*

Line	Statement	D1. Gender?						Group Total
		Women		Man		Total		
		n	%	n	%	n	%	
Q.4. Time	Not Important At All	2	22,2 %	0	0,0%	2	0,8%	0,8%
	Not Important	0	0,0%	0	0,0%	0	0,0%	
	Wont Affect	0	0,0%	2	0,8%	2	0,8%	0,8%
	Important	1	11,1 %	43	17,8 %	44	17,5 %	98,4%
	Most Important	6	66,7 %	197	81,4 %	203	80,9 %	
Q4. Trained Search Teams	Not Important At All	0	0,0%	0	0,0%	0	0,0%	0,8%
	Not Important	2	22,2 %	0	0,0%	2	0,8%	
	Wont Affect	0	0,0%	0	0,0%	0	0,0%	0,0%
	Important	0	0,0%	58	24,0 %	58	23,1 %	99,2%
	Most Important	7	77,8 %	184	76,0 %	191	76,1 %	

Table 45 (continued)

Q4. Reaching to the information of survivor within 10 Minutes	Not Important At All	0	0,0%	6	2,5%	6	2,4%	4,4%
	Not Important	2	22,2 %	3	1,22 %	5	2,0%	
	Wont Affect	1	11,1 %	15	6,2%	16	6,4%	6,4%
	Important	4	44,4 %	71	29,3 %	75	29,9 %	89,2%
	Most Important	2	22,2 %	147	60,7 %	149	59,4 %	
Q4. Existence of Support Team and Volunteers	Not Important At All	0	0,0%	2	0,8%	2	0,8% +-	9.2%
	Not Important	2	22,2 %	19	7.9%	21	8.4%	
	Wont Affect	4	44.4 %	78	32.2 %	82	32.7	32.7%
	Important	3	33,3 %	110	45,5 %	113	45,0 %	58,2%
	Most Important	0	0,0%	33	13,6 %	33	13,1 %	
Q4. Conducting the Wreckage Search Activities with Technological Tools	Not Important At All	0	0,0%	0	0,0%	0	0.0%	1.6%
	Not Important	2	22,2 %	2	0.8%	4	1,6%	
	Wont Affect	0	0,0%	10	4,1%	10	4,0%	4,0%
	Important	3	33,3 %	138	57,0 %	141	56,2 %	94,4%
	Most Important	4	44,4 %	92	38,0 %	96	38,2 %	
Q4. Technological Competency of Tools	Not Important At All	0	0,0%	0	0,0%	0	0,0%	0,8%
	Not Important	2	22,2 %	0	0,0%	2	0,8%	
	Wont Affect	0	0,0%	7	2,9%	7	2,8%	2,8%
	Important	6	66,7 %	135	55,8 %	141	56,2 %	96,4%
	Most Important	1	11,1 %	100	41,3 %	101	40,2 %	

Table 45 (continued)

Q4. Technological Sufficiency of Tools for Activities	Not Important At All	0	0,0%	0	0,0%	0	0,0%	0,8%
	Not Important	2	22,2%	0	0,0%	2	0,8%	
	Wont Affect	0	0,0%	21	8,7%	21	8,4%	8,4%
	Important	3	33,3%	111	45,9%	114	45,4%	90,8%
	Most Important	4	44,4%	110	45,5%	114	45,5%	
Q4. The Pace of Rescuing Actions from Wreckage	Not Important At All	1	11,1%	0	0,0%	1	0,4%	4,0%
	Not Important	2	22,2%	7	2,9%	9	3,6%	
	Wont Affect	0	0,0%	16	6,6%	16	6,4%	6,4%
	Important	0	0,0%	94	38,8%	94	37,5%	89,6%
	Most Important	6	66,7%	125	51,7%	131	52,2%	
Q4. Accuracy of Survivor Information	Not Important At All	0	0,0%	0	0,0%	0	0,0%	2,0%
	Not Important	2	22,2%	3	1,2%	5	2,0%	
	Wont Affect	0	0,0%	9	3,7%	9	3,6%	3,6%
	Important	2	22,2%	95	39,3%	97	38,6%	94,4%
	Most Important	5	55,6%	135	55,8%	140	55,8%	

Q5. What is the importance of the phrases, when you consider the survivor "Search and Rescue Activities" under wreckage?

Table 46 Important Statements at Search And Rescue

Line	Statement	D1. Gender?						Group Total
		Women		Man		Total		
		n	%	n	%	n	%	
Q5. Early/Fast Transportation with Vehicles to the Location	Not Important At All	2	22,2 %	0	0,0%	2	0,8%	0,8%
	Not Important	0	0,0%	0	0,0%	0	0,0%	
	Wont Affect	0	0,0%	7	2,9%	7	2,8%	2,8%
	Important	2	22,2 %	50	20,7 %	52	20,7 %	96,4%
	Most Important	5	55,6 %	185	76,4 %	190	75,7 %	
Q5. Wreckage Construction Features	Not Important At All	2	22,2 %	0	0,0%	2	0,8%	1,2%
	Not Important	0	0,0%	1	0,4%	1	0,4%	
	Wont Affect	0	0,0%	47	19,4 %	47	18,7 %	18,7%
	Important	4	44,4 %	120	49,6 %	124	49,4 %	80,1%
	Most Important	3	33,3 %	74	30,6 %	77	30,7 %	
Q5. Rescue Teams with Knowledge of Disaster Zone / Building	Not Important At All	0	0,0%	1	0,4%	1	0,4%	2,0%
	Not Important	3	33,3 %	1	0,4%	4	1,6%	
	Wont Affect	2	22,2 %	50	20,7 %	52	20,7 %	20,7%
	Important	3	33,3 %	122	50,4 %	125	49,8 %	77,3%
	Most Important	1	11,1 %	68	28,1 %	69	27,5 %	

Table 46 (continued)

Q5. Reaching to the information of survivor within 10 Minutes	Not Important At All	0	0,0%	6	2,5%	6	2,4%	4,0%
	Not Important	2	22,2 %	2	0,8%	4	1,6%	
	Wont Affect	1	11,1 %	16	6,6%	17	6,8%	6,8%
	Important	1	11,1 %	80	33,1 %	81	32,3 %	89,2%
	Most Important	5	55,6 %	138	57,0 %	143	57,0 %	
Q5. Sufficient Number of Technical Devices	Not Important At All	0	0,0%	0	0,0%	0	0,0%	0,8%
	Not Important	2	22,2 %	0	0,0%	2	0,8%	
	Wont Affect	1	11,1 %	2	,8%	3	1,2%	1,2%
	Important	4	44,4 %	106	43,8 %	110	43,8 %	98,0%
	Most Important	2	22,2 %	134	55,4 %	136	54,2 %	
Q5. Interfering with Trained Teams	Not Important At All	0	0,0%	0	0,0%	0	0,0%	0,8%
	Not Important	2	22,2 %	0	0,0%	2	0,8%	
	Wont Affect	0	0,0%	4	1,7%	4	1,6%	1,6%
	Important	4	44,4 %	64	26,4 %	68	27,1 %	97,6%
	Most Important	3	33,3 %	174	71,9 %	177	70,5 %	
Q5. Overload of Trained Search Teams	Not Important At All	0	0,0%	2	0,8%	2	0,8%	13,1%
	Not Important	2	22,2 %	29	12,0 %	31	12,4 %	
	Wont Affect	0	0,0%	80	33,1 %	80	31,9 %	31,9%
	Important	5	55,6 %	72	29,8 %	77	30,7 %	55,0%
	Most Important	2	22,2 %	59	24,4 %	61	24,3 %	

Table 46 (continued)

Q5. Accuracy of and Confirmed Survivor Information under Wreckage	Not Important At All	0	0,0%	0	0,0%	0	0,0%	1,6%
	Not Important	2	22,2 %	2	0,8%	4	1,6%	
	Wont Affect	0	0,0%	13	5,4%	13	5,2%	5,2%
	Important	3	33,3 %	133	55,0 %	136	54,2 %	93,2%
	Most Important	4	44,4 %	94	38,8 %	98	39,0 %	
Q5. Sufficient Number of Wreckage Search Methods	Not Important At All	0	0,0%	0	0,0%	0	0,0%	10,4%
	Not Important	2	22,2 %	24	9,9%	26	10,4 %	
	Wont Affect	0	0,0%	52	21,5 %	52	20,7 %	20,7%
	Important	4	44,4 %	109	45,0 %	113	45,0 %	68,9%
	Most Important	3	33,3 %	57	23,6 %	60	23,9 %	
Q5. Features of Wrecked Building	Not Important At All	0	0,0%	1	0,4%	1	0,4%	6,0%
	Not Important	2	22,2 %	12	5,0%	14	5,6%	
	Wont Affect	2	22,2 %	93	38,4 %	95	37,8 %	37,8%
	Important	4	44,4 %	97	40,1 %	101	40,2 %	56,2%
	Most Important	1	11,1 %	39	16,1 %	40	15,9 %	

Q6. According to your experiences, how would you divide 100 points to Search and Rescue works' importance?

Table 47 Search and Rescue Works' Importance

	D1. Gender?		Total
	Women	Man	
	%	%	%
Q6. Search	46,7	53,9	53,6
Q6. Rescue	53,3	46,1	46,4

Female participants placed importance to Search activities with 46,7%, meanwhile male participants number is recorded as 53,9%. In total, participation to Search Activities is recorded as 53,6%. Female participants placed importance to Rescue activities with 53,3%, meanwhile male participants number is recorded as 46,1%. In total, participation to Rescue Activities recorded as 46,4%.

Q7. When you consider your experiences in search and rescue in general, how would you divide 100 points to the time that is spent to search and rescue activities?

Table 48 The Time at Search and Rescue

	D1. Gender?		Total
	Women	Man	
	%	%	%
Q6. Search	53,8	42,4	42,8
Q6. Rescue	46,2	57,6	57,2

With this question, the percentage evaluation of time of spared for search and rescue activities is asked. According to the experiences of the participants, the total time ratio for rescue activities is 57,2%, meanwhile the search rescue time is 42,8%.

Q8. What is the crucial point of a successful search and rescue activity?

Table 49 Succesful Search and Rescue

Q8. What is the crucial point of a successful search and rescue activity?	D1. Gender?				Total	
	Women		Man			
	n	%	n	%	n	%
Pace/Speed	2	11,8%	66	9,7%	68	9,8%
Technology	3	17,6%	49	7,2%	52	7,5%
Training	1	5,9%	114	16,8%	115	16,6%
Equipment and Hardware	4	23,5%	173	25,6%	177	25,5%
Organization/Team	1	5,9%	34	5,0%	35	5,0%
Personnel	1	5,9%	82	12,1%	83	12,0%
Security/Consistency	0	0,0%	43	6,4%	43	6,2%
Exercise	3	17,6%	37	5,5%	40	5,8%
Experience	2	11,8%	61	9,0%	63	9,1%
Communication	0	0,0%	7	1,0%	7	1,0%
Silence	0	0,0%	8	1,2%	8	1,2%
Dogs	0	0,0%	3	0,4%	3	0,4%

Q9. Please mark the technical/systems/tools or devices that you used for search and rescue under wreckage.

Table 50 Search and Rescue Tools and Techniques

Q9. Please mark the technical/systems/tools or devices that you used for search and rescue under wreckage.	D1. Gender?				Total	
	Women		Man			
	n	%	n	%	n	%
Search and Rescue Decision Support Systems	2	5,9%	45	5,2%	47	5,2%
Search Dog Under Wreck	5	14,7%	180	20,9%	185	20,6%
Survivor Listening Tools under Wreck	7	20,6%	214	24,8%	221	24,7%
Survivor Scanning Tools Under Wreck	6	17,6%	175	20,3%	181	20,2%
Remote Search Robots	0	0,0%	4	0,5%	4	0,4%
Mobile Phone With SAR Application	5	14,7%	10	1,2%	15	1,7%
Wireless Hardwares (Tablets, laptops except phones)	3	8,8%	14	1,6%	17	1,9%
Geographical Information Systems	2	5,9%	64	7,4%	66	7,4%
Sensor Systems	1	2,9%	122	14,2%	123	13,7%
Facebook/Twitter (Social Networks)	0	0,0%	3	0,3%	3	0,3%
Detection Radar	3	8,8%	26	3,0%	29	3,2%
Wearable Computer	0	0,0%	5	0,6%	5	0,6%

Q10. According to your experiences, please put the search and rescue methods in order from the weakest to the strongest.

Table 51 Search And Rescue Methods

Line	Statement	D1. Gender?						Group Total
		Women		Man		Total		
		n	%	n	%	n	%	
Q10. Search and Rescue Decision Support Systems	Weakest	2	22,2%	30	12,4%	32	12,7%	33,9%
	Weak	2	22,2%	51	21,1%	53	21,1%	
	Medium	4	44,4%	93	38,4%	97	38,6%	38,6%
	Powerful	1	11,1%	63	26,0%	64	25,5%	27,5%
	Most Powerful	0	0,0%	5	2,1%	5	2,0%	
Q10. Search Dog Under Wreck	Weakest	2	22,2%	9	3,7%	11	4,4%	13,9%
	Weak	1	11,1%	23	9,5%	24	9,6%	
	Medium	0	0,0%	74	30,6%	74	29,5%	29,5%
	Powerful	6	66,7%	73	30,2%	79	31,5%	56,6%
	Most Powerful	0	0,0%	63	26,0%	63	25,1%	
Q10. Survivor Listening Tools under Wreck	Weakest	2	22,2%	0	0,0%	2	0,8%	2,8%
	Weak	1	11,1%	4	1,7%	5	2,0%	
	Medium	0	0,0%	62	25,6%	62	24,7%	24,7%
	Powerful	6	66,7%	109	45,0%	115	45,8%	72,5%
	Most Powerful	0	0,0%	67	27,7%	67	26,7%	

Table 51 (continued)

Q10. Survivor Scanning Tools Under Wreck	Weakest	2	22,2%	3	1,2%	5	2,0%	9,6%
	Weak	1	11,1%	18	7,4%	19	7,6%	
	Medium	0	0,0%	78	32,2%	78	31,1%	31,1%
	Powerful	4	44,4%	73	30,2%	77	30,7%	59,4%
	Most Powerful	2	22,2%	70	28,9%	72	28,7%	
Q10. Remote Search Robots	Weakest	3	33,3%	27	11,2%	30	12,0%	27,9%
	Weak	0	0,0%	40	16,5%	40	15,9%	
	Medium	1	11,1%	77	31,8%	78	31,1%	31,1%
	Powerful	4	44,4%	62	25,6%	66	26,3%	41,0%
	Most Powerful	1	11,1%	36	14,9%	37	14,7%	
Q10. Mobile Phone With SAR Application	Weakest	0	0,0%	20	8,3%	20	8,0%	24,3%
	Weak	3	33,3%	38	15,7%	41	16,3%	
	Medium	4	44,4%	121	50,0%	125	49,8%	49,8%
	Powerful	2	22,2%	54	22,3%	56	22,3%	25,9%
	Most Powerful	0	0,0%	9	3,7%	9	3,6%	
Q10. Wireless Hardwares (Tablets, laptops except phones)	Weakest	0	0,0%	12	5,0%	12	4,8%	21,1%
	Weak	4	44,4%	37	15,3%	41	16,3%	
	Medium	1	11,1%	116	47,9%	117	46,6%	46,6%
	Powerful	4	44,4%	73	30,2%	77	30,7%	32,3%
	Most Powerful	0	0,0%	4	1,7%	4	1,6%	

Table 51 (continued)

Q10. Geographical Information Systems	Weakest	0	0,0%	9	3,7%	9	3,6%	16,3%
	Weak	6	66,7 %	26	10,7 %	32	12,7 %	
	Medium	2	22,2 %	103	42,6 %	105	41,8 %	41,8%
	Powerful	1	11,1 %	94	38,8 %	95	37,8 %	41,8%
	Most Powerful	0	0,0%	10	4,1%	10	4,0%	
Q10. Sensor Systems	Weakest	0	0,0%	4	1,7%	4	1,6%	8,4%
	Weak	2	22,2 %	15	6,2%	17	6,8%	
	Medium	7	77,8 %	63	26,0 %	70	27,9 %	27,9%
	Powerful	0	0,0%	127	52,5 %	127	50,6 %	63,7%
	Most Powerful	0	0,0%	33	13,6 %	33	13,1 %	
Q10. Facebook/Twitter (Social Networks)	Weakest	2	22,2 %	138	57,0 %	140	55,8 %	83,7%
	Weak	7	77,8 %	63	26,0 %	70	27,9 %	
	Medium	0	0,0%	28	11,6 %	28	11,2 %	11,2%
	Powerful	0	0,0%	12	5,0%	12	4,8%	5,2%
	Most Powerful	0	0,0%	1	0,4%	1	0,4%	
Q10. Detection Radar	Weakest	0	0,0%	6	2,5%	6	2,4%	12,7%
	Weak	3	33,3 %	23	9,5%	26	10,4 %	
	Medium	2	22,2 %	78	32,2 %	80	31,9 %	31,9%
	Powerful	2	22,2 %	99	40,9 %	101	40,2 %	55,4%
	Most Powerful	2	22,2 %	36	14,9 %	38	15,1 %	

Table 51 (continued)

Q10. Wearable Computer	Weakest	0	0,0%	9	3,7%	9	3,6%	33,1%
	Weak	4	44,4 %	70	28,9 %	74	29,5 %	
	Medium	2	22,2 %	108	44,6 %	110	43,8 %	43,8%
	Powerful	3	33,3 %	46	19,0 %	49	19,5 %	23,1%
	Most Powerful	0	0,0%	9	3,7%	9	3,6%	

Q11. Please put the wreckage construction type in order from the MOST EFFECTIVE TO SAVE A SURVIVOR to LEAST EFFECTIVE in search and rescue methods after your consideration of the evaluation of existed technical for each type of wreckage construction. (1 IS THE MOST SUCCESSFUL, 5 IS THE WEAKEST)

Table 52 Construction Types

Line	Statement	D1. Gender?					
		Women		Man		Total	
		n	%	n	%	n	%
1st	Steel	3	33,3%	161	66,5%	164	65,3%
	Wooden	4	44,4%	46	19,0%	50	19,9%
	Ferro-Concrete	0	0,0%	24	9,9%	24	9,6%
	Masonry	2	22,2%	11	4,5%	13	5,2%

Table 52 (continued)

2nd	Steel	1	11,1%	52	21,5%	53	21,1%
	Wooden	3	33,3%	70	28,9%	73	29,1%
	Ferro-Concrete	4	44,4%	103	42,6%	107	42,6%
	Masonry	1	11,1%	17	7,0%	18	7,2%
3rd	Steel	3	33,3%	7	2,9%	10	4,0%
	Wooden	1	11,1%	120	49,6%	121	48,2%
	Ferro-Concrete	3	33,3%	90	37,2%	93	37,1%
	Masonry	2	22,2%	25	10,3%	27	10,8%
4th	Steel	2	22,2%	22	9,1%	24	9,6%
	Wooden	1	11,1%	6	2,5%	7	2,8%
	Ferro-Concrete	2	22,2%	25	10,3%	27	10,8%
	Masonry	4	44,4%	189	78,1%	193	76,9%

Q12. How do you describe the evaluation of effectiveness of existed technologies in search and rescue activities?

Table 53 Existing Technologies

Q12. How do you describe the evaluation of effectiveness of existed technologies in search and rescue activities?	D1. Gender?				Total	
	Women		Man			
	n	%	n	%	n	%
Not Effective At All	0	0,0%	1	0,4%	1	0,4%

Not Effective	3	33,3%	89	36,8%	92	36,7%
Moderately Effective	3	33,3%	47	19,4%	50	19,9%
Effective	3	33,3%	95	39,3%	98	39,0%
Very Effective	0	0,0%	10	4,1%	10	4,0%

Q13. What are the situations that existed technologies are effective?

Table 54 Effective Sides of Existing Technologies

Q13. What are the situations that existed technologies are effective?	D1. Gender?				Total	
	Women		Man			
	n	%	n	%	n	%
Our country has a strong search and rescue organizations	0	0,0%	74	39,4%	74	38,5%
Search and rescue tools are very powerful at our organization	1	25,0%	54	28,7%	55	28,6%
Search and rescue system is the one with informatics based automatic system	0	0,0%	10	5,3%	10	5,2%
Searching and rescuing the alive underground does not require highly technological gadgets	0	0,0%	22	11,7%	22	11,5%
Natural disasters rarely happen in our country, therefore existing technologies are sufficient.	2	50,0%	11	5,9%	13	6,8%
Only few people can be rescued from under wreckage, existing technologies are sufficient.	1	25,0%	17	9,0%	18	9,4%

Q14. What are the situations that existed technologies are not effective?

