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Message from the Editor-in-Chief

TOJSAT welcomes you. TOJSAT looks for academic articles on the issues of science and technology. The articles should discuss the perspectives of academics and researcher. It contributes to the development of both theory and practice in the field of science and technology.

The aim of TOJSAT is to help students, academics, teachers and communities better understand what technology and science are. The submitted articles should be original, unpublished, and not in consideration for publication elsewhere at the time of submission to TOJSAT. It provides perspectives on topics relevant to the study, implementation and management of technology and science.
This journal was initiated in January, 2011 to share knowledge with researchers, innovators and practitioners. We are delighted that a lot of researchers, academics, practitioners, educators, teachers, and students from around the world have visited last five issues between January 01, 2011 and April 01, 2014. It means that TOJSAT has diffused successfully new developments on science and technology around the world. We hope that this volüme 4 issue 2 will also successfully accomplish our global educational goal.

We are always honored to be the editors of TOJSAT. Many persons gave their valuable contributions for this issue. I would like to thank the editorial board of this issue.
TOJSAT, Sakarya University, Governor State University and Ohio University will organize International Science and Technology Conference (ISTEC 2014) (www.iste-c.net) in December 2014 in Doha, Qatar. TOJSAT also supports Sakarya University to organize International Educational Technology Conference (www.iet-c.net) in Chicago, USA and International New Horizons in Education (INTE-2014) (www.int-e.net) in Paris, France.

For any suggestions and comments on the international online journal TOJSAT, please do not hesitate to contact with us.

April 1, 2014
Editor-in-Chief
Prof. Dr. Aytekin İŞMAN
Sakarya University

Dear Tojsat Readers,

This is the volume 4, issue 2 of the Journal of Science and Technology which covers the whole areas of Science and Technology all over the World. Studies either applied or social sciences that are used to fill in the gap between science and technology. Globally, this century scientific and technological developments are going very fast and importance of the journal will be most important for the papers.

The journal, which covers all scientific and technological subjects, is published 4 times a year. Selected papers of the Science and Technology Conference will be published in the journal.

Prof. Dr. M. Şahin DÜNDAR

Editor, TOJSAT

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Urban Public Bus Adequacy Evaluation Analysis: A Johor Bahru, Johor, Malaysia Case Study

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Abstract: The attractiveness of public transportation to current and/ or future users is highly related upon the adequacy and reliability level of public transportation in an urban area. In order to enhance the strategy development for decision makers as well as transit agencies an evaluation of current situation of urban transportation network is needed. This study aims to evaluate and find ways to improve the performance adequacy of public bus networks in Johor Bahru, Johor state of Malaysia using GIS. Three most effective parameters, namely, drivers' punctuality, ease of accessibility, and bus schedule adherence are proposed for the evaluation of bus routes service quality and evenness. Various factors relative to the effectiveness of the bus routes are processed using geospatial analysis techniques of ArcGIS by means of real-world data. The results show that 18.75 percent of the actual running times are longer than (and thus behind) the scheduled, and 16.67 percent of those shorter than (and thus ahead of) the scheduled. However, the results are considered applicable for urban transportation planning and management in order to not only analyze the efficiency of current working buses but also improve the level of service (LOS) within a certain place of interest, thereby demonstrating that it can provide quick and accurate quality control.

Key words: GIS, Public Transportation, Urban GIS, GIS-T

Introduction

Planning and management of urban areas requires a set of precise and accurate data in a sequence of time from changes in land use plans. Monitoring of these changes is truly core material for planners and decision makers, additionally, GIS , as mentioned above, offers the essential tools in order to analyze the ground surface data that provide the framework of sustainable urban growth and development. Population density analysis, disaster management, crises analyses, land fill cite selections, land management and registration, optimal route selection, transit roads network management, maintenance of Intelligent Transportation Systems (ITS), and so many others are such examples of geographic information systems applications. Arampatzis et al., (2002) presented a model by analyzing the benefits of GIS in urban transportation policies that reduced 50% of Athena traffic based on the number of travels, environmental situation, and energy indicators.

By having the need for keeping relationships and communication with other people, we humans should think to the ways which make us able to efficiently mobilize from one place to another. Undoubtedly, transportation is one of the best solutions to fulfill such needs while virtual communication (e.g., Internet, telecommunication) and mail post are the others. By the term of transportation we may remember the process in which we can physically travel from our origins to destinations. Mobility enables us to separate home from work and visit friends and family, as well as to allow us to do business across a wider region (Gohari, 2011).

In thinking about transportation, it is helpful to make a distinction between systems that focus on the movement of travelers and systems that focus on freight. Therefore, the characteristics and issues of urban transportation networks will be considered in this study.

There are a several modes in the field of transportation that provide opportunities to move a traveler. Although each

mode has its own characteristics and/ or components, there are also some advantages and disadvantages for the mode will be chosen on the basis of cost, capability, routes, safety, and speed. The list bellow briefly summarizes possible modes of a transportation system:

1. Air
2. Rail
3. Road
4. Water
5. Other modes (e.g., pipeline, cable transport, spaceflight)

Transportation is a broad and ubiquitous field- important in a political, social, and economic sense. Everywhere you look, transportation is there. We commute. We drive to shop at the supermarket - and the goods arrived there by truck. We are impacted by the environmental consequences of transportation operations. Transportation is an integral part of our everyday life.

Socially, politically, and economically, transportation is important throughout the world. It can be a major public policy lever. The public sector often makes important public policy decisions through transportation investments. Moreover, it provides connections to other metropolitan areas, to the nation, and to the world. Urban transportation planning and development is therefore a significant activity, both for promoting the efficient movement of people and goods in an urban area as well as for providing a strong supportive role in achieving other community objectives.

Bus transportation system, is one of the most common modes of public transportation in almost all developing countries. Existence of an intercity bus transportation system by considering its accessibility and cost for the passengers could be an efficient way to handle not only the citizens' needs, but to diminish the urban issues. Every action in which we can improve the adequacy of the system is highly helpful to either passengers or reducing the environmental pollutions. Therefore, paying more attention to the part of public transportation (especially bus networks) planning and development causes reduction of the level of personal intercity travels and increasing the capabilities of transportation services.

Therefore, in order to achieve efficient development in public urban transportation management, the decision makers have to understand and implement the concept of sustainable transport. While understanding the concept is an effortless approach, adopting the sustainable transport and do materialize them is always become a problem (Mukhtarah, 2009). The problem with sustainable transport in cities in the world today is that, in most cities, including Malaysian cities, the needs to use public transports are getting less and less due to a lack of managed networks. The most significant issues we can easily observe among urban public transportation users nowadays come from the value of time, fees, service frequency, safety and security, as well as traveling comfort.

There are a number of scientists have been used geographic information systems (GIS) in their studies to solve these kinds of problems (Golnarkar et al., 2009).

As Harvey and Shih-Lung Shaw, (2001) discussed geographic information systems for transportation (GIS-T) have arrived and represent one of the most important applications of GIS. GIS-T applications cover much of the broad scope of transportation. Transportation analysts and decision makers are using GIS tools in infrastructure planning, design and management, public transit planning and operations, traffic analysis and control, transportation safety analysis, environmental impact assessment, hazards mitigation, and conFigureuring and managing complex logistics systems, just to name a few application domains. GIS-T can play a central role in the new environment for public land use and transportation decision making. By allowing a wide range of information to be integrated based on location, GIS-T fosters (but certainly does not guarantee) a holistic perspective on complex land use and transportation problems. GIS-T allows analytical and computational tools to be used in conjunction with detailed representations of the local geography, allowing analysis and problem-solving to be adapted to the local context. GIS-T can also reduce the gap between analysis and communication, allowing greater public input into analytical decisions such as choice of data, modeling, assumption and scenario development.

Geographic Information System (GIS) is a powerful tool that provides the simultaneous access and usage of a computerized system. GIS can generate a variety of thematic maps by overlaying a number of data layers to analyze

the area which is in interest. These systems are able to perform different spatial and non-spatial operations as well as data management and manipulation. This kind of characteristics made GIS to be known as a handy tool in which increase the decision making ability. Nowadays, GIS assists humanity in technological, industrial, environmental, economic, social, and thousands of disciplines. By having GIS in hand, people, especially managers and decision makers, can save their money and time.
GIS maps are interactive. On the computer screen, map users can scan a GIS map in any direction, zoom in or out, and change the nature of the information contained in the map. They can choose whether to see the roads, how many roads to see, and how roads should be depicted. Then they can select what other items they wish to view alongside these roads such as storm drains, gas lines, rare plants, or hospitals. Some GIS programs are designed to perform sophisticated calculations for tracking storms or predicting erosion patterns. GIS applications can be embedded into common activities such as verifying an address (Getis, 2008).

Problem and Methodology

Land transport such as road and rail transport is the main mode of transportation in Malaysia. To coordinate all activities, the Land Division of The Ministry of Transportation plays a crucial role as a generator and driving the development and implementation for National Transport Policy throughout the country.
To meet the general requirements, the land division designed a various public transport policies to ensure that public land transport sector remains as safe and efficient as possible based on current needs. According to the Road Transport Act and the Railways Act 1991, the enforcement and regulatory duties are under the roles and responsibilities of agencies such as the Road Transport Department (JPJ), Department of Railways, Railway Assets Corporation (RAC), Road Safety Department (RSD) and the Institute of Road Safety Research (MIROS). All of these agencies are regulated by a set of units such as Unit LRT, KTM Unit, Roads Transport Unit and NTTCC Unit directly.

Johor Bahru, with approximately 900,000 in the city population, and nearly 2 million in the metropolitan area, is the second largest urban area in Malaysia after Kuala Lumpur. The rapid urbanization causes Johor Bahru, like many Asians cities, to face increased demand in efficient urban public bus transportation.
In general, there are about 600 buses in Johor Bahru operating on 117 routes which owned and managed by 6 bus companies in order to serve its citizens' intercity mobility needs. Even though the current public transport is accessible to a large number of the city population, but a modal split ratio- the process of separating person trips by the mode of travel usually expressed as a fraction, ratio, or percentage - at 30:70 is not in favors of public transport to private vehicles (Mukhtarah, 2009). Based on the current modal split it can be said that the most trips in Malaysian cities has shifted towards the private automobiles.
Based on the researches conducted by Mukhtarah, 2009 on the automobile dependency of Johor Bahru citizens, and Annamalai, 2008 on the public bus data management in Johor Bahru, there are a number of evidences that severely convey the necessity of considering the current situation of public transportation (especially bus network) in the study area.
Annamalai, 2008 denoted that there is still a kind of conventional methods in the field of data management taking place among six public bus operators. The study has been carried out by the author was to depict the data management condition in Johor Bahru public bus transportation system in terms of the data collection methods and frequency, records keeping, purpose of data collection, use of collected data, analyzing methods, and so on. As an example, only one operator (i.e., Handal Indah) collects the data about its buses punctuality and seat condition which are very important factors for public transportation users. While four operators (i.e., Maju, Handal Indah, S & S, and Triton) have their own department for data management, yet there are only two bus operators which store and analyze their collected data using computer software. Moreover, there is no idea among these six bus operators to assist maps in order to present their analysis results.
Another study conducted by Mukhtarah, in 2009 as to determine whether Malaysian cities are indeed automobile dependent based on several parameters. Johor Bahru and two other cities (Muar and Batu Pahat) were the study areas in which a number of factors that play roles in urban automobile dependency were surveyed. Among those factors, mode of travel, vehicle ownership, satisfaction by public transportation, waiting time, and safety are most

related things that can be used to recognize the citizens' issues facing to choose public transportation as their traveling mode.
The followings are some responds of the 134 Malaysians and non-Malaysians who live in Johor Bahru and were asked during the data gathering of study:

- Only 18.1 percent of citizens prefer to use public transports (either taxi or bus).
- 81.9 percent of them owned at least one car.
- 75 percent severely feel disadvantaged by public transports - they believe that public transports limit their ability to move.
- 67.1 percent go to job by their private cars.
- 69 percent walk more than 400 meters to reach the nearest available transit service.
- 42.6 percent claimed the frequency of public transportations is "good" while 13.4 percent said that it does not cover their area and it is "very poor".
- 47.9 percent respond that waiting time condition and also convenience of public transports is "poor", whereas the same numbers of people believe its safety is "very poor".

Regarding to these issues, there is a need to design and develop the public bus transportation network in Johor Bahru due to not only shift from using private cars to public transport, but to improve the existing services quality. These problems can make the use of public transport systems less satisfying and leads to more serious overcrowding issues. If we, as urban managers, are unable to overcome the problem of public transport in Johor Bahru, the roads would become too congested and will affect the productivity of surrounding major cities, quality of life and overall ability to boost cities in Malaysia as world status cities. Taking note of this problem, and given that transport is an important factor in achieving better employment, health services, education and social services, the improving of current public bus transportation network in Johor Bahru is a subject to attention.
As a matter of fact, reduction the capability of public transportation system in Johor Bahru and managing its performance using Geographic Information System (GIS) can handle most various problems that users may face like inefficient services (high delay and cancellation rates), limited service network, lack of continuity of public transport modes, as well as serious congestion issues.

The key points in this research are to assess the overall performance of the buses working on four sampled routes and also find the percentage of residential land-use that lies inside a certain buffer zone from a given distance to the bus stops in MPJB and MBJBT Regions. The following steps and approaches were needed to achieve this goal:

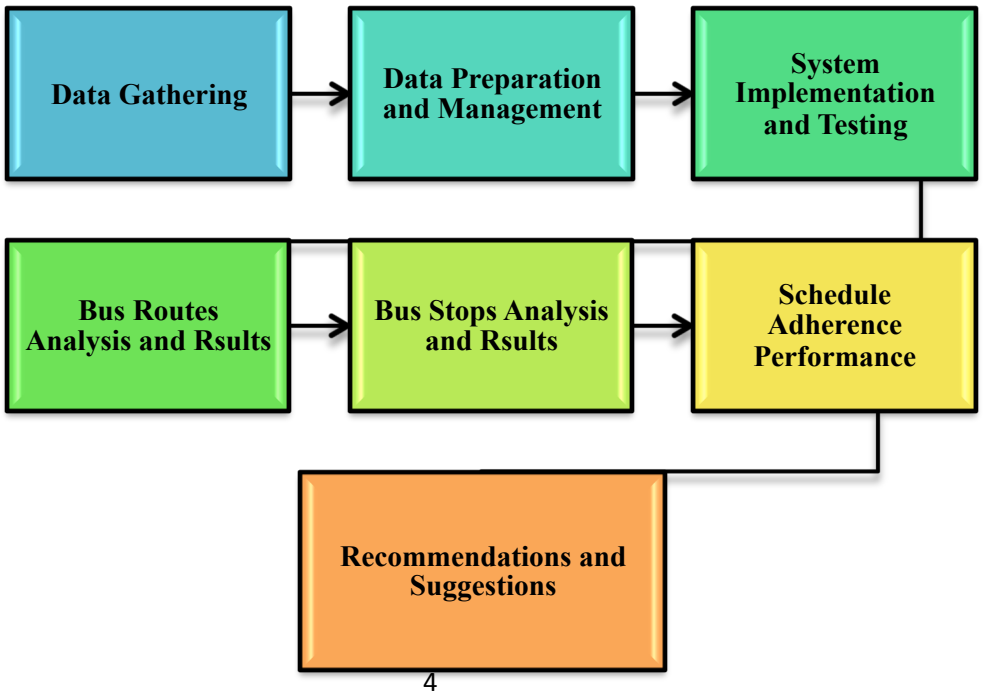

Figure 1: Research Work Flow

Transit Service Coverage and Effectiveness of the Bus Routes: Analysis and Results

Transit service coverage or, in other words, the service area of each bus route which serve citizens of a particular part of city plays a key role on entire quality and also tendency to use of the urban transport systems.
One may not choose to walk for a round half kilometer, especially if it is too hot or rainy, in order to reach the nearest bus stop or any other public transport facilities. The various number of interchanges between modes due to lack of straight stops at the desired destinations could be another factor in this regard.
In Johor Bahru, from users' opinions surveyed by Mukhtarah (2009), the condition of public transport services is not at a good level (refer to Figure 2 and Figure 3).

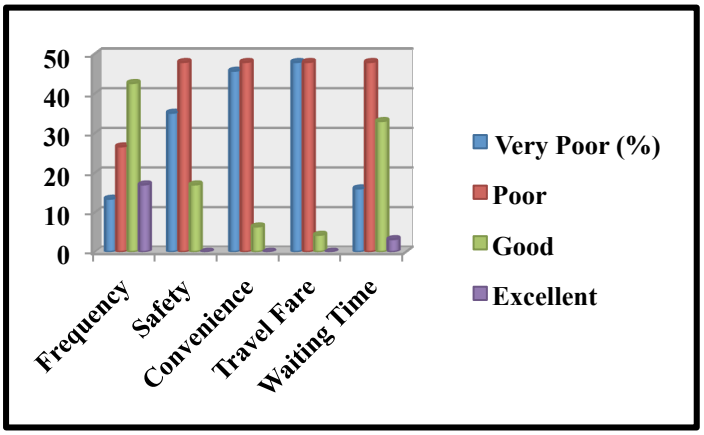

Figure 2: Quality of Public Transport Services in Johor Bahru

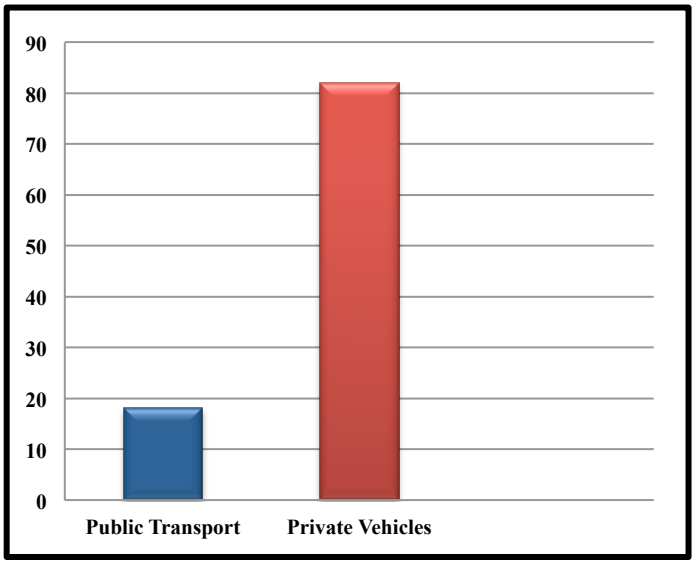

Figure 3: Current Travel Mode in Johor Bahru

As a result, 69 percent of the citizens claimed that they have to travel from home to the nearest available transit service for more than 400 meters. Based on Cervero (1998), for transit oriented development to work, the substantial distance between transit service and neighborhood area is within 400 meters.
The situation in Johor Bahru implies that current public bus transport service does not consider the significant walking distance (i.e., 400 meters) that may applicable to transit users. Therefore, this is a vital point to study whether they are attracted to cars and how they view the current level of service offered by local public transport.

