Service Area Capability of Emergency Units Based on Traffic Accidents; Case Study of Samsun

Ridvan Ertugrul YILDIRIM and Aziz SISMAN, Turkey

Key words: Fire Stations, Emergency Stations, Response Time, GIS, Network Analysis

SUMMARY

Traffic accidents are one of the most important social problems all around the world today. 1.2 million people have been lost their life by traffic accidents in per year and 20-50 million people have been injured or disabled. When an accident occurred, ambulances and fire vehicles first come to mind as an emergency response team. Depending on the scientific studies, it is represented that 10% of the deaths were occurred in first 3-5 minutes and 54-60 % of the deaths were occurred in 30 minutes It is having important role for performing emergency response facilities in a shortest time by the team of experts. Besides expert teams and modern equipment, real time instant conditions must be considered. Traffic volume, number of vehicles on the road of emergency vehicles, road conditions, driver's behaviors and giving way to emergency vehicles are different life conditions which are effect response time. The best way for providing life-property safety and to minimize or preventing the casualties is using Geographical Information System (GIS) and Technologies with its comprehensive functions. Thus through the queries and analysis functionalities of GIS, it is aim to enable for providing availability of the emergency fields, evaluation of current position of the emergency response units/stations and siting the new emergency response units/stations with using the current and actual accident data and information. In this study, for all mentioned above, cases which occurred in 2014 in Atakum, İlkadım, Canik and Tekkeköy districts which are located in Samsun city and responded by Fire Brigade and Ambulance Stations are using for buffer, density and network analysis methods. In studies response time determined between 5-8 minutes for rescue and medical emergency cases. In this study 8 minute is taken as the maximum response time and the coverage area of the rescue and medical emergency station are examined.

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1. INTRODUCTION

Traffic accidents are one of the most important social problems all around the world today. 1.2 million people have been lost their life by traffic accidents in per year and 20-50 million people have been injured or disabled. The traffic accidents are rising as a critical challenge in most of the world countries (WHO, 2009). World Heathy Organization (WHO), it is supposed that the death within injuries would be fifth orders among the all causes of deaths towards to 2030, and also it is highlighted that the range of death of 10-24 ages are the first. Depending on the Turkish Statistical Institute (TUIK) outputs of 2009 for Turkey, generally, 2886 traffic accidents occurred in each day and 12 people was dead and 552 people was injured (TUIK, 2010). So, the traffic accidents are called as a public healthy and security problems in Turkey. Knowing the occurring time and reasons of the mortal or injury traffic accidents are so important based on determining the measures to be taken and effective use of limited financial resources. For this reason it is certain that the mapping of the traffic accidents with spatial data is essential for management of the all traffic accidents.

Depending on the scientific studies, it is represented that 10% of the deaths were occurred in first 3-5 minutes and 54-60 % of the deaths were occurred in 30 minutes. It is clear that it is important for the first response by the authorized persons for decreasing of the mortality and injured rates in accident scenes. So this state is the beginning of the first and emergency aid organizations systematically within the Ambulance Services (Demirhan, 2003, WHO 2008), and also the rescue operations are another important point as the responding part. The rescue operation is all the periods for the beginning of rescue actions to provide to delivering the injured person to health care center with Ambulance Services (Ankara BSB, 2013). The rescue actions are provided by fire rescue teams and additionally the other rescue units such as AFAD and AKUT as well. The fire rescue and response team and units are responsible for intervene and extinguish fire, traffic accidents, and accidents at work, earthquake, flood and landslide. For establishing of the fire rescue teams, the population, physical situation and geographical state are so important (Law Information System, 2013).

2. RESPONSE TIME

As all other emergency cases; in fire and rescue cases, “conscious” first response to be done as early and fast as possible is the most effective method to prevent loss of life and property (NFPA, 2010). This time frame named as “response time” in technical literature is crucial in emergency cases. In medical cases, along with different approaches to the response time, it is defined in various studies that, basically, during danger of a heart attack or respiratory tract diseases therapy, the first 4-8 minutes are important. While Peleg, at al. (2004) defines the first response time as 8 minutes, Cromley (2010) states it as 6 and 8 minutes in his study (Peleg, at al., 2004, Cromley, at al., 2010).

In studies that take part in literature as first response time in fire cases, 3 and 8 minutes time frames are defined. While Yang, at al. (2007) defines the first response time as 5-8 minutes, Habibi, at al. (2008) defines it 3-5, Challands, (2010) 4-7 minutes and Catay (2011) as 8 minutes (Yang, at al., 2007, Habibi, at al., 2008, Challands, 2010, Catay, 2011).