Table 55 Not Effective Sides of Existing Technologies

Q14. What are the situations that existed technologies are not effective?	D1. Gender?				Total	
	Women		Man			
	n	%	n	%	n	%
Turkey search and rescue organizations are not strong enough.	2	13,3%	45	12,5%	47	12,5%
Search and Rescue Tools are not powerful at our organization	5	33,3%	53	14,7%	58	15,4%
Search and rescue system is not supported by information systems	2	13,3%	75	20,8%	77	20,5%
Searching and rescuing the alive underground requires highly technological gadgets	2	13,3%	85	23,5%	87	23,1%
Natural disasters oftenly happen in our country, in addition to this existing technologies are not sufficient.	1	6,7%	42	11,6%	43	11,4%
A lot of people can be rescued from under wreckage, if the existing technologies are sufficient	3	20,0%	61	16,9%	64	17,0%

Q15. Please put an "X" to the options regarding to existed technological features of tools that are used in general search and rescue actions which are effective, after you consider your experiences.

Table 56 Features of Existing Tools

Line	Statement	D1. Gender?						Group Total
		Women		Man		Total		
		n	%	n	%	n	%	
Q15 - Search and rescue activity tools are expensive	I Absolutely Not Agree	3	33,3 %	21	8,7%	24	9,6%	21,5%
	Not Agree	0	0,0%	30	12,4 %	30	12,0 %	
	Uncertain	3	33,3 %	12	5,0%	15	6,0%	6,0%
	I Agree	1	11,1 %	96	39,7 %	97	38,6 %	72,5%
	I Absolutely Agree	2	22,2 %	83	34,3 %	85	33,9 %	
Q15 - Tools are in use are imported	I Absolutely Not Agree	0	0,0%	1	0,4%	1	0,4%	3,6%
	Not Agree	2	22,2 %	6	2,5%	8	3,2%	
	Uncertain	2	22,2 %	17	7,0%	19	7,6%	7,6%
	I Agree	4	44,4 %	94	38,8 %	98	39,0 %	88,8%
	I Absolutely Agree	1	11,1 %	124	51,2 %	125	49,8 %	
Q15 - It is hard to supply of tools are in use	I Absolutely Not Agree	0	0,0%	30	12,4 %	30	12,0 %	29,5%
	Not Agree	1	11,1 %	43	17,8 %	44	17,5 %	
	Uncertain	4	44,4 %	63	26,0 %	67	26,7 %	26,7%
	I Agree	3	33,3 %	75	31,0 %	78	31,1 %	43,8%
	I Absolutely Agree	1	11,1 %	31	12,8 %	32	12,7 %	

Table 56 (continued)

Q15 - There are no domestic tools or domestic tools are of poor quality	I Absolutely Not Agree	0	0,0%	14	5,8%	14	5,6%	27,9%
	Not Agree	1	11,1 %	55	22,7 %	56	22,3 %	
	Uncertain	7	77,8 %	73	30,2 %	80	31,9 %	31,9%
	I Agree	0	0,0%	64	26,4 %	64	25,5 %	40,2%
	I Absolutely Agree	1	11,1 %	36	14,9 %	37	14,7 %	
Q15 - Trusting to domestic tools are difficult.	I Absolutely Not Agree	0	0,0%	15	6,2%	15	6,0%	27,9%
	Not Agree	0	0,0%	55	22,7 %	55	21,9 %	
	Uncertain	7	77,8 %	80	33,1 %	87	34,7 %	34,7%
	I Agree	1	11,1 %	72	29,8 %	73	29,1 %	37,5%
	I Absolutely Agree	1	11,1 %	20	8,3%	21	8,4%	
Q15 - There are no sufficient or experiment personnel for tool maintenance.	I Absolutely Not Agree	0	0,0%	24	9,9%	24	9,6%	28,7%
	Not Agree	1	11,1 %	47	19,4 %	48	19,1 %	
	Uncertain	4	44,4 %	49	20,2 %	53	21,1 %	21,1%
	I Agree	4	44,4 %	97	40,1 %	101	40,2 %	50,2%
	I Absolutely Agree	0	0,0%	25	10,3 %	25	10,0 %	

Q16. If you give an importance level degree to the all factors below, how would you consider?

Table 57 Importance Levels

Line	Statement	D1. Gender?						Group Total
		Women		Man		Total		
		n	%	n	%	n	%	
Q16 - The existence of information regarding survivors under wreckage	Not Important At All	0	0,0%	0	0,0%	0	0,0%	0,0%
	Not Important	0	0,0%	0	0,0%	0	0,0%	
	Wont Affect	2	22,2 %	4	1,7%	6	2,4%	2,4%
	Important	4	44,4 %	88	36,4 %	92	36,7 %	97,6%
	Most Important	3	33,3 %	150	62,0 %	153	61,0 %	
Q16 - The fast pace of reaching the information of survivors	Not Important At All	0	0,0%	0	0,0%	0	0,0%	0,0%
	Not Important	0	0,0%	0	0,0%	0	0,0%	
	Wont Affect	2	22,2 %	1	,4%	3	1,2%	1,2%
	Important	1	11,1 %	84	34,7 %	85	33,9 %	98,8%
	Most Important	6	66,7 %	157	64,9 %	163	64,9 %	
Q16 - Information of the numbers of survivors under wreckage	Not Important At All	0	0,0%	0	0,0%	0	0,0%	2,4%
	Not Important	0	0,0%	6	2,5%	6	2,4%	
	Wont Affect	3	33,3 %	26	10,7 %	29	11,6 %	11,6%
	Important	4	44,4 %	124	51,2 %	128	51,0 %	86,1%
	Most Important	2	22,2 %	86	35,5 %	88	35,1 %	

Table 57 (continued)

Q16 - Territorial Ground Structure	Not Important At All	0	0,0%	0	0,0%	0	0,0%	8,4%
	Not Important	1	11,1 %	20	8,3%	21	8,4%	
	Wont Affect	3	33,3 %	73	30,2 %	76	30,3 %	30,3%
	Important	4	44,4 %	122	50,4 %	126	50,2 %	61,4%
	Most Important	1	11,1 %	27	11,2 %	28	11,2 %	
Q16 - Survivor Detection Tools with Technological ground	Not Important At All	0	0,0%	0	0,0%	0	0,0%	2,0%
	Not Important	0	0,0%	5	2,1%	5	2,0%	
	Wont Affect	2	22,2 %	25	10,3 %	27	10,8 %	10,8%
	Important	4	44,4 %	130	53,7 %	134	53,4 %	87,3%
	Most Important	3	33,3 %	82	33,9 %	85	33,9 %	
Q16 - Search Method in Use	Not Important At All	0	0,0%	0	0,0%	0	0,0%	0,8%
	Not Important	0	0,0%	2	0,8%	2	0,8%	
	Wont Affect	2	22,2 %	21	8,7%	23	9,2%	9,2%
	Important	2	22,2 %	139	57,4 %	141	56,2 %	90,0%
	Most Important	5	55,6 %	80	33,1 %	85	33,9 %	
Q16 - Experience of Search Teams	Not Important At All	0	0,0%	0	0,0%	0	0,0%	0,8%
	Not Important	0	0,0%	2	0,8%	2	0,8%	
	Wont Affect	2	22,2 %	20	8,3%	22	8,8%	8,8%
	Important	4	44,4 %	67	27,7 %	71	28,3 %	90,4%
	Most Important	3	33,3 %	153	63,2 %	156	62,2 %	

Table 57 (continued)

Q16 - Number/Density of Search and Rescue Teams	Not Important At All	0	0,0%	0	0,0%	0	0,0%	10,0%
	Not Important	1	11,1 %	24	9,9%	25	10,0 %	
	Wont Affect	3	33,3 %	75	31,0 %	78	31,1 %	31,1%
	Important	3	33,3 %	99	40,9 %	102	40,6 %	59,0%
	Most Important	2	22,2 %	44	18,2 %	46	18,3 %	
Q16 - Certainty of Survivor Information	Not Important At All	0	0,0%	0	0,0%	0	0,0%	0,4%
	Not Important	0	0,0%	1	0,4%	1	0,4%	
	Wont Affect	3	33,3 %	16	6,6%	19	7,6%	7,6%
	Important	1	11,1 %	118	48,8 %	119	47,4 %	92,0%
	Most Important	5	55,6 %	107	44,2 %	112	44,6 %	
Q16 - Content/Details of Survivor Information	Not Important At All	0	0,0%	2	0,8%	2	0,8%	4,0%
	Not Important	0	0,0%	8	3,3%	8	3,2%	
	Wont Affect	4	44,4 %	47	19,4 %	51	20,3 %	20,3%
	Important	1	11,1 %	114	47,1 %	115	45,8 %	75,7%
	Most Important	4	44,4 %	71	29,3 %	75	29,9 %	

Q17. Could you indicate the sufficiency levels of techniques/tools and devices of search and rescue activities suggested below?

Table 58 Sufficiency Levels of Tools & Techniques

Line	Statement	D1. Gender?					
		Women		Man		Total	
		n	%	n	%	n	%
Q17 - Seismometer	enough/ needs development	5	55,6 %	161	66,5 %	166	66,1 %
	not applicable/ not sufficient	4	44,4 %	81	33,5 %	85	33,9 %
Q17 - Survivor Listening Tools under Wreck	enough/ needs development	7	77,8 %	202	83,5 %	209	83,3 %
	not applicable/ not sufficient	2	22,2 %	40	16,5 %	42	16,7 %
Q17 – Megaphones	enough/ needs development	7	77,8 %	217	89,7 %	224	89,2 %
	not applicable/ not sufficient	2	22,2 %	25	10,3 %	27	10,8 %
Q17 - Digging Tools	enough/ needs development	7	77,8 %	229	94,6 %	236	94,0 %
	not applicable/ not sufficient	2	22,2 %	13	5,4%	15	6,0%
Q17 – Dogs	enough/ needs development	3	33,3 %	188	77,7 %	191	76,1 %
	not applicable/ not sufficient	6	66,7 %	54	22,3 %	60	23,9 %
Q17 – Wired/Wireless Information Systems	enough/ needs development	2	22,2 %	103	42,6 %	105	41,8 %
	not applicable/ not sufficient	7	77,8 %	139	57,4 %	146	58,2 %
Q17 – Mobile Technologies	enough/ needs development	4	44,4 %	72	29,8 %	76	30,3 %
	not applicable/ not sufficient	5	55,6 %	170	70,2 %	175	69,7 %
Q17 – Data Fusion	enough/ needs development	2	22,2 %	28	11,6 %	30	12,0 %
	not applicable/ not sufficient	7	77,8 %	214	88,4 %	221	88,0 %

Table 58 (continued)

Q17 – Wearable Technologies	enough/ needs development	5	55,6 %	44	18,2 %	49	19,5 %
	not applicable/ not sufficient	4	44,4 %	198	81,8 %	202	80,5 %
Q17 - Search and Rescue Robots	enough/ needs development	4	44,4 %	24	9,9%	28	11,2 %
	not applicable/ not sufficient	5	55,6 %	218	90,1 %	223	88,8 %
Q17 – Information Systems Softwares	enough/ needs development	4	44,4 %	39	16,1 %	43	17,1 %
	not applicable/ not sufficient	5	55,6 %	203	83,9 %	208	82,9 %
Q17 – Geographical Information Systems	enough/ needs development	5	55,6 %	98	40,5 %	103	41,0 %
	not applicable/ not sufficient	4	44,4 %	144	59,5 %	148	59,0 %
Q17 – Communitcation Technologies	enough/ needs development	8	88,9 %	153	63,2 %	161	64,1 %
	not applicable/ not sufficient	1	11,1 %	89	36,8 %	90	35,9 %
Q17 - GPS	enough/ needs development	7	77,8 %	150	62,0 %	157	62,5 %
	not applicable/ not sufficient	2	22,2 %	92	38,0 %	94	37,5 %

Q18. How would the changing the existed tools and devices with modern tools of informatics effect the search and rescue phases?

Table 59 Modern Tools of Informatics Effects

Q18. How would the changing the existed tools and devices with modern tools of informatics effect the search and rescue phases?	D1. Gender?				Total	
	Women		Man			
	n	%	n	%	n	%

It absolutely deteriorates	0	0,0%	0	0,0%	0	0,0%
Deteriorates	0	0,0%	2	0,8%	2	0,8%
Wont Affect	0	0,0%	0	0,0%	0	0,0%
Enhance	6	66,7%	57	23,6%	63	25,1%
It absolutely enhance them	3	33,3%	183	75,6%	186	74,1%

Q19. Does changing the tools and devices in existed phases with more informatic tools and devices provide a progress regarding the detection of survivors under wreckage in those existed phases?

Table 60 Information Systems Effect

Q19. Does changing the tools and devices in existed phases with more informatic tools and devices provide a progress regarding the detection of survivors under wreckage in those existed phases?	D1. Gender?				Total	
	Women		Man			
	n	%	n	%	n	%
It absolutely deteriorates	0	0,0%	0	0,0%	0	0,0%
Deteriorates	0	0,0%	4	1,7%	4	1,6%
Wont Affect	2	22,2%	1	0,4%	3	1,2%
Enhance	4	44,4%	61	25,2%	65	25,9%
It absolutely enhance them	3	33,3%	176	72,7%	179	71,3%

APPENDIX E: EHDS Source Code

Splash Screen

```
package com.via.adits;
import android.content.Intent;
import android.content.SharedPreferences;
import android.content.pm.ActivityInfo;
import android.os.Bundle;
import android.support.v7.app.AppCompatActivity;
import android.view.View;
import android.view.Window;
import android.view.WindowManager;
import android.view.animation.Animation;
import android.view.animation.AnimationUtils;
import android.widget.ImageView;
import android.widget.TextView;
/*This function has been created for Splash Screen*/
public class SplashScreen extends AppCompatActivity {
  /*onCreate method defines what will happen when created the screen*/
  @Override
  protected void onCreate(Bundle savedInstanceState) {
    super.onCreate(savedInstanceState);
    //No title will be shown
    requestWindowFeature(Window.FEATURE_NO_TITLE);
    //Bottom navigation bar of Android will not be shown.
getWindow().setFlags(WindowManager.LayoutParams.FLAG_LAYOUT_NO_LIMIT
S, WindowManager.LayoutParams.FLAG_LAYOUT_NO_LIMITS);
    //No Status Bar will be shown
    View decorView = getWindow().getDecorView();
    int uiOptions = View.SYSTEM_UI_FLAG_FULLSCREEN;
    decorView.setSystemUiVisibility(uiOptions);
    //welcome_screen layout will be loaded as this classes layout
    setContentView(R.layout.splash_screen);
    //This screen will always shown vertical
this.setRequestedOrientation(ActivityInfo.SCREEN_ORIENTATION_PORTRAIT);
    //Variable definitions will be made under this block.
    ImageView appLogo = (ImageView) findViewById(R.id.appLogoSplash);
    TextView aditsSplash = (TextView) findViewById(R.id.adits2);
    TextView aditsLong = (TextView) findViewById(R.id.adits3);
    TextView companyName = (TextView) findViewById(R.id.companyName);
    Animation animation_i =
```

```
AnimationUtils.loadAnimation(getApplicationContext(), R.anim.rotate_clockwise);
        //Setting the duration of the animation as 3000 milliseconds = 3 seconds
        animation_i.setDuration(3000);
        appLogo.setAnimation(animation_i);
        animation_i.setAnimationListener(new Animation.AnimationListener() {
            /*Defines what will happen on the start of the animation*/
            @Override
            public void onAnimationStart(Animation animation) {
            }
            /*Defines what will happen on the end of the animation*/
            @Override
            public void onAnimationEnd(Animation animation) {
                //Ends the animation
                finish();
                //If the app runned for first time open WelcomeScreen
                SharedPreferences prefs =
getSharedPreferences("prefs",MODE_PRIVATE);
                if (prefs.getBoolean("firstrun", true)) {
                    prefs.edit().putBoolean("firstrun", false).apply();
                    startActivity(new Intent(getApplicationContext(), WifiScreen.class));
                    finish();
                }
                //Else open WifiScreen.
                else {
                    startActivity(new Intent(getApplicationContext() , WifiScreen.class));
                    finish();
                }
            }
            /*Defines what will happen on animation repeat*/
            @Override
            public void onAnimationRepeat(Animation animation) {
            }
        });
    }
    /*Defines what will happen during the animation*/
    @Override
    protected void onResume() {
        super.onResume();
    }
}
```