Assumptions of the Research:
This research has the following assumptions:

1. It is assumed that bus routes in the Johor Bahru region are adequate if 80 percent or more of the residential or the commercial land-use are located inside a buffer zone of 400 meters from all routes.
2. It is assumed that bus stops in the Birkenhead region are adequate if 80 percent or more of the residential land-use or the commercial are located within a buffer zone of 400 meters from all bus stops.

These two assumptions are based on the author's observations and judgment which will allow a normal person to walk about eight-to-ten minutes to catch a bus provided he can walk 40 meters per minute.

JB- Taman Universiti Bus Route

There are 33 bus stops through an approximately thirty-seven kilometers bus route in JB- Taman Universiti area collected in this study. Nine bus stops out of thirty three are known as peak-hour bus stops in which the bus stops only at them during the morning and evening peak-hour (5 am to 9 am and 5 pm to 8 pm).
Figure 4 shows 33 bus stops alongside the road from Johor Bahru town to Taman Universiti. A buffer zone with a buffer distance of 400 meters was drawn around the existing bus stops using ArcGIS spatial analysis functions.
The resulted buffer zone then superimposed onto the base map layer which includes residential areas as well as urban features. Basically, the aim of this analysis is to depict the areas covered by these 400 buffer zones which have been known as transit service distance or walking distance.

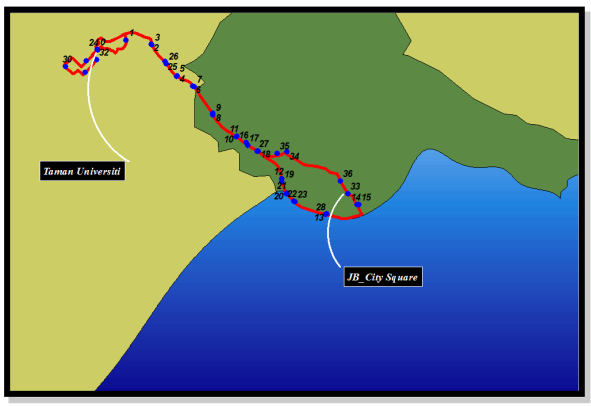

Figure 4: JB-Taman U Bus Route and Bus Stops

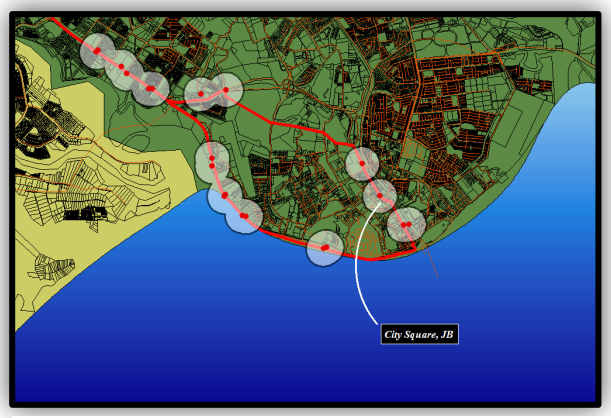

Figure 5: Buffer Zone of 400 meters around Existing JB-Taman U Bus Stops

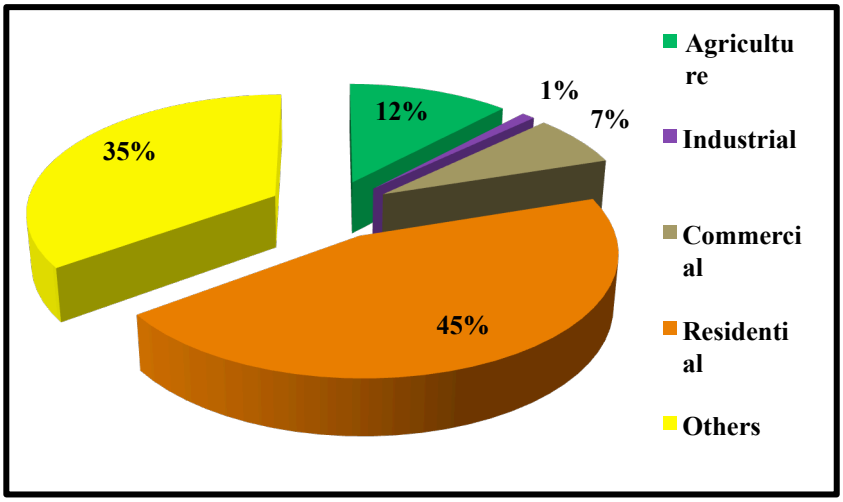

Figure 6: Landuse Types Covered in JB-Taman U

Based on Figure 5, there is a quite long distance (approximately 4 kilometers) over the bus route which does not covered by any bus stop. Looking its nearby features on the base map layer we can say that this roughly 4,000-meter distance between two adjacent bus stops is reasonable due to the current land-use condition.

It is fairly obvious that the above-mentioned residential and commercial coverage area, at 45 and 7 percent in turn, are not far below the level of adequacy for bus stops. In order to make it better, it is thought of increasing the bus stops where needed. By adding these new bus stops, the result of the overlay is much better than the existing condition but still lower than the desired level.

The result showed that 50 percent of the residential areas in Johor Bahru- Taman Universiti region were inside the buffer zone of all bus stops while only 13 percent of commercial and 2 percent of industrial zones were covered. In the case of agriculture area, 8 percent were inside all the thirty-eight bus stops (33 existing and 5 suggested) buffer zone (Figure 7).

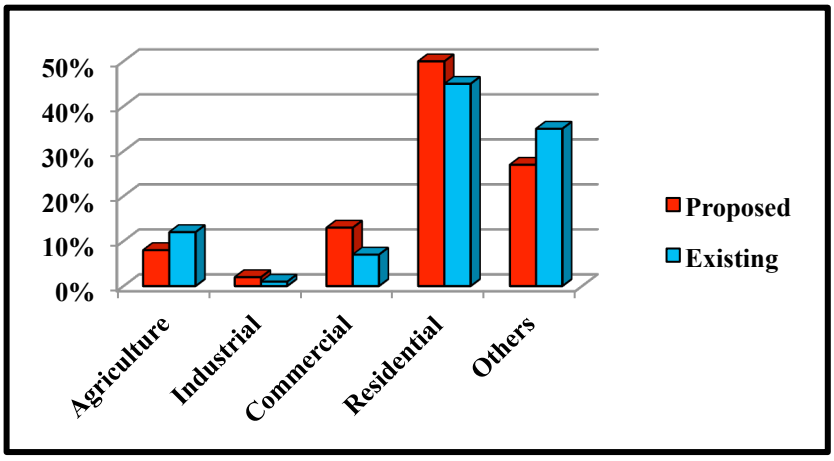

Figure 7: Bus Stops Transit Coverage -Existing vs. Proposed-

JB- Taman Kempas Bus Route

A total number of 36 bus stops have been collected throughout the JB- Taman Kempas bus route which is about 23 kilometers in length. Twenty two bus stops out of 36 are known as peak-hour.
Figure 8 shows 36 the bus routes and bus stops alongside the road from Johor Bahru town to Taman Kempas.

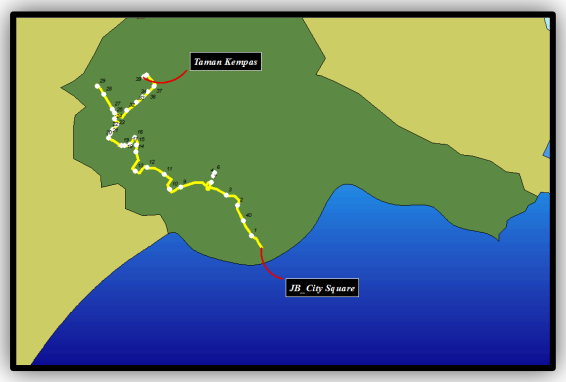

Figure 8: JB-Taman U Bus Route and Bus Stops

Figure 9: Buffer Zone of 400 meters around Existing JB-Taman U Bus Stops

The output of the buffer analysis then superimposed over the base map layer which includes residential, industrial, agriculture, and other urban areas. Figures 9 and 10 show the service area coverage of bus stops along the bus route from Johor Bahru town to Taman Kempas.

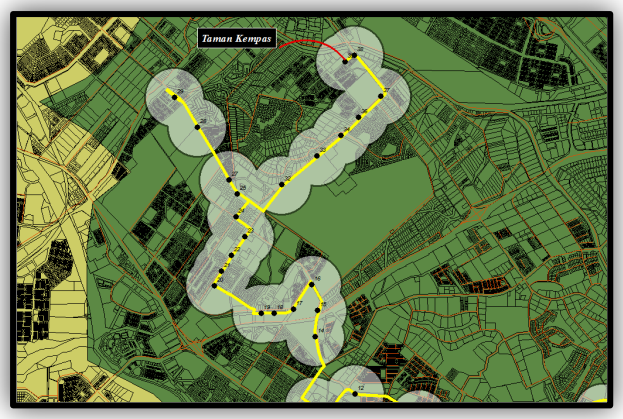

Figure 10: Buffer Zone of 400 meters around Existing JB-Taman U Bus Stops

Based on Figure 11, Residential at 42 percent is the most covered landuse type in JB- Taman Kempas bus route. Agriculture type of landuse with a percentage of 27 is at the second stage. Others type of landuse (i.e., vacant lands, green spaces, water bodies, etc.) with a percentage of 16 is at the third stage. Correspondingly, Commercial, and Industrial regions at 13 and 2 percent out of total area of the city are in the lower levels of landuse coverage by bus stops. So, there is no doubt that in this specific area we do need to not only add some more bus stops to cover wider

residential places but also review the bus route or even redesign it for making the public transport facilities easier to access.

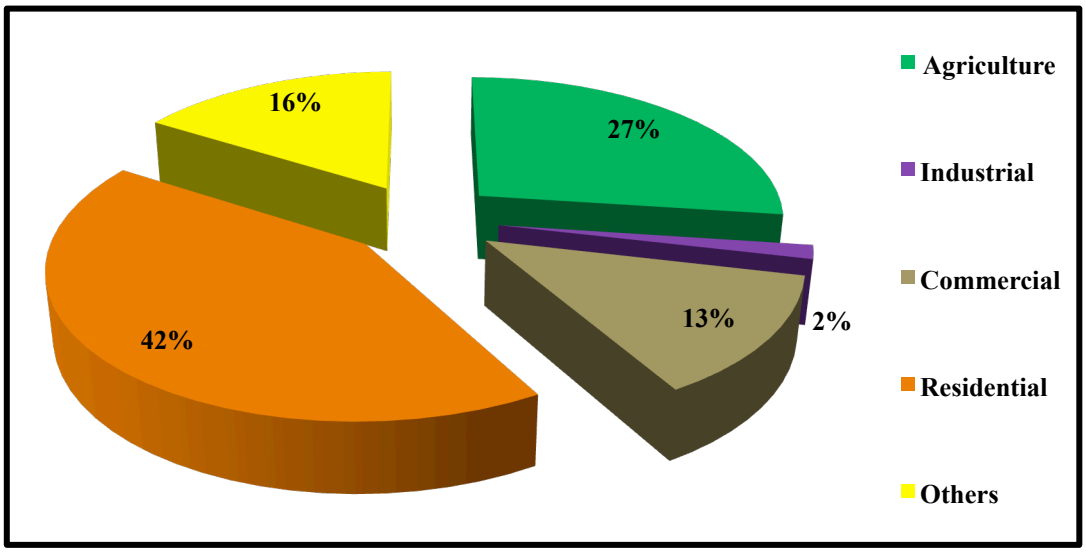

Figure 11: Landuse Types Covered in JB- Taman Kempas

Therefore, there are three suggested bus stops to increase the service area coverage of urban buses through JB-Taman Kempas route. The results showed a 16 percent enlargement in residential areas and also 7 percent decrease in agriculture coverage area as following:

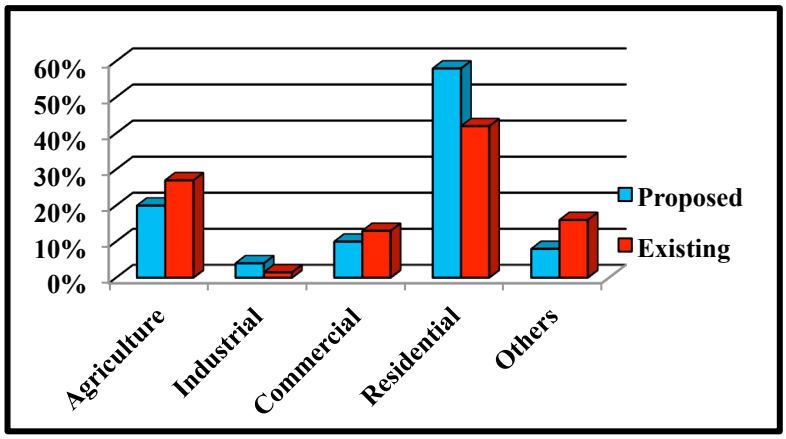

Figure 12: Bus Stops Transit Coverage -Existing vs. Proposed-

Regarding to the Figure 9, it could turn up that there is an approximately 3 kilometers gap between two adjacent bus stops at the junction and right underneath the first suggested bus stop along the bus route. Although, there is a moderately big gap between two bus stops next to each other the landuse type of the certain place is not residential,

commercial, or even industrial. In this occasion, therefore, it has been put into the no need to add new bus stop bucket.
So far we looked into two urban bus routes and analyzed their bus stops' transit service area coverage or walking distance individually. These two bus routes, JB- Taman U and JB- Taman Kempas, but, are serving the public bus users consistently. In order to demonstrate the total service area coverage of them and also to analyze whether bus stops are well positioned, we need to depict both bus routes together. Figure 13 illustrates JB- Taman U and JB- Taman Kempas in concert:

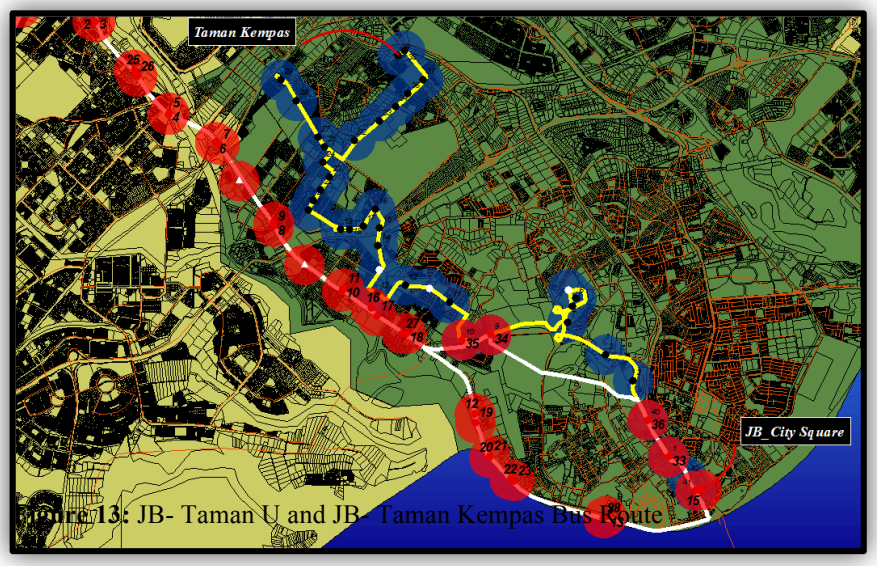

Figure 13: JB- Taman U and JB- Taman Kempas Bus Route

JB- Taman Johor Jaya

The 16.5 kilometers bus route in Johor Bahru- Taman Johor Jaya comprises of twenty seven bus stops in which 16 of them known as peak-hour.
Figure 14 demonstrates JB- Taman Johor Jaya bus route in a single exposure.

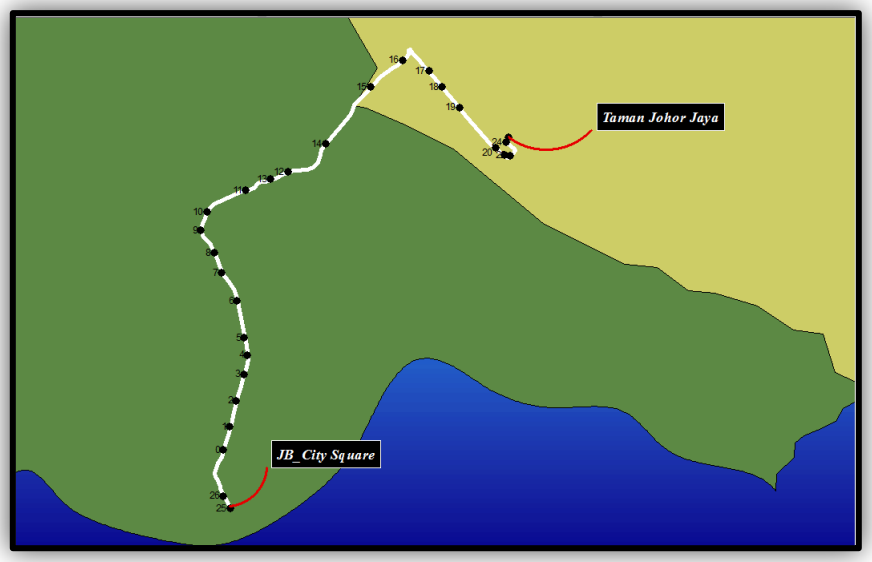

Figure 14: JB- Taman Kempas Bus Route and Bus Stops

From Figure 14, we see that the bus stops through the bus route placed in two municipality areas of JB. The area shown in darker green is MPJB and the one in olive-green hue is called MBJBT. Figures 15 and 16 show the buffered bus stops and landuse types covered percentage in Johor Bahru town to Taman Johor Jaya.
The results from the analysis of landuse types which located within 400 meters around bus stops are presented in the pie chart below (Figure 17). In general, it can be seen that the major landuse type covered by bus stops in JB-Taman Johor Jaya route is Residential at 59 percent. Agriculture type of landuse at 15 percent came in second and what is important in these findings from pie chart above is that only small parts of industrial and business regions (6 percent) could be accessed using public buses.

Figure 15: Buffer Zone of 400 meters around Existing JB-Taman Johor Jaya Bus Stops

Figure 16: Buffer Zone of 400 meters around Existing JB-Taman Johor Jaya Bus Stops

As it can be seen in Figure 18, there are moderate increases in the coverage of residential regions (5 percent) and decrease in agriculture lands (3 percent). It is also important to note that the covered area of mostly vacant areas (i.e., Others) decreased by 5 percent after area calculation of suggested bus stops which means a growth in landuse coverage efficiency by public bus transportation.