It is understood from these approaches that first response time is the most critical parameter to control emergency case (Hacioglu, 2010). First response time includes the periods of taking emergency call, interpreting it, leaving the station, travel time and preparation of response time (NFPA, 2010). Except from travel time, all time frames among all of these may be managed at their best rate with well-educated and having high sense of mission staff; however, travel period depends on numerous uncontrollable factors such as case's location being in the first place, road condition, traffic volume and driver attitudes. Controlling all of these factors is impossible, but determining the station's location at the most proper area will facilitate to reduce travel time (Sisman and Yildirim, 2014).

3. STUDY AREA

In this study, cases which occurred in 2014 in Atakum, İlkadım, Canik and Tekkeköy (Figure 1) districts which are located in Samsun city and responded by Fire Brigade and Ambulance Stations are mentioned. Cases have been recorded at monthly statistic tables by Department of Fire and Ambulance stations. In this study 1509 cases were determined listed in statistic tables. The addresses of the cases were examined and allocated in map.

Figure 1. Study area

In the first stage of study, road network (Figure 2) belonging to working area was organized by digitizing the map which constitutes the transportation infrastructure of Samsun.

Travel time is the major factor which affect the response time. But, travel time is affected by various factors; such as traffic volume, driver habits, quality of road networks, etc. Average travel speed is one of the most important factors which affect the travel time. While organizing road network, roads were classified as; main road, street, branch road and alley. Besides, different average speed is determined for each class and transferred to data base. In this study average speed of the different type of roads were determined using vehicle trace system data (Table 1). The

vehicle trace systems collect the position, speed, maximum speed, driver name of the vehicles etc. Average speeds were determined using three months vehicle tracking data for four types of road.

Table 1. Average speeds of road types

Road Type	Fire Rescue (km/h)	Ambulance (km/h)
Main Road	40	50
Street	30	37.5
Branch Road	25	31.25
Alley	15	18.75

Figure 2. Road Network

Locations of cases which are mentioned in the study as a separate layer are indicated by digitizing on the map and feature information of all cases was provided. According to statistics about 1500 accidents occur each year in center of Samsun and hundreds of people injured and dozens of them lost their lives in these accidents (Figure 4).

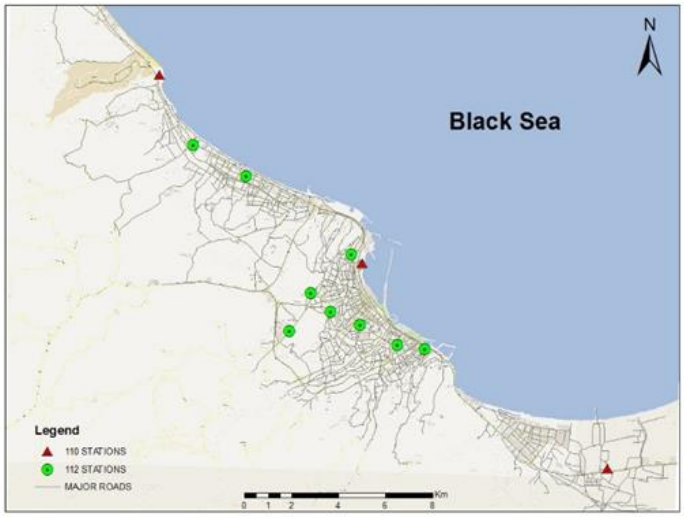

Figure 3. Stations in the study area

This study was included nine ambulance (call 112) stations and three fire (call 110) stations (Figure 3). Detailed address data (i.e. local district and street) were obtained for all emergency ambulances and fire brigades traffic accidents call out locations (Figure 4). The positional data of the ambulance stations, fire departments and emergency calls were also digitized and uploaded into the ArcGIS 10.1 software and evaluated together according to the response time coverage area.