Welcome Screen

```
package com.via.adits;
```

```java
import android.annotation.SuppressLint;
import android.app.ProgressDialog;
import android.content.Context;
import android.content.Intent;
import android.content.pm.ActivityInfo;
import android.graphics.Color;
import android.net.wifi.WifiConfiguration;
import android.net.wifi.WifiManager;
import android.os.AsyncTask;
import android.os.Bundle;
import android.support.annotation.NonNull;
import android.support.v7.app.AppCompatActivity;
import android.util.Log;
import android.view.View;
import android.view.ViewGroup;
import android.view.Window;
import android.view.WindowManager;
import android.widget.AdapterView;
import android.widget.ArrayAdapter;
import android.widget.Button;
import android.widget.EditText;
import android.widget.ImageView;
import android.widget.RelativeLayout;
import android.widget.Spinner;
import android.widget.TextView;
import android.widget.Toast;
import com.via.adits.FunctionalUses.OnSwipeTouchListener;
import com.via.adits.FunctionalUses.ControlClass;
import com.via.adits.FunctionalUses.JsonSetter;
import org.jsoup.Jsoup;
import java.io.IOException;
import java.util.ArrayList;
import java.util.Arrays;
import java.util.List;
/*This class has been created for sending the Json information to the site*/
public class WelcomeScreen extends AppCompatActivity {
    /*Defining the global variables to use in the processes of this class*/
    public String healtInfo;
    public int Position;
    public boolean nameBoolean;
    public boolean tcBoolean;
    public boolean ageBoolean;
    public boolean healthBoolean;
    String[] health = {"Health Status", "Good", "Moderate", "Poor"};
    String name;
    String tc;
```

```
    String age;
    String health1;
    Integer level;
    public RelativeLayout relativeLayout;

    /*Defines what will happen when the screen has been created*/
    @SuppressLint("ClickableViewAccessibility")
    @Override
    protected void onCreate(Bundle savedInstaveState) {
        super.onCreate(savedInstaveState);

        //No title will be shown
        requestWindowFeature(Window.FEATURE_NO_TITLE);
        //Bottom navigation bar of Android will not be shown.

getWindow().setFlags(WindowManager.LayoutParams.FLAG_LAYOUT_NO_LIMIT
S, WindowManager.LayoutParams.FLAG_LAYOUT_NO_LIMITS);
        //No Status Bar will be shown
        View decorView = getWindow().getDecorView();
        int uiOptions = View.SYSTEM_UI_FLAG_FULLSCREEN;
        decorView.setSystemUiVisibility(uiOptions);
        //welcome_screen layout will be loaded as this classes layout
        setContentView(R.layout.welcome_screen);
        //This screen will turn if sensor of the phone sense the phone has turned
this.setRequestedOrientation(ActivityInfo.SCREEN_ORIENTATION_PORTRAIT);
        //Variable definitions will be made under this block.
        ImageView appLogo = (ImageView) findViewById(R.id.appLogo);
        TextView adits = (TextView) findViewById(R.id.adits);
        TextView kayitText = (TextView) findViewById(R.id.kayitText);
        TextView companyNameWelcome = (TextView)
findViewById(R.id.companyNameWelcome);
        final EditText nameInput = (EditText) findViewById(R.id.name_input);
        final EditText tcInput = (EditText) findViewById(R.id.tc_input);
        final EditText ageInput = (EditText) findViewById(R.id.age_input);
        Button submitButton = (Button) findViewById(R.id.submitBtn);
        WifiManager wifiManager = (WifiManager)
getBaseContext().getApplicationContext().getSystemService(Context.WIFI_SERVIC
E);
        relativeLayout = (RelativeLayout) findViewById(R.id.welcomeScreen);
        //Getting the instance of Spinner and applying OnItemSelectedListener on it
        final Spinner healthInput = (Spinner) findViewById(R.id.health_input);
        final List<String> healthList = new ArrayList<>(Arrays.asList(health));
        //Creating a control class object to control processes.
        final ControlClass controller = new ControlClass();
        //Creating a JsonClass object to send Json data.
        final JsonSetter json = new JsonSetter();
```

```
        /*This function controls what will happen when swiping left(on Layout) */
        relativeLayout.setOnTouchListener(new
OnSwipeTouchListener(WelcomeScreen.this){
            @Override
            public void onSwipeLeft() {
                startActivity(new Intent(WelcomeScreen.this,WifiScreen.class));
                finish();
            }
        });
        /*This function controls what will happen when the "SUBMIT" button
pressed*/
        submitButton.setOnClickListener(new View.OnClickListener() {
            @Override
            public void onClick(View view) {
                nameBoolean = controller.editTextEmptyCheck(nameInput,
WelcomeScreen.this);
                tcBoolean = controller.editTextEmptyCheck(tcInput,
WelcomeScreen.this);
                ageBoolean = controller.editTextEmptyCheck(ageInput,
WelcomeScreen.this);
                healthBoolean = controller.spinnerEmptyCheck(Position,
WelcomeScreen.this);
                controlEditTexts(nameInput, tcInput, ageInput, nameBoolean, tcBoolean,
ageBoolean);
                if (!nameBoolean && !tcBoolean && !ageBoolean && !healthBoolean) {
                        name = nameInput.getText().toString();
                        tc = tcInput.getText().toString();
                        age = ageInput.getText().toString();
                        health1 = healtInfo.toString();
                        level = json.calculateLevel(age, health1, WelcomeScreen.this);
                        Log.d("Name", name);
                        Log.d("tcNo", tc);
                        Log.d("Age", age);
                        Log.d("Health", health1);
                        Log.d("Level", String.valueOf(level));
                        new sendData().execute();
                }
            }
        });
        // Initializing an ArrayAdapter
        final ArrayAdapter<String> spinnerArrayAdapter = new
ArrayAdapter<String>(
                this, android.R.layout.simple_spinner_item, healthList) {
            @Override
            public boolean isEnabled(int position) {
                if (position == 0) {
```

```
                // Disable the first item from Spinner
                // First item will be use for hint
                return false;
            } else {
                return true;
            }
        }
        @Override
        public View getDropDownView(int position, View convertView,
                                    @NonNull ViewGroup parent) {
            View view = super.getDropDownView(position, convertView, parent);
            TextView tv = (TextView) view;
            if (position == 0) {
                // Set the hint text color gray
                tv.setTextColor(Color.GRAY);
            } else {
                tv.setTextColor(Color.BLACK);
            }
            return view;
        }
    };
spinnerArrayAdapter.setDropDownViewResource(android.R.layout.simple_spinner_
item);
    healthInput.setAdapter(spinnerArrayAdapter);

    healthInput.setOnItemSelectedListener(new
AdapterView.OnItemSelectedListener() {
        @Override
        public void onItemSelected(AdapterView<?> parent, View view, int position,
long id) {
            String selectedItemText = (String) parent.getItemAtPosition(position);
            // If user change the default selection
            // First item is disable and it is used for hint
            if(position == 1){
healthInput.setBackground(getDrawable(R.drawable.health_green));
            }
            else if(position == 2){
healthInput.setBackground(getDrawable(R.drawable.health_yellow));
            }
            else if(position == 3){
healthInput.setBackground(getDrawable(R.drawable.health_red));
            }
            if (position > 0) {
                // Notify the selected item text
                healtInfo = selectedItemText;
                Position = position;
```

```
            }
        }
        /*This function controls what will happen when nothing selected*/
        @Override
        public void onNothingSelected(AdapterView<?> parent) {
        }
    });
}
/*This function controls if EditTexts null or empty (or not) */
public void controlEditTexts(EditText name, EditText tc, EditText age, boolean
nameB, boolean tcB, boolean ageB) {

    if (nameB) {
        name.setBackground(getDrawable(R.drawable.edittext_bg_red));
    } else if (!nameB) {
        name.setBackground(getDrawable(R.drawable.edittext_bg));
    }

    if (tcB) {
        tc.setBackground(getDrawable(R.drawable.edittext_bg_red));
    } else if (!tcB) {
        tc.setBackground(getDrawable(R.drawable.edittext_bg));
    }
    if (ageB) {
age.setBackground(getDrawable(R.drawable.edittext_bg_red));
    } else if (!ageB) {
        age.setBackground(getDrawable(R.drawable.edittext_bg));
    }
}
/*This function displays a message on the screen*/
public void showMessage(String message) {
    Toast.makeText(this, message, Toast.LENGTH_SHORT).show();
}
/*This class is used for updating the data on the webpage*/
class sendData extends AsyncTask<Void, Void, Void> {
    private ProgressDialog progress;
    private boolean isSended;
    /*This function controls what will happen before the process*/
    @Override
    protected void onPreExecute() {
        progress = ProgressDialog.show(WelcomeScreen.this, "Sending...",
                "JSON Information ", true);
        progress.setCancelable(true);
    }
    /*This function controls what will after before the process*/
    @Override
```

```
        protected void onPostExecute(Void aVoid) {
            progress.dismiss();
            if (isSended){
                showMessage("Data sended succesfully");
            }
            else{
                showMessage("Couldn't send the Json data, please try again !");
            }
        }
        /*This function controls what will happen during the process*/
        @Override
        protected Void doInBackground(Void... voids) {
            try {
                Jsoup.connect("http://192.168.4.1/buffer").data("u_name",
String.valueOf(name)).data("u_tcno", String.valueOf(" "+tc)).data("u_age",
String.valueOf(age)).data("u_healts", String.valueOf(health1)).data("u_level",
String.valueOf(level)).post();
                isSended = true;
            } catch (IOException e) {
                isSended = false;
            }
            return null;
        }
    }
}
```

Wi-Fi Screen

```
package com.via.adits;

import android.Manifest;
import android.annotation.SuppressLint;
import android.app.ProgressDialog;
import android.content.Context;
import android.content.DialogInterface;
import android.content.Intent;
import android.content.pm.ActivityInfo;
import android.content.pm.PackageManager;
import android.location.LocationManager;
import android.net.wifi.ScanResult;
import android.net.wifi.WifiConfiguration;
import android.net.wifi.WifiManager;
import android.os.AsyncTask;
import android.support.v4.app.ActivityCompat;
import android.support.v4.content.ContextCompat;
import android.support.v4.widget.SwipeRefreshLayout;
```

```
import android.support.v7.app.AlertDialog;
import android.support.v7.app.AppCompatActivity;
import android.os.Bundle;
import android.util.Log;
import android.view.View;
import android.view.WindowManager;
import android.widget.AdapterView;
import android.widget.ImageView;
import android.widget.ListView;
import android.widget.RelativeLayout;
import android.widget.TextView;
import android.widget.Toast;
import com.via.adits.Adapters.WifiAdapter;
import com.via.adits.Adapters.WifiAddress;
import com.via.adits.FunctionalUses.OnSwipeTouchListener;
import org.json.JSONArray;
import org.json.JSONObject;
import java.io.BufferedReader;
import java.io.InputStream;
import java.io.InputStreamReader;
import java.net.HttpURLConnection;
import java.net.URL;
import java.util.ArrayList;
import java.util.List;
public class WifiScreen extends AppCompatActivity {
    /*Public Definitions*/
    // Personal Information TextViews
    TextView nameTxt;
    TextView tcTxt;
    TextView ageTxt;
    TextView healthTxt;
    TextView levelTxt;
    TextView networkTxt;

    //Wifi List
    ListView wifiList;
    //İnformation Tab at the bottom of the screen
    ImageView warning;
    TextView warningTxt;
    //Refreshing functions object
    SwipeRefreshLayout swipeRefreshLayout;
    // Managers
    WifiManager wifiManager;
    LocationManager locationManager;
    // Multiple Permissions
    private static final int REQUEST_ID_MULTIPLE_PERMISSIONS = 1;
```

```
    // Creating a list which takes WifiAdress class objects as input.
    List<WifiAddress> wifiAddresses = new ArrayList<WifiAddress>();
    // Creating a list to store ScanResults
    List<ScanResult> scanResults = new ArrayList<ScanResult>();
    //Wi-Fi configuration variables.
    String SSID,Password;
    //Relative layout definition for swiping the screen.
    RelativeLayout relativeLayout;
    //Variable for checking the json data from the server.
    Boolean sameNetwork;
    @SuppressLint("ClickableViewAccessibility")
    @Override
    /*Defines what will happen after creating the screen*/
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.wifi_screen);
        //Bottom navigation bar of Android will not be shown.
getWindow().setFlags(WindowManager.LayoutParams.FLAG_LAYOUT_NO_LIMIT
S, WindowManager.LayoutParams.FLAG_LAYOUT_NO_LIMITS);
        //No Status Bar will be shown
        View decorView = getWindow().getDecorView();
        int uiOptions = View.SYSTEM_UI_FLAG_FULLSCREEN;
        decorView.setSystemUiVisibility(uiOptions);
        //This screen will always shown horizontal
this.setRequestedOrientation(ActivityInfo.SCREEN_ORIENTATION_PORTRAIT);
        /*Variable Initialization*/
        nameTxt = (TextView)findViewById(R.id.name_info);
        tcTxt = (TextView)findViewById(R.id.tc_info);
        ageTxt = (TextView)findViewById(R.id.age_info);
        healthTxt = (TextView)findViewById(R.id.health_info);
        levelTxt = (TextView)findViewById(R.id.level_info);
        networkTxt = (TextView) findViewById(R.id.network_info);
        wifiList = (ListView) findViewById(R.id.wifi_list);
        swipeRefreshLayout = (SwipeRefreshLayout)
findViewById(R.id.pullToRefresh);
        relativeLayout = (RelativeLayout) findViewById(R.id.wifiScreen);
        wifiManager = (WifiManager)
getApplicationContext().getSystemService(Context.WIFI_SERVICE);
        locationManager = (LocationManager)
getApplicationContext().getSystemService(Context.LOCATION_SERVICE);
        final WifiAdapter wifiAdapter = new WifiAdapter(this, wifiAddresses);
        wifiList.setAdapter(wifiAdapter);
        //Initializing the isJson as nodata
        sameNetwork = false;
        /*CODE START*/
        if(checkAndRequestPermissions()){
```

```
        checkAndRequestPermissions();
    }
if(!locationManager.isProviderEnabled(LocationManager.GPS_PROVIDER)){
        buildAlertMessageNoGps();
    }
if(wifiManager.getConnectionInfo().getSupplicantState().toString().equalsIgnoreCas
e("completed")){
        networkTxt.setText("Network : " +
wifiManager.getConnectionInfo().getSSID());
        getJSONdata();
    }
    else{
        networkTxt.setText("Network : Not Found");
    }
    if (wifiManager != null){
        wifiManager.setWifiEnabled(true);
        scanWifi();
    }
    /*Page Swiping Function to Range and Welcome Screens*/
    relativeLayout.setOnTouchListener(new
OnSwipeTouchListener(WifiScreen.this){
        @Override
        public void onSwipeRight() {
                startActivity(new Intent(WifiScreen.this,WelcomeScreen.class));
                finish();
        }
        @Override
        public void onSwipeLeft() {
                startActivity(new Intent(WifiScreen.this,RangeScreen.class));
                finish();
        }
    });
    wifiList.setOnTouchListener(new OnSwipeTouchListener(WifiScreen.this){
        @Override
        public void onSwipeRight() {
            startActivity(new Intent(WifiScreen.this,WelcomeScreen.class));
            finish();
        }
        @Override
        public void onSwipeLeft() {
            startActivity(new Intent(WifiScreen.this,RangeScreen.class));
            finish();
        }
    });
    /*Defines what will happen when clicking an item on Wi-Fi List*/
    wifiList.setOnItemClickListener(new AdapterView.OnItemClickListener() {
```

```
            @Override
            public void onItemClick(AdapterView<?> adapterView, View view, int
position, long l) {
                SSID = wifiAddresses.get(position).getSSID();
                if
(wifiManager.getConnectionInfo().getSupplicantState().toString().equalsIgnoreCase(
"completed")){
                    if
(wifiManager.getConnectionInfo().getSSID().equalsIgnoreCase(SSID)){
                        sameNetwork = true;
                    }
                    else{
                        sameNetwork = false;
                    }
                }
                Password = "xxxxxx";
                if (SSID.contains("ADITS")){
                    Password = "xxxxxx";
                }
                else{
                    Password = "xxx";
                }
                connect();
            }
        });
        /*Refreshing Function for Wi-Fi List */
        swipeRefreshLayout.setOnRefreshListener(new
SwipeRefreshLayout.OnRefreshListener() {
            @Override
            public void onRefresh() {
if(wifiManager.getConnectionInfo().getSupplicantState().toString().equalsIgnoreCas
e("completed")){
                    networkTxt.setText("Network : " +
wifiManager.getConnectionInfo().getSSID().toString());
                    getJSONdata();
                }
                else {
                    networkTxt.setText("Network : Not Found");
                }
                scanWifi();
                wifiAdapter.notifyDataSetChanged();
                swipeRefreshLayout.setRefreshing(false);
            }
        });
    }
    /*CODE END*/
```

```
    /*onResume function for checking if there is Json data or not continuously*/
    @Override
    protected void onResume() {
        super.onResume();
        new Thread(new Runnable() {
            @Override
            public void run() {
                while(true){
                    runOnUiThread(new Runnable() {
                        @Override
                        public void run() {
                            if
(!wifiManager.getConnectionInfo().getSSID().contains("ADITS")){
                                nameTxt.setText("Name : Not Found");
                                tcTxt.setText("TC ID : Not Found");
                                ageTxt.setText("Age : Not Found");
                                healthTxt.setText("Health Status : Not Found");
                                levelTxt.setText("Level : Not Found");
                            }
                            if
(wifiManager.getConnectionInfo().getSupplicantState().toString().equalsIgnoreCase(
"completed")){
                                if (!sameNetwork){
                                    getJSONdata();
                                }
                            }
                        }
                    });
                    try {
                        Thread.sleep(250);
                    } catch (InterruptedException e) {
                        e.printStackTrace();
                    }
                }
            }
        }).start();
    }
    /*Wi-Fi Scanning Function*/
    public void scanWifi(){
        wifiAddresses.clear();
        Toast.makeText(this, "Scanning Available Networks...",
Toast.LENGTH_SHORT).show();
        wifiManager.startScan();
        scanResults = wifiManager.getScanResults();
        for (ScanResult scanResult:scanResults){
            if (scanResult.SSID.contains("ADITS") || scanResult.SSID.contains("Via")){
```

```
            wifiAddresses.add(new WifiAddress(scanResult.SSID, scanResult.BSSID,
Integer.toString(scanResult.level),
String.valueOf(wifiManager.calculateSignalLevel(scanResult.level,100))));
         }
      }
   }
   /*Connecting Function for clicked item on Wi-Fi List*/
   public void connect(){
      List<WifiConfiguration> configurationList =
wifiManager.getConfiguredNetworks();
      WifiConfiguration newCon =new WifiConfiguration();
      newCon.SSID = "\"" + SSID + "\"";
      newCon.preSharedKey = "\"" + Password + "\"";
      int netId = wifiManager.addNetwork(newCon);
      if (netId != -1)
      {
         Log.d("SSID and Password 1", SSID + Password);
         wifiManager.disconnect();
         wifiManager.enableNetwork(netId, true);
         wifiManager.reconnect();
         networkTxt.setText("Network : " + SSID);
      }
      else
      {
         for( WifiConfiguration i : configurationList ) {
            if (i.SSID.equals(newCon.SSID)){
               Log.d("SSID and Password -1", SSID + Password);
               wifiManager.disconnect();
               wifiManager.enableNetwork(i.networkId, true);
               wifiManager.reconnect();
               networkTxt.setText("Network : " + SSID);
               break;
            }
         }
      }
   }
   /*Calls the AsyncTask which gets JsonData from Server*/
   public void getJSONdata (){
      new getJSON().execute("http://192.168.4.1/json");
   }
   /*checkAndRequestPermissions */
   public boolean checkAndRequestPermissions() {
      final int permissionAccessCoarseLocation =
ContextCompat.checkSelfPermission(this,
            Manifest.permission.ACCESS_COARSE_LOCATION);
      final int permissionWifiState = ContextCompat.checkSelfPermission(this,
```

```
            Manifest.permission.ACCESS_WIFI_STATE);
        final int permissionChangeWifiState =
ContextCompat.checkSelfPermission(this,
            Manifest.permission.CHANGE_WIFI_STATE);
        final int permissionInternet = ContextCompat.checkSelfPermission(this,
            Manifest.permission.INTERNET);
        final int permissionFineLocation = ContextCompat.checkSelfPermission(this,
            Manifest.permission.ACCESS_FINE_LOCATION);
        List<String> listPermissionsNeeded = new ArrayList<>();
        /*Function for checking if the permissions has been granted or not*/
        if (permissionAccessCoarseLocation !=
PackageManager.PERMISSION_GRANTED) {
listPermissionsNeeded.add(Manifest.permission.ACCESS_COARSE_LOCATION);
        }
        if (permissionChangeWifiState!= PackageManager.PERMISSION_GRANTED)
{
listPermissionsNeeded.add(Manifest.permission.CHANGE_WIFI_STATE);
        }
        if (permissionFineLocation!= PackageManager.PERMISSION_GRANTED) {
listPermissionsNeeded.add(Manifest.permission.ACCESS_FINE_LOCATION);
        }
        if (permissionInternet!= PackageManager.PERMISSION_GRANTED) {
          listPermissionsNeeded.add(Manifest.permission.INTERNET);
        }
        if (permissionWifiState!= PackageManager.PERMISSION_GRANTED) {
listPermissionsNeeded.add(Manifest.permission.ACCESS_WIFI_STATE);
        }
        /*Function for requesting mandatory permissions from user*/
        if (!listPermissionsNeeded.isEmpty()) {
          ActivityCompat.requestPermissions(this,
listPermissionsNeeded.toArray(new String[listPermissionsNeeded.size()]),
REQUEST_ID_MULTIPLE_PERMISSIONS);
          return false;
        }
        return true;
    }
    /*Function for requesting Location permission from user*/
    private void buildAlertMessageNoGps() {
        final AlertDialog.Builder builder = new AlertDialog.Builder(this);
        builder.setMessage("You should open your Location Service to search Wi-Fi
networks. Do you want to open it?")
            .setCancelable(false)
            .setPositiveButton("Yes", new DialogInterface.OnClickListener() {
              public void onClick(final DialogInterface dialog, final int id) {
                startActivity(new
Intent(android.provider.Settings.ACTION_LOCATION_SOURCE_SETTINGS));
```

```
            }
        })
        .setNegativeButton("No", new DialogInterface.OnClickListener() {
            public void onClick(final DialogInterface dialog, final int id) {
                buildAlertMessageNoGps();
            }
        });
    final AlertDialog alert = builder.create();
    alert.show();
}
/*getJSON - Json Data in the Webserver has parsed. */
class getJSON extends AsyncTask<String,String,String>{
    @Override
    protected String doInBackground(String... params) {
        // Frist Item is Host address.
        HttpURLConnection connection = null;
        BufferedReader br = null;
        try {
            URL url = new URL(params[0]);
            connection = (HttpURLConnection) url.openConnection();
            connection.connect();
            InputStream is = connection.getInputStream();
            br = new BufferedReader(new InputStreamReader(is));
            String satir;
            String dosya = "";
            while ((satir = br.readLine()) != null) {
                Log.d("satir", satir);
                dosya += satir;
            }
            connection.disconnect();
            if (dosya.length()<= 1){
                getJSONdata();
                int x = 0;
                Log.d("Yeniden Deneniyor", x+ "kere denendi");
                x++;
            }
            return dosya;
        } catch (Exception e) {
            e.printStackTrace();
        }
        return "dataError";
    }
    /*Function for defining what will happen after the process*/
    @Override
    protected void onPostExecute(String s) {
        try{
```

```
            JSONObject jo = new JSONObject(s);
            JSONArray information = jo.getJSONArray("people");
            for (int i=0; i < information.length(); i++)
            {
                JSONObject kisi = information.getJSONObject(i);
                nameTxt.setText("Name : " + kisi.getString("Name"));
                tcTxt.setText("TC ID : " + kisi.getString("TC No"));
                ageTxt.setText("Age : " + kisi.getString("Age"));
                healthTxt.setText("Health Status : " + kisi.getString("Healt Status"));
                levelTxt.setText("Level : " + kisi.getString("Level"));
                networkTxt.setText("Network : " +
wifiManager.getConnectionInfo().getSSID());
                sameNetwork = true;
            }
        }
        catch (Exception e){
            e.printStackTrace();
        }
        super.onPostExecute(s);
    }
  }
}
```