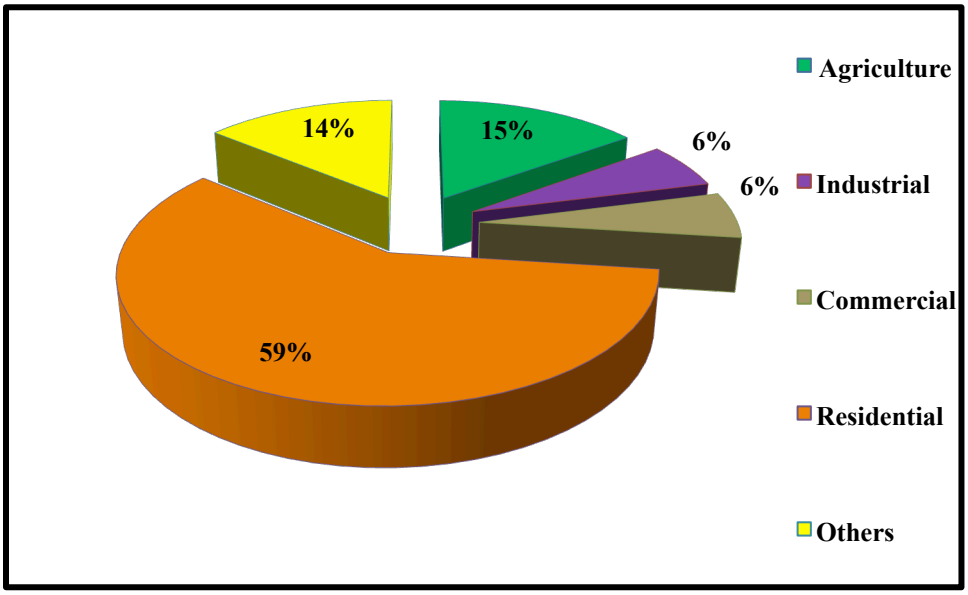

Figure 17: Landuse Types Covered in JB- Taman Johor Jaya

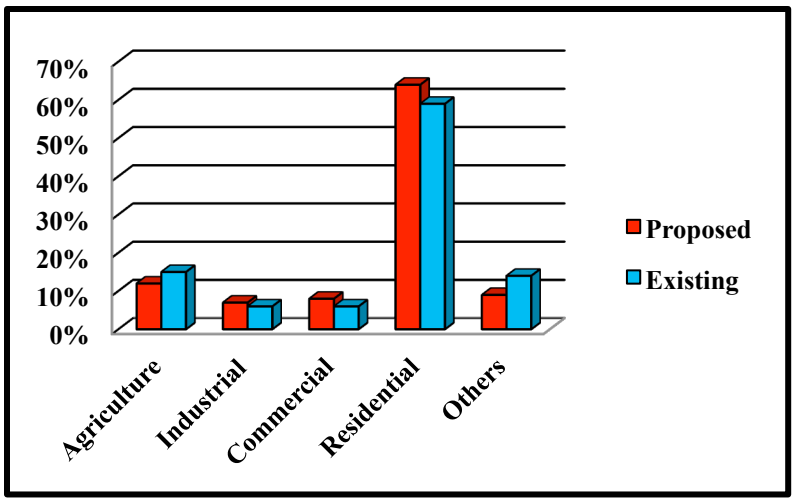

Figure 18: Bus Stops Transit Coverage -Existing vs. Proposed-

Conclusions

The use of GIS in the developed countries started in the late 1960s and early 1970s. Very few departments, however, installed them because of the prohibitive cost of the hardware and the limited capabilities of the software. Since the early 1980s, a marked increase in the installation of GIS is noticed not only in the developed countries but also in the developing countries as well; it is becoming an important component of planning support systems.

GIS and state-of-the-art technologies applications in urban transportation planning have become increasingly popular in recent years. Among the many benefits in using GIS, in this field are: improved mapping, greater efficiency in retrieval of information, faster and more extensive access to the types of geographical information

important to planning, improved analysis, better communication to the public, and speeder access to information for planning application processes.

Existing service reliability on the public bus transit is not as much as enough that can make users to tend to the usage of public vehicles rather than their personals. This study revealed that the actual running time is by some means longer than the scheduled time which is important to the users and, as a result, it saw as a suffering factor for the reliability of transportation system in Johor Bahru.

As a conclusion, it is hoped that whatever information and finding of this research can contribute some meaningful information to public bus operators in Johor Bahru as well as useful for the relevant authorities especially for Road Transport Department (JPJ), Johor Bahru City Council and Commercial Vehicles License Board to design new version of transport policies and implementation for Johor Bahru city. The information in this study also can be used as a reference for future studies as explore and carry out research in depth that relates to the formulation of service quality.

The scope of this study is limited because of some factors like time, data boundary, and cost. From the results obtained, a few possible ideas are pointed out for the future studies in order to not only improve the research result but apply more information useful in decision making process.

As it mentioned earlier, this study focused on only major fixed bus routes in two specific regions of Johor Bahru City namely MPJBT and MBJB. It is recommended that other researches be conducted on other suburbs in the city for more comparison purposes and verification of the findings of this study. Other research can also deal with the number of people using a certain bus route or stop.

Future studies could consider using more extensive data including the daily traffic conditions data to test the effects of additional contributing factors on bus service reliability, thereby offering more practical strategies to monitor and improve the quality of bus service. The conclusions of this research and the inferences drawn from them, therefore, are just uncertain. More accurate conclusions may be obtained if suggested future research can be taken into consideration.

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Evacuation plan as a risk mitigation measure:
Scenario - based time estimation of partial evacuation operation

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Abstract: This paper concentrates on evacuation procedure as a risk mitigation measure for managing and coping with emergency due to flood hazard. Emergency Management has been known as an ever-growing area of academic research in the recent decades. Particularly, Emergency Planning ahead of threatening events is crucial for moving toward a resilient society. Effective implementation of Emergency Contingency Plans during the situation of real Risk Scenarios is mainly a matter of situation awareness, cooperation and collaboration of involved organizations, timely decision-making under stressful circumstances, and availability of resources. Having defined a plan for evacuation operations as a protective measure is necessary for reduction of risk consequences to exposed population. This paper presents partial evacuation time estimations related to vehicle movement time by two methods applied to a case study (San Rocco al Porto, Italy) due to flood event: Time is estimated as a result of modeling by Mesoscopic approach. Second, the "timeline of emergency response for flood evacuation" proposed by Steve Opper is used as a quick handy method to estimate vehicle movement time.

Key words: Emergency Planning; Evacuation Time Estimates; Transport Management; Zoning; Flood

Introduction

According to FEMA definition, Emergency management is the managerial function charged with creating the framework within which communities reduce vulnerability to hazards and cope with disasters (FEMA, 2007). The Emergency management process consists of four phases: Mitigation, Preparedness, Response, and Recovery. Figure 1 shows a schematic view of this process.

According to Perry and Lindell (2003), emergency planning, training and exercising are the key aspects of emergency preparedness (Perry & Lindell, 2003). Planning for emergency as a process during the preparedness phase is crucial for coping with disasters. Although developing an effective emergency plan is necessary, there are other crucial aspects: keeping the plan updated, appropriate cooperation and collaboration, and in general real-time implementation.

Emergency evacuation procedures could be included in Emergency plan ahead of occurrence of threatening events. The implementation however will start after the imminent event is realized.

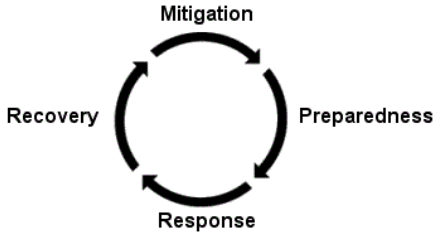

Fig. 1. Emergency Management Process

In order to effectively and comprehensively plan and implement in real time the evacuation procedures, the collaboration of wide spectrum of discipline and expertise is required; beside technical and managerial aspects, the psychological behavior of exposed population should be considered as well. The relevance of some important variables from disaster psychology has been discussed in (Vorst, 2010), in which it is expressed that modeling psychological variables will enhance prediction of human behavior during evacuations. Although this research does not go into such details, some factors in this regard are considered implicitly; for instance, a percentage of people who decide not to evacuate after being warned is assumed, which is influenced by the behavior of people during emergencies.

Evacuation strategies generally vary based on two types of disaster-induced evacuation characterizations: short-notice or no-notice disasters. Short-notice disasters have a desirable lead time between 24 and 72 h (Wolshon, et al., 2001); conversely, a no-notice evacuation takes place when a large-scale and unexpected incident occurs. The evacuation that takes place immediately after the occurrence of such a disaster event is defined as a ‘‘no-notice evacuation’’ (Chiu & Zheng, 2007). Due to the characteristics of hazard in this case study, the second type is our interest since the lead time is in range of few hours.

Irrespective of the diverse contexts of emergency response decisions, no-notice evacuation often entails the following common decision dimensions: To which place (shelters, medical facilities or general safe zones destinations) the evacuees should be evacuated to, which routes they should take and in how much time they should be mobilized in, in order to minimize potential casualties and property losses. In more advanced evacuation plans, which is out of scope of this paper, requirements may arise to permit quick arrival of certain prioritized evacuees (the elderly, hospital patients, or nursing home residents, etc.) at the intended safe zone. This implies allowing them to preempt ordinary evacuees by taking a shorter or less congested route, or overtaking other ordinary evacuees in order to expedite their arrival at intended destinations such as triages, airports, or shelters (Litman, 2006), (Chiu &Zheng, 2006).

Definition of Risk Scenario is a practical way toward having a perspective of what could happen, how, when, and where in the future. “Scenarios are not about predicting the future; rather they are about perceiving futures in the past. The end result is not an accurate picture of tomorrow, but better decisions about the future” (Schwartz, 1996). In this paper we are interested in a flood risk scenario which imposes evacuation of exposed population to predefined shelters.

This paper presents evacuation time estimations by two methods:

First, the evacuation time is estimated by the Mesoscopic Model, which has been simulated by the Cube software. Cube Avenue is the Cube Voyager program for performing dynamic traffic assignment. In our study, the traffic modeling has been performed just from the centroid of each zone (origin) to the shelters (destinations). However, total evacuation time depends on many parameters including the time required for warning, preparation, and so on. The focus of software simulation is on the time required for the movement of vehicles from origins to destinations, which usually consists a considerable portion of the total time.

Second, the “timeline of emergency response for flood evacuation” proposed by Steve Opper is used to estimate evacuation time. In addition to NSW SES (State Emergency Service), some parts of the proposed timeline are also formulated by Lindell. Although the timeline is a basic analysis model and does not contain sophisticated traffic network analysis or real time feedback mechanisms, it is a simple powerful tool; especially, considering the

importance of making decisions under pressure about evacuation and the lives of perhaps thousands of people, the timeline is, at worst, much better than nothing at all. In a flood planning context the timeline has filled a void in which no easily accessible analytical tool were available and it provides a reasonable estimate of evacuation requirements (Opper, 2004).

To justify the effort of this paper, it should be mentioned that the two methods only differ from each other in the phase of vehicle movement time, which, depending on the case study, is expected to be one of the most time-consuming phases of the evacuation procedure. It is obvious that for performing a reasonably accurate traffic assignment analysis, there is a need for updated, precise, and comprehensive database. On the other hand, the second method is simpler and more available, which make it quite suitable and practical in the emergency decision making, although the accuracy is less than that of the first method.

Case Study

The case study is about evacuation of the population of the city of San Rocco al Porto exposed to flooding of Po River. The city of San Rocco al Porto belongs to the province of Lodi of Lombardy region in northwest Italy. It is located on the northern side of Po River, which is surrounded by the vast Po valley. The city has 3582 inhabitants, an area of 30 km², which stretches for about ten kilometers and occupies fully a wide bend of the river Po, which defines the area from the west, south and east. (San Rocco al Porto commune webpage, 2012), (Raggi, 2009), (ISTAT Webpage, 2012). The Po is the longest river in Italy and subject to heavy flooding. Consequently over half its length is controlled with dikes .The slope of the valley decreases from 0.35% in the west to 0.14% in the east, a low gradient. (Zwingle, 2009), (Burghout, 2005).

It is assumed in our scenario that, according to Figure 2, the "San Rocco Al Porto" Town is endangered by Flooding because it is located between embankment of Po River and Border of morphological terrace. Since this is a highly populated area, in case of flooding, it would suffer substantial damage. To reduce the exposure as an important element of risk, an evacuation plan has been developed by Local Civil Protection. The effort of this paper is concentrated on methods for time estimation of vehicle movement phase in order to further improve evacuation planning, management, and operations.

The aim of evacuation emergency operation is to move inhabitants from exposed area to safe shelters, which could be existing buildings like schools, hospitals, and offices. In our case safe shelters are located in the north border of the city since other sides (east, west, and south) are expected to be fully flooded since they are adjacent to the Po River.

There are 48 defined zones all over the city; for implementing evacuation, the origin centroids are considered in the zones 5 to 48. In zones (5-17 and 18-48), households are distributed like residential buildings: zones 5 through 17 are considered in the town, while other zones (from 18 to 48) are regarded as settlements and scattered. On the other hand, zones 1 to 4 indicate the destinations where the safe shelters are located.

Fig. 2. Primary evacuation routes for Sanrocco al Porto.

First Method – Mesoscopic model

Traffic assignment models can be divided into Static and Dynamic network loading models; in Static modeling, variables such as origin-destination flows (travel demand) and choice of the paths, link flows (vehicle volumes), link costs (congested times), and path costs (cost of origin to destination) are constant and do not change during the model period. Dynamic modeling has Time-varying inputs (origin-destination travel demand, average link costs by time segment, and capacities) and outputs (dynamic path/link flows and path/link costs, and trajectories).

Another classification divides traffic assignment models into categories based on the level by which the model is aggregate or disaggregate:

- Macroscopic models, in which vehicles are analyzed globally by studying fundamental variables (flow, speed, density).
- Microscopic models, in which vehicles are analyzed individually, studying vehicles behavior and vehicles interactions (decisions of accelerating or change lane, behavior at intersection, reaction time ...).
- Mesoscopic models try to find a middle solution between macro and micro models, which can study traffic flows over time (Dynamic). In this model vehicles are analyzed as "packets" of vehicles by studying fundamental variables (flow, speed, density)

Mesoscopic model fill the gap between the aggregate level approach of macroscopic models and the individual interactions of the microscopic ones. These models normally describe the traffic entities at a high level of detail, but their behavior and interactions are described at a lower level of detail (Dell'Orco, 2006).

These models consider the traffic as a sequence of "packets" of vehicles. Two approaches can be followed:
Continuous packets, where vehicles are distributed inside each packet, defined by the head and the tail points;
Discrete packets, where all users belonging to a packet are grouped and represented by a single point, for instance the head (Citilabs webpage, 2012).

The packet of vehicles acts as one entity and its speed on each road (link) is derived from a speed density function defined for that link, and the density on the link at the moment of entry. The density on a link is defined as the number of vehicles per kilometer per lane. A speed-density function relates the speed of vehicles on the link to the density. If there is a lot of traffic on the link (the density is high), the speed-density function will give a low speed to the vehicles, whereas a low density will result in high speeds.

In this paper, a Mesoscopic model based on discrete packets has been developed. Simulation of emergency evacuation plans is an important application of Mesoscopic models. For example for small city like San Rocco al Porto, Mesoscopic modeling of vehicle movement for evacuation operation, taking into consideration the available required data, gives the desired level of accuracy. In this research Cube-avenue software has been used to simulate the above mentioned model.

The following scheme gives an idea of three aforementioned models:

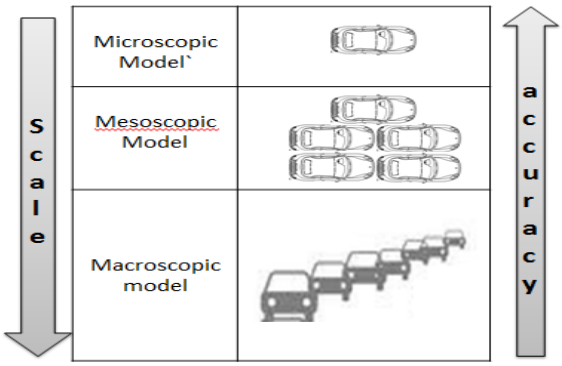

Fig. 3. Three approaches for traffic assignment.

Procedure

As an assumption, in the case of evacuation people and society should handle the situation, so the important thing is to notice whether people have enough number of vehicles to evacuate the risk zone on their own or not. According to the San Rocco al Porto statistics, there are enough vehicles to support the operations.

The model focuses on reaching designated gathering points in each zone, and then to shelters, with least congestion and shortest time. In this regard, four shelters are defined as the destination zones. As mentioned before, the Po River encompasses the city from south, east, and west. As a result the only safe area not expected to be flooded would be the north side of the city, which is appropriate for defining shelters. Moreover, there are 44 regions in the town to be treated as the origin zones. The population of each group of zones will be redirected to the same predefined shelter. These groups of zones will be specified according to two scenarios for zoning. Using Cube AVENUE, the vehicle movement phase of evacuation procedure has been simulated.

Transport offer (supply) is the road network of San Rocco Al Porto. The demand, on the other hand, can be represented by origin-destination matrix, which is defined separately for each scenario. In this case we should build the OD matrix, since the origins and destinations should be determined by the analysis of raw data. Origins are assumed to be defined gathering points (Centroids), and destinations are assumed to be predefined shelters.

In this regard by considering the characteristics of the town itself and also the simplifying hypotheses and Individual data, it would be possible to compute the number of vehicles in each zone to be evacuated. Two scenarios are defined for how people evacuate according to two different zoning schemes. Figure 4, and 5 show these scenarios, which are different in Evacuation Distribution Pattern.

The mentioned data and hypotheses are as following:

- The number of residents is evenly distributed in households (number of residents per household is considered to be constant for all the type of areas)

- Transform household in population considering the average number of inhabitants per household. Population is divided into three categories: Those who have evacuated before the alarm, those who decide not to evacuate, and those who evacuate after the alarm. The latter is our group of concern, which is assume to be 49% of the whole population.

It should be noted that we considered the proximity of the regions as a factor justifying the defined zoning patterns. For example, in both scenarios, the population of the zones characterized by red colour will be redirected to the first shelter.

There are a lot of parameters such as different characteristics of evacuation routes, that are important for deriving the optimum solution for how people evacuate, (i.e. the population of which zones are evacuated to each shelter). However, among different possible solutions just two scenarios are chosen, mainly based on the proximity of zones, and ease of access to main evacuation routes towards the shelters.

To study the sensitivity of evacuation time to zoning scenarios, at least two distribution patterns of zoning should be considered. Of course, the more scenarios are considered, the more accurate the sensitivity analysis would be. As we will see in the results, the choice of zoning affects traffic analysis, and therefore evacuation time.