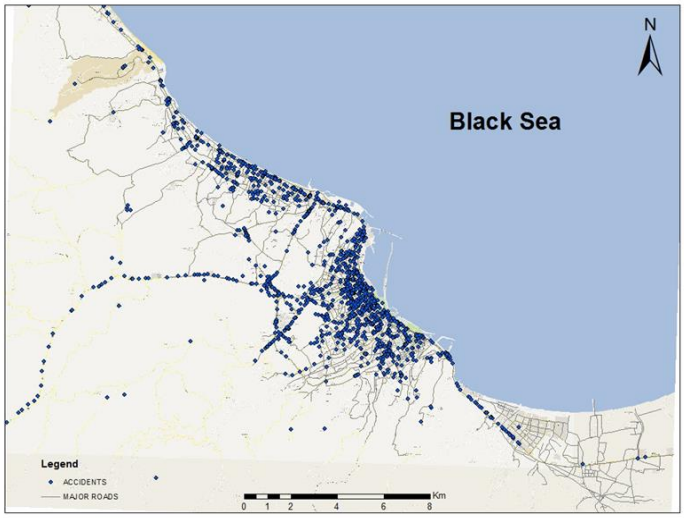

Figure 4. Cases in 2014

4. APPLICATION

Main purpose of this study was analyzing existed fire stations and ambulance stations response sufficiency and capability at a particular time frame according to responded traffic accidents by Samsun Metropolitan Municipality Department of Fire and Samsun Emergency Ambulance Services in 2014.

In accordance with road network map, network analysis is performed in GIS network analysis and according to determined road speeds of present three fire stations and nine ambulance stations, coverage areas within 8 minutes time frames which are in first response time and referred as travel time are examined by network analysis.

Fire Stations can response 914 per 1509 accidents, its shows us that %60,56 coverage (Figure 5). Ambulance Stations can response 1401 per 1509 accidents, its mean that %92.84 coverage (Figure 6). But when traffic accident occur fire and ambulance services first come to mind. So intersections of coverage areas give more correct results. After combine coverage areas, 898 per 1509 accidents are in safe area (Figure 7), (Table 2).

Table 2. Coverage rate of cases

	Cases (per 1509)	Rate (%)
Fire Stations	914	60.56
Ambulance Stations	1401	92.84
Combine	898	59.50

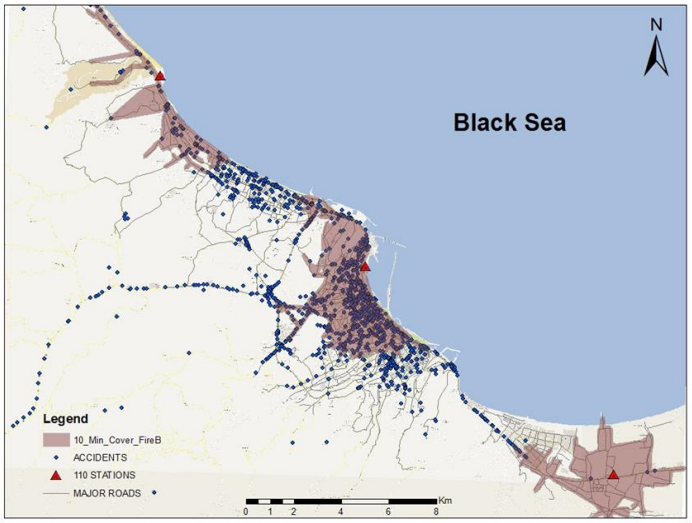

Figure 5. Fire Stations coverage area

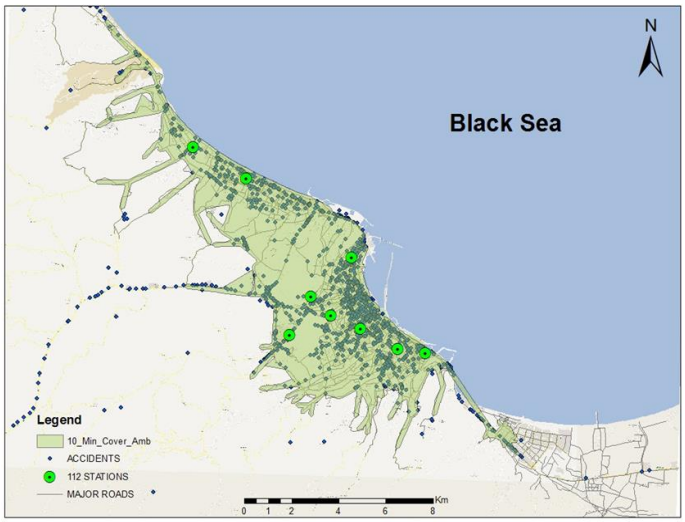

Figure 6. Ambulance Stations coverage area

Figure 5 and Figure 6 shows ambulance and fire stations each ones 8 minutes coverage area. Traffic accidents are requiring multiple intervention. For the realistic approach coverage areas of emergency stations must be evaluated together. For traffic accident invention ambulance services and fire stations coverage areas intersect and the result area is using for realistic coverage area (Figure 7).