Range Screen

```
package com.via.adits;
import android.annotation.SuppressLint;
import android.annotation.TargetApi;
import android.content.Context;
import android.content.Intent;
import android.content.pm.ActivityInfo;
import android.graphics.Color;
import android.net.ConnectivityManager;
import android.net.NetworkInfo;
import android.net.wifi.WifiManager;
import android.os.Build;
import android.os.Bundle;
import android.support.v7.app.AppCompatActivity;
import android.util.Log;
import android.view.View;
import android.view.Window;
import android.view.WindowManager;
import android.widget.ImageView;
import android.widget.LinearLayout;
import android.widget.RelativeLayout;
import android.widget.TextView;
```

```
import com.github.mikephil.charting.charts.LineChart;
import com.jjoe64.graphview.GraphView;
import com.jjoe64.graphview.GridLabelRenderer;
import com.jjoe64.graphview.Viewport;
import com.jjoe64.graphview.series.DataPoint;
import com.jjoe64.graphview.series.LineGraphSeries;
import com.via.adits.FunctionalUses.OnSwipeTouchListener;
public class RangeScreen extends AppCompatActivity {
   /*Defining global variables to use in the processes of this class*/
   private LineGraphSeries<DataPoint> series;
   private int lastX = 0;
   private WifiManager mainWifi;
   public int level = 0;
   public int leveldbm;
   private TextView label1;
   String portIp;
   ConnectivityManager connManagerr;
   String label;
   public RelativeLayout rangeLay;
   private GraphView lineChart;
   public TextView ssid;
   public TextView dbm;
   /*Defines what will happen after creating the screen*/
   @TargetApi(Build.VERSION_CODES.M)
   @SuppressLint("ClickableViewAccessibility")
   @Override
   protected void onCreate(Bundle savedInstanceState) {
      super.onCreate(savedInstanceState);
      //No title will be shown
      requestWindowFeature(Window.FEATURE_NO_TITLE);
      //Bottom navigation bar of Android will not be shown.
getWindow().setFlags(WindowManager.LayoutParams.FLAG_LAYOUT_NO_LIMIT
S, WindowManager.LayoutParams.FLAG_LAYOUT_NO_LIMITS);
      //No Status Bar will be shown
      //View decorView = getWindow().getDecorView();
      //int uiOptions = View.SYSTEM_UI_FLAG_FULLSCREEN;
      //decorView.setSystemUiVisibility(uiOptions);
      //welcome_screen layout will be loaded as this classes layout
      setContentView(R.layout.range_screen);
      //This screen will always shown horizontal
this.setRequestedOrientation(ActivityInfo.SCREEN_ORIENTATION_USER_LANDS
CAPE);
      //Variable definitions will be made under this block.
      ImageView appLogoRange = (ImageView)
findViewById(R.id.appLogoRange);
      ImageView rangeInfo = (ImageView) findViewById(R.id.range_info);
```

```
        rangeLay = (RelativeLayout) findViewById(R.id.rangeScreen);
        lineChart = (GraphView) findViewById(R.id.range_chart);
        connManagerr = (ConnectivityManager)
getSystemService(Context.CONNECTIVITY_SERVICE);
        mainWifi = (WifiManager)
getApplicationContext().getSystemService(WIFI_SERVICE);
        ssid = (TextView) findViewById(R.id.ssid);
        dbm = (TextView) findViewById(R.id.dbm);
        /*Editing Visual Settings of the Range Chart*/
        GraphView graph = (GraphView) findViewById(R.id.range_chart);
        series = new LineGraphSeries<DataPoint>();
        graph.addSeries(series);
        /*Editing Visual settings of the line shown in the chart*/
        series.setColor(Color.GREEN);
        series.setDrawBackground(true);
        series.setBackgroundColor(Color.argb(70,100, 255, 100));
        series.setDrawDataPoints(false);
        series.setThickness(20);
        series.setTitle("dBm");
        rangeLay = (RelativeLayout) findViewById(R.id.rangeScreen);
        /*Editing Visual settings of the chart itself*/
        graph.getGridLabelRenderer().setHorizontalAxisTitle("dBm");
        graph.getGridLabelRenderer().setNumHorizontalLabels(0);
        graph.getGridLabelRenderer().setNumVerticalLabels(3);
        graph.setBackground(getDrawable(R.color.Transparent));
        /*This function controls what will happen when swiping right(On Layout) */
        rangeLay.setOnTouchListener(new OnSwipeTouchListener(RangeScreen.this)
{
            public void onSwipeRight() {
                startActivity(new Intent(RangeScreen.this,WifiScreen.class));
                finish();
            }
        });
        /*This function controls what will happen when swiping right(On Graph) */
        graph.setOnTouchListener(new OnSwipeTouchListener(RangeScreen.this) {
            public void onSwipeRight() {
                startActivity(new Intent(RangeScreen.this,WifiScreen.class));
                finish();
            }
        });
        GridLabelRenderer gridLabel = graph.getGridLabelRenderer();
        gridLabel.setPadding(3);
        graph.getGridLabelRenderer().setHumanRounding(false);
        Viewport viewport = graph.getViewport();
        viewport.setXAxisBoundsManual(true);
        viewport.setMinX(0);
```

```
        viewport.setMaxX(500);
        viewport.setMinY(-100);
        viewport.setMaxY(-20);
        viewport.setYAxisBoundsManual(true);
        viewport.setScrollable(false);
    }
    /*onResume function for adding new dBm data to chart*/
    @Override
    protected void onResume() {
        super.onResume();
        new Thread(new Runnable() {
            @Override
            public void run() {
                while(true){
                    runOnUiThread(new Runnable() {
                        @Override
                        public void run() {
                            if
(mainWifi.getConnectionInfo().getSupplicantState().toString().equalsIgnoreCase("co
mpleted")){
                                addEntry();
                                ssid.setText("Connected Network : " +
mainWifi.getConnectionInfo().getSSID());
                                dbm.setText("dBm : " +
mainWifi.getConnectionInfo().getRssi());
                            }
                            else{
                                addEntryManual(-100);
                                ssid.setText("Connected Network : " + "No Connection");
                                dbm.setText("dBm : " + "No Connection");
                            }
                        }
                    });
                    try {
                        Thread.sleep(100);
                    } catch (InterruptedException e) {
                        e.printStackTrace();
                    }
                }
            }
        }).start();
    }
    /*This function adds the new dBm data to the series (Series is the line on the
graph)*/
    private void addEntry(){
        ConnectivityManager connManagerr = (ConnectivityManager)
```

```
getSystemService(Context.CONNECTIVITY_SERVICE);
        NetworkInfo mWifii =
connnManagerr.getNetworkInfo(ConnectivityManager.TYPE_WIFI);
        if (mWifii.isConnected()) {
            level = mainWifi.getConnectionInfo().getRssi();
            leveldbm = mainWifi.getConnectionInfo().getRssi();
        }
        if(series.getHighestValueX() < 500){
            series.appendData(new DataPoint(lastX++, level), false, 1000000);
        }
        else{
            series.appendData(new DataPoint(lastX++, level), true, 1000000);
        }
    }
    private void addEntryManual(int Level){
        ConnectivityManager connManagerr = (ConnectivityManager)
getSystemService(Context.CONNECTIVITY_SERVICE);
        NetworkInfo mWifii =
connManagerr.getNetworkInfo(ConnectivityManager.TYPE_WIFI);
        if (mWifii.isConnected()) {
            level = mainWifi.getConnectionInfo().getRssi();
            leveldbm = mainWifi.getConnectionInfo().getRssi();
        }
        if(series.getHighestValueX() < 500){
            series.appendData(new DataPoint(lastX++, Level), false, 1000000);
        }
        else{
            series.appendData(new DataPoint(lastX++, Level), true, 1000000);
        }
    }
}
```

People Class

```
package com.via.adits.FunctionalUses;

/*This class has been created for defining the Personal Information variables*/
public class People {
    /*Defining the global variables for using them in the processes of this class*/
    private String Name, Age, TCNo, Health, Level;
    /*This function returns the "Name" variable*/
    public String getName() {
        return Name;
    }
    /*This function returns the "Age" variable*/
    public String getAge() {
```

```
        return Age;
    }
    /*This function returns the "Tc No" variable*/
    public String getTCNo() {
        return TCNo;
    }
    /*This function returns the "Health" variable*/
    public String getHealth() {
        return Health;
    }
    /*This function returns the "Level" variable*/
    public String getLevel() {
        return Level;
    }
    /*This function sets the "Name" variable*/
    public void setName(String name) {
        Name = name;
    }
    /*This function sets the "Age" variable*/
    public void setAge(String age) {
        Age = age;
    }
    /*This function sets the "Tc No" variable*/
    public void setTCNo(String TCNo) {
        this.TCNo = TCNo;
    }
    /*This function sets the "Health" variable*/
    public void setHealth(String health) {
        Health = health;
    }
    /*This function sets the "Level" variable*/
    public void setLevel(String level) {
        this.Level = level;
    }
    /*Constructor Method for initializing an object from this class*/
    public People(String Name, String TCNo, String Age, String Health, String Level)
{
        this.Name = Name;
        this.TCNo = TCNo;
        this.Age = Age;
        this.Health = Health;
        this.Level = Level;
    }
    /*This function converts the data to String format and returns it*/
    @Override
    public String toString() {
```

```
        return Name + TCNo + Age + Health + Level;
    }
}
```

OnSwipeTouchListener Class

```
package com.via.adits.FunctionalUses;

import android.content.Context;
import android.view.GestureDetector;
import android.view.GestureDetector.SimpleOnGestureListener;
import android.view.MotionEvent;
import android.view.View;
import android.view.View.OnTouchListener;
/*This class has been created for controlling the swipe actions on the application
screens*/
public class OnSwipeTouchListener implements OnTouchListener {
    /*Defining the global variable for using in the processes of this class*/
    private final GestureDetector gestureDetector;
    /*Constructor Method for initializing an object from this class*/
    public OnSwipeTouchListener (Context ctx){
        gestureDetector = new GestureDetector(ctx, new GestureListener());
    }
    /*This function controls if there is a touch on the screen or not*/
    @Override
    public boolean onTouch(View v, MotionEvent event) {
        return gestureDetector.onTouchEvent(event);
    }
    private final class GestureListener extends SimpleOnGestureListener {
        private static final int SWIPE_THRESHOLD = 100;
        private static final int SWIPE_VELOCITY_THRESHOLD = 100;
        @Override
        public boolean onDown(MotionEvent e) {
            return true;
        }
        /*This function controls the swipe direction and returns it*/
        @Override
        public boolean onFling(MotionEvent e1, MotionEvent e2, float velocityX, float
velocityY) {
            boolean result = false;
            try {
                float diffY = e2.getY() - e1.getY();
                float diffX = e2.getX() - e1.getX();
                if (Math.abs(diffX) > Math.abs(diffY)) {
                    if (Math.abs(diffX) > SWIPE_THRESHOLD && Math.abs(velocityX) >
SWIPE_VELOCITY_THRESHOLD) {
```

```
                    if (diffX > 0) {
                        onSwipeRight();
                    }
                    if(diffX < 0) {
                        onSwipeLeft();
                    }
                    result = true;
                }
            }
            else if (Math.abs(diffY) > SWIPE_THRESHOLD && Math.abs(velocityY)
> SWIPE_VELOCITY_THRESHOLD) {
                if (diffY > 0) {
                    onSwipeBottom();
                } else {
                    onSwipeTop();
                }
                result = true;
            }
        } catch (Exception exception) {
            exception.printStackTrace();
        }
        return result;
    }
  }
  /*This is a constructor function to define what will happen when swiping Right*/
  public void onSwipeRight() {
  }
  /*This is a constructor function to define what will happen when swiping Left*/
  public void onSwipeLeft() {
  }
  /*This is a constructor function to define what will happen when swiping Up*/
  public void onSwipeTop() {
  }
  /*This is a constructor function to define what will happen when swiping Down*/
  public void onSwipeBottom() {
  }
}
```

JSON Setter Class

```
package com.via.adits.FunctionalUses;

//Author: İlker YONCACI, Ömer Ayberk ŞENCAN
import android.content.Context;
import android.os.AsyncTask;
import org.jsoup.Jsoup;
```

```
import java.io.IOException;
public class JsonSetter extends AsyncTask<Void, Void, Void> {
    String Name;
    String TcId;
    String Age;
    String Health;
    Integer Level;
    int flag;
    /*Constructor Method for initializing an object from this class*/
    public void sendData(String name, String tcId, String age, String health, Integer
level){
        Name = name;
        TcId = tcId;
        Age = age;
        Health = health;
    }
    /*This function calculates the Level data and gets Health and Age as input to make
the calculation*/
    public Integer calculateLevel(String age, String health, Context c){
        Integer ageStatus = 0;
        Integer healthStatus = 0;
        Integer level = 0;

        if (Integer.valueOf(age) >= 80 ){
            ageStatus = 5;
        }
        else if (Integer.valueOf(age) >= 60 && Integer.valueOf(age) < 80 ){
            ageStatus = 4;
        }
        else if(Integer.valueOf(age) >= 40 && Integer.valueOf(age) < 60){
            ageStatus = 3;
        }
        else if (Integer.valueOf(age) >= 25 && Integer.valueOf(age) < 40){
            ageStatus = 2;
        }
        else if (Integer.valueOf(age) >= 18 && Integer.valueOf(age) < 25){
            ageStatus = 1;
        }
        else if(Integer.valueOf(age) >= 10 && Integer.valueOf(age) < 18){
            ageStatus = 3;
        }
        else if (Integer.valueOf(age) >= 0 && Integer.valueOf(age) <10){
            ageStatus = 5;
        }

        if (health.equalsIgnoreCase("Good")){
```

```
            healthStatus = 1;
        }
        else if (health.equalsIgnoreCase("Moderate")){
            healthStatus = 3;
        }
        else if (health.equalsIgnoreCase("Poor")){
            healthStatus = 5;
        }
        level = ageStatus + healthStatus;
        Level = level;
        return level;
    }
    /*This function sets the "flag" variable*/
    @Override
    protected Void doInBackground(Void... voids) {
        flag = 1;
        return null;
    }
    /*This function gets the "flag" variable*/
    public int getFlag (){
        return flag;
    }
}
```

Item Class

```
packagecom.via.adits.FunctionalUses;

//Author: İlker YONCACI, Ömer Ayberk ŞENCAN
public class Item {
    /*Defining the global variables of this class*/
    private String ssid;
    private String rssi;
    private String bssid;
    private String signalP;
    private String connected;
    /*This function returns the SSID(Name) of the network*/
    public String getSsid() {
        return ssid;
    }
    /*This function returns the RSSI(dBm) of the network*/
    public String getRssi() {
        return rssi;
    }
    /*This function returns the BSSID(Mac Address) of the network*/
    public String getBssid() {
```

```
        return bssid;
    }
    /*This function returns the signal percentage of the network*/
    public String getSignalP(){
        return signalP;
    }
    /*This function returns the connected networks information*/
    public String getConnected(){
        return connected;
    }
    /*This function sets the RSSI of the network manually*/
    public void setRssi(String rssi) {
        this.rssi = rssi;
    }
    /*This function sets the SSID of the network manually*/
    public void setSsid(String ssid) {
        this.ssid = ssid;
    }
    /*Constructor Method for initializing an object from this class*/
    public Item(String ssid, String bssid, String rssi, String signalP, String connected)
{
        this.ssid = ssid;
        this.bssid = bssid;
        this.rssi = rssi;
        this.signalP = signalP;
        this.connected = connected;
    }
    /*This function converts the data to String format*/
    @Override
    public String toString() {
        return ssid + bssid + rssi + signalP;
    }
}
```

Control Class

```
package com.via.adits.FunctionalUses;

//Author: İlker YONCACI, Ömer Ayberk ŞENCAN
import android.content.Context;
import android.net.ConnectivityManager;
import android.net.NetworkInfo;
import android.net.wifi.WifiConfiguration;
import android.net.wifi.WifiManager;
import android.support.v7.app.AppCompatActivity;
import android.util.Log;
```

```
import android.widget.EditText;
import android.widget.Spinner;
import android.widget.Toast;
import com.via.adits.SplashScreen;
import com.via.adits.WelcomeScreen;
import java.util.ArrayList;
import java.util.List;
/*This class has been created to control some variables outside where they used. So,
we can decrease the load of the variables' class*/
public class ControlClass extends AppCompatActivity {
   /*Defining global variables to use in the processes of this class*/
   public static final int REQUEST_ID_MULTIPLE_PERMISSIONS = 1;
   List<String> listPermissionsNeeded = new ArrayList<>();
   ControlClass controlClass;
   WelcomeScreen welcomeScreen = new WelcomeScreen();
   SplashScreen splashScreen = new SplashScreen();
   public int position;
   public Context context;
   /*This function controls if given EditText is null or not*/
   public boolean editTextNullCheck(EditText e, Context c){
      if(e == null){
         Log.d("This is null: ", String.valueOf(e));
         return true;
      }
      else {
         return false;
      }
   }
   /*This function controls if the given Spinner is null or not*/
   public boolean spinnerNullCheck(Spinner s, Context c) {
      if (s == null) {
         Log.d("This is null: ", String.valueOf(s));
         return true;
      } else {
         return false;
      }
   }
   /*This function controls if the given EditText is empty or not*/
   public boolean editTextEmptyCheck(EditText e, Context c){
      if (e.getText().toString().isEmpty()){
         Toast.makeText(c, e.getHint()+ " CAN'T BE EMPTY !",
Toast.LENGTH_SHORT).show();
         return true;
      }
      else return false;
   }
```

```
    /*This function controls if the given spinner is empty or not*/
    public boolean spinnerEmptyCheck(int position, Context c){
        if (position == 0){
            Toast.makeText(c, "Please choose a health status !",
Toast.LENGTH_SHORT).show();
            return true;
        }
        else{
            return false;
        }
    }
    /*This function controls if the device is connected to a network or not*/
    public boolean isConnected(Context context){
        ConnectivityManager connectivityManager = (ConnectivityManager)
context.getSystemService(Context.CONNECTIVITY_SERVICE);
        NetworkInfo networkInfo =
connectivityManager.getNetworkInfo(ConnectivityManager.TYPE_WIFI);
        if(networkInfo.getState() == NetworkInfo.State.CONNECTED){
            return true;
        }
        else{
            Toast.makeText(context, "Please try again after connected to a network !",
Toast.LENGTH_SHORT).show();
            return false;
        }
    }
    /*This function shows the given mesaage at the given Context(Can be thought as
screen) */
    public void showMessage(String s, Context c){
        Toast.makeText(c, s, Toast.LENGTH_LONG).show();
    }
    /*This function controls if the connected network is an ADITS network or not*/
    public boolean isAdits(Context context){
        WifiManager wifiManager = (WifiManager)
context.getApplicationContext().getSystemService(Context.WIFI_SERVICE);
        assert wifiManager != null;
if(wifiManager.getConnectionInfo().getSSID().equalsIgnoreCase("00adits00")){
            return true;
        }
        else{
            Toast.makeText(context, "Please connect to an ADITS network !",
Toast.LENGTH_SHORT).show();
            return false;
        }
    }
}
```

Wifi Address Class

```
package com.via.adits.Adapters;

//Author: İlker YONCACI, Ömer Ayberk ŞENCAN
public class WifiAddress {
   private String SSID;
   private String BSSID;
   private String DBM;
   private String SIGNAL;
   /*Constructor Method for initializing an object from this class*/
   public WifiAddress(String mSSID, String mBSSID, String mDBM, String
mSIGNAL){
      SSID = mSSID;
      BSSID = mBSSID;
      DBM = mDBM;
      SIGNAL = mSIGNAL;
   }
   /*Function for returning the SSID(Name) of the network*/
   public String getSSID() {
      return SSID;
   }
   /*Function for setting the SSID of the network*/
   public void setSSID(String SSID) {
      this.SSID = SSID;
   }
   /*Function for getting the BSSID(Mac Address) of the network*/
   public String getBSSID() {
      return BSSID;
   }
   /*Function for setting the BSSID of the network*/
   public void setBSSID(String BSSID) {
      this.BSSID = BSSID;
   }
   /*Function for returning the dBm of the network*/
   public String getDBM() {
      return DBM;
   }
   public void setDBM(String DBM) {
      this.DBM = DBM;
   }
   public String getSIGNAL() {
      return SIGNAL;
   }
   public void setSIGNAL(String SIGNAL) {
      this.SIGNAL = SIGNAL;
```

```
    }
}
```