Scenario_1:

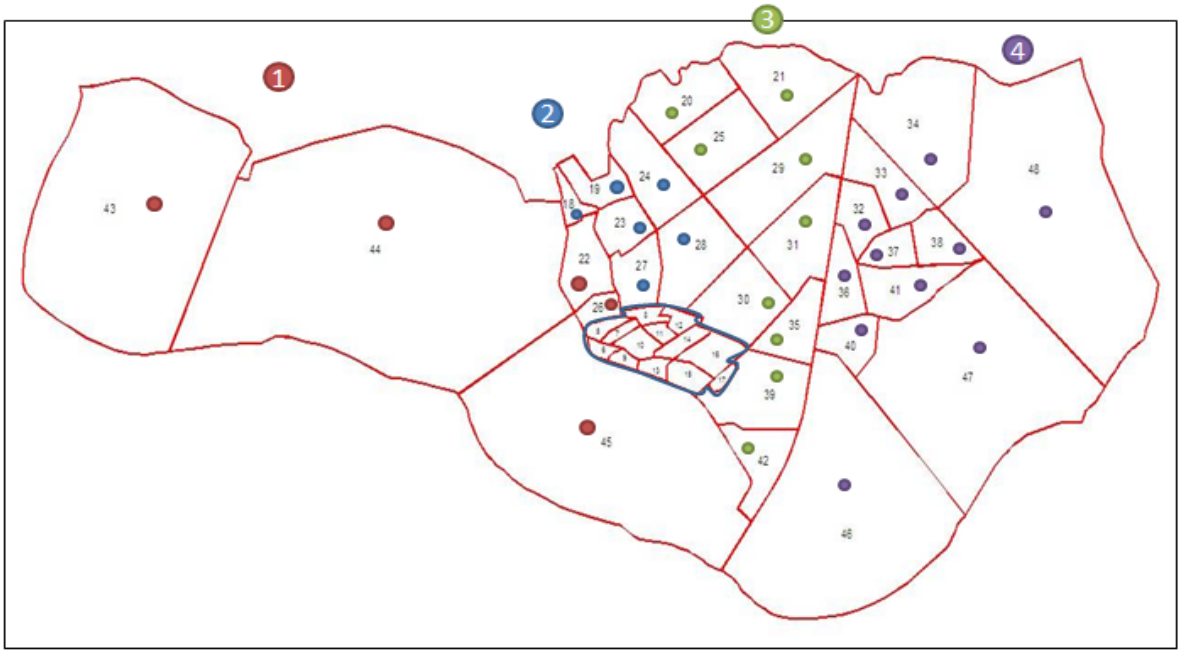

Fig. 4, First scenario of zoning and evacuation

Scenario_2:

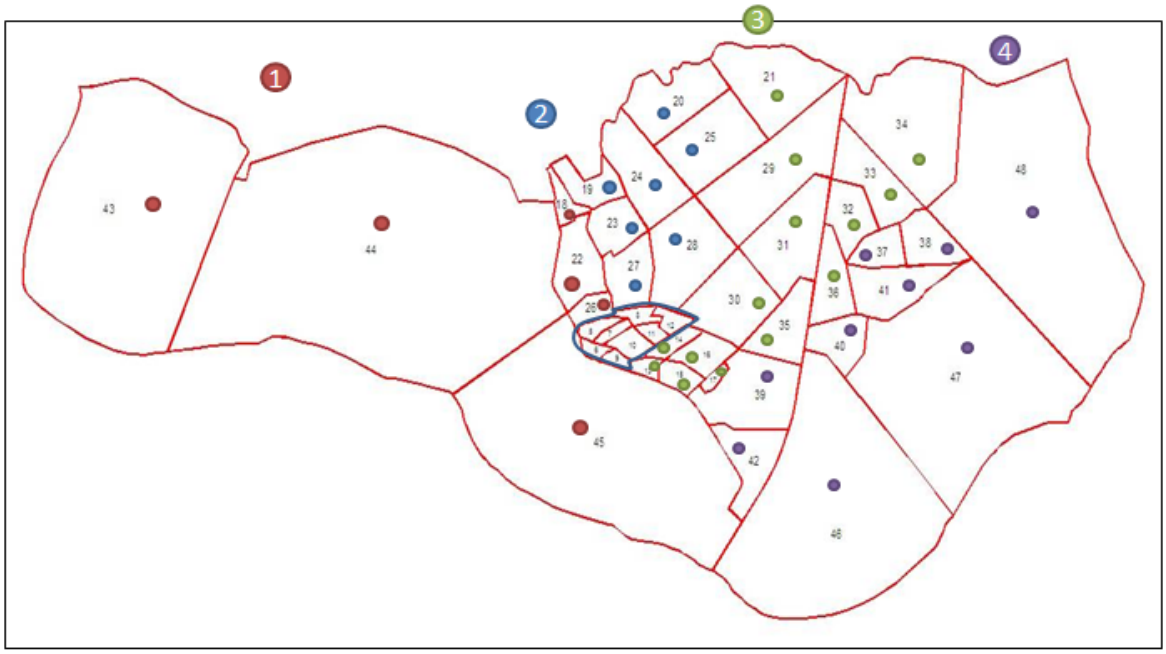

Fig. 5, Second scenario of zoning and evacuation

For each scenario related to the evacuation distribution, it would be interesting to consider two cases in in timing and percentage of people to be evacuated in the considered time intervals. By assuming the evacuation in 15 minutes time intervals during one hour the first portioning would be the case in which 20, 50, 20, and 10 percent of people are evacuated respectively. The second portioning however is that 40, 10, 40, and 10 percent of people will be evacuated respectively in 15 minute intervals during one hour. This one hour duration indicates the time during which all the trips have been generated.

These two types of portioning have been considered for each evacuation distribution scenario, and the results of the dynamic analysis have been derived for each case. It should be mentioned that the packet size is assumed 5, meaning that each 5 vehicles is considered as one packet, for which the analysis is done by the Software.

Before showing the results, it should be noted that for the sake of deriving more accurate results, four intersections located on certain points of the evacuation routes, are considered to be defined in the transportation network of San Rocco Al Porto, which have been simulated by Cube-Avenue.

Cube Avenue Simulation

Cube Avenue is a dynamic equilibrium traffic assignment model. It loads and tracks the movement of vehicle packets throughout the roadway network. Vehicle packets can be of any size, from an individual vehicle up to platoons of 20 or more vehicles. As mentioned before our assumption for vehicle packet size is five.

This software can model traffic signals, roundabouts, stop-controlled intersections, and ramp merges. The modeler can Quantify impacts of upstream traffic congestion, Measure queuing at intersections and merge points in a network, Isolate secondary impacts from one intersection through another, Simulate alternative infrastructure, operational, and policy changes to optimize emergency evacuation plans and strategies, and Test strategies to improve arrival and departure from stadiums and other special-event facilities.

Cube Avenue works with traditional four-step transportation planning models (Citilabs webpage, 2012). It is worth mentioning that the four steps of transportation demand analysis are Generation, Distribution, Modal Split, and Choice of the Route.

Our method simulates the evacuation of the city based on Mesoscopic Model and gives some results regarding to the time needed for the evacuation. Moreover, it considers different scenarios in timing and also in population transfer distributions.

Results

To make a comparison between the four cases, in both scenarios, the second portioning gives a more congested flow at the end of the first interval compared to the first portioning. It is because the percentage of the vehicle being evacuated in the first portion is 20% in the first 15 minute, while this percentage is 40% for the second portioning.

Final evacuation time can be derived by the output of the Cube Software analysis as well. The final evacuation time is the time for which there is no vehicle left on the network anymore, and all the desired trips have been already done. The results of the different four cases are shown in the Table 1.

Vehicle Movement Time (hour)		
	Scenario_1	Scenario_2
Portion_1	2:22	1:31
Portion_2	2:24	1:33

Table. 1. Duration of evacuation by scenarios and portions

It is observed that the portioning (timing and percentage of vehicles to be evacuated), makes relatively negligible difference in the total time of evacuation procedure. On the other hand, the difference of the defined scenarios has an important effect on the final time of evacuation. As observed, the second scenario gives less total time in evacuating people. It can be explained by the characteristics of the 2nd scenario, for which the assigning origin to destination centroids are defined and in a more distributed way; for instance, the most crowded area of the town will be redirected to different shelters in the second scenario, which itself makes the evacuation routes less congested.

Second Method – Timeline Evacuation

The NSW SES (SES Webpage, 2012), has been developing a graphical method for the analysis of flood warning and evacuation scenarios. The method is an adaptation of basic time line management or critical path diagrams. The resulting diagram is a timeline of emergency response for flood evacuation. This method has the advantage of showing how critical the relationship is between flood prediction, evacuation decisions, emergency service response and community actions and the passage of time in a flood.

Figure 6 shows the proposed Schematic Timeline of Emergency Response for Flood Evacuation by NSW SES. A horizontal line represents how much time is expected to be available in a flood with the amount of time available will be influenced by the rate of river rise. Marked off along the line are the points of occurrence of known events e.g. when a flood prediction will be given, when roads will be closed by flooding. Next, in sequential order along the line, the duration of each decision or action is marked off, including safety factors. The resulting time-line can then be used to show participants in a flood planning or response activity what has to be done, when it has to be started, and approximately how long it might take during the flood scenario analyzed (Lindell, 2008).

Procedure

Along the line, the start and end points showing the duration of the common elements in the evacuation process are identified. Some of these elements include: flood prediction; emergency service mobilization; community warning and evacuation traffic movement. Since the evacuation simulation by Mesoscopic model only covers the "Vehicle Movement" phase of evacuation process, in order to compare its results with those of the Evacuation Timeline method, here we are just interested in Vehicle Movement Time. It should be noted however, that the evacuation timeline method covers the entire procedure of evacuation, which is not the case of our research.

The closure by flooding of the last useable evacuation route marks the effective end of the available evacuation time. Its timing with respect to the time required for the evacuation is crucial. If flooding is slow and safety roads are cut after the minimum time required for the evacuation, a safety factors is available and evacuation can succeed even in the case of unexpected events during evacuation (traffic jam, accidents, etc.) If flooding is fast and available time is less than those required by evacuation, other strategies must be planned (Lindell, 2008). The characteristics of the flood event will determine the time available for successful implementation of evacuation. This available time can be considered as a rough estimation of the concentration time of the catchment. However the details about this estimation are out of scope of this paper since our focus in on the time which is needed for vehicles to move on evacuation routes in order to reach from the centroids of zones to the shelters.

To estimate the evacuation time by the aforementioned Timeline, two famous tools can be used. The first tool has been indicated by (opper, et al., 2010), and the second tool has been suggested by Lindell (Lindell & Prater, 2007), (Lindell, et al., 2002). The fundamental assumption in this method is that people evacuate by their own vehicles.

Although the phase of Vehicle Movement Time is our concentration, it's worth to describe all the phases of an evacuation operation in a concise way. According to the Timeline, evacuation is composed of time intervals expressing procedure's phases:

Prediction Time

It is defined as the time required for flood prediction, which can be influenced by factors such as:

- Physical characteristics of the catchment, leading to flood model.
- Data collection, including methods, hardware, and transmission.
- Flood modeling capability, including data, software, and history.
- Human resources, consisting of staff availability, experience, and activation time.
- Weather forecasting capability.

Since the above mentioned parameters are unique for each region of study, an estimation of the prediction time is rather a case specific task.

Decision Making and Mobilization

It is the time required to decide on a course of action and mobilize resources. Decision making in a timely manner is significantly important especially in the case of floods with lower concentration time, when available time from prediction to impact is limited.

A reference value for Decision making and mobilization time is six hours, recommended by NSW SES. On the other hand Lindell method does not provide any estimation in this respect. In fact when catchment response time is too short (e.g. in flash floods) decision making must be anticipated in order to implement evacuation; therefore uncertainty increases.

Warning Time

It is the time required to warn people. The influencing factors for warning time estimation are as following:

- Warning methods which could be door knocking, radio, TV, web, sirens, telephone, and so on.
- Human resources such as staff availability, experience, and activation time.
- Extension and features of area at risk.

According to SES the time required by a two person team to physically knock on the door of a house and warn is equal to five minutes.

According to Lindell, on the other hand, the following formula could be used:

$$P_t = 1 - e(-at^b)$$

In which, "Pt" is the proportion of the households that have been warned at time t. "a" and "b" factors depend on how rapid the warning is expected to be accomplished. For example a=2.5 and b=0.6 are suggested in a case of very rapid warning.

While warning technology does hold great promise in terms of broadening the arsenal of warning methods, the SES is confident that door knocking provides a high degree of warning reliability. Importantly, the SES has found that a very short warning time may not only be unnecessary, it may be entirely counter-productive and lead to traffic congestion or total grid-lock. (Opper, 2004)

Response Time

It is the time required for people to organize themselves for preparation. SES considers a reference value of three hours for response time, which is derived by summation of Warning Lag Factor (WLF), and Warning Acceptance Factor (WAF).

To be noted is that response time must be added to the start of the concurrent traffic movement element. This is done because traffic flow begins only after the first period WLF has ended i.e. literally after the occupants of the

first house warned have begun to depart. WAF takes into account that people usually wait some time before deciding to respond.

Lindell suggests a similar formula to that of warning time however, "Pt" is the proportion of households prepared, and "a", "b" are empirical factors depending on the number of residence per home.

Lindell asked residents to report the length of time they estimated that it would take them to prepare to leave work, travel from work to home, gather household members, pack travel items, install storm shutters, and secure their home before evacuating from a hurricane. A plausible assumption is that tourists would be three times as fast as permanent residents at home. The rationale for this assumption is that transients would only need to pack and check out. For this case "a=0.35 and b=3.00".

Vehicle Movement Time

It is the time required for vehicle to move to safe areas. The two methods for calculating the vehicle movement time are as following:

- SES Method:

The purpose of the model is to produce a best estimate of how much time is expected to be needed for traffic clearance from the area being evacuated. To enable the timeline to be developed some assumption has to be made about the scenario and the number of vehicles.

It may be possible to calculate actual demand on a scenario by scenario basis but the SES has adopted a proxy for maximum vehicle demand. SES model assumes that maximum traffic demand is likely to be based on the total of all private vehicle ownership within the target area (Opper, 2004).

SES considers a traffic safety factor (TSF) to take into account of possible accidents and road interruptions. Moreover, a road reduction capacity factor is considered for taking into account of adverse traffic conditions, heavy rain, and so on.

Vehicle movement time is calculated by the following expression:

$$VMT = N_v / (C_{PER} * f_r) + f_{TSF}$$

In which,

N_v: Number of evacuating vehicles
C_{PER}: Capacity of primary evacuation route.
f_r: Capacity reduction factor
f_{TSF}: Traffic safety factor

To allow for the delays that would be caused by a major traffic incident or a tree/power line falling onto the road, a specific Traffic Safety Factor (TSF) must be added to the calculated traffic movement duration.
To account for and the time needed to attend to a serious traffic incident and get traffic flowing again, it is considered that the minimum TSF is one hour. It was considered that a minimum TSF of 1 hour for traffic flow durations of l-3 hours should be applied. The TSF then increases by 0.5hrs for each additional 3hrs of flow duration i.e. TSF = 1.5 hours for 4-6 hours duration and 2 hours for 7-9 hours duration, etc (Opper, 2004). The following table shows a more detailed of TSF values.

Base Time (Hours)	Safety Factor (hours)	Total Time (Hours)	Base Time (hours)	Safety Factor (Hours)	Total Time (hours)
1	1	2	9	2	11
2	1	3	10	2.5	12.5
3	1	4	11	2.5	13.5
4	1.5	5.5	12	2.5	14.5
5	1.5	6.5	13	3	16
6	1.5	7.5	14	3	17
7	2	9	15	3	18
8	2	10	16	3.5	19.5

Table. 2. Evacuation Traffic Flow Traffic Safety Factors

SES method does not consider an explicit separate parameter for the influence of waiting time in queue, but this effect can be implicitly taken into account in capacity reduction factor. In our case for both scenarios a capacity reduction factor is equal to 0.5.

For the sake of simplicity and necessity of gaining timely and applicable information to support decision making in emergency situation, a simplifying assumption is made: for deriving the number of vehicles to evacuate in each scenario, the zone with longest distance to the safe shelter is chosen, and corresponding number of vehicles is extracted from the available data. It's worth to mention that this parameter is different for the two scenarios because of difference in zoning.

- Lindell Method:

To use this method the following steps are required:

Step1- Compute the Trip Generation Time (TGT); According to Safwat and Youssef's procedure, trip generation time (TGT) - the time required for households to begin evacuating - is assumed to take three hours after local authorities make an evacuation decision. This time lag, which is designed to account for warning dissemination and household preparation to evacuate, implicitly assumes a step function in which no vehicles enter the evacuation route system for three hours, after which time the system immediately reaches capacity (Lindell, et al,. 2002).

Step2- Compute the number of evacuating vehicles.
Considering the population, the number of households and total number of vehicles in the town, a reference value of 1.55 is set for vehicles per household. It is the same assumption made in Cube analysis.

Step3- Compute the vehicle movement time:

$$VMT = tc + tq + th$$

tc: time spent travelling on collectors to the PER (Primary Evacuation Route).
tq: time spent in a queue awaiting access to the PER.
th: time spent travelling on the PER.

The first term (tc) is determined by the speed at which each vehicles travels and the distance from their home to the primary evacuation route. A reasonable value for evacuation travel speed can be considered due to the case study (e.g. 50 km/h). The distance from home to PER varies by household.

The second term (tq) can be computed by using the procedure in which the beginning of warning dissemination is defined as t=0. For each time interval t>1, three equation are solved repeatedly until the time value

tq (total queue duration) is reached at which all households that intend to evacuate have entered the PER (the time value at which At=0 and Qt has returned to zero is tq).

$\Delta Dt=\Delta At + Q_{t-1}$
$Pt= Min (\Delta Dt, C)$
$Qt=\Delta Dt - Pt$

In which:
ΔDt: The incremental PER demand at time t
ΔAt: The incremental access flow on collectors and arterials at time t (which is defined by the TGT distributions)
Qt: size of the queue awaiting entry onto the PER at time t (Q0 is assumed to be zero)
Pt: the flow onto the PER at time t
C: the highway capacity (which is assumed to be a constant value of 80% of normal capacity during the evacuation.

The third term (th) is computed by the calculating the time required for the last vehicle to travel from its point of entry onto the PER to the inland boundary of the risk area.

Each of the parameters above can be calculated by the formulas suggested by Lindell method. It would be interesting to perform a sensitivity analysis in order to understand which parameters have the most important role in minimizing the vehicle movement time. This analysis should be case-specific, and it is not performed here.

In general there is uncertainty about the estimates for many of the input variables, so further analyses should be conducted to determine the extent to which any ETEs (Evacuation Time Estimates) will be significantly affected by changes in the values of these parameters. In particular, these analyses should examine the effects of variation in the distributions of warning times and preparation times, the number of evacuating vehicles per household, the rate of warning compliance and spontaneous evacuation, and evacuee route choice as well as the effects of capacity changes such as lane reversals (Lindell, et al,. 2002).