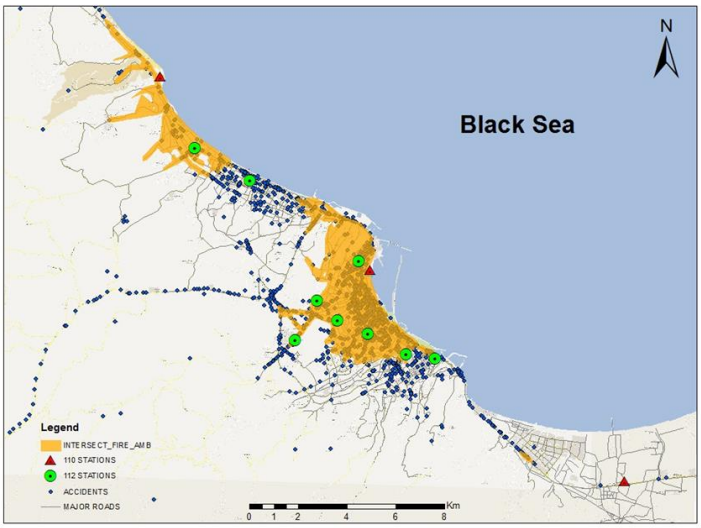

Figure 7. Intersection of fire and ambulance stations coverage area

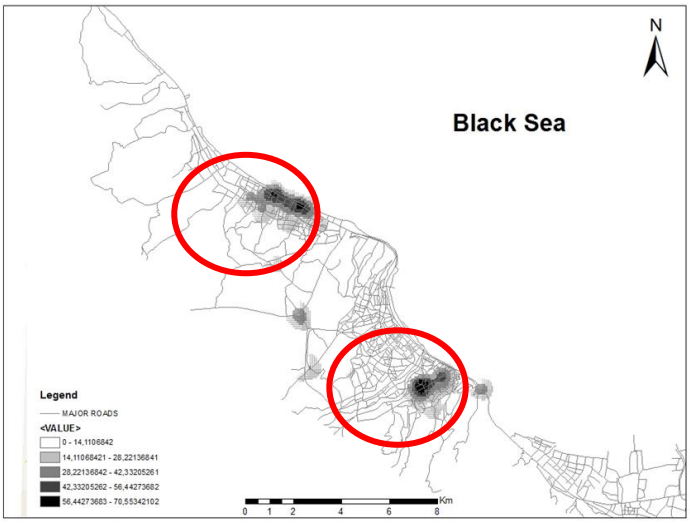

Figure 8. Non-reachable areas

5. RESULTS

The primary goal of this study was to evaluate the coverage area of the existing medical emergency and fire stations and to determine the need for new stations according to the response time approach which was determined from the previous work in the literature.

As a result of examining the locations of station units and cases in 2014, it is seen that fires are become dense in İlkadım and Atakum districts and response of fire and ambulance stations to the traffic accidents occurring in İlkadım district is sufficient due to the locations of stations. But combined coverage area show deficient coverage areas in south of İlkadım district and southeast of Atakum district. The reason of this situation fire and ambulance stations cannot always work simultaneously and cannot reach one traffic accident at the same time, all time.

Result of study non-reachable areas determine with density analysis and this indicate new station needs (Figure 8).

An increase in number of vehicles and growing populations will be cause more traffic accidents. Numbers of died and injured people shows this accidents one of the most important reason to losing human life. To solve this problem new stations are needed which define locations with network and density analysis.

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BIOGRAPHICAL NOTES

Ridvan Ertugrul YILDIRIM
Graduated from Karadeniz Technical University, Department of Geomatics Engineering in 2013 Trabzon, TURKEY.
Still continues his postgraduate studies at Ondokuz Mayıs University, Samsun, TURKEY.
Working in Ondokuz Mayis University as a research assistant since 2014.

Aziz SISMAN
Graduated from Karadeniz Technical University, Department of Geomatics Engineering in 1994 Trabzon, TURKEY.
He was completed his Phd education Yıldız Technical University, The Graduate School of Natural and Applied Sciences in 2006
Still Working in Ondokuz Mayis University as an Associated Proffesor.

CONTACTS

Ridvan Ertugrul YILDIRIM
Ondokuz Mayis University, Faculty of Engineering
Korfez, Atakum District, 55139
Samsun
TURKEY
Tel.: +903623121919 /1048
Email: ridvan.yildirim@omu.edu.tr
Web site: https://personel.omu.edu.tr/en/ridvan.yildirim