WifiAdapter Class

```
package com.via.adits.Adapters;

//Author: İlker YONCACI, Ömer Ayberk ŞENCAN
import android.app.Activity;
import android.content.Context;
import android.view.LayoutInflater;
import android.view.View;
import android.view.ViewGroup;
import android.widget.BaseAdapter;
import android.widget.TextView;
import com.via.adits.R;
import java.util.List;
public class WifiAdapter extends BaseAdapter {
    LayoutInflater layoutInflater;
    List<WifiAddress> wifiAddressList;
    Activity activity;
    /*Constructor Method for initializing an object from this class*/
    public WifiAdapter(Activity activity, List<WifiAddress> mList){
        layoutInflater = (LayoutInflater)
activity.getSystemService(Context.LAYOUT_INFLATER_SERVICE);
        wifiAddressList = mList;
        this.activity = activity;
    }
    /*Function for returning the item count*/
    @Override
    public int getCount() {
        return wifiAddressList.size();
    }
    /*Function for returning the item*/
    @Override
    public Object getItem(int position) {
        return wifiAddressList.get(position);
    }
    /*Function for returning the ID of the item*/
    @Override
    public long getItemId(int position) {
        return position;
    }
    /*Function for returning the View of the item*/
    @Override
    public View getView(int position, View convertView, ViewGroup parent) {
```

```
        View rowView;
        rowView = layoutInflater.inflate(R.layout.row, null);
        TextView ssid = (TextView) rowView.findViewById(R.id.ssid);
        TextView bssid = (TextView) rowView.findViewById(R.id.mac);
        TextView dbm = (TextView) rowView.findViewById(R.id.dbm);
        TextView signal = (TextView) rowView.findViewById(R.id.signal);
        final WifiAddress wifiAddress = wifiAddressList.get(position);
        /*Editing this items TextViews with the information of this network*/
        ssid.setText("SSID : " + wifiAddress.getSSID().toString());
        bssid.setText("BSSID : " + wifiAddress.getBSSID().toString());
        dbm.setText("DBM : " + wifiAddress.getDBM());
        signal.setText(wifiAddress.getSIGNAL());
        /*This block converts the dBm data to signal percentage*/
        signal.setText(wifiAddress.getSIGNAL());
        int mySignal =
Integer.parseInt(wifiAddress.getSIGNAL().replaceAll("[\\D]]",""));
        return rowView;
    }
}
```

HttpHandler Class

```
package com.via.adits.Adapters;

//Author: İlker YONCACI, Ömer Ayberk ŞENCAN
import java.io.BufferedInputStream;
import java.io.BufferedReader;
import java.io.IOException;
import java.io.InputStream;
import java.io.InputStreamReader;
import java.net.HttpURLConnection;
import java.net.MalformedURLException;
import java.net.URL;
public class HttpHandler {
    public HttpHandler(){}
    /*Function for connecting via HTTP*/
    public String makeServiceCall(String requestUrl){
        String response = null;
        try {
            /*Creating an object, type of URL to use while trying to connect*/
            URL url = new URL(requestUrl);
            /*Making a HTTP connection with the website at the given URL*/
            HttpURLConnection connection = (HttpURLConnection)
url.openConnection();
            /*Defining Request Method as "GET" to get information. "POST" can be
used for sending information*/
```

```
            connection.setRequestMethod("GET");
            BufferedInputStream in = new BufferedInputStream
(connection.getInputStream());
            response = convertStreamToString(in);
        } catch (MalformedURLException e) {
            e.printStackTrace();
        }
        catch (
                IOException e) {
            e.printStackTrace();
        }
        return response;
    }
    /*Function for converting the data from server to String format*/
    private String convertStreamToString(InputStream is){
        BufferedReader reader = new BufferedReader(new InputStreamReader(is));
        StringBuilder sb = new StringBuilder();
        String satir = "";
        try{
            /*If reader.redLine is not null, there still is lines to read. Function for adding
the new data as a new line-------------------*/
            while((satir = reader.readLine()) != null){
                sb.append(satir).append("\n");
            }
        } catch (IOException e){
            e.printStackTrace();
        } finally {
            try{
                is.close();
            }
            catch (IOException e){
                e.printStackTrace();
            }
        }
        return sb.toString();
    }
}
```

CustomAdapter Class

```
Package com.via.adits.Adapters;

//Author: İlker YONCACI, Ömer Ayberk ŞENCAN
import android.annotation.SuppressLint;
import android.app.Activity;
import android.content.Context;
```

```
import android.view.LayoutInflater;
import android.view.View;
import android.view.ViewGroup;
import android.widget.BaseAdapter;
import android.widget.TextView;
import com.via.adits.FunctionalUses.Item;
import com.via.adits.R;
import org.w3c.dom.Text;
import java.util.List;
import static com.via.adits.R.color.*;
public class CustomAdapter extends BaseAdapter {
   /*Defining global variables which will be used inside of the processes of this
class*/
   private LayoutInflater mInflater;
   private List<Item> mItemList;
   /*Constructor Method for initializing an object from this class*/
   public CustomAdapter(Activity activity, List<Item> items) {
      mInflater = (LayoutInflater) activity.getSystemService(
            Context.LAYOUT_INFLATER_SERVICE);
      mItemList = items;
   }
   /*Function for returning item count*/
   @Override
   public int getCount() {
      return mItemList.size();
   }
   /*Function for returning the item*/
   @Override
   public Object getItem(int position) {
      return mItemList.get(position);
   }
   /*Function for returning the item ID*/
   @Override
   public long getItemId(int position) {
      return position;
   }
   /*Function for returning the view of the item*/
   @SuppressLint("ViewHolder")
   @Override
   public View getView(int position, View convertView, ViewGroup parent) {
      //View initialized.
      convertView = mInflater.inflate(R.layout.row, null);
      //Initializing variables from view.
      TextView tvSsid = (TextView) convertView.findViewById(R.id.ssid);
      TextView tvBssid = (TextView) convertView.findViewById(R.id.mac);
      TextView tvRssi = (TextView) convertView.findViewById(R.id.dbm);
```

```
        TextView signalP = (TextView) convertView.findViewById(R.id.signal);
        TextView connected = (TextView)
convertView.findViewById(R.id.connected);
        //Creating an Item object.
        Item item = mItemList.get(position);
        //Setting textviews with network informations.
        tvSsid.setText(item.getSsid());
        tvBssid.setText(item.getBssid());
        tvRssi.setText(item.getRssi());
        signalP.setText(item.getSignalP());
        connected.setText(item.getConnected());
        //Calculating signal rate as percentage and storing it.
        signalP.setText(item.getSignalP());
        int myRssi = Integer.parseInt(item.getRssi().replaceAll("[\\D]", ""));
        return convertView;
    }
}
```

APPENDIX F: Curriculum Vitae

PERSONAL INFORMATION

Surname, Name: Yoncacı, İlker

Nationality: Turkish (TC)

Date and Place of Birth: 11 August 1969, Eskişehir

Marital Status: Married

Phone: +90 532 762 81 01

Fax: +90 312 266 24 30

email: ilker.yoncaci@metu.edu.tr

EDUCATION

Degree	Institution	Year of Graduation
MS	Information Systems, METU, Ankara	2002
MS	Computer Engineering., Bilkent University, Ankara	2001
BS	Military Academy (Bussiness Administration), Ankara	1991
High School	Kuleli Military High School, İstanbul	1987

WORK EXPERIENCE

25.03.2013- Continuing VİA Computer Systems Ltd.Co. General Manager,

2018-2018 Tübitak Mentoring (Prog.No. 2170043),

2018-2018 Tübitak Mentoring (Prog.No. 2170312),

2017-2017 Tübitak Mentoring (Prog.No. 2150196),

2017-2017 Tübitak Mentoring (Prog.No. 2150486),

2016-2017	TÜBİTAK TEYDEB 1507, Prog.No. 7150684, Succesfully Completed,
2015-2015	Smartsunited Mentor Training,
2013-2015	Babil Grup Information Technology, Head of IT Group,
2014-2015	Tübitak Mentoring (Prog.No.2130065),
2014-2015	Tübitak GCIP Mentoring (Team DEHA),
2013-2014	TÜBİTAK TEYDEB 1512 Individual-phased Supporting Program (%100 granted) Succesfully Completed,
2008-2012	Land Forces, Cisco (NAC) Network Accessing Control System Project, Nationwide,
2011-2012	Land Forces Information Techlonogies Department Manager,
2010-2011	Land Forces Information Techlonogies Department Deputy Manager,
2009-2010	War Academies Commandership and Staff Officer Training,
2006-2009	Land Forces Adjuntant of Information Technologies Branch Office,
2005-2006	Afghanistan War Academy Consultant of Head Teaching, Mentor for Afghan Cadets,
2004-2005	General Staff, Department of Comm. And Information Technologies,
2002-2004	General Staff, Personnel Division,
2000-2002	Graduate Study at Bilkent University,
1998-2000	General Staff, Department of Comm. And Information Technologies,
1997-1998	METU OBİ Officer Fundamental Course,
1992-1997	Team Commander, Battalion Commander,
1991-1992	Artillery and Missile School Trainee.

FOREIGN LANGUAGES

Advanced English

APPENDIX G: Turkish Summary/Türkçe Özet

AFET YÖNETİMİ ARAMA VE KURTARMA OPERASYONLARI İÇİN YOL HARİTASI VE ACİL DURUM YARDIM VE TESPİT SİSTEMİ GELİŞTİRİLMESİ

GİRİŞ

Afetler insanlığın varoluşundan itibaren insan yaşantısını ve toplumsal yapısı derinden etkileyen olaylar olmuştur. İster doğal afetler olsun isterse insan kaynaklı afetler olsun, bu olaylar yıkımlara yol açabilecek boyutlarda insanı ve yaşamı etkilemiş ve etkilemeye devam etmektedir. Geçmişte farklı yer, zaman ve boyutlarda meydana gelmiş olan afetler günümüzde de insan yaşamını büyük boyutlarda etkileyen kaçınılmaz olaylardır. Ülkemizde 17 Ağustos 1999'da yaşanan Gölcük merkez üslü 7.4 şiddetindeki deprem başta olmak üzere pek çok bölgede ve büyüklükte gerçekleşen doğal afetlere rastlamak mümkündür. Gölcük depremi Türkiye'nin 20. Yüzyılda yaşadığı en büyük afet olarak tanımlanmaktadır (JICA, 2004). Ölü sayısının yanında afetlerden etkilenenlerin sayısı ise her yıl milyonlarla ifade edilmektedir (Guha-Sapir ve ark., 2015). Afetlerin sürekli tekrar etmeleri ve kaçınılmaz olmalarının yanında etkileri dünyanın her yerinde farklı sonuçlar ve etkiler göstermektedir. Bunda da en önemli etken, toplumların afetlere olan duyarlılığının ve yaklaşımının farklı olmasıdır (Değerliyurt ve Erkal, 2009). Değerliyurt ve Erkal (2009) tarafından bu duruma çarpıcı bir örnek olarak çok kısa aralıklarla gerçekleşen 17 Ağustos 1999 Türkiye depremi ile 2003 Japonya depremi gösterilmiştir. Büyüklük olarak daha fazla olan Japonya depreminde bir kişi kalp krizi sonucu hayatını kaybederken Türkiye'de daha küçük bir deprem olmasına rağmen kayıplar yaklaşık 16.000 civarındadır. Benzer şekilde ekonomik olarak kayıpların da paralellik taşıdığı tartışma götürmez bir gerçekliktir. Türkiye'de doğal afetlerin neden olduğu can ve mal kayıplarının %97'si ise deprem nedeniyle olmaktadır (Macit, 2010). Bu nedenle de afet denilince akla ilk deprem gelmektedir. Ülke topraklarımızın % 66'sı, nüfusumuzun % 70'i 1. ve 2. derece deprem bölgesindedir. Bir milyonun üzerinde nüfusu bulunan 11 büyük kentimiz ve büyük sanayi tesislerinin % 75'inin kurulmuş bulunduğu bu bölgelerde, her an büyük bir deprem olma olasılığı oldukça yüksektir (AFAD, 2014a). Teknolojik gelişmelere ve alınan güvenlik önlemlerine rağmen teknolojik afetlerle de sık sık karşılaşılmaktadır. Teknolojik afetler artık ülkelerin tek başına tedbirler alabileceği bir afet türü olmaktan çıkmış ve küresel olaylar haline gelmiştir. Özellikle şehirlerde meydana gelen afetlerin etkileri çok daha yüksek olmakta, karmaşık caddeler ve yüksek binalarla sarılı bölgelerde etnik ve dini açıdan çok farklı yoğun nüfus kitlelerini etkileyebilmektedir. Teknolojik afetlerin insan kaynaklı tetiklenebilmesi nedeniyle, uluslararası ekonomik ve sosyal uçurumlar, Dünya üzerindeki adaletsiz paylaşımlar ve rekabet unsurları bir arada değerlendirildiğinde, önümüzdeki yıllarda teknolojik afetler uluslararası alanda değerlendirilmesi ve kayıtsız kalınmaması gereken ciddi bir konudur (Tüney ve Gücüyener, 2015).

Doğal veya teknolojik olsa da afetler engellenemez ve afetlerden korunmak için tedbirler alınmalıdır. Deprem anında ortaya çıkan tehlikeleri önlemek için afet öncesi planlamalar yapılması gerekirken, sonrasında ortaya çıkan hasarlar için de afet sonrası planlara ihtiyaç duyulmaktadır. Afet yönetim sistemleri genel olarak; afet öncesi zarar azaltma ve önleme faaliyetlerini, afet sırasında ve hemen sonrasında arama kurtarma gibi yaşam kaybını azaltan müdahale faaliyetlerini kapsamaktadır.

Yapılan araştırmaların pek çoğunda arama kurtarma çalışmalarını hızlandırmak ve en fazla sayıda canlı kurtarabilmek için yürütülen çalışmalar, yapılan organizasyonlar ve geliştirilen sistemler merkezî yapılarla kurulmaktadır. Özellikle geniş çaplı afetlerin yaşanması durumunda enerji ve iletişim altyapılarının çökmesi, iletişim trafiğinin çok yüksek oranlarda artması ve kaos ortamının etkileri ile merkezî sistemlerinin pek çoğunun afetin hemen sonrasında çalışamaz duruma geldiği pek çok kez şahit olunan bir gerçektir. Böylesi durumlarda afet sonrası ilk müdahaleyi gerçekleştiren arama ve kurtarma ekipleri (itfaiye ve polis teşkilatı dâhil) geçen zamanın kritik öneme sahip olduğu bilinci ile vakit kaybetmeden çalışmaya başlayacak şekilde eğitilmişlerdir. Oysa merkezî sistemlerin çalışmaması ve bilgi akışının olmaması nedeniyle yürütülen arama ve kurtarma çalışmalarının etkinliği azalmakta, arama ve kurtarma ekiplerinin enerjileri tükenmekte, enkaz altındaki kurbanların psikolojik durumları bozulmaktadır. Bu tez çalışması kapsamında gerçekleştirilen çalışmalar ve öneriler; afet yönetim sistemi içerisinde, müdahale sürecinde arama ve kurtarma birimlerinin yerel olarak bilgi sağlamasına, süratli müdahalede bulunabilmesine, merkezî sistemlerden bağımsız olarak çalışma yapılabilmesine, pek çok arama ve kurtarma ekibi ile gönüllülerin dahi eş zamanlı olarak çalışabilmesine imkân sağlayacak şekilde tasarlanmıştır.

Afet sonrası kurtarma faaliyetlerinin başarısını sağlayan en önemli etkenlerden biri ise; ekiplerin arama-kurtarma faaliyetlerini hızlandıracak ve kolaylaştıracak bilgilere en kısa sürede ulaşabilmeleridir. Ülkemizde bugüne kadar arama kurtarma uzmanları ile yapılan görüşmelerimiz ve tespitlerimiz neticesinde, bizim düşüncelerimize göre, arama kurtarma faaliyetlerinde bilgi teknolojilerinin etkin olarak kullanımı ile zaman ve etkinlik kazanmaya yönelik yeterince ilgi çekilememiştir.

Bu doktora tezinin temel hedefleri;

- Türkiye'de afet yönetimi aşamalarından müdahale süreci arama ve kurtarma faaliyetlerinin ayrıntılı incelenmesi,
- Arama ve kurtarma faaliyetlerinde enkaz altından canlı kurtarmayı etkileyen faktörlerin tespit edilmesi,
- Arama ve kurtarma faaliyetlerinde ekiplerin etkinliğini ve süratini artırmada geliştirilebilecek hususların bir anket uygulaması ile arama ve kurtarmada görev almış uzman kişilere teyit ettirilmesi,
- Arama ve kurtarma faaliyetlerinde enkaz altındaki canlı varlığı bilgisine ulaşma süresini kısaltan ve böylece planlama, durumsal farkındalık ve görev güvenliğine yönelik fayda sağlayan bir uygulamanın önerilmesidir.

AFET YÖNETİMİ

Afet, insan hakları için fiziksel, ekonomik ve sosyal kayıplar meydana getiren, birçok kuruluşun koordineli şekilde görev almasını gerektiren, normal yaşamı ve insan aktivitelerini durduran, yaşamı kesintiye uğratarak toplumları etkileyen doğal, teknolojik ve insan kökenli olaylara denilmektedir (AFAD, 2014b).

Dünya Risk Raporu (UNU-EHS, 2015) tespitlerine göre 1950'lerde dünya nüfusunun 2/3'ü kırsal kesimlerde yaşarken, 2007 yılında bu oran yüzde elliye ulaşmış ve 2050 yılında tam tersine dönerek 2/3'ünün şehirlerde yaşayacağı öngörülmüştür. Bu öngörülerle paralel olarak, insan topluluklarının daha yoğun ve riskli ortamlarda bir arada yaşaması neticesinde doğal veya insan kaynaklı afetlerin insan ve toplum yaşamını etkilemeye ve daha büyük etkiler yaratmaya devam edeceği tartışılmaz bir gerçektir. Ülkemizin 20. Yüzyılda yaşadığı en büyük felaket olan 1999 Marmara depreminde yaklaşık 250.000 bina çeşitli seviyelerde zarar görmüştür (Albayrak ve ark., 2015).

Türkiye'de ve Dünyada sürekli geliştirilen ve artırılan çabalara rağmen afetler sonrası enkaz altından canlı olarak kurtarılan kurban sayıları ölenlere nazaran düşük seviyededir (Bartels ve VanRooyen, 2012). Teknolojik afetlerin doğal afetlerle bütünleşik yapısı ve etki alanları bakımından ulusal sınırlar çoktan aşılmıştır. Hem doğal ve teknolojik afetler birbirini tetikleyebilmekte, hem de ilgili ve sorumlu ülke/kurum/ kuruluşlar açısından yoğun işbirliği ve koordinasyon gerektirmektedir.

Afet yönetimi ülkeden ülkeye, gerek yönetim gerek organizasyon yapısı, gerekse de işleyiş biçimleri açısından farklılıklar içermektedir. Ancak aynı zamanda afetler sınırları gözetmediği için özellikle uluslararası operasyonlarda standartlık oluşturulması, ortak çalışma ve etkinlik açısından fayda sağlamaktadır. Son yüzyılda Türkiye en çok kayıp veren ülkeler arasında olduğundan, afet yönetimi ve daha fazla canlı kurtarılmasına yönelik çalışmaların yapılması önemlidir. Literatürde afet yönetimi iki safhalı olarak tanımlanmıştır. Afetlerin oluşma zamanına kadar yürütülen risklerin analizi, hazırlık, risklerin azaltılması faaliyetlerine "Risk Yönetimi", afetlerin meydana gelmesinden sonra müdahale ile başlayıp iyileştirme ve normal hayata dönüş çalışmalarının tamamına ise "Kriz Yönetimi" denilmiştir (JICA, 2008).

Türkiye'de afetlerle mücadelede farklı birimler ve farklı sorumluluklar yürütülen çalışmalarda zaman zaman aksaklıklara sebep olmuştur ancak özellikle 1999 Marmara Depremi'nde afet ve acil durumlarda yönetim eksikliği hissedilmiş ve yetkilerin tek bir elde toplanmasının bir ihtiyaç olduğu görülmüştür. Öncelikle 2000 yılında Türkiye Acil Durum Yönetimi Genel Müdürlüğü kurulmuştur. Ancak bu on yıllık dönemde aynı göreve yönelik Türkiye Acil Durum Yönetimi, Afet İşleri Genel Müdürlüğü ve Sivil Savunma Genel Müdürlüklerinin farklı bakanlıklar altında çalışması koordinasyon sorunları yaratmıştır. 2009 Yılına kadar yaşanan acılardan çıkarılan dersler sonrasında yerel çalışmaların güçlendirilmesi, merkezde koordinasyonun daha kolay ve hızlı sağlanmasına yönelik olarak çalışmalar yapılmıştır. Türkiye de 2009 yılında çıkarılan 5902 sayılı yasa ile Başbakanlık'a bağlı olan Afet ve Acil Durum Yönetimi Başkanlığı kurulmuş ve tüm yetkiler bir yerde toplanmıştır (AFAD, 2015a). Buna bağlı olarak Sivil Savunma Genel Müdürlüğü, Afet İşleri Genel Müdürlüğü, Türkiye Acil Durum Yönetimi Genel Müdürlüğü kapatılmıştır.