Result

Taking into consideration the characteristics and the parameters of the case study, reasonable assumptions have been made for the variables and factors in order to calculate the vehicle movement time by SES and Lindell methods.

The table 3 shows the results of the two methods for both scenarios described previously. It should be noted that the two scenarios are the same as what were considered for Mesoscopic simulation in order to make the result comparable:

Vehicle Movement Time (hour)		
Method	Scenario_1	Scenario_2
NSW SES	3:07	2:12
Lindell	1:54	1:21

Table 3. Duration of evacuation by scenarios and methods

It should be noted that due to the difference in evacuation routes of different group of zones in the town, the maximum calculated VMT is considered as the vehicle movement time in order to make sure that the entire process of evacuation has been completed; for instance, in the second scenario, 46 vehicles go to the first shelter, 601 vehicles go to the second shelter, 513 vehicles go to the third shelter, and finally, 44 vehicles go to the fourth shelter.

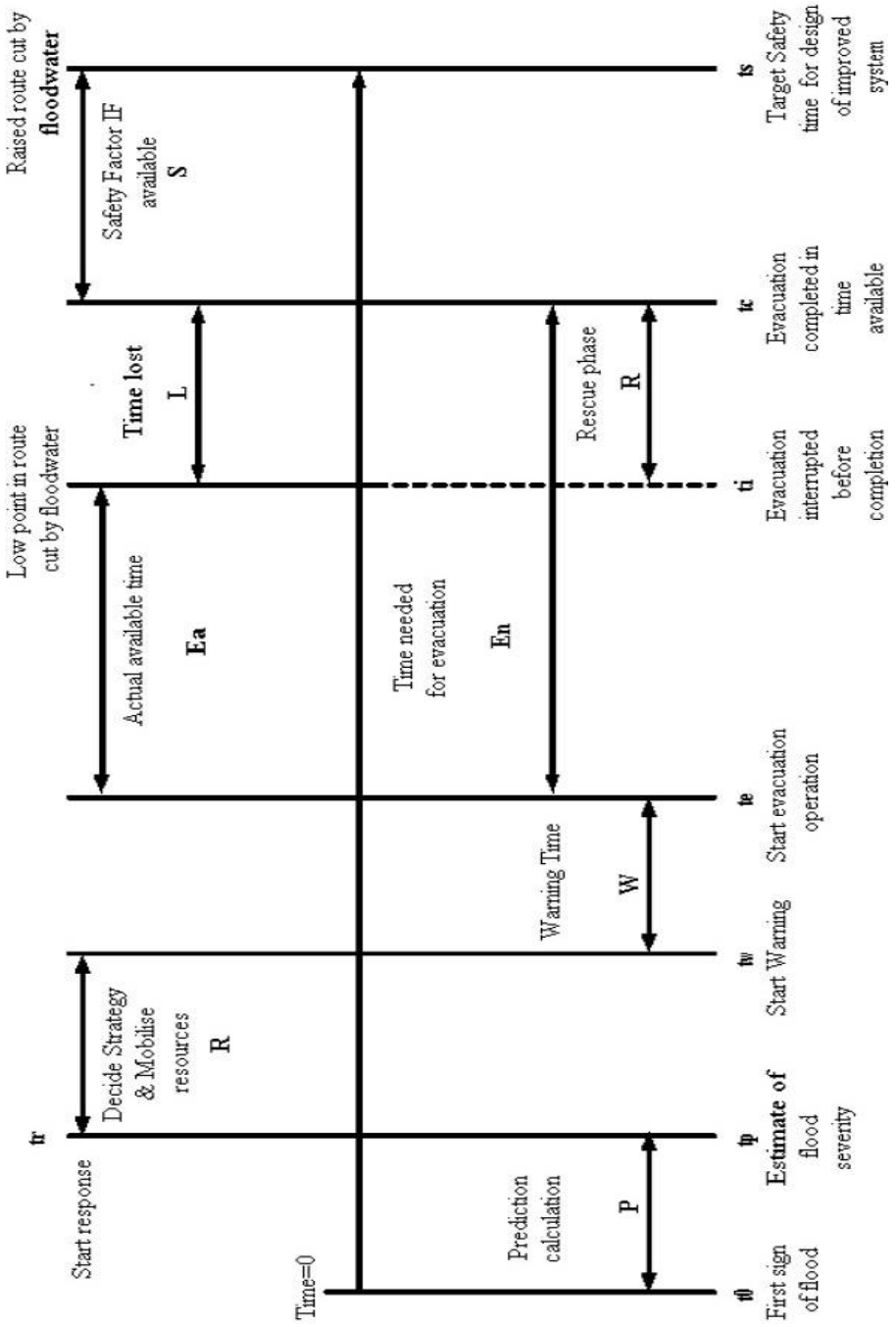

Fig. 6. Timeline of Emergency Response for Flood Evacuation

Conclusions

The two above-mentioned methods only differ from each other in the phase of vehicle movement time, which, depending on the case study, is expected to be one of the most time-consuming phases of the evacuation procedure. It is obvious that for performing a reasonably accurate traffic assignment analysis, there is a need for updated, precise, and comprehensive database. On the other hand, the second method is simpler and more available, which make it quite suitable and practical in the emergency decision making, although the accuracy is less than that of the first method.

The Timeline evacuation method is capable of estimating the time required for entire evacuation operations; although it is not so accurate, it could be beneficial for gaining a perspective of available time for evacuation. In our study, Mesoscopic modeling was used for just the vehicle movement time (VMT) of the evacuation procedure. In order to compare the results of the two models, the focus is concentrated on the vehicle movement phase also in the Evacuation Timeline Method.

According to the table 4, results suggest that the SES method gives a higher VMT with respect to those calculated by Lindell and Mesoscopic methods. On the other hand, Lindell gives lowest values for this part of evacuation process.

Achieved results can be explained by the parameters that each method uses to compute the total time of vehicle movement.

Mesoscopic method which was implemented by Cube software simulation in this study, considers some parameters that enhance the accuracy of the computations; for instance, waiting time before intersections was defined. Also, the simulation is flexible in defining different portions and zones for origins and destinations.

NSW SES Method takes into account a reduction factor for capacity and a TSF factor which can be estimated due to characteristics of roads, probable waiting in queue, possible accidents, road interruptions, heavy rain, and adverse traffic conditions.

Lindell Method considers some parameters in computation of vehicle movement time such as queue time in evacuation routes, and the time needed for vehicles to reach such routes by moving through collectors.

In emergency conditions, using available time in the most efficient way is a crucial factor in coping with unexpected events. Making decisions in such conditions requires timely and actionable information. Having a vision of total evacuation time before its implementation in real time is useful for decision makers to assess whether an evacuation by road travel is totally applicable or not.

One important part of the total evacuation time is the time needed for evacuation vehicles to move on evacuation routes; for deriving the total time of evacuation however, it is necessary to add the time required to response to warnings. While some portions of population have started to move toward the predefined shelters, others are being warned to prepare for evacuation.

An idea for future research is to compare the results of SES and Lindell Methods based on the entire Evacuation Timeline with those of analytical models which are supposed to give more accurate results.

	Mesoscopic		NSW SES	Lindell
	portion1	portion2		
Scenario1	2:22	2:24	3:07	1:54
Scenario2	1:31	1:33	2:12	1:21

Table 4. The summary of results for the Mesoscopic, NSW SES, and Lindell method

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The Determination of the Impact Level of Life Satisfaction, Ecological Perception and Emotional Intelligence on Participating in Recreational Outdoor Sports: Logit Analysis for Turkey Case

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Abstract: The aim of this research is to determine by using logit model, the impact level and direction of variables like ecological perception, emotional intelligence, gender, marital status, monthly income, age, education, occupation and life satisfaction level on participating in recreational outdoor sports.

Sampling group consists of Recreational Outdoor Sport participants like cyclists, mountaineers/rock climbers and hikers whose number is not determined exactly in Turkey and non-participant of any recreational outdoor sports. In this study, electronic questionnaire form which consists of demographics variables, Emotional Intelligence Scale, New Ecological Paradigm scale and Life Satisfaction Scale were used to collect the data. It has been sent to all members of clubs which are bound to Turkish Cycling Federation (TCF) and Turkish Mountaineering Federation (TMF) by using social media between the dates 1th November, 2011 - 31th March, 2012.

As a result of this study, it is determined that; being a man, having a high monthly income, being employed in private sector or self employed person or student increases the probability of participating in recreational outdoor sports. Furthermore, as age, life satisfaction level, the level of supporting the reality of ecological crisis, hegemony of nature, having positive emotional management increase, the possibility of participating in recreational outdoor sports increases too, and, as monthly income decreases, the possibility of participating in recreational outdoor sports decreases also.

***Key Words*:** Ecological perception, Emotional Intelligence, Life Satisfaction, Recreational Outdoor Sports, Logit Model

Introduction

In recent times, the negative affect of city life on individuals has increased individuals' in interests in nature, particularly in outdoor sports. The situation is generally a result of modernity, in connection the individuals' demands who want to be in nature in a way, when looked in the lens of the individuals, this situation constitutes and activity on the other hand, when looked in the lens of the recreation leaders and businesses, it constitutes potential for products and services (Ardahan ve Mert, 2012).

A lot of approaches have been used in the studies amid at explaining reasons why individuals demand or participate in Recreational Outdoor Sports (ROS). While Crandall (1980) claims that the personality and the situation of individual determine the reasons in participating in ROS, Levy (1979) tries to explain participation in ROS with behavior which is the result of interaction between social situations and personality. The best example of this is when a university student starts to dance or climbing, just because his/her friends do these activities. In addition, the existence of relation between recreational demands and the motivating factors which were put forward by Lawler (1973) and David's articles (1983) which are related to recreational experiences and which was accepted as base for

a lot of studies, then have been turned in to Recreation Experience Preference Scale by Manfredo, Driver and Tarrant (1996) in order to explain the structure of recreational need.

In addition, in order to explain why people participate in ROS; Ibrahim and Cordes (2002), "The Need Theory", Deci and Ryan (1985), "The Self-Determination Theory", Pintrich (2000), "The Achievement Goal Theory", Engeström, Miettinen and Punamaki (2003), "The Activity Theory", Knutson (1995), "The Personality Theory" have used. Apart from these, writers such as Bradshaw (1978), Mitchell (1983), Gattas, Roberts, Schmitz-Scherzer, Totarski and Vitanyi (1986) Daghfous, Petrof and Pons (1999) have put forward the there is a relation between the products individual buy and their life styles and values.

So far, plenty of studies relating recreational needs, the reasons of visiting nature the reasons of why individual participate in outdoor sports and why they do outdoor sports have been conducted. However, no studies have examined, besides gender, age, marital status, income, education, and profession, if life satisfaction, ecological sense and emotional intelligence affect participation in outdoor sports and activities or not. It is still not certain why individuals prefer participating in ROS.

The purpose of this study is to define unquestioned aspects of ecological perception and emotional intelligence in other studies and factors as gender, marital status, income, education level, occupation, affecting individuals' participation in ROS and individuals' life satisfactions as independent variables and examine if these factors affect individuals' participations in ROS or not by using logit model.

Materials and Method

This is a definitive research which defines unquestioned aspects of Ecological Perception and Emotional Intelligence (EQ) in other studies and factors as gender, marital status, income, education level, occupation, affecting individuals' participation in ROS and individuals' life satisfactions as independent variables and examine if these factors affect individuals' participations in ROS or not by using logit model.

The scope of study consists of the mountain climbers, rock climbers, cyclists, hikers, and individuals who have never done these sports. The numbers of individuals doing these sports are not defined exactly in Turkey. In this study sampling has been done and an electronic survey has been to send all members of Turkish Mountaineering Federation (MFD) and Turkish Cycling Federation between 1st December 2011 and 31st May 2012. All surveys (1181) which were filled and send back have been assessed. The sampling of study consists of individuals who participate in outdoor sports (n=1181, $\overline{X}_{age}$=35.82 ± 10.61) and who do not participate in outdoor sports (n=538, $\overline{X}_{age}$ =31.78 ± 11.47) the total number is 1719.

In the survey questionnaire form which was developed to collect suitable data, apart from finding out demographic characteristics of individuals who participate in activities such as mountain and rock climbing, cycling and hiking, in order to scale their emotional intelligence EQ scale which was developed by Chan (2004, 2006) and adapted into Turkish, NEP scale which was revised by Dunlap, Van Liere, Mertig and Jones (2000) and which was adapted into Turkish in Erdogan's study and articles that developed by Diener, Emmons, Larsen and Griffin have been used.

The variables used in this study are defined as follows:

Dependent Variable

POS : Participating in Outdoor Sports (If individual does outdoor sports it is, 1, if not, the value is 0)

Shadow (dummy) Variables

Gender: If individual is Male it is 1, if individual is Female value is 0
MS: Marital Status (If individual is single it is 1, if individual is married the value is 0)
Income2: If the monthly income is between 1001-2000 1, otherwise the value is 0.
Income3: If the monthly income is between 2001-3000 1, otherwise the value is 0.
Income4: If the monthly income is between 3001-4000 1, otherwise the value is 0.

Income5: If the monthly income is over 4000, 1, otherwise the value is 0.
Education2: If the education level is High school or equal, 1, otherwise the value is 0.
Education3: If the education level is University, 1, otherwise the value is 0.
Education4: If the education level is Post-Graduate, 1, otherwise the value is 0.
Profession1: If the job of individual is in private sector, 1, otherwise the value is 0.
Profession2: If the job of individual is in public sector, 1, otherwise the value is 0.
Profession3: If individual has his/her own place, 1, otherwise the value is 0.
Profession4: If individual is self-employed, 1, otherwise the value is 0.
Profession5: If individual is a student, 1, otherwise the value is 0.
Profession6: If individual is retired, 1, otherwise the value is 0.

Continues Variables

Age: The age of individual
LS: The Life Satisfaction Level of Individual
HH: The Level of Human Hegemony's superiority
EC: The level of believing in ecological crises
CN: The level of believing in capability of nature
HN: The level of supporting hegemony of nature
EA: The level of emotional assessment
ES: The level of emphatic sensitiveness
PEM: The level of positive emotional management
UEP: The level of utilization of emotions positively

The HH, EC, HN variables are the name of factors which were found by comparing NEP sense of participants and non-participants in outdoor sports, these variables are the result of correcting factor analysis in Ardahan's (2012) study and same set of data has been used. EA, ES, PEM, PEP are the name of factors which were found by comparing EQ of participants and non-participants in outdoor sports and the results have been reached by using correcting factor analysis.

In an econometric model if the dependent variable is binary the most used modeling methods are Logit and Probit. Even though there is a slight difference between these two methods relating probability density functions these two methods generally provide same results.

P_i is the probability of POS variable's taking 1 value, put it differently if it is defined as the probability of individual to participate in outdoor sports, $Li=P_i / (1-P_i)$ is defined as odds ratio and it is the individual's Logit value (Gujarati 2003). The Logit model used in this study is as follows:

$$L_i=P_i / (1-P_i)=\alpha_0 + \alpha_1 Gender_i + \alpha_2 MD_i + \alpha_3 Income2_i + \alpha_4 Income3_i + \alpha_5 Income4_i + \alpha_6 Income5_i + \alpha_7 Education2_i + \alpha_8 Education3_i + \alpha_9 Education4_i + \alpha_{10} Profession1_i + \alpha_{11} Profession2_i + \alpha_{12} Profession3_i + \alpha_{13} Profession4_i + \alpha_{14} Profession5_i + \alpha_{15} Profession6_i + \beta_1 LnAge_i + \beta_2 LnLS_i + \beta_3 LnHH_i + \beta_4 LnEC_i + \beta_5 LnCN_i + \beta_6 LnHN_i + \beta_7 LnEA_i + \beta_8 LnES_i + \beta_9 LnPEM_i + \beta_{10} LnUEP_i + u_i$$

In the equation, α_0 is constant term, α_i, $i\neq0$ are coefficients of dummy variables, β_j are coefficients of continues variables and u_i are error terms. Natural Logarithms of defined continues variables have been included in model. The estimated coefficients have been obtained by using "maximum likelihood" method. Variance inflation factors (VIF) have been calculated in order to find out if there is multicolinearity problem between continues variables. The biggest value of VIF is 2.71. This value is smaller than the top 10 value of high multicoliearity. As a result there is not a problem about multicolinearity. In order to prevent a possible heteroskedasticity problem the robust standard errors of estimated coefficients have been calculated.

Results

In this section the results of Logit model which were estimated by aforementioned will be discussed.

The results of Logit analysis to model the participation in outdoor sports have been given in Table-1. According to this chart the model is significant (Wald chi2(25)=268.51, Prob>chi2=0.000). The gender has a significant affect on participation in outdoor sports. According to model, if the gender of individual is male it increases the possibility of participation in outdoor sports (coefficient: 1.3591, p:0.000). The marital status does not have a significant affect on participation in outdoor sports. While having a low income does not have a significnt affect on participation in outdoor sports having high income has a significant affect on participation in outdoor sports. Having an income between 3001-4000 TL decreases the chance of participation in outdoor sports (coefficient: 0.4581, P: 0.095). However, having an income over 4000 TL increases the possibility of participation in outdoor sports (coefficient: O.5O16, P: 0.090). The education of individual has not got a significant affect on participation in outdoor sports. Having a job in private sector has a positive and significant affect on participation in outdoor sports (coefficient: 0.5873, P:0.040). Similarly, working as a self-employer has a significant affect on participation in outdoor sports (coefficient: 0.9806, P: 0.016). Furthermore, being a student increases the possibility of participation in outdoor sports (coefficient: 0.5277, P: 0.090). Belonging to other profession groups does not affect participation in outdoor sports significantly. Age has a significant affect on participation in outdoor sports. The older the individual get the bigger the possibility in participation in outdoor sports is (coefficient: 0.8748, P: 0.000). The level of LS has a significant affect on participation in outdoor sports. The higher the LS get the bigger the possibility in participation in outdoor sports is (coefficient: 0.8748, P: 0.000). The level of human hegemony's superiority has a negative and significant affect on participation in outdoor sports. The higher The HH gets the smaller the possibility in participation in outdoor sports get (coefficient: 0.6367, P: 0.007). The level of believing in Ecological Crisis has a positive and significant affect on participation in outdoor sports (coefficient: 0.9226, P: 0.003). Similarly the level of supporting hegemony of nature has a positive and significant affect on participation in outdoor sports (coefficient: 0.7013, P: 0.059). The level of positive emotional management (PEM) has a positive and significant affect on participation in outdoor sports (coefficient: O.9608, P: 0.015). The level of utilization of emotions positively (UEP) decreases participation in outdoor sports significantly (coefficient: 1.6667, P: 0.001). The level of believing in capability of nature (CN), The level of emotional assessment (EA) and The level emphatic sensitiveness (ES) do not have a affect on participation in outdoor sports.