5902 Sayılı kanunun yürürlüğe girmesiyle Afet ve Acil Durum Yönetim Başkanlığı kurulmuştur. Başkanlığın yapısında, diğer bakanlıkları da afet yönetimine dâhil edebilmek amacıyla kurul şeklinde birimler de (Afet ve Acil Durum Yüksek Kurulu, Afet ve Acil Durum Koordinasyon Kurulu, Deprem Danışma Kurulu) yer almaktadır. Afet ve Acil Durum Yönetimi (AFAD) Başkanlığının görev ve sorumluluklarına ait ayrıntılar Aktel (2009)'in çalışmasında yer almaktadır. Ayrıca kuruluşundan bu güne kadar birkaç düzenleme ile AFAD yapısı genişletilmiştir. Bu tez kapsamında afet yönetim sürecinin müdahale aşaması üzerinde odaklanıldığından, burada sadece Müdahale Dairesi Başkanlığının görev ve sorumlulukları üzerinde durulmuştur.

Müdahale Dairesi Başkanlığı afet ve sonrasında etkin şekilde görev yapacak şekilde teşkilatlandırılmıştır. Ayrıca yerel yönetimlerin sorumluluğunda olan itfaiye hizmetleri ile gönüllü kuruluşların oluşturduğu arama ve kurtarma hizmetlerinin düzenlenmesinden ve denetlenmesinden sorumludur. Müdahale Dairesi Başkanlığı'nın görevlerinden biri de koruyucu ve kurtarıcı faaliyetleri planlamak ve yürütmektir.

AFAD Taşra yapılanmasında özel bir durum olarak Sivil Savunma Arama ve Kurtarma Birlik Müdürlükleri karşımıza çıkmaktadır. Bu müdürlükler 2001 yılından itibaren faaliyete geçmiştir. Görevleri seferberlik ve savaş hali ile doğal afetlerdeki can ve mal kaybını en aza indirmek, genel yaşamın hızla normal haline dönmesini sağlamaktır. Birlik müdürlükleri Afyon, Adana, Ankara, Bursa, Diyarbakır, Erzurum, İstanbul, İzmir, Sakarya, Samsun ve Van'da kurulmuştur ve çevre illeri de kapsayacak şekilde sorumluluk alanları belirlenmiştir. 5902 Sayılı Kanun öncesi var olan İl Savunma Müdürlüklerinin görevleri Afet ve Acil Durum Yönetim Başkanlığı'nın hayata geçmesi ile sona ermiştir ve birlik personeli araç ve malzemeleri ile İl Özel İdarelerine devredilmiştir.

Türkiye'de özellikle 1999 Marmara Depremi'nden sonra bilinçlendirme ve katılım konusunda büyük gelişmeler yaşanmış ve afet yönetiminde eğitim, doğrudan kurtarma veya bilinçlendirme amacıyla kurulmuş organizasyonlar mevcuttur. Bunlar arasında İstanbul Valiliği ve İsviçre Kalkınma ve İşbirliği Dairesi'nin desteğinde "Mahalle Afet Destek Projesi (MADP) ile halkın bilinçlendirme çalışmaları 15 yıla yakın süredir devam etmektedir (Kutluk, 2011). Bu kapsamda Mahalle Afet Gönüllüleri (MAG) İstanbul'da 109 mahallede 5008 gönüllüye ulaşmışlardır (MAG, 2015). 1996 Yılında kurulan AKUT arama ve kurtarma faaliyetlerine etkin olarak katılım sağlayarak çalışmalarını genişletmektedir (AKUT, 2015). 1999 Marmara Depremi'ne müdahale süreci ile başlayan çalışmaları 2003 yılında dernek haline döndüren Afetlere Hazırlık ve Deprem Eğitimi Derneği (AHDER) hazırlık ve eğitim faaliyetlerine devam etmektedir (AHDER, 2015). Bu sayılanların dışında farklı organizasyonlar içinde afet bilincinin oluşturulması, eğitim ve planlamalara destek sağlamak amacıyla faaliyet gösteren başka yapılar da mevcuttur.

Türkiye'de AFAD'ın benimsediği Bütünleşik Afet Yönetim Sistemi temelde dört evreden oluşmaktadır: Zarar azaltma, hazırlık, müdahale ve iyileştirme (AFAD, 2014a). Afet yönetim döngüsü olarak adlandırılan birbirini takip eden, birbirleri ile bağlantılı olan bu dört evreyi bir birbirlerinden ayırmak doğru değildir.

Zarar Azaltma; "doğal, teknolojik ve insan kaynaklı tehlikelerle, çevresel bozulmaların afet sonucunu doğurmasını önlemek veya etkilerini azaltmak amacıyla, afet öncesinde, sırası ve sonrasında alınması gereken yapısal veya yapısal olmayan önlem ve faaliyetlerin tümü" olarak tanımlanmaktadır (AFAD, 2014b). Afetler öncesi risklerin değerlendirmesi ile zararın ortaya çıkması olasılığının azaltılması veya şiddeti ile etkilerini azaltmaya yönelik faaliyetler bu evrede icra edilir.

Hazırlık evresi, afetin oluşturabileceği zararları önlemek amaçlı etkili organizasyon ve müdahale edebilmek için yapılan çalışmalardır. Bu evre kişi bazında tüm nüfusu ve kurumları yoğun koordinasyon ile müdahaleye yönelik hazırlama ve eğitme çalışmalarını kapsar. Ekipman ve donanımların bakımı, tahmin ve erken uyarı sistemlerinin kullanımı, personelin eğitimi ve diğer aktiviteler sürekli güncellenmelidir.

Müdahale "afet ve acil durumlarda can ve mal kurtarma, sağlık, iaşe, ibate, güvenlik, mal ve çevre koruma, sosyal ve psikolojik destek hizmetlerinin verilmesine yönelik çalışmalar" olarak tanımlanmaktadır (AFAD, 2014b). Bu bölümde yürütülecek çalışmalar en fazla sayıda insan hayatını kurtarmaya yönelik olarak enkaz altında kalan canlıların arama ve kurtarması, yaralıların tedavisi, açıkta kalanların hayatlarını devam ettirebilmeleri için içecek ve yiyecek, enkaz kaldırma (Ramezankhani & Najafiyazdi, 2008), barınma, ısınma gibi ihtiyaçların karşılanmasıdır. Ülkemizde şimdiye kadar yapılan afet çalışmalarının arkasında daha çok, hatta sadece "arama-kurtarma" mantığı olmuş ve müdahale konusunda eksik kalmıştır. 1999 Marmara Depreminde farklı kaynaklardaki can kaybı ve yaralı sayılarından ne kadarının arama ve kurtarma ekiplerince kurtarıldığı konusunda kesin rakamlar bilinmemektedir.

İyileştirme evresinde, afete uğrayan bölgenin haberleşme (Luna & Pennock, 2018), ulaşım, su, elektrik, eğitim, uzun süreli geçici iskân, ekonomik ve sosyal faaliyetler gibi gereksinimlerini minimum düzeyde karşılanabilmesi için gereken çalışmalar yapılmaktadır (Güzel, 2013).

AFAD Tarafından yürütülen çalışmalar neticesinde; afet yönetiminde temel teşkil edecek Afet Yönetim ve Karar Destek Sistemi (AYDES) projesi geliştirilmiştir. Proje; 2017 yılına kadar coğrafi bilgi sistemleri altyapısıyla entegre, erken uyarı imkânına sahip, tahmin-modelleme ve simülasyon destekli risk yönetimi aşamaları ile karar destek mekanizmalarının oluşturduğu bir genel yönetim sistemidir. Bu kapsamda günümüze kadar afet sırasında kaynakların yönetimini sağlayan Olay Komuta Sistemi (OKS) modülü, çeşitli amaçlarla kullanılan barınma merkezlerinin yönetildiği Afet Geçici Kent Yönetim Sistemi (AKFEN) modülü, yardımların organize edildiği Elektronik Yardım Dağıtım Sistemi (EYDAS) modülü, coğrafi verilerin yönetildiği Mekansal Bilgi Sistemi modülü tamamlanmıştır. Bu çalışmalar planlandığı şekilde afet yönetiminin etkinliğinin artırılmasına yönelik planlı bir şekilde devam etmektedir.

Geçmiş yıllarda Telekom operatörleri tarafından farklı projelerle afet yönetimine katkı sağlanmıştır. En son Turkcell tarafından DroneCell isimli proje ile afet sonrası baz istasyonlarının devre dışı kalması durumunda kullanılmak üzere mobil baz istasyonları projelendirilmiştir.

Dünya üzerinde afet yönetimi konusunda uluslararası pek çok organizasyon vardır. Bu organizasyonlar arasında katılım ve faaliyetler açısından en büyük örgüt Birleşmiş Milletler Kalkınma Programı (United Nations Developing Program-

UNDP)'dır. Bu örgüt Birleşmiş Milletler etki alanında bir şemsiye örgüt olarak uzmanlık örgütleri kurarak faaliyetleri organize etmektedir. İnsani Yardım Koordinasyon Örgütü (OCHA), Dünya Sağlık Örgütü (WHO), Dünya Gıda Programı (WFP) ve Birleşmiş Milletler Çocuklara Yardım Fonu (UNICEF) gibi örgütler UNDP koordinasyonunda Birleşmiş Milletler şemsiyesi altında afet bölgelerine çeşitli yollarla yardımda bulunmaktadır (Gülkan ve ark., 2003).

Uluslararası Arama ve Kurtarma Danışma Grubu (INSARAG) benzer uluslararası faaliyet gösteren örgütlerdendir. Diğerlerinin aksine gayri resmî bir küresel ağ yapısındadır. INSARAG'ın amacı, uluslararası yardım gerektirecek depreme müdahale ve yardımlardaki koordinasyon metodolojisi ve standartlarını geliştirmek amacıyla ülkelere ve örgütlere platform sağlamaktır. INSARAG Birleşmiş Milletler şemsiyesi altında 80'den fazla ülke ve organizasyonun katılımı ile faaliyet göstermektedir.

AFET YÖNETİMİNDE ARAMA VE KURTARMA FAALİYETLERİ

Arama; afet ve acil durumlarda enkaz altında kalmış insanların yerinin belirlenmesine yönelik yürütülen faaliyetler olarak tanımlanmaktadır. Arama ve kurtarma ise "afet nedeniyle güç durumda kalmış insanları, özel olarak eğitilmiş ve donatılmış resmî veya özel ekipler tarafından aranması, bulunması ve kurtarılmasına yönelik çalışmalara" denilmektedir (AFAD, 2014b). Arama ve kurtarma faaliyetleri kritik bir süreçtir ve hızlı bir kurtarma operasyonu için ayrıntılı planlama temel şarttır. Bu planlamada afetten etkilenen kurbanların bulunması ihtimalinin en yüksek olduğu yerlerin tespit edilmesi de yer almalıdır. Ayrıca çökmüş binaların hızlı bir şekilde zarar tespitinin yapılması için de sınıflandırması bu planlamada yer almalıdır. Kişisel bazda enkaz altında sıkışmış kişilerin bulunabilmesini sağlayacak teknolojiler, bu kişilerin en kısa zamanda, güvenli ve en az çabayla kurtarılmasına yardımcı olacak teknikler üzerine odaklanmış planlamalar arama ve kurtarma faaliyetlerinin özünü teşkil etmektedir. Wong ve Robinson (2004)'a göre arama ve kurtarma ekibi enkaz altında sıkışmış canlıların, tehlikelerden ve yıkıntılardan kurtarılmasından sorumludur. Bu ekibin kullandığı aletler arasında görsel görüntüleme araçları, sismik cihazlar, termal kameralar, köpekler ve fiziksel aramaya fayda sağlayacak diğer araçlar bulunur. Duruma göre bu cihazlar tek tek veya toplu kullanılabilir. Afetler ülkemizde ve Dünyada kaçınılmak olarak sürekli yaşanmaktadır. Afet sonrasında ise arama ve kurtarma ekipleri enkaz bölgesinden canlı kurtarmak için Altın Saatler olarak tanımlanan ilk 72 saati değerlendirmeye çalışırlar. Coburn ve ark. (1991) büyük afetler sonrası yürütülen arama ve kurtarma çalışmalarında zamana karşı hayatta kalma oranlarını ülkemizin de içinde olduğu (30 Ekim 1983 Erzurum Depremi, Büyüklüğü 6,9 Ms ,1.155 ölü, 537 yaralı, 3.241 konut ağır, 3 bin konut orta ve 4 bin konut hafif hasar, 30 bini aşkın hayvan telef) dört büyük deprem verileri ile tespit etmiştir (Ochoa ve Rodrigo, 2015). Araştırmalar afetler sonrası hayatta kalma oranlarının her afette aynı olmadığını göstermektedir ancak ilk 72 saat tüm Dünyada en kritik saatler olarak kabul edilmektedir. Fiedrich ve ark. (2000) bu oranların öngörülebilmesi için bir model önermişler ve yine ilk 72 saatin en kritik zaman dilimi olduğu sonucu elde edilmiştir (Ochoa ve Rodrigo, 2015). Leblebici (2014)'ye göre afetlerden hemen sonrasında ilk müdahale kolektif bir reaksiyon olarak yakınlardan, kurtulanlardan ve bölgede bulunan yerel kaynaklardan gelmektedir. Çünkü resmî müdahale ekiplerinin bölgeye gelmesi uzun sürebilmektedir. Hatta geniş çaplı afetler sonrası ilk resmî müdahale ekibinin gelmesi, gerekli hazırlık ve ulaşım süresinden sonra 24 saati bulabilmektedir.

İnsani ve ekonomik kayıpları en aza indirmek ve arama ve kurtarma çalışmalarının süratini artırmak için bu faaliyetlerin tüm aşamalarını standartlaştırmaya ihtiyaç bulunmaktadır. Bu aşamaların standart süreleri yoktur. INSARAG tanımlamasına göre arama ve kurtarma faaliyetlerinin süreçleri arama ve kurtarma ekiplerinin canlı tespiti, yerinin tespiti ve kurtarılmasını içine alan bir döngü şeklindedir. Bu döngü enkaz altında canlı kalmayıncaya veya canlı kalma ümidi kaybolup çalışmaların sonlandırılmasına kadar devam etmektedir. Burada kurbanların aranıp bulunması ve yerinin tespiti için geçen zaman "tahmin edilemeyen bir süre" olarak öngörülmüştür.

Bu da Birleşmiş Milletler tabanlı çalışmalarda bile canlı varlığı bilgisine ulaşma süresinin önemini gösteren önemli bir noktadır.
Statheropoulos ve ark. (2015) tespitlerine göre yerleşim yerlerinde bir arama ve kurtarma operasyonunu geciktiren/uzatan faktörler sıralanmıştır. Bu faktörler Port au Prince/Haiti (2010) ve L'Aquila/İtalya (2009) depremleri sırasında açıkça gözlenmiştir. Bir diğer husus ise afetten etkilenen halk kitlelerinin rolüdür. Eğer afet büyük çaplı ve geniş kitleleri etkileyen bir yapıda ise – ki 1999 Gölcük depremi bu şekilde geniş bir coğrafyada etkili olmuştur – halk, enkaz altında kalan insanların yakınları ve gönüllüler arama ve kurtarma ekiplerinden çok önce olay yerine ulaşıp arama ve kurtarma faaliyetlerine başlamış olabilir. Bu durumda aynı faktörler geçerli olmasına rağmen etkileri değişik olabilecektir. Örnek olarak 1999 Gölcük depreminden günlerce sonra bile halkın bölgeye hücum etmesi neticesinde ulaşım yolları ve trafik kapalı kalmış ve yardımların bile ulaştırılmasında büyük gecikmeler yaşanmıştır. Ancak aynı zamanda bir enkaz önünde toplanmış gönüllülerle ağır vasıta ve yıkıntılar araçlar olmadan kaldırılarak yaralılara ulaşım da sağlanmıştır. Dolayısıyla gayri resmî olarak bölgede bulunan ve arama ve kurtarma faaliyetlerine karışan insanların da bu faktörlere olumlu ya da olumsuz etkisi vardır.

ABD'nin ulusal afet yönetiminde FEMA'nın kullandığı sistemlere ve hedeflerine baktığımızda büyük çaplı arama ve kurtarma çalışmalarında en kısa sürede en fazla can kurtarma amacına yönelik olarak geleneksel ve asimetrik arama ve kurtarma yeteneklerinin kullanılması öngürülmektedir (DHS, 2011).

Enkaz altında kalan canlılar için "dört kuralı" geçerlidir. Bir enkazzede hava olmadan 4 dakika yaşayabilir, su olmadan 4 gün, yiyecek olmadan 4 hafta (Agapiou ve ark., 2015), bu yüzden arama ve kurtarma operasyonları 72 saatten sonra sonlandırılmakta veya öncelikleri değiştirilmektedir. Kısa zaman içerisinde bilgi sağlanması ve bu bilginin doğruluk düzeyinin yüksek olmasının kaos ortamında faaliyetlerin etkinliğini artırabileceği veya daha fazla karmaşa ve zarara yol açabileceği değerlendirilmektedir. Afet bölgesi, kendisi ile büyük benzerlikler gösteren muharebe bölgesi gibi yüksek seviyede durumsal farkındalık gerektirmektedir. Endsley ve ark. (2003) durumsal farkındalığı çevredeki maddelerin belirli bir yer ve zaman çerçevesinde algılanması, şu andaki anlamlarının ve yakın gelecekteki durumlarının projeksiyonu olarak tarif etmiştir.

Afet yönetim sürecinde müdahale bölümünün zamana dayalı olarak kritiklik taşıyan evresi şüphesiz ki arama ve kurtarma sürecidir. Bu süreç genelde arama ve kurtarma operasyonlarının bir kontrol merkezi / komuta merkezi şeklinde kurulan merkezden yönetilmesi şeklinde gerçekleşmektedir. Bu merkez arama ve kurtarma faaliyetlerine yönelik tüm aktörleri ve tüm kaynakları yönetmeye çalışır. Zaman kritik böyle bir görevi yürütürken komuta/kontrol merkezinin en geniş kapsamlı durumsal farkındalığa sahip olacak şekilde bilgilere sahip olması gerekmektedir (Seppanen ve Virrantaus, 2015). Komuta/kontrol merkezlerinde görevler daha önceden belirlenmiş ve açık şekildedir, zaman kritiktir ve tek amaç afetin zararlarını azaltmak ve daha fazla canlı kurtarmaktır. Bu ortamda çalışan arama ve kurtarma birimleri genellikle kurumsal yapıya sahip devlet organizasyonlarıdır. Bu organizasyonların arama ve kurtarma birimleri benzer senaryolar için hazırlıklıdır, tatbikat ve eğitim yapmış durumdadır ve genelde bu konuda uzun süreli eğitimler almışlardır. Buna benzer, "zaman kritik" görevlerde eldeki hazır bilgi kısıtlıdır ve yeni bilgi toplayacak veya analiz edecek zaman da yoktur. Afetin büyüklüğüne göre bölgede görev yapacak aktörler onlardan binlere kadar büyüyen çapta olabilir. Görev yapacak organizasyonlar devletin resmî organizasyonları, gönüllüler veya sivil toplum kuruluşlarıdır ve bunların ortak çalışma yapmış olsun veya olmasın ortak bir dil ile bilgi paylaşmaları ve çalışmaları kaçınılmazdır çünkü zamanın bu kadar kısıtlı olduğu görevlerde yanlış anlamalara veya karşılıklı çalışabilirlik için gerekli uyum sorunlarına ayırılacak zaman yoktur. Seppanen ve Virrantaus (2015) bu durumlarda bilgi erişimi ve paylaşımı için bir portal uygulamasının kullanılmasını önermişlerdir.