Table 1: Logit Model For Outdoor Sport Participation

Variables	Coefficient	Robust St. Error	z	P-Value
Cons	-8.7494 ***	1.3445	-6.51	0.000
Gender	1.3591 ***	0.1294	10.50	0.000
MS	0.1141	0.1460	0.78	0.434
Income2	0.2149	0.1904	1.13	0.259
Income3	-0.1616	0.2152	-0.75	0.453
Income4	-0.4581 *	0.2746	-1.67	0.095
Income5	0.5016 *	0.2957	1.70	0.090
Education2	0.5651	0.4160	1.36	0.174
Education3	-0.1524	0.3991	-0.38	0.703
Education4	0.6193	0.4544	1.36	0.173
Profession1	0.5873 **	0.2854	2.06	0.040
Profession2	0.4372	0.3181	1.37	0.169
Profession3	0.2539	0.3271	0.78	0.438
Profession4	0.9806 **	0.4051	2.42	0.016
Profession5	0.5277 *	0.3113	1.70	0.090
Profession6	-0.3982	0.3539	-1.13	0.261
LnAge	1.6776 ***	0.3253	5.16	0.000
Ln LS	0.8748 ***	0.1996	4.38	0.000
Ln HH	-0.6367 ***	0.2349	-2.71	0.007
Ln EC	0.9226 ***	0.3071	3.00	0.003
Ln CN	0.4126	0.2845	1.45	0.147

Ln HN	0.7013 *	0.3714	1.89	0.059
Ln EA	0.5611	0.4386	1.28	0.201
Ln ES	-0.4268	0.4278	-1.00	0.319
Ln PEM	0.9608 **	0.3949	2.43	0.015
Ln UEP	-1.6667 ***	0.5183	-3.22	0.001
N	1719			
Wald chi2(25)	268.51			
Prob > chi2	0.000			
Pseudo R2	0.1544			
Log peseudolikelihood	-903.3304			

* Significant at 0.10 level, ** Significant at 0.05 level, *** Significant at 0.01 level

Discussion

In a lot of studies, it is claimed that gender has a positive affect on motivation on participation in recreational activities and it is asserted that because of the social habits, sub-culture expectations and structures which are supported by family and professions male are more active and relaxed about recreational preferences. Even though lately the gap between males and females has been getting thinner ROS is under hegemony of males (Ardahan and Lapa, 2010; Floyd, Nicholas, Lee, Lee ve Scoott, 2006; Henderson and Bialeschki, 1991; Lee, Scoott and Floyd, 2001; Wearing, 1999). This claim has been confirmed in this study.

So far any correlation between marital status and participation in ROS has been found. However, individuals who have meaningful and satisfied marriage are more inclined in participation ROS than others (Ardahan and Lapa, 2010; Kalkan, 2012; Kalkan and Ardahan, 2012). Results reached in this study are in line with this fact.

The professions of individual play significant role relating having time for participation in ROS and for interaction with other participators. Some of professions are more advantageous than others. For instance: compared to people who have jobs in public sectors, self-employed, housewife, retired, private sector employees because of managing their leisure times more affectively are more advantageous. Students are advantageous because of opportunities provided by school, getting affected and tendency. Ardahan and Lapa (2010), Kalkan (2012), Kalkan and Ardahan (2012) the results in these studies are in line with this study. In this respect, being employed in private sector, having a self-employed job and being a student are a determent factor in participation in ROS.

Similarly, age has significant affect on participation in ROS. Despite participating outdoor sports as an professional requires to be young since participation can occur irrespective of age even since the older people get the higher individuals' sensitiveness about health expectations get people want to be in nature much more because of pressure coming from friends and family, responsibilities, city life work (Kalkan, 2012; Kalkan and Ardahan, 2012; Ardahan, 2012c; Ardahan, 2012d. These discussions are completely in line with the results of this study.

In fact, the affect of LS on ROS is expected. Even the meaningful difference between participants and non-participants could be seen a sing of this. In these studies, Ardahan (2011), Ardahan and Mert (2012), Ardahan (2012b), Burnett (1994), Hilton (1992), McKenzie (2000), McRoberts (1994), Yerlisu Lapa, Ardahan and Yıldız (2010), it has been found that individual gain positive energy by participating recreational activities and in particular ROS. Given these results, it could be said by participating in ROS individuals raise their level of LS or in order to be positive-inclined persons individuals prefer participating in ROS. The higher the LS get the likelier the participation in ROS get is a significant result which supports previous studies.

Ecological sense which is the main topic of this study has an affect on participation in ROS or participating in ROS activities. NEP scale's sub-dimension Ecological crisis shows that there is and ecological crisis and it defines the faith that if it is not stopped it will ruin the Earth (Dunlap ve oth., 2000). The level of perception of the corresponding variable in Logit model has a positive affect on participation in ROS. In other words, it means that people who believe in the existence of ecological crisis that it will destroy the Earth will be participators in ROS. Non-participators have lower scores than participators in additional scores and this difference is significant statistically. Similarly, the capability of nature has a positive affect on participation in ROS which is sub-dimension in NEP scale which defines the belief that if man-made pollution lowers environment will renew itself. Like in

additional variable non-participators in ROS have lower scores than participators and the difference is meaningful in terms of statistic. When these variables have positive affect HH variable has negative affect even though it was expected otherwise. According to Human Hegemony sub-dimension of NEP scale, which expresses sooner or later humanity will find a solution to stop the ecological crisis, the higher the level of human hegemony gets the lower the participation gets (Erdoğan, 2009; Dunlap and oth. 2000). In other words, participators in believe that humanity cannot find a concrete solution for this problem. The non-participators have higher HH scores than participators and this difference is significant statistically.

The PEM variable in the model is sub-dimension of EQ which defines the durability of individual to struggle with difficulties, responsibilities and difficult situations. As Kalkan (2012), Kalkan and Ardahan (2012) define it, no wonder the spirit of combativeness and the presence of the feature to cope with challenges affects my success in ROS. In terms of EQ the value of PEM variable to be higher means that people can be more combative against these situations. In this it is expected that this value to be higher and has a positive affect. Result is in line with theoretical realities.

UEP variable which defines the level of utilization of emotions positively is the sub-dimension of EQ scale and this scale mostly defines the capability of people to solve problems and using emotional intelligence positively.

Even tough outdoor sports are a sport which is done with other participators it includes processes relating mental and physical performances. In particular, when looked how the participators define their characteristics and seeing themselves inadequate can turn UEP variable into a negative variable in the model. When the value of UEP assessed in terms of participators and non-participators in ROS even though the difference between these two groups is insignificant statistically the fact that non-participators have higher value supports this result.

In conclusion, with Ecological Sense and Emotional Intelligence demographic variables such as gender, marital status, income, age, education, professions and level of life satisfactions of individuals has been defined as independent variable and it has been questioned if these variable have affect on participation in outdoor sports by using Logit Model. If the individuals are male, students, have high income, having a job in private sector, it means they have higher chance to participate in outdoor sports. It has been reached that the higher the age, LS, the level of believing in ecological crisis, The level of supporting hegemony of nature, the level of positive emotional management get the more inclined people to participate in outdoors sports become and the higher the Level of Human Hegemony's superiority and the level of utilization of emotions positively get and the lower the income get the smaller the chance to participate in outdoor sports get.

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Effect of Several Oxides on Ultrasonic Degradation of Formic Acid

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Abstract: In this study, ultrasonic degradation of formic acid was investigated. The effects of several oxides on sonolytic degradation of formic acid were studied. An ultrasonic bath was used and formic acid was sonicated indirectly. The study showed that initial degradation of formic acid with SiO_2 and zeolite was greater than without solid. In the present study, the obtained degradation of formic acid is about 10 %. Hybrid techniques based on sonolysis can be used for higher degradation degrees of formic acid.

Key words: degradation, cavity, formic acid, sonication, ultrasound

Introduction

In recent years, due to the growing need to eliminate hazardous chemical compounds from sewage and industrial effluents, the utilization of power ultrasound for waste water treatment has been explored with great interest. The advantage of this process is based on the fact that reactions can be carried out under ambient global conditions, otherwise application of rigorous conditions such as high temperature and pressure (wet air oxidation and/or incineration) is required.

Sonochemistry is the application of ultrasound to chemical reactions and processes. The origin of sonochemical effects in liquids is the phenomenon of acoustic cavitation. Sound is passed through a liquid as a wave consisting of alternating compression and rarefaction cycles. If the rarefaction wave has a sufficiently high negative pressure, it can overcome the intermolecular forces bonding fluid. As a result, the molecules are torn apart from each other and tiny micro bubbles are created. These micro bubbles gradually grow during compression and rarefaction cycles until they reach a critical size. Subsequent compression causes these cavities to collapse almost instantaneously with a large amount of energy and extremely high temperatures of the order of 5000 K and pressures of the order of 1000 atm are attained. Under such extreme conditions, water molecules dissociate into $OH^{\cdot}$ and $H^{\cdot}$. The radical species can either recombine or react with other gaseous substrates within the cavity. There are three potential sites for chemical reactions in ultrasonically irradiated liquids. A volatile substrate would be readily taken into the cavity and its main decomposition reaction pathway may be one of pyrolysis within the cavitation bubble. The second region is the interfacial zone between gas phase and bulk solution, where large temperature and pressure gradients exist. Therefore, at this site substrate can be degraded by two reaction pathways, either by oxidation with $OH^{\cdot}$ or by thermal reaction. The third possible reaction zone involves the bulk solution, where the decomposition of pollutants might occur by the reaction of ultrasonically produced bubbles of $OH^{\cdot}$ diffusing into the bulk solution. Thus, the reaction zone, or degradation pathways of a particular substrate depends on its chemical nature, for example, its volatility, solubility and chemical structure, etc. Volatile organic compounds may easily undergo direct thermal reactions within the cavitation bubble; however semivolatile or non volatile solutes react at the bubble interfaces or within the bulk solution (Ince et al., 2001; Wu et al., 2001; Nam et al., 2003).

There are several factors affecting the extent of ultrasonic degradation of pollutants, such as; time of destruction, initial concentration of pollutants, intensity and frequency of irradiation, introduction of gas, temperature, solid catalyst, several salts, H_2O_2, pH, different cavitation equipments and the level of coupling fluid (Petrier and Francony, 1997; Ince et al., 2001; Sutkar and Gogate, 2009). The effects of these parameters in the ultrasonic degradation of organic pollutants have been widely investigated in literature (Rajan et al., 1998; Vischer et al., 1998; Naffrechoux et al., 2000; Okuno et al., 2000; Peters, 2001; Kim et al., 2001; Goskonda et al., 2002; Jiang et

al., 2002a; Sivakumar et al., 2002). Effect of each parameter changes with reaction parameters, type of organic compounds and ultrasonic equipments.

Formic acid (methanoic acid) is a colorless , odorous acid , the first and by far the strongest of the unsubstituted series of carboxylic acids. It is miscible with water and most polar organic solvents and somewhat soluble in hydrocarbons. Formic acid is mainly produced as a by product of liquid phase oxidation of hydrocarbons to acetic acid. Large quantities of formic acid are consumed by the textile and leather industries. Small amounts of formic acid are used for coagulating rubber latex, in nickel plating baths, in stripping the enamel from wire and the manufacture of drugs, dyes, flavors,paper, fumigants, pesticides and synthetic perfume ingredients, (Enc.of Chem. Tech., 1980). Formic acid as other lower acids is formed during the oxidation of chemicals including longer chain acids and rate of degradation of formic acid is the rate controlling step in deciding the overall treatment times as well as the efficiency of the process.

There are many studies using different advanced oxidation techniques such as photocatalytic oxidation (Aguado and Anderson, 1993; He et al., 2005), photo-fenton reaction (Rossetti et al., 2004) and catalytic wet air oxidation (CWAO) (Gallezot et al., 1996; Harmsen et al., 1997; Lee and Kim, 2000; Miachon et al., 2003; Iojoiu et al., 2005) for the degradation of formic acid. However, it is difficult to oxidize it by the above methods. For instance, in the case of CWAO, rather high temperatures and pressures are required for oxidation. Sonochemical degradation is capable of being developed into a successful technology for environmental clean up. It is necessary to determine the ultrasonic destruction of formic acid which is obtained from ultrasonic degradation of various compounds to produce a clean effluent. In literature, a few studies have been reported on the ultrasonic degradation of formic acid (Gogate et al., 2003; Bhirud et al., 2004; Gogate et al.,2006).

Gogate et al. (2003) studied the degradation of formic acid using different cavitation equipments such as ultrasonic horn, ultrasonic bath, dual frequency flow cell and triple frequency flow cell. Power and frequency of each equipment is as follows: ultrasonic horn 240W, 22.7kHz; ultrasonic bath 120W, 22kHz; dual frequency flow cell 120W, 25-40kHz and triple frequency flow cell 150W, 20-30-50kHz. They investigated the effect of several parameters such as time of destruction, initial concentration of formic acid, intensity and frequency of irradiation, introduction of air and liquid level in the case of ultrasonic bath on the extent of degradation. Bhirud et al. (2004) investigated efficacy of a novel configuration for large scale wastewater treatment applications using formic acid degradation as a model reaction. Effect of initial concentration of formic acid on the degradation was also studied and comparison was made with the conventional ultrasonic horn in terms of energy efficiency and cavitational yield for the model reaction. In another research, Gogate et al. (2006) studied the degradation of formic acid in a high frequency cup horn type reactor with an aim of understanding the effect of operating parameters on the destruction efficiency. The effect of time of irradiation, initial concentration of pollutant, stirrer speed, presence of sodium sulfite, effect of NaCl addition on the extent of degradation has been investigated.

The aim of this work is to investigate the degradation of formic acid sonicated indirectly using an ultrasonic bath with 40 kHz. In the study, the effects of several oxides were studied on the degradation degree of formic acid.

Materials and Method

Figure 1 shows the experimental set up for the indirect sonication of formic acid. An ultrasonic bath was used for sonication reaction. The ultrasonic bath operates at 40 kHz and at an ultrasound power in the range 70-140 W. Operating temperature of the bath could be regulated between 20-80 °C. Sonication time could be adjusted to a desired value in the range of 1-60 minutes. Aqueous solution with a known concentration of organic pollutant was prepared using ultra pure water and reactor was filled with 200ml of solution, then reactor was inserted into the ultrasonic bath. The volume of coupling fluid (water) was 1700ml. Liquid soap (0.17% in weigh)t was added to improve cavitation.

Reactor was a spherical pyrex-glass flask (83 mm in diameter with a wall thickness of 0.9 mm) with three neck and 250 ml volume. The two necks housed a reflux condenser and gas entrance. Third neck was used to take samples. The position of the flask with respect to transducer was always constant at 2 cm above the transducer. Formic acid was sonicated indirectly to avoid the damage of formic acid to bath surface.

The efficiency of a reaction vessel placed in an ultrasonic bath depends strongly on the distance of the bottom of the reaction vessel to the bottom of water bath. The distance from the bottom was measured so that ultrasonic

intensity reached maximum at the bottom of the flask. The maximum intensity occurs at half wavelength which is a function of frequency used in ultrasound bath. For ultrasonic frequency 40 kHz the distance from bottom was obtained to be 2cm (Goel et. al., 2004).

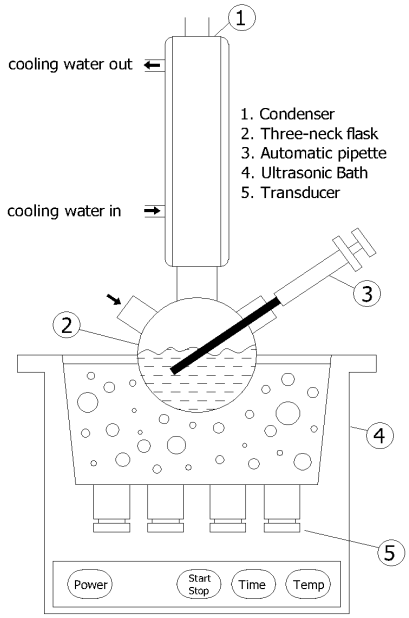

Figure 1: Experimental set up for indirect sonication

Formic acid was obtained from Saf Kimya, Turkey (%85 pure) and used without further purification.

An experiment took 1 hour and all the experiments repeated at least 4 times mostly 7 times. The samples were withdrawn from the reaction mixture periodically. The unreacted amount of formic acid was determined by titration with 10^{-3} M NaOH solution, using 2 % (in weight) of phenol phtalein indicator. Dilute NaOH solution was used so that readings of titration were in the range of 10-14 ml with the least count of burette as 0.01 ml.

The percentage of degradation of pollutant was calculated from equation 1:

$$\text{Degradation, } \% = \left(\frac{Co - C}{Co}\right) * 100 \quad (1)$$

where C_0 initial concentration, C concentration measured at corresponding time.

Results and Discussion

The presence of solid particles affects the cavitational activity in two different and opposing ways, firstly it intensifies the process by providing additional nuclei due to the discontinuities in liquid medium and hence the number of cavitation events may increase but at the same time due to the scattering of incident sound waves the net energy dissipation into the system may decrease (Gogate et al., 2004; Sutkar and Gogate, 2009).

In this study, the effect of TiO_2, Al_2O_3, SiO_2 and natural zeolite on sonolytic degradation of formic acid has been investigated. The experiments with solid oxide were done with different oxide amounts in the range of 0.01g-0.8g at a temperature of 43±3 °C and at a power of 84 W with 200 ml of 300 ppm aqueous solution of formic acid. Experiments for studying the adsorption characteristics of formic acid on the solid particles were also performed because adsorption of formic acid interferes in the determination of concentration of the residual pollutant. It was observed that the adsorption of formic acid on oxides used was negligible.

Experiments for formic acid degradation were done with 0.01, 0.02 and 0.03g TiO_2. There was no response at

0.02 and 0.03g. Degradation with 0.01g of TiO_2 is less than that without TiO_2. Figure 2 shows the results.

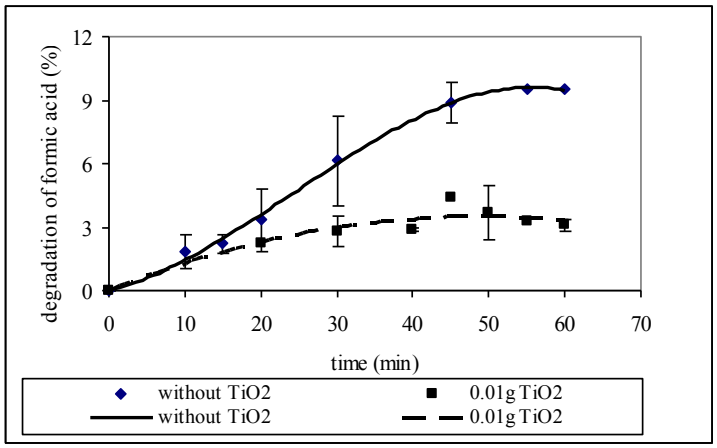

Figure 2: Effect of TiO_2 addition on the degradation of formic acid (power=84W , temperature= 43±3°C, initial concentration =300ppm)

Experiments with Al_2O_3 were made with three different amounts, 0.05, 0.1 and 0.2g of Al_2O_3 for degradation of formic acid. There was no response at 0.2g and nearly the same degradation level was obtained with 0.05g and 0.1g Al_2O_3, but less than that without Al_2O_3. Figure 3 presents the results. It can be said that addition of the above mentioned oxides inhibits bubble formation which causes decreases in degradation degree.

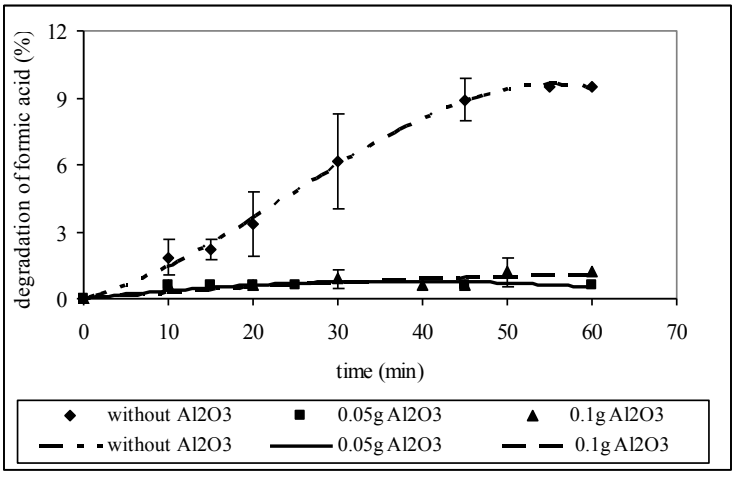

Figure 3: Effect of Al_2O_3 addition on the degradation of formic acid (power= 84W, temperature= 43±3°C, initial concentration=300ppm)

Another oxide tested was SiO_2. Experiments were done with SiO_2 in different amounts; 0.05, 0.1 and 0.2g. Figure 4 shows the effect of SiO_2 addition on the ultrasonic degradation. From the Figure 4, it is seen that initial degradation rate of formic acid with SiO_2 is greater than that without SiO_2, except for 0.2g SiO_2. Degradation of formic acid remains nearly constant after 40 min regardless of SiO_2 amount used.

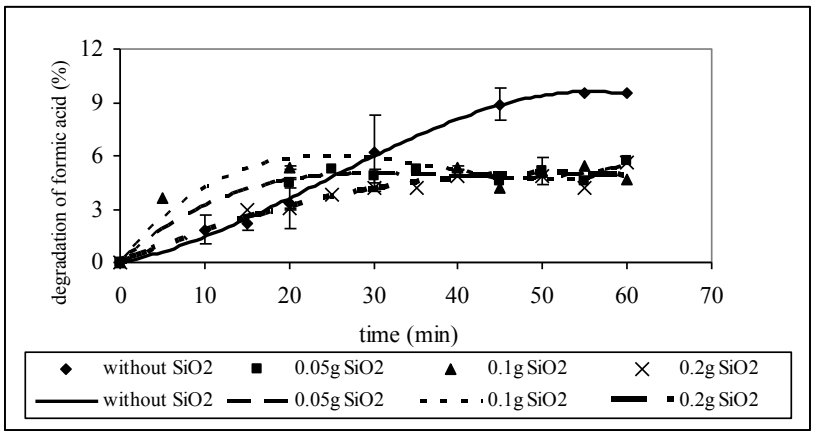

Figure 4: Effect of SiO_2 addition on the ultrasonic degradation formic acid (power=84W, temperature=43±3°C, initial concentration=300ppm)

Figure 5 represents the typical curves for degradation of formic acid as a function of time in the presence of natural zeolite. Natural zeolite is from Bigadiç region of Turkey, it is rich in clinoptilolite with a chemical composition of 78.05 % SiO_2, 2.57 % Na_2O, 1.82 % K_2O, 0.45 % Fe_2O_3, 2.31 % CaO, 6.34 % Al_2O_3, 0.33 % MgO, 8.14 % H_2O.

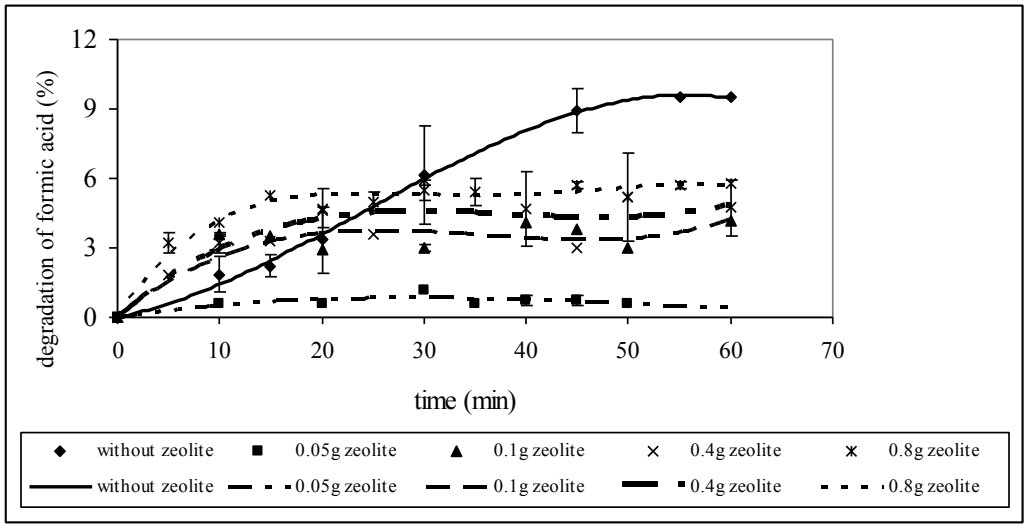

Figure 5: Effect of zeolite addition on the degradation of formic acid (power=84 W, initial concentration=300 ppm, temperature=43±3 °C)

As shown from Figure 5 with 0.05g of zeolite, degradation of formic acid is very small. Initial degradation rate of formic acid increases as zeolite amount increases, but with lower degradation levels than that without natural zeolite. As zeolite amount increases, additional nuclei are provided causing an increase in the number of cavitation events but negative effect of sound scattering becomes dominant resulting in lowering the extent of degradation. The combined effect is observed as lower degradation degrees than that in the absence of zeolite.
In literature, similar and opposite results have been reported in the ultrasonic degradation of several compounds.

Gogate et. al (2004) studied the effect of TiO_2 for sonolytic degradation of phenol at 22.7kHz and 240W for ultrasonic horn. The presence of TiO_2 at 300ppm caused lower extent of degradation as compared with that observed in the absence of solid particles. In the same study TiO_2 (300ppm powdered TiO_2 particles) has positive effect for the flow cell. Drijver et. al (1999) investigated ultrasonic degradation of trichloroethylene (TCE) by addition of CuO but CuO particles didn't enhance the degradation of TCE. It means no extra cavitations were caused by CuO in thew case of TCE. In another study Goel et. al (2004) observed that rate constant decreased with increasing concentration of silica due to the attenuation of energy by scattering of the particles.

Conclusions

In this study, ultrasonic degradation of formic acid was investigated. Formic acid was sonicated indirectly. Effect of several oxides to degradation of formic acid were studied. An ultrasonic bath was used for sonication. This study showed initial degradation of formic acid was greater than without solid.

In the present study, the obtained degradation degree of formic acid is about 10 %. Sonolysis of formic acid combined with other advanced oxidation processes, such as ozonation, UV, photolysis may give better results than the sonolysis method alone.

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The Determination of the Impact Level of Life Satisfaction, Emotional Intelligence and Participating in Recreational Outdoor Sports on Ecological Perception: Turkey Case

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Abstract: The aim of this research is to determine by using regression model, the impact level and direction of variables like life satisfaction, emotional intelligence, gender, marital status, monthly income, age, education, occupation and participating in recreational outdoor sports on ecological perception. Sampling group consists of Recreational Outdoor Sport participants like cyclists, mountaineers/rock climbers and hikers whose number is not determined exactly in Turkey and non-participant of any recreational outdoor sports. In this study, electronic questionnaire form which consists of demographics variables, Emotional Intelligence Scale which was used in Chan's (2004, 2006) study and adapted into Turkish by Aslan and Ozata (2008), RNEP scale which was revised by Dunlap et al. (2000) and adapted into Turkish by Erdogan (2009) and Life Satisfaction Scale which was developed Diener, Emmons, Larsen and Griffin (1985) was used to collect the data. Electronic questionnaire form has been sent to all members of clubs which are bound to Turkish Cycling Federation (TCF) and Turkish Mountaineering Federation (TMF). As a result of this regression model, it is determined that gender, age, monthly income, education level, life satisfaction level, emotional intelligence level, participating in recreational outdoor sports like mountaineering/rock climbing, cycling and trekking have effect on one's ecological perception.

Key Words: Ecological perception, Emotional Intelligence, Life Satisfaction, Recreational Outdoor Sports, Regression Model

Introduction

Recently, even though individual do not cause, because of the products they demand or which are provided by the system to be used, also including second and third houses, the increasing visits to nature with recreational purposes lead pollution (as air, water, earth, appearance and light) on environment The activities such as changing curriculum and changing education processes, focusing on more concerned individuals, campaigns via media, systematic works by volunteer organizations and non governmental organizations, to enhance the sensitiveness of individuals towards nature, and in order to raise awareness have changed people's environmental value, environmental value orientations, environmental attitude, environmental normative value, environmental behavior positively (Homer ve Kahle, 1988; Rokeach, 1973, 1979). This situation naturally has a positive affect on people's ecological sense and conscious.

So far the factors which affect ecological sense and conscious namely environmental value, environmental value orientations, environmental attitude, environmental normative value, have been taken up and examined by a lot of researchers. To sum up, the factors which affect this process positively or negatively are gender, income, type of school, education, age, the place of living, personality, the individual's life paradigm, the affect of environment, ethnicity, family, life style, level of awareness, political opinion, the main politics, level of development in the country, relations, values of friends, belief and religion (Dunlap, Grieneeks ve Rokeach, 1983; Dunlap, Van Liere, Mertig ve Jones 2000; Kim, 1999; Mohai ve Bryant, 1998; Rokeach, 1973; Taskin, 2009; Zinn and Graefe, 2007).

The relation between Recreational Outdoor Sports (ROS) and ecological perception has been examined by a lot of researchers and a meaningful relationship has been found. Dunlap and Heffernan (1975) who are first researchers to advocate the hypothesis "participating in recreational outdoor sports increases the level of ecological perception" has been supported by researchers namely Jackson (1986), Thapa and Graefe (2003), Bjerke, Thrane and Keiven (2006), Berns and Simpson (2009). According to these researchers participating in ROS creates and develops awareness relating environment. So far, no study has been conducted about if there is relationship between ecological perception and Life Satisfaction (LS) Emotional Intelligence (EQ). However, there is a meaningful relation between LS and EQ. The purpose of this study is to build a relation between these variables and ecological perception.

Material and Method

In this study besides demographic variables such as gender, marital status, income, education, the variables such as life satisfaction (LS), the level of emotional intelligence (EQ), rock/mountain climbing, hiking and cycling which were not taken up in other studies but which we think they have an affect on the ecological perception of individuals have been examined and questioned if there is participating in these activities cause an affect on ecological perception of individuals. ROS is restricted by mountaineering, rock climbing, cycling and hiking. The scope of the study consists of individuals who participate in mountaineering, rock climbing, cycling, hiking and non-participators in these activities. The number of these participators is not determined in Turkey. In this study sampling has been conducted and an electronic survey has been send to all members of Turkish Mountaineering Federation (TMF) and to Turkish Cycling Federation between 1st December 2011 and 31st March 2012. The completed 1181 surveys which were sent back have been assessed. The sampling of study consists of 1719 individuals mountain/rock climbers (n=426, $\overline{X}_{age}$=36.12±10.10), cyclists (n=373, $\overline{X}_{age}$ =31.36± 9.73), hikers (n=382, $\overline{X}_{age}$=39.92±10.30) non-participators (n=382, $\overline{X}_{age}$=39.92±10.30). In this study besides questions to learn the demographic characteristics of participators in mountain/rock climbers, cyclists, hikers, and not-participators, the study includes articles in following studies : The EQ scale which was used by Chan (2004,2006) and adapted in Turkish by Aslan and Özata (2008), the New Ecological Paradigm (NEP) scale which was revised by Dunlap and others (2000) and adapted in Turkish in the study of Erdogan (2009), LS scales which were developed by Diener, Emmons, Larsen and Griffin.

The variables used in this study are as following;

HH- Human Hegemony,
EC- the level of believing in ecological crisis,
CN- the level of believing in capability of nature,
HN- the level of supporting superiority of nature,
CYC- If individual cycles 1 otherwise the value is 0,
MNT- If individual is mountain/rock climber 1 otherwise the value is 0,
TRK- if individual tracks 1 otherwise the value is 0,
GEN- Gender, if individual is male 1 otherwise the value is 0,
MS- Marital Status, if individual is single 1 otherwise the value is 0,
Income2- if the income is between 1001-2000 1 otherwise the value is 0,
Income3- If the income is between 2001-3000 1 otherwise the value is 0,
Income4- If the income is between 3001-4000 1 otherwise the value is 0,
Income5- If the income is between over 4000 TL 1 otherwise the value is 0,
Education2- If the education level is high school or equivalent 1 otherwise the value is 0,
Education3- If the education level is university 1 otherwise the value is 0,
Education4- If the education level is post-graduate 1 otherwise the value is 0,
Profession1- If individual works in private sector 1 otherwise the value is 0,
Profession2- If individual works in public sector 1 otherwise the value is 0,
Profession3- If individual runs his/her own place 1 otherwise the value is 0,
Profession4- If individual is self-employed 1 otherwise the value is 0,

Profession5- If individual is a student 1 otherwise the value is 0,
Profession6- If individual is retired 1 otherwise the value is 0,
Age- the age of individual,
LS- The level of life satisfaction,
EA- The level of emotional assessment,
ES- The level of emphatic sensitiveness,
PEM- The level of positive emotional management,
UEP- the level of utilization of emotions positively,

The HH, EC, CN, HN variables are the name of factors which were found by comparing NEP sense of participants and non-participants in outdoor sports, these variables are the result of correcting factor analysis in Ardahan's (2012) study and same set of data has been used. EA, ES, PEM, UEP are the name of factors which were found by comparing EQ of participants and non-participants in outdoor sports and the results have been reached by using correcting factor analysis. In this study the four sub-dimensions (HH, EC, CN, and HN) of ecological perception have taken up as dependent variables and the estimated regression models are as following:

$$\begin{aligned}LnHH=a_0 &+ a_1CYC + a_2MNT + a_3TRK + a_4GEN + a_5MS + a_6Income2 + a_7Income3 + a_8Income4 + a_9Income5\\ &+ a_{10}Education2 + a_{11}Education3 + a_{12}Education4 + a_{13}Profession1 + a_{14}Profession2\\ &+ a_{15}Profession3 + a_{16}Profession4 + a_{17}Profession5 + a_{18}Profession6\\ &+ a_{19}LnAGE + a_{20}LnLS + a_{21}LnEA + a_{22}LnES + a_{23}LnPEM + a_{24}LnUEP + u_1 \qquad (1)\end{aligned}$$

$$\begin{aligned}LnEC= b_0 &+ b_1CYC + b_2MNT + b_3TRK + b_4GEN + b_5MS + b_6Income2 + b_7Income3 + b_8Income4 + b_9Income5\\ &+ b_{10}Education2 + b_{11}Education3 + b_{12}Education4 + b_{13}Profession1 + b_{14}Profession2\\ &+ b_{15}Profession3 + b_{16}Profession4 + b_{17}Profession5 + b_{18}Profession6\\ &+ b_{19}LnAGE + b_{20}LnLS + b_{21}LnEA + b_{22}LnES + b_{23}LnPEM + b_{24}LnUEP + u_2 \qquad (2)\end{aligned}$$

$$\begin{aligned}LnCN= c_0 &+ c_1CYC + c_2MNT + c_3TRK + c_4GEN + c_5MS + c_6Income2 + c_7Income3 + c_8Income4 + c_9Income5\\ &+ c_{10}Education2 + c_{11}Education3 + c_{12}Education4 + c_{13}Profession1 + c_{14}Profession2\\ &+ c_{15}Profession3 + c_{16}Profession4 + c_{17}Profession5 + c_{18}Profession6\\ &+ c_{19}LnAGE + c_{20}LnLS + c_{21}LnEA + c_{22}LnES + c_{23}LnPEM + c_{24}LnUEP + u_3 \qquad (3)\end{aligned}$$

$$\begin{aligned}LnHN= d_0 &+ d_1CYC + d_2MNT + d_3TRK + d_4GEN + d_5MS + d_6Income2 + d_7Income3 + d_8Income4 + d_9Income5\\ &+ d_{10}Education2 + d_{11}Education3 + d_{12}Education4 + d_{13}Profession1 + d_{14}Profession2\\ &+ d_{15}Profession3 + d_{16}Profession4 + d_{17}Profession5 + d_{18}Profession6\\ &+ d_{19}LnAGE + d_{20}LnLS + d_{21}LnEA + d_{22}LnES + d_{23}LnPEM + d_{24}LnUEP + u_4 \qquad (4)\end{aligned}$$

In the equations (1), (2), (3) and (4); a_i, b_i, c_i, d_i, i=0, are constant terms; a_i, b_i, c_i, d_i, i=1,...,18 are the regression coefficients of dummy variables; a_i, b_i, c_i, d_i, i=19,...,24 are the regression coefficients of covariates and u_i, i=1,...,4, are error terms.

In order to estimate coefficients, ordinary least square (OLS) estimator have been used. To find out if there is heteroskedasticity, Breusch-Pagan/Cook Weisberg test has been performed for each model. Since for all four models constant variance hypothesis have been rejected the robust standard errors of coefficients have been calculated.

Results

In Table-1, the results of the estimated regression models in equation (1), (2), (3), (4) have been given. The estimated four models are significant. The results about demographic variables could be seen in the table, cycling has a positive affect on EC, CN, HN but it does not have a significant affect on HH. While the affect of mountaineering and rock climbing has negative on HH, it has positive significant effect on EC, CN, and HN. Participating in trekking activities decreases HH, HN level of participants. While this variable has a negative and significant effect on HH and HN, it does not have a significant affect on EC and CN.