Arama ve kurtarma çalışma alanları tehlikeli, yıkılmış ve zarar görmüş, çalışması büyük gayret ve dikkat isteyen alanlardır. Bu alanlarda yürütülecek çalışmalarda kullanılmak üzere geliştirilen aletler ve sistemler pratik ve hafif olmalıdır. Bu aletler kısa ve dayanıklı olmalı, ayrıca egzoz gaz çıkışları enkaz dışında olmalıdır. Ayrıca yeni geliştirilen lazer teknolojileri, basınçlı su sistemleri, ufak ama güçlü kaldıraçlar, otomatik stabilizasyon sağlayan aletler hayat kurtarmaya devam etmektedir (Wong & Robinson, 2004). Bu tez çalışma kapsamında görüşülen uzmanlardan elde edilen bilgilerle Türkiye'de arama ve kurtarma çalışmalarında kullanılan alet ve sistemlerin listesi oluşturulmuştur. Bu liste ABD FEMA teşkilatının listeleri ile karşılaştırılmıştır. Aynı zamanda bu listedeki alet ve sistemlere gelecek projeksiyonu oluşturması bakımından Statheropoulos (2015b) tarafından geliştirilen Gelecek Teknolojilerinde Öncelikler listesi ile karşılaştırılmıştır. Bu yukarıdaki karşılaştırmalar yapıldığında, özellikle gelişmiş ülkelerin alet ve sistemlerinde daha fazla teknoloji kullanımı, yazılımlar, yapay zeka ve otomatik sistemler dikkat çekmektedir.

Genel olarak 3 çeşit arama metodu bulunmaktadır (Wong & Robinson, 2004):

- ✓ Fiziksel Arama – bölge araması, görsel ve ses ile arama,
- ✓ Köpek Araması – eğitimli köpekler ile,
- ✓ Elektronik Arama – çeşitli elektronik alet ve sistemler ile.

Canlı tespiti yapmak için en yaygın kullanılan teknik "Sesimi duyan var mı?" şeklinde seslenmektir. Bu teknik enkaz altı dinleme cihazları ile birlikte kullanılabilir. Enkazın altını sessizce dinlemek de sık kullanılan tekniklerdendir. Bu tekniği hiçbir eğitimi olmayan insanlar da ayrı bir teçhizata gerek duymadan kullanabilir ancak bu teknik tehlikeli olabilmektedir. Bir şekilde kendisinden geçmiş, bayılmış, yaralı olması nedeniyle kendini kaybetmiş insanlar bu teknikle tespit edilemezler. İmkânlar doğrultusunda enkaz altına kamera indirilerek de arama çalışmaları yapılabilmektedir. Kameralar basit kullanımları, video veya fotoğraf kayıtları ve uzaktan izleme imkânları ile büyük avantajlar sağlamaktadır. Bu teknik ise kısıtlı batarya gücü, boyut ve maliyetler nedeniyle çok yaygınlaşmamıştır. Ayrıca infrared veya termal kameralar ile elektronik dinleme cihazları da bu alanda kullanılan araçlardandır. Infrared ve termal kameralar büyük ve karanlık açık alanlarda, toz ve dumanın olduğu alanlarda çok kullanışlıdırlar. Elektronik dinleme cihazları ise büyük alanlarda özel tekniklerle (triangulation vb.) kurbanın yerini ve soluk alış verişlerini tespit edebilmektedir (Wong ve Robinson, 2004). Yukarıdaki tekniklerden başka kullanılan diğer usuller ise arama robotlarının kullanılması, otonom kamera tabanlı cihazların kullanılması (Dandoulaki ve Andritsos, 2007) ve mikrodalga sistemlerin kullanılmasıdır. Ayrıca enkaz altında kalan canlıların vücutlarından salgılanan organik bileşenlerin (Volatile Organic Compounds-VOCs) tespit edilmesine yönelik köpeklerin veya cihazların kullanılması da karşılaşılan tekniklerdendir.

İnsanlık tarihi boyunca hassas koku alma duyuları ve hisleri nedeniyle köpekler arama ve kurtarma faaliyetlerinin vazgeçilmezi olmuştur. Özellikle afetler sonrası zamanın çok kısıtlı olduğu, enkaz altında kalan kurbanların sesini duyuramadığı, güçsüz veya baygın olduğu yerlerin tespitinde köpekler önemli rol üstlenmektedir. Bu görevleri üstlenen köpekler aslında bir mekanik cihaz değildir ve her zaman aynı başarıyı göstermeleri beklenemez. Özellikle düz arazilerde arama ve kurtarma faaliyetlerinde köpeklerin başarısını ve etkinliğini ölçmeyi amaçlayan Greatbatch ve ark. (2015) tarafından İngiltere'de 2014 yılında 10 köpekle 25 test yapılmış ve sonuçlar değerlendirilmiştir. Ülkemizde arama ve kurtarma ekipleri ile birlikte köpekler kullanılmaktadır ve literatürde köpeklerin performansları üzerine benzer bir çalışmaya rastlanmamıştır. AFAD'ın Kasım 2015 ayında yaptığı Köpek Arama Timi Görev Yeterlilik Sınavı'nda başarılı olan 32 köpekten 17'sine madalya verilmesi töreninde AFAD Başkanı Dr.Fuat Oktay "Köpekle arama verilerine bakacak olursak aralarında en hızlı sonuç veren teknik olarak görülüyor." demiştir. Bu haberdeki bilgilere göre köpekli arama timlerinin canlıyı enkaz altında bulma süresinin 3-7 dakika arasında değiştiği, sismik ve sesle arama cihazlarıyla yapılan aramaların bundan daha uzun sürdüğü ifade edilmiştir (AFAD, 2015b).

Büyük çaplı afetlerden sonra kurbanlar genelde büyük bina yıkıntıları arasında kurtarılmaya ve acil sağlık müdahalesine ihtiyaç duyacak şekilde sıkışıp kalmış durumda bulunmaktadır. Genellikle böyle durumlarda yerel imkânlar hatta bazen ulusal imkânlar bile yetersiz kalmakta ve uluslararası yardım ekiplerinin de acil arama ve kurtarma faaliyetlerine katılmasına ihtiyaç bulunmaktadır. 1999 Gölcük depreminde ve benzer şekilde 2008 Wenchuan/Çin depreminde merkez üssündeki binaların %75'inden fazlası zarar görmüştür. Buralarda binlerce insanın enkaz altında kaldığı tahmin edilmektedir (Chen ve Miller-Hooks, 2012). 2010 Haiti başkenti Port-au-Prince depreminde yaklaşık 225.000 kişinin yaşadığı 10.000 den fazla bina yıkılmış veya ciddi zarar görmüştür (UNOSAT, 2010). 2011 Tohoku/Japonya depremi ve ardından meydana gelen tsunami 59806 binayı yok etmiş, 190.000 den fazla binaya ise zarar vermiştir (Norio ve ark., 2011). Bu deprem sonrası müdahale için Japonya'nın kendi ekiplerinin yanısıra 23 ülkeden arama ve kurtarma ekipleri yardıma gitmiştir. Etkin bir arama ve kurtarma faaliyeti için kısa sürede müdahale imkânlarının yaratılması büyük önem taşımaktadır. Örnek olarak 2003 Bam/İran'da meydana gelen deprem sonrası yüzlerce ulusal ekip, 44 uluslararası yardım kuruluşu, Birleşmiş Milletler ve diğer sivil toplum kuruluşları müdahale için bölgeye gitmiştir. Koordinasyon ve iletişim eksiklikleri nedeniyle bu arama ve kurtarma ekiplerinin müdahalesi oldukça gecikmiştir (Ramezankhani ve Najafiyazdi, 2008). Oysa afetler sonrası kaos ortamında zamana karşı yarış halinde kararlar yerinde ve zamanında verilmek zorundadır.

Daha önce yapılan çalışmalarda deprem, yangın gibi bir afetten sonra arama ve kurtarma ekiplerinin bölgeye kısa sürede ulaşması, afet bölgesi hakkında kısa sürede bilgi edinmeleri ve enkaz altında kalan insanları canlı olarak kurtarmanın, arama ve kurtarma çalışmalarının başarılı olmasında en önemli parametreler olduğu belirlenmiştir (Pehlevan, 2012, Özerdem, 2006). Bu tespitlere yönelik olarak uzman arama ve kurtarma ekipleri ile yapılan görüşme ve anketlerde bu faktörler içerisinde canlı tespit sürecinin süre olarak kısaltılarak iyileştirilebileceği tespit edilmiştir. Bu konuya yönelik olarak tespit edilen problem cümlesi hipotezleri test edilmiştir. Bu çalışma kapsamında 2013-2015 yılları arasında Türkiye'de arama ve kurtarma faaliyetlerinde görev almış / görev alan, doğrudan arama ve kurtarma faaliyetlerine yönelik çalışmış / çalışan teknik personel ile yüzyüze görüşmeler gerçekleştirilmiştir. Bu doktora tezinde; arama ve kurtarma ekiplerinin çalışmaları sırasında arama ve kurtarma süresine etki eden hususlardan canlı varlığı bilgisine ulaşma süresinin etkisi üzerinde odaklanılmıştır. Yüzyüze görüşmeler 32 arama ve kurtarma uzmanı personel ile farklı zaman ve yerlerde yapılmıştır. Uzmanlarla görüşmelerden elde edilen ilk veriler yine aynı uzmanlara teyit ettirilerek olgunlaştırılmış ve nihai haline getirildikten sonra anket olarak uygulanmıştır. 2014 Yılında 27-29 Kasım tarihleri arasında Ankara'da gerçekleştirilen "IDME 3. Uluslararası Afet Yönetim Fuarı ve Konferansı"nda açılan stand ile konferans ve fuar katılımcısı arama ve kurtarma uzmanı kişilerle tespit edilen hususlar teyit edilmiştir. Bu çalışmalardan elde edilen sonuçlar Türkiye'de arama ve kurtaram çalışmalarında önemli hususlar olarak listelenmiştir (Tablo 16). Bu hususların literatürde ilk defa yer alması önemlidir. Ayrıca çalışmada görüşülen uzmanlara yönelik hususlar da üçüncü bölümde ayrıntılı olarak açıklanmıştır. Bu tez çalışması dışında uluslararası ve çok yeni bir çalışma olarak Statheropoulos ve ark. (2015) tarafından kentsel bölgelerde arama ve kurtarma faaliyetlerini ve süreleri etkileyen temel faktörlerin belirlenmesine yönelik bir çalışma mevcuttur. Bu tez çalışmasındakine benzer şekilde Statheropoulos ve ark. (2015) tarafından arama ve kurtarma faaliyetlerine etki eden, öncelik arz eden veya önemli olduğu tespit edilen hususlar belirlenmiştir.

Halkın Arama ve Kurtarma Faaliyetlerine Katılımı konusunda geniş halk kitlelerinin gücü ile uzman ekiplerin tecrübesinin birleşimi bazen çok önemli olmaktadır. Afet bölgesinde afetin hemen sonrasında yürütülecek ilk yardım ve arama-kurtarma çalışmalarında profesyonel ekipler bölgeye ulaşmadan önce yerel halk, gönüllüler ve afetten etkilenmiş ancak kurtulmuş insanlar ilk müdahaleleri yaparlar. Özellikle geniş çaplı ve kitlesel yıkımların yaşandığı deprem gibi afetlerden sonra yeterli ve gerekli liderlik/yönetim özellikleri sergilenirse afet bölgesinde kaostan kaynaklanan zorluklar aşılıp arama ve kurtarma faaliyetlerinde zaman kazanılabilir. Acil ilk yardım uygulamaları yapılabilir. Kaba yüzey taraması ve basit uğraşlarla kurtarılacak enkaz altında kalmış insanlar kurtarılabilir. Lojistik destek yerinden sağlanabilir, temel gıda maddeleri temin edilebilir. Arama ve kurtarma görevlerine doğrudan etkisi olan ve güvenlik endişelerini destekleyen bilgiler toplanabilir. Profesyonel ekipler bölgeye geldikçe arama ve kurtarma faaliyetlerine esas istihbarat bilgileri sağlanabilir.

Yerel halkın desteği arama ve kurtarma faaliyetlerinde büyük önem taşımaktadır. Halkın desteği sağlanırken özellikle liderlik konusunda öne çıkan profesyonellerin halkın kültürel ve ahlaki değerlerini anlaması da gereklidir. Statheropoulos ve ark. (2015) makalelerinde afet sonrası halkın özelliklerini bir tablo şeklinde sıralamıştır.

Teknoloji Entegrasyonu konusunda arama ve kurtarma faaliyetlerine yönelik teknolojilerin geliştirilmesi ihtiyacı vardır. Afetler ve müdahale sürecine yönelik geliştirilen teknolojiler olmasına rağmen enkazların içerisine giren, test edilmiş ve geçerliliği kanıtlanmış teknolojilerin sayısı azdır. Türkiye'de afet yönetimi müdahale sürecinde bu çalışmada sayılı teknolojilerin bir bölümü kullanılmakta, bir bölümü henüz kullanılmamaktadır. Kullanılan veya geliştirilmesi gereken teknolojilere yönelik uzman görüşleri dördüncü bölümde uygulanan anket sonuçlarında ayrıntılı olarak verilmektedir. Teknolojik araçların fonksiyonlarının mümkün olduğunca bütünleştirilmesi ve birbirini destekler şekilde birleştirilmeleri önem kazanan bir husus olarak ortaya çıkmaktadır. Arama ve kurtarma faaliyetlerinde yeni yeteneklerin kazanılması esnasında bu teknolojilerin bütünleşik kullanımına yönelik çözümler göz önünde bulundurulmalıdır.

TÜRKİYE'DE AFET YÖNETİMİ ARAMA VE KURTARMA FAALİYETLERİNE YÖNELİK BİR ARAŞTIRMA

Çalışmanın bu kısmında Türkiye'deki afet yönetim sistemi içerisinde arama ve kurtarma faaliyetlerini etkileyen hususlar, önemli parametreler, canlı varlığı bilgisine ulaşma şekilleri ve etkileri ile ilgili hususlarda yapılan anket sonuçları incelenmiştir. Afet yönetiminde arama ve kurtarma uygulamalarıyla ilgili olarak literatür taranmış ve konu ile ilgili olduğu tespit edilen önemli hususlar tespit edilmeye çalışılmıştır. Bu çalışmada daha önce yapılan yüz yüze görüşmeler ve mülakatlarda tespit edilen hususlar doğrultusunda uzman görüşü alınan 8 adet demografik soru ve 19 adet mesleki/teknik sorudan oluşan bir anket hazırlanmıştır. Hazırlanan anket AFAD (merkez ve taşra teşkilatı), AKUT (Ankara ve taşra teşkilatı), Sivil Savunma Arama ve Kurtarma Birlik Müdürlükleri, GEA Arama ve Kurtarma, Antalya Büyükşehir Belediyesi İtfaiye Daire Başkanlığı gibi afet yönetim sisteminin bir parçası olan organizasyonların ilgili personeline ve resmî e-postalarına doldurulmak üzere gönderilmiştir. Personelin toplu olarak bulunduğu yerlerden gelen talebe göre anketler basılı olarak da gönderilmiştir.

Ayrıca toplam 57 ilin İl Afet ve Acil Durum Müdürlerine hitaben yapılan çalışma ile ilgili e-posta yoluyla veya telefonla bilgi verilmiş ve bilgi alınmıştır. Bu araştırmada kullanılan veriler arama ve kurtarma uzmanı kişilerden toplanmıştır. Yüz yüze görüşme ve mülakatlar hem resmî hem gayri resmî organizasyonlara mensup arama ve kurtarma uzmanı kişilerle yapılmıştır.

Yüz yüze görüşmeler 32 arama ve kurtarma uzmanı personel ile farklı zaman ve yerlerde yapılmıştır. Bu 29 soru üç grup halinde gruplanmıştır. İlk bölümde (1-12. sorular) afetler ve arama ve kurtarma faaliyetlerine yönelik genel ve demografik sorular ve tecrübe paylaşımı yer almıştır. İkinci bölümde (13-24. sorular) arama ve kurtarma faaliyetleri sırasında ihtiyaç duyulan bilgi ve malzemelere yönelik sorular yer almıştır. Son bölümde (25-29. sorular) bilgi teknolojilerinin veya yeni teknolojik araçların kullanılmasının arama ve kurtarma faaliyetlerine etkilerini tecrübelerine göre değerlendirmelerini isteyen sorular yer almıştır.

Bu teşkilatlardan Türkiye'deki en büyük resmî organizasyon olan AFAD'ın merkez teşkilatında 2013 yılı itibariyle arama ve kurtarma teknisyeni bulunmamaktadır. Taşra teşkilatında ise 2013 yılı itibariyle İl Özel İdarelerine bağlı Arama ve Kurtarma Birlik Müdürlükleri bünyesinde 1.100 arama ve kurtarma teknisyeni kadrosu bulunmaktadır. Bu personelden sadece arama ve kurtarma uzmanlığı ve görevi olan personel sayısı ise 900 civarındadır. 20 Şubat 2014 tarihli 6525 sayılı Kanunda yapılan değişiklik ile İl Özel İdarelerine bağlı olan İl Afet ve Acil Durum Müdürlükleri AFAD bünyesine katılmış ve 2014 yılı içerisinde kadro değiklikleri ve atamalar yapılmıştır. Türkiye'deki tek resmi arama ve kurtarma organizasyonu olan

AFAD bünyesindeki arama ve kurtarma teknisyenlerinden 251'ine ulaşılmıştır. Yüz yüze görüşmelerden elde edilen veriler ışığında hazırlanan anket soruları hem basılı ortamda hem de bir web sitesi aracılığı ile online olarak uygulanmıştır. Toplamda tam olarak cevaplanan anket sayısı 251'dir. Basılı olan anketler toplamda 384 adet uygulanmış ancak toplamda 99 kişiden cevap alınabilmiştir. Online olarak doldurulan anket sayısı ise 152'dir. Anketler farklı illerden ve farklı bölgelerden doldurulmuştur. Ankete katılanlar tarafından anketin ne amaçla ve kim tarafından uygulandığı açıkca bilinmektedir. Bu yüzden anketin samimi ve gerçekçi bir şekilde cevaplandığı gözlenmiştir. Anketlerden elde edilen veriler araştırmanın hipotezlerini test edebilmek için yeterli görülmüştür. Katılımcıların cinsiyet, yaş, eğitim durumu, bölgesel farklılık, meslekte bulunma süreleri gibi özelliklerinin ankete verilen cevapları etkilemeyeceği varsayılmıştır. Ankete katılan arama uzmanlarının sahip oldukları demografik özelliklerin genel durumunun araştırmanın etkinliğine olumlu katkı sağlayacağı düşünülmektedir.

Anket uygulaması sonucu elde edilen verilerin çözümünde; Arama ve Kurtarma Faaliyetlerinde Kullanılan Tekniklerin ve Süreçlerin Analizi ve Değerlendirilmesi anket çalışmasından elde edilen verilerin analizinde betimleyici istatistiklerden ve hipotez testlerinden faydalanılmış ve veriler IBM SPSS 20 Paket Programı yardımı ile analize tabi tutulmuştur. Çalışmamızda toplamda 251 katılımcı yer almıştır. Katılımcıların büyük çoğunluğu erkek katılımcılardan oluşmaktadır. % 96,4 Erkek ve % 3,6 Kadın katılımcı söz konusudur. Kullanılan istatistiksel model genellikle ortalama, standart sapma, t testi ve korelasyon tekniklerine dayanmaktadır. Ölçek güvenirliğine ilişkin verilerin güvenirlik analizi için alfa cronbach ile yapılmıştır.
Anketlerden elde edilen verilerin tamamı bilgisayar ortamına aktarılmış ve sayısal verilerin analizinin tümü bilgisayar yoluyla yapılmıştır.

Afetler sonrası etkin ve hızlı müdahale hayat kurtarma açısından temel şarttır. Bu amaçla Türkiye'deki afet yönetimi arama ve kurtarma faaliyetlerinin etkinliğinin ve müdahale süratinin artırılmasına yönelik sorunların tespiti, bu sorunlara uygun çözüm önerileri sunulmalıdır. Bu nedenle, bu tez çalışmasında uygulanan ankette, arama ve kurtarma yöntemlerinin, teçhizatının ve usüllerin Türkiye'deki afet yönetiminde ne kadar yeterli olduğu, geliştirilmesi gereken hususlar hakkında öneriler toplanmaya çalışılmıştır. Bu tez çalışması kapsamında, uygulanan anket çalışmasından elde edilecek verilerin sonucuna göre aşağıdaki hipotezler test edilmiştir.

"Arama ve Kurtarma Faaliyetlerinde Kullanılan Tekniklerin ve Süreçlerin Analizi ve Değerlendirilmesi"ne yapılan güvenirlik analizi sonucunda, Standardize edilmiş Cronbach's Alfa değeri 0,817 yani %81,7 olarak hesaplanmıştır. Söz konusu değere bakılarak, anketin yüksek düzey güvenilir olduğu belirlenmiştir. Çok cevaplı soruların dâhil edilmediği güvenilirlik analizi sonucunda, analize dâhil edilen değişkenlerin ortalama değerleri (Ort), Standart sapmaları (SS) ve Geçerli Olan Toplam Katılımcı Sayısı (N) SPSS çıktıları tablolarda verilmiştir.

Afet yönetimi sistemlerinde arama ve kurtarma süreçlerinin teorik çerçevesi ve afet yönetiminde başarılı olan bazı ülkelerin uygulamalarına ilişkin literatür incelenmiştir. Öte yandan afet deneyimi fazla olan Amerika Birleşik Devletleri FEMA örgütünün arama ve kurtarma teçhizatı ve kullanılan teknolojik sistemler gözden geçirilmiştir. Arama ve kurtarma temel ilkeleri ankette soru olarak yer almıştır. Gerek yazın taramasından, gerekse ülke uygulamalarından verimli ve etkin bir arama ve kurtarma sürecinde önemli hususları ortaya koyacak ölçekler geliştirilmiştir. Ayrıca, anketin uygulanmasından önce konu uzmanlarına geliştirilen ölçekler teyit ettirilmiştir. Ayrıca, görüşülen arama ve kurtarma uzmanlarının tecrübeleri gereği bildikleri kabul edilen, kendi görev alanları içinde yer alan, eğitim programlarında gösterilen, temel arama ve kurtarma terminolojisi ile ölçekler oluşturulmuştur.

Türkiye'deki arama ve kurtarma faaliyetlerinin mevcut durumunun analizi ve sorunlarının tespitine yönelik 29 ölçek belirlenmiştir. Her yargı ifadesi beşli Likert ölçekle sorulmuştur. Yargı ifadelerinin belirgin olması için beşli ölçek tercih edilmiştir. Ayrıca, konu değerlendirme anketlerinde beşli Likert tercihinin çokça yapıldığı tespit edilmiştir. Bu çalışmanın da bir değerlendirme anketi içerdiği göz ardı edilmemelidir. Ucu açık soru ile katılımcılara bu konudaki önerileri sorulmuştur. Toplanan öneriler ortak konularına göre sınıflandırılmıştır. Bu kapsamda tez yazımının anket çalışması kısmında elde edilecek verilerin sonucuna göre hipotezleri test edecek sorular belirlenmiştir.

H1: Arama ve kurtarma takımlarının enkaz altındaki canlı bilgisine ulaşma süresini kısaltmak takımların arama ve kurtarma etkinliğini artırır.

H2: Afetler sonrası müdaha aşamasında arama ve kurtarma takımlarının bilişim tabanlı alet ve sistemleri kullanması arama ve kurtarma çalışmalarının etkinliğini artırır.

Anket uygulamasından elde edilen veriler arama ve kurtarma çalışmalarına yönelik önemli sonuçlar ortaya koymuştur. Türkiye'de arama ve kurtarma çalışmalarında çalışanların çok büyük bir bölümü erkektir. Fiziksel olarak ağır bir iş olması bu durumu açıklar niteliktedir. Fakat afet bölgesinde karşılaşılacak özellikle kadınlar ve çocukların bulunması ve kurtarılması faaliyetlerinde kadın arama ve kurtarma uzmanlarının bulunması fayda sağlayacaktır.

Araştırma evreninin yaş ortalaması 36.7 dir ve çok yüksek bir rakamdır. 2014 Yılında çıkarılan 6525 sayılı Kanun ve onun ardından yapılan yönetmelik düzenlemesi ile arama ve kurtarma teknisyeni olma şartları yeniden düzenlenmiştir. Bu düzenlemeler ve sınav ile alım şartları neticesinde yaş ortalaması önümüzdeki yıllarda da artmasına rağmen gençleşme eğilimine girecektir. Bu çalışma sonrası 2016 yılında yapılan Yönetmelik değişikliği ile arama ve kurtarma teknisyenliğinde 50 yaş üzerinde çalışma izne tabi duruma getirilmiştir.

Anket sonuçlarında %90'ın üzerinde katılımcı zaman, eğitimli personel ve afetzede bilgisinin arama ve kurtarma çalışmalarında öncelikli olduğunu belirtmiştir. Bu durum afetzedeye ulaşmanın ve ona ait bilgileri elde etmenin önemini göstermektedir. Bu maddede elde edilen sonuçlar literatürdeki çalışmalarla (Statheropoulos et al., 2015b) paralellik taşımaktadır.

Anketin son bölümünde afetzedeye ait bilgilere ulaşmayı ve ulaşılan bilginin doğruluğunun %90 üzerinde birinci derece önemli olduğu sonucu elde edilmiştir. Bu durum da hipotezleri confirm eden bir durumdur, uzman görüşlerinden elde edilen konu başlıkları, anket içerisinde sorulan sorular ve elde edilen sonuçların tutarlı bir sonucu olarak uzmanlar bu konunun önemi üzerinde fikir birliği sağlamıştır.

EHDS-ENKAZ ALTINDA CANLI BİLGİSİNE ULAŞMA SÜRESİNİ AZALTAN BİR UYGULAMA

Türkiye'de geçmişte bölgesel ve büyük çapta yıkımlara yol açan pek çok felaket yaşanmıştır. Bu felaketlerde yıkılan onlarca, yüzlerce hatta binlerce binada, mevcut profesyonel ekiplerle ilk 24 saat içinde arama ve kurtarma faaliyetlerinin yürütülmesi neredeyse imkansız olmuştur. Uluslararası destek için gelen yabancı ekipler ise koordinasyon eksikliği nedeniyle fayda sağlayamadan ülkeyi terk etmek zorunda kalmıştır (AFAD, 2014c; Ramezankhani & Najafiyazdi, 2008). Bu durumlarda bölgede bulunan ve afetten sağ kurtulan gönüllüler ise bir hazırlık yapılamadığı için etkin olarak kullanılamamıştır. Arama süreci enkaz altında canlı bulunana kadar tekrar eden belirsiz bir süreçtir (INSARAG, 2012), bu sürecin uzaması ise daha fazla can kaybı anlamına gelmektedir. Bu projede hem afetlerin hemen ardından bölgede bulunan gönüllüler tarafından arama faaliyetlerine etkinlik sağlamak hem de profesyonel ekiplerin arama süratlerinin artırılması hedeflenmiştir.

Bu değerlendirmeler neticesinde aşağıdaki maddelerde fayda sağlayabilecek, aynı zamanda anket hipotezlerini destekleyecek bir proje üretilmiştir.

✓ Afetler öncesi dönemde hazırlık safhasında kullanılıp afete hazır olmayı sağlayacak,

- ✓ Afetlerin hemen sonrasında arama ve kurtarma ekiplerine doğru bilgi sağlayacak,
- ✓ Basit, local ve kablosuz kullanımı olan,
- ✓ Arama ekiplerine ve gönüllülere zaman kazandıracak,
- ✓ Kullanımı kolay, eğitimi basit olan,
- ✓ Hafif ve mobil kullanım ile enkaz üstündeki arama ve kurtarma ekiplerine kolaylık sağlayan,
- ✓ Arama süresini kısaltarak kurtarma süresini de kısaltan,
- ✓ Canlı kurtarma etkinliğini artıran.

Bu proje özellikle afet bölgesinde bulunan ilk müdahaleciler tarafından enkaz altında canlı varlığı bilgisine kısa sürede ulaşılması amacıyla tasarlanmıştır. Bu amaca yönelik olarak insanların sürekli üzerinde taşıyabilecekleri, saat gibi aksesuar içine konulabilen bir sinyal üreteci ve bu sinyali alıp işleyebilen bir mobil yazılım hazırlanmıştır. Bu kapsamda bir sinyal üreteci (EHU) bir de sinyal tespit eden mobil yazılım (EHDU) hazırlanmıştır. Bu çerçevede hazırlanan proje TÜBİTAK TEYDEB Başkanlığına sunulmuş ve destek almaya hak kazanmıştır. Proje Temmuz 2016 ile Aralık 2017 ayları arasında 18 ay boyunca yürütülmüş ve başarı ile tamamlanmıştır. Projede 6 iş paketi halinde amaçlanan teknik çalışmalar yapılmıştır.

- ✓ Bu projede ortaya çıkan prototip müdahale aşamasında arama ekiplerinin çalışma süratini artırmaya imkân sağlayacaktır. Bu durum birim zamanda daha fazla arama yapılabilmesine, özellikle büyük çaplı yıkımlarda İlk 72 Altın Saatin daha etkin kullanılmasına olanak sağlayacaktır. Arama ekiplerinin doğrudan canlıya yönlendirilmesi sayesinde daha fazla hayat kurtarılmasına imkân sağlayacaktır.
- ✓ Bu projede ortaya çıkan prototip ile enkaz üzerinde arama ekiplerinin daha rahat çalışmasını, hafif olması nedeniyle arama ekiplerinin daha az yorulmasını ve daha çevik davranabilmesine imkan sağlayacaktır.
- ✓ Bu projede ortaya çıkan prototip ile cihazların çalışması için gerekli güç ihtiyacı azalacak, mobil cihazların esnek ve dinamik kullanımı arama çalışmalarına da esneklik sağlayacaktır.

- ✓ Bu projede ortaya çıkan prototip; eğitim almadan olay bölgesinde bulunan ilk müdahaleciler (first responders) veya enkazdan kurtulan survivors tarafından kolaylıkla kullanılabilecektir.
- ✓ Bu projede ortaya çıkan prototip arama ve kurtarma ekiplerine ve gönüllülere ilk 72 Altın Saat içerisinde daha fazla arama çalışması yapabilmek için zaman kazandıracaktır.
- ✓ Bu projede ortaya çıkan prototip local ve kablosuz çalışması nedeniyle kolaylık sağlayacaktır. Enerji altyapısına ihtiyaç duymayacaktır. Ulusal sistemlere entegrasyon ihtiyacı olmayacaktır.
- ✓ Bu projede ortaya çıkan prototip ile arama ve kurtarma ekiplerine doğru ve zamanında bilgi sağlayacaktır. Projede yapılan çalışmalarda sadece canlı varlığı bilgisi değil, aynı zamanda survivor ın kimlik bilgileri, sağlık bilgilerinin de aktarılması sağlanmıştır. Bu sadece hem alınan verilerin (data) bilgiye dönüştürülmesi, hem de doğrulanması (validation) ile survivor henüz kurtarılmadan onun hakkında pek çok bilgiye erişilmesine imkan sağlayacaktır.
- ✓ Bu projede ortaya çıkan prototip ile afetler öncesi hazırlık aşamasında kişilerin ve toplumun benzeri araçları kullanarak afetlere hazır olmasına imkan sağlayacaktır. Hazırlık aşamasında benzeri araçların eğitimlerinin kolayca ve geniş kitlelere verilebilmesi fırsatı ortaya çıkacaktır. Afet etkilerinin en aza indirilmesi amacıyla bir katkı sağlanmış olacaktır.
- ✓ Projede tasarlanan parçalar, çalışma prensipleri, mesafe ve penetrasyon test sonuçları 5. Bölümde ayrıntılı olarak açıklanmıştır.

TÜRKİYE'DE AFET YÖNETİMİNDE TEKNOLOJİ POLİTİKALARINA BİR YOL HARİTASI, SONUÇLAR VE TAVSİYELER

Türkiye'de afet yönetiminde müdahale aşamasında son yıllarda pek çok çalışma yapılmıştır. Bu çalışmaların büyük bir bölümü bina yapıları veya zemin ile ilgili çalışmalardır. Oysa afet yönetimi afetler öncesinde yıllarca sürebilecek, uzun hazırlıklar, eğitimler, koordinasyon ve üst seviye hazırlık çalışmaları gerektirmektedir. Yapılan bu çalışmada afet yönetiminde bilişim teknolojilerinin etkin kullanımının arama ve kurtarma çalışmalarını süratlendirdiği ve zaman kazandırdığı ortaya çıkmıştır. Arama ve kurtarma çalışmalarında zaman kazanmak aynı zamanda hayat kurtarmak anlamına da gelmektedir.

Bu tez çalışmasında literatür taraması, uzman görüşmeleri ve yapılan anket sonucunda; yürütülen çalışmalar afet yönetiminde müdahale aşamasında 4 yatay eksene bölünmüştür :

- ✓ Türkiye'de Afet Yönetiminde Politika ve Stratejiler (Türkiye'deki afet yönetiminde uygulanan politikalar, stratejiler, geliştirilen kaynaklar, süreçleri toptan etkileyen hususlar, diğer Kurum/Bakanlıklar/Sivil Toplum Kuruluşları ile olan entegre hususlar vs.),
- ✓ Türkiye'de Afet Yönetimi Müdahale Aşamasında Tehditler / Sınırlılıklar (Afet yönetiminde öne çıkan tehditler, kısıtlılıklar, bağımlılıklar, yetersizlikler, üzerinde çalışılması gereken kritik hususlar vs.),
- ✓ Arama ve Kurtarma Çalışmalarını Destekleyen Altyapılar (Afet yönetiminde arama ve kurtarma safhası özelinde ortak kullanılan altyapı, kurumsal altyapılar, süreçleri etkileyen önemli hususlar, afet yönetiminde afet öncesi hazır olması beklenen hususlar vs.),
- ✓ Müdahale Aşamasında Kullanılan Araçlar ve Teknikler (Afet yönetiminde arama ve kurtarma safhası özelinde kullanılan aletler, araç ve gereçler, teknolojiler, sistemler, süreçler ve iş yapma şekilleri vs.).

Yatay eksenler belirlendikten sonra, literatür taraması sonucunda arama ve kurtarma özelinde önemli olarak referans edilen ve bu tez çalışmasına validasyon sağlayacak konular da beş dikey eksen olarak şekillendirilmiştir. Bu dikey eksenler aşağıdaki şekilde oluşturmuştur.

- ✓ Afet Sonrasında Toplumun Durumu (Afet yönetiminde arama ve kurtarma çalışmalarına etki edecek toplumsal tespitler, afet sonrasında insanların ihtiyaçları ve kapasiteleri, arama ve kurtarma süreçlerine yapabilecekleri katkılar vs.),

- ✓ Hızlı Bir Arama ve Kurtarma Operasyonunda Öncelikler (Uluslararası literatürden öncelikler listesi, yatay eksenlere göre arama ve kurtarma faaliyetlerinde önemli ve öncelikli hususlar vs.),
- ✓ Uzmanlarla Yüz Yüze Görüşmelerden Elde Edilen Önemli Hususlar (Türkiye'de görev yapan arama ve kurtarma uzmanlarından elde edilen bilgilerden yatay eksenlere uyan önemli hususlar vs.),
- ✓ Anket Çıkarımları (Anket uygulamasında ortaya çıkan sonuçların yatay eksenler bazında değerlendirmeleri vs.),
- ✓ Uygulama Projesinden Önemli Notlar (Bu tez çalışmasında elde edilen bilgiler ve literatür çalışmaları neticesinde yürütülen uygulama projesinin yatay eksenler bazında değerlendirmeleri vs.).

Hem yatay eksenler, hem dikey eksenler birlikte değerlendirildiğinde, literatürde yer alan hususlar ile uzmanlarla yapılan görüşmeler, uygulanan anket ve uygulama projesi sonuçlarının birbiri ile tutarlı, birbirini destekler nitelikte sonuçlar olduğu ortaya çıkmaktadır. Bu durum doğrultusunda; yatay dört eksen için aşağıdaki beş dikey eksende yol haritası oluşturulmuştur:

- ✓ Mevcut Durum (Türkiye'de afet yönetiminde mevcut durum, kullanılan sistemler, araçlar ve teknikler, süreçler ve altyapıda mevcut durum vs.),
- ✓ Girişimler (Girişimler, kampanyalar, öne çıkan hususlar, ana aktörler vs.),
- ✓ Öncelikler (Öncelikler, kısıtlılıklar, key notes, önemli hususlar vs.),
- ✓ Sorumlular (Sorumlular, sorumluluklar, yetkili kurum veya kişiler, aktörler vs.),
- ✓ Hedef Nokta (Yol haritası sonunda hedeflenen son durum, nihai hedef, amaç vs.).

Oluşturulan yol haritasında ortaya çıkan hususların tamamı kısa, orta ve uzun vadeli hedefler olarak bir sınıflandırma ile üç gruba ayrılmıştır. Her yatay eksen için yol haritası maddeleri ayrı ayrı listelenmiştir.

Bu tez çalışması sırasında elde edilen bilgiler ve uzman görüşleri doğrultusunda Türkiye'de arama ve kurtarma çalışmalarında kullanılan araç ve gereçlerin temel seviyede olduğu görülmüştür. AFAD'ın 2009 yılında kurulduğu göz önünde bulundurulursa, aradan geçen 10 yıllık süreçte AFAD yapılandırmasını tamamlamış, stratejik projelerinin hazırlık ve hayata geçirme aşamalarını yürütmüş durumdadır. Bu on yıllık süreçte doğal olarak pek çok afetle karşı karşıya kalmış durumdadır. AFAD bir yandan kendi sistemlerini geliştirmeye odaklanırken, henüz 2 yaşındayken Suriye krizi ile karşı karşıya kalmıştır. Mülteci akınları pek çok doğal afetten daha fazla zarara yol açmış, toplumsal yapıyı etkiler hale gelmiş ve ortaya çıkardığı sorunlar kapsamında afetlerden çok daha geniş etkilere sahip olmuştur. AFAD Kaynaklarının büyük bölümünü bu krize yönlendirmek durumunda kalmıştır. Bu durum bir Türkiye gerçeğidir. Suriye krizinin etkilerini görmeden sadece AFAD'ın arama ve kurtarma faaliyetlerini ve sistemlerini değerlendirmek doğru olmayacaktır. Bu bilgiler ışığında; afetler sonrası müdahale aşamasında zamana karşı yürütülen arama ve kurtarma çalışmalarının çok daha hızlı, çok daha koordinasyon içerisinde, çok daha etkin olması gerektiği de açıktır. Halen arama ve kurtarma ekiplerinin kullandıkları alet ve sistemlere baktığımızda, temel arama ve kurtarma faaliyetlerini yürütmelerini sağlacak teçhizata sahip olduklarını görüyoruz. Özellikle enkaz altında canlı tespitine yönelik kullanılan en etkili araçlar ise köpeklerdir. Dolayısıyla bilgi ve iletişim teknolojilerindeki gelişmeler ışığında, konvansiyonel arama tekniklerinin yanında yeni teknolojileri, özellikle bilişim tabanlı teknolojik araç ve sistemlerin kullanılmasının arama ve kurtarma etkinliğini artıracağı bu tez çalışmasının ana hipotezidir. Uzmanlarla yürütülen çalışmalar neticesinde bu hipotezin desteklendiği görülmüştür. Bu bölümde bu amaca yönelik olarak arama ve kurtarma araç ve sistemlerine yönelik öneriler sıralanmıştır.

APPENDIX H: Thesis Permission Form / Tez İzin Formu

ENSTİTÜ / INSTITUTE

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Sosyal Bilimler Enstitüsü / Graduate School of Social Sciences **X**

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Deniz Bilimleri Enstitüsü / Graduate School of Marine Sciences ☐

YAZARIN / AUTHOR

Soyadı / Surname : YONCACI ....
Adı / Name : İLKER ....
Bölümü / Department : SCIENCE AND TECHNOLOGY POLICY STUDIES......................

TEZİN ADI / TITLE OF THE THESIS (**İngilizce** / English) :
DEVELOPMENT OF A ROAD MAP AND EMERGENCY HELP AND DETECTION SYSTEM FOR DISASTER SEARCH AND RESCUE OPERATIONS ....

TEZİN TÜRÜ / DEGREE**:** **Yüksek Lisans** / Master ☐ **Doktora** / PhD **X**

1. **Tezin tamamı dünya çapında erişime açılacaktır. /** Release the entire work immediately for access worldwide. **X**
2. **Tez iki yıl süreyle erişime kapalı olacaktır.** / Secure the entire work for patent and/or proprietary purposes for a period of **two years. *** ☐
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A copy of the decision of the Institute Administrative Committee will be delivered to the library together with the printed thesis.

Yazarın imzası / Signature .... **Tarih** / Date 03.02.2020