Tablo 1: Regresion Model Results

Depended Variables	**Ln HH**		**Ln EC**		**Ln CN**		**Ln HN**	
Variables	Coefficient	P	Coefficient	P	Coefficient	P	Coefficient	P
Cons.	1.15025 ***	0.000	0.47895 ***	0.000	0.39487 ***	0.001	0.50534 ***	0.000
	(0.1417)		(0.1094)		(0.1231)		(0.1141)	
CYC	-0.00807	0.674	0.06585 ***	0.000	0.05569 ***	0.000	0.06030 ***	0.000
	(0.0191)		(0.0140)		(0.0154)		(0.0133)	
MNT	-0.0502 ***	0.004	0.04948 ***	0.000	0.05813 ***	0.000	0.05438 ***	0.000
	(0.0189)		(0.0139)		(0.0139)		(0.0129)	
TRK	-0.04700 **	0.013	0.00625	0.607	-0.01576	0.258	-0.03504 ***	0.008
	(0.0190)		(0.0121)		(0.0139)		(0.0132)	
GEN	-0.00757	0.624	-0.00429	0.675	-0.01309	0.215	-.02448 **	0.017
	(0.0154)		(0.0102)		(0.0105)		(0.0102)	
MS	0.00261	0.872	0.01634	0.155	-0.01260	0.256	-0.00891	0.347
	(0.0162)		(0.0115)		(0.0111)		(0.0095)	
Income2	-0.02398	0.235	0.00535	0.717	0.00783	0.662	-0.02528 *	0.051
	(0.0202)		(0.0148)		(0.0179)		(0.0129)	
Income3	-0.05342 **	0.024	-0.02662	0.141	-0.00230	0.906	-0.01539	0.284
	(0.0237)		(0.0181)		(0.0196)		(0.0143)	
Income4	-0.03256	0.264	-0.01318	0.518	0.02030	0.392	-0.02616	0.171
	(0.0291)		(0.0204)		(0.0237)		(0.0191)	
Income5	-0.04422	0.162	-0.02525	0.290	-0.03948	0.126	-0.03346 *	0.093
	(0.0316)		(0.0239)		(0.0258)		(0.0199)	
Education2	-0.09660 **	0.012	-0.02190	0.323	-0.03679	0.259	0.03449	0.216
	(0.0384)		(0.0222)		(0.0325)		(0.0279)	
Education3	-0.11017 ***	0.003	0.00423	0.835	0.00949	0.734	0.03257	0.224
	(0.0364)		(0.0203)		(0.0279)		(0.0267)	
Education4	-0.14615 ***	0.001	0.00590	0.808	0.02053	0.509	-0.00358	0.906
	(0.0421)		(0.0243)		(0.0311)		(0.0302)	
Profession1	-0.02514	0.456	-0.03264 *	0.098	0.03682 *	0.099	-0.02025	0.220
	(0.0337)		(0.0197)		(0.0223)		(0.0165)	
Profession2	-0.01877	0.609	-0.01686	0.419	0.02261	0.377	-0.01234	0.504
	(0.0366)		(0.0208)		(0.0256)		(0.0185)	
Profession3	-0.04228	0.260	0.00460	0.835	0.00506	0.881	-0.02949	0.152
	(0.0375)		(0.0221)		(0.0339)		(0.0206)	
Profession4	0.03903	0.363	-0.01831	0.467	0.05195 **	0.057	-0.00170	0.938
	(0.0428)		(0.0252)		(0.0273)		(0.0218)	
Profession5	-0.02297	0.523	-0.05437 **	0.012	0.05103 **	0.057	-0.03513 *	0.088
	(0.03597)		(0.0216)		(0.0268)		(0.0206)	
Profession6	0.08887 **	0.024	0.05119 **	0.039	0.04146	0.131	-0.00027	0.990
	(0.0393)		(0.0248)		(0.0274)		(0.0214)	
Ln AGE	-0.09601 ***	0.005	0.02937	0.249	0.07504 ***	0.004	-0.00084	0.971
	(0.0344)		(0.0255)		(0.0261)		(0.0232)	
Ln LS	0.08387 ***	0.001	0.00096	0.960	-0.06181 ***	0.001	-0.01983	0.302
	(0.0243)		(0.0193)		(0.0185)		(0.0192)	
Ln EA	0.04269	0.444	0.17119 ***	0.002	0.17744 ***	0.008	0.26873 ***	0.000
	(0.0558)		(0.0555)		(0.0667)		(0.0608)	
Ln ES	0.11459 **	0.034	0.06093	0.150	0.05436	0.162	0.10974 ***	0.002
	(0.0539)		(0.0423)		(0.0389)		(0.0357)	
Ln PEM	0.10259 **	0.028	-0.03872	0.383	-0.03670	0.391	-0.01440	0.734
	(0.0466)		(0.0444)		(0.0427)		(0.0424)	
Ln UEP	-0.09642 *	0.060	0.31965 ***	0.000	0.33293 ***	0.000	0.32547 ***	0.000
	(0.0513)		(0.0505)		(0.0649)		(0.0589)	
N	1719		1719		1719		1719	
F(24,1694)	6.42		10.67		9.70		23.12	
Prob>F	0.000		0.000		0.000		0.000	

R-squared	0.07	0.21	0.21	0.36
Root MSE	0.263	0.190	0.205	0.170

Robust st. Error are given in parentheses * Significant at 0.10 level, ** Significant at 0.05 level, *** Significant at 0.01 level

Discussion

The negative affect of Demographic variables gender and being male on the HN which is one of four sub-dimensions of NEP scale measuring ecological perception supports that females are much more sensitive to nature than males and this can be found in the studies of Steger and Witt (1989), Ardahan (2012b). Besides, so far a correlation between MS and environmental awareness has been mentioned in studies. The results of this study are in line with this fact. Income and ecological perception have been examined in a lot of studies. As Öztürk (2005) mentions in his study, most of the time, increasing income is not seen as changing recourse of income, it is seen as an upward process relating education and profession. In the profession pyramid the income of the individual could change because of external factors such as having better education. Having better education means having higher income and getting older leads to upward trend relating career. Acording to Milbrath (1984) even though the income is related to education most of the time income could show a different line than education. In the recreational studies too having better income and education leads to visits far places or participating activities alone or with friends (Kalkan, 2012; Kalkan and Ardahan, 2012; Ardahan and Lapa, 2010). Because of the increasing income and educations, the general consciousness of people increase, and as a result of this, it is normal that in natural sciences the decrease in believing human superiority, this result is in line with the general facts. As Vaske, Donnelly, Williams and Lonker (2001) emphasized the relation between age and environment awareness should be seen in two dimensions. First, the environment awareness of youth maybe because of the education they gained or because of the campaign on media most of the time out and beyond of traditional environmental awareness living with higher environmental awareness second is changing paradigms and learning a lot of things over the time. The results of this study overlap with this fact. The older someone gets the lower the level of HH gets and the higher the level of CN gets. Even though there are a lot of factors which affect LS it is normal that people with low or average incomes have lower LS. (Ardahan, 2012a: Dagdelen, 2008: Otacıoglu, 2008, Schmitter, 2003). Even though participants in ROS have higher level LS than non-participants and even though this difference is meaningful participants in this study have average LS. When it is thought that this result is related personal characteristics of individuals living in their hectic life having positive environment awareness in HN level, and negative in CN, in the situation of having high LS it is expected to have reverse results and it is normal in the light of demographic data. As Buttel and Flinn (1978) and Nelson (1999) mentioned in their studies the fact that negative inclined movements are conducted by people who have low income is in line with the result. The relation between EQ and environmental awareness could be explained by the definition which is related skills about managing feelings and senses or being a mature person which leads to a desirable behavior (Goleman 2007). This theoretical fact could be seen in the relation between the four sub-dimensions EA, EC, CN, HH and the in the relation between ES and HN and in the relationship between MNT, EC, CN, and HN. Considering environmental awareness it is expected that people having high level of EQ have negative level of HH. As Dunlap and others (2000) mentioned in the NEP scale humans are a part of environment and they have same rights as other creatures. Given this fact the results of ES and PEM do not have a negative affect as expected but they describe and an environmental awareness which defends human superiority. This could be because of not having sufficient environmental awareness, not having internalized the role the individuals they play or because of the Islamic teachings that humans are the owners of the universe that everything has been created for them. Even though according to Islam humans are seen as the obsolete owners of the universe and even though this has been repeated several times in Ku'ran this situation authorizes people with managing recourses wisely, and protecting environment (Kula, 2000: Yılıdrım 2012). This situation should be taken up in Friday prays and it should be put in curriculum and in every instance public should be educated about this situation. The results of the study supports the facts which were examined by Dunlap and Heffernan (1975), Jackson (1986), Thapa and Graefe (2003), Bjerke and others (2006), Berns and Simpson (2009), Ardahan (2012b) that participants in ROS have higher level ecological perception non-participators and participating in ROS leads to a positive affect on ecological perception, ecological behavior and ecological attitude. Even though hikers have lower level of ecological perception than participants in ROS cycling, mountaineering, hiking strengthen and increase ecological perception.

In conclusion, when ecological perception is thought as a result which is affected by a lot of independent variables excluding marital status, gender, marital status, income, education, age, the level of LS and EQ, cycling, mountaineering, hiking affect ecological perception, attitude and behavior.

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Visualizing of Bicycle Properties by using Self-organizing Map: A Case Study for Assessing Road Bike Wheels

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Abstract This study aims to understand bicycle property easily via visualizing it by using Self-organizing Map, SOM. Whole property of the bicycle is not defined only by individual performances of components, such as frame, wheels and tires. The whole property is affected by interaction among those components and various situations. Therefore it is difficult to understand the effectiveness of each part to the bicycle performance. This paper describes a case study for assessing two road bike wheels by using SOM. We measured various outputs such as the speed of the bike, the heart rate of the rider and the driving power from some test ridings. And then we assessed effectiveness of the wheels to the body of the rider and the running performance of the bicycle by visualizing these measured data by using SOM.

Key words: self-organizing map, bicycle, visualization of measurement.

Introduction

A bicycle is composed of various components, such as frame, wheels and tires, with depending on its user's purpose and preference. Whole property of the bicycle is not defined only by individual performances of each component, such as frame, wheels and tires. The whole property is affected by interaction among those components and various situations. Therefore it is difficult to understand the effectiveness of each component to the bicycle performance. So it is necessary to understand the relationship, such as the interaction and the contributions, among the whole property and those components. In order to understand the relationship, it is considered that a data mining is effective. The data mining uses various input and output data, such like each component's property and condition, speed, and rider's heart rate and pedaling power, as a high-dimensional data set.

In this paper, some test ridings of a road bike is reported, and its measured data is visualized by using SOM. Then an assessment of the bicycle component which affects to the rider's body and performance is reported by using the visualized data.

Self-organizing Map and Its Example by using Visualization of Virtual Data

In this section, an overview of Self-organizing Map, SOM, is set forth firstly, and then, a concrete example of visualization by the SOM is shown.

Self-organizing Map

Self-organizing Map, SOM is a type of artificial neural network which visualize a non-linear statistical relationship of a high-dimensional data set by translating it to a geometrical relationship of a low-dimensional map. Geometric distance on the above low-dimensional map represents the similarity among the high-dimensional data (Kohonen 2001). Recently, the SOM is utilized as a data mining method for a large scale data's classification and correlation analysis at wide areas, such like medical care (Abe 2009), business (Honkela 2009), industry and engineering (Cottrell 2009).

In this research, components and conditions of a road bike are set as input data. And then various data

measured at test ridings, such as speed, heart rate and pedaling power are set as output data. The input and output data are treated as a high-dimensional data set and its relationship is visualized by using SOM. As the result, it enables to understand the components' properties which affect to the driving performance and the body visually.

Visualization of virtual testing data by using SOM

Here, some results of visualizing a virtual testing data set are shown as concrete examples of SOM. The virtual testing data set is generated by approximation equations of driving power at riding of a road bike.

Approximation equations of driving power at riding

When a road bike cruises at a constant speed V [km/h] on a gradient of road G [%] with windless condition, required driving power P [W] is approximated by the following eqn (1). Where R_A [N] is air resistance force, R_R [N] is rolling resistance force and R_{Gr} [N] is climbing resistance force.

$$P = \left(R_A + R_R + R_{Gr}\right)\left(V \diagup 3.6\right) \tag{1}$$

The resistance forces in the eqn (1) are approximated by the following equations. Firstly, the air resistance force R_A [N] is approximated by the following eqn (2). Where ρ [kg/m^3] is air density, C_D is coefficient of drag and A [m^2] is frontal projected area.

$$R_A = \frac{1}{2}\rho C_D A\left(V \diagup 3.6\right)^2 \tag{2}$$

The coefficient of drag varies according to shape of a road bike and posture of a rider. The frontal projected area also varies according to physique and posture of the rider. Here, the coefficient of drag and the frontal projected area are approximated according to Basset's report (Bassett 1999). The coefficient of drag is C_D = 0.88 and the frontal projected area A [m^2] is approximated by the following eqn (3). Where M_{Rider} [kgf] is rider's weight and T_{Rider} [cm] is rider's height.

$$A = 0.0276 \times M_{Rider} \times \left(T_{Rider} \diagup 100\right)^{0.275} + 0.1647 \tag{3}$$

Secondly, the rolling resistance force R_R [N] is approximated by the following eqn (4). Where M_{Bike} [kgf] is bike's total weight, g [m/s^2] is gravitational acceleration and C_R is coefficient of rolling resistance. The coefficient of rolling resistance varies according to some conditions such as tire and road.

$$R_R = C_R\left(M_{Rider} + M_{Bike}\right)g\cos\left(\arctan\left(Gr \diagup 100\right)\right) \tag{4}$$

Finally, the climbing resistance force R_{Gr} [N] is approximated by the following eqn (5).

$$R_{Gr} = \left(M_{Rider} + M_{Bike}\right)g\sin\left(\arctan\left(Gr \diagup 100\right)\right) \tag{5}$$

Generation of virtual testing data

According to the above approximation equations, some velocities at running on some gradients of road with the driving power P = 300 [W] are calculated. Where, the bike's total weight M_{Bike} [kgf] and the coefficient of drag

C_D are set as input variables. The speed V_{Gr0}, V_{Gr5} and V_{Gr10} [km/h] are the speed at the gradient of road, 0, 5, 10 [%] respectively.

The input, output variable ranges and the constant values of the other parameters are shown in table 1. Virtual testing data set of 121 cases is calculated by 11×11 full factorial DOE of 11 level input variable ranges shown in Table 1.

Table 1: Input, output variable ranges and the constant values of the other parameters

	Item	Range or constant value
Input variable	Total weight of Bike [kgf]	$6.0 \leqq M_{Bike} \leqq 10.0$
	Coefficient of drag	$0.7 \leqq C_D \leqq 0.9$
Constant	Rider's weight [kgf]	$M_{Rider} = 55$
	Rider's height [cm]	$T_{Rider} = 165$
	Air density [kgf/m^3]	$\rho = 1.1689$
	Coefficient of rolling resistant	$C_R = 0.005$
	Gravitational acceleration [m/s^2]	$g = 9.81$
	Driving power [W]	$P = 300$
Output variable	Speed at gradient of road 0% [km/h]	$39.46 \leqq V_{Gr0} \leqq 42.87$
	Speed at gradient of road 5% [km/h]	$24.40 \leqq V_{Gr5} \leqq 26.23$
	Speed at gradient of road 10% [km/h]	$15.37 \leqq V_{Gr10} \leqq 16.42$

Visualization by using SOM

SOM maps were made by using the above virtual testing data set of 121 cases. The map of total weight of bike, coefficient of drag, speed at gradient of road 0%, 5% and 10% are shown in fig. 1 to 5 respectively.

Each case was put on the same location of each map by SOM. Correspondence among input and output variables were visualized by the location on the map. For example, a testing case put on the upper right on each map had the lightest total weight and the lowest coefficient of drag. And we can understand that the test case has the fastest speed at every gradient of road from watching the location of the speed map. On the other hand, a testing case put on the upper left on each map had heavy total weight and low coefficient of drag. And we can understand that the speed of the test case is relatively fast at the gradient of 0%, intermediate at the gradient of 5% and low at the gradient of 10%.

Furthermore, we can understand interaction relationships among variables by comparing the tendency of distribution of each map. For example, the map of speed at the gradient of 10% shown in fig. 5 and the map of total weight of bike shown in fig. 1 are opposed each other but their distributions seem similar tendency. This means that they have strong negative correlation. Secondly, it does not seem commonality in comparing the distribution in fig. 5 with the map of the coefficient of drags shown in fig. 2. This means that the speed at the gradient of 10% and the coefficient of drag have low correlation. On the other hand, by comparing the map of speed at the gradient of 0% shown in fig.3 with fig. 1 and fig. 2, we can understand that the correlation with total weight of bike is low and the correlation with the coefficient of drag is strong negative.

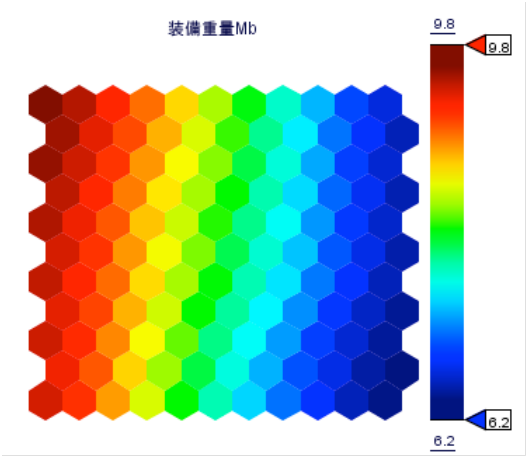

Figure 1: Map of total weight of bike [kgf]

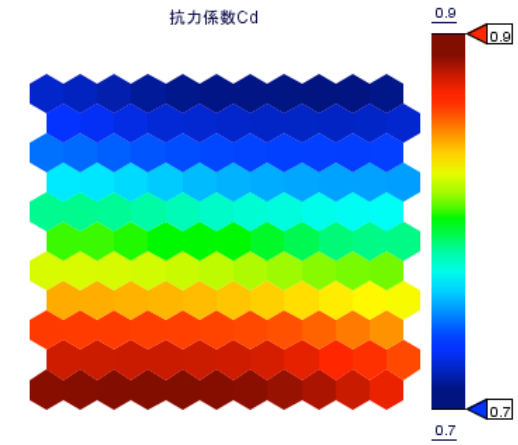

Figure 2: Map of coefficient of drag

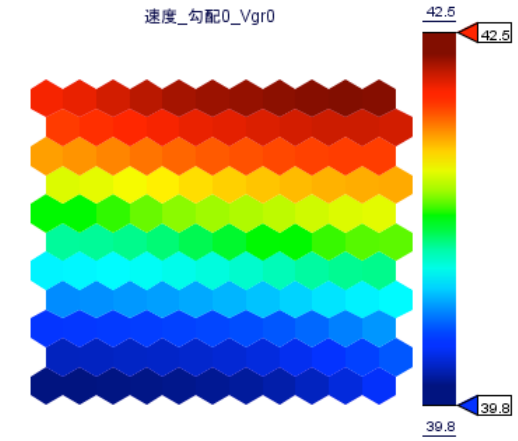

Figure 3: Map of speed at gradient 0% [km/h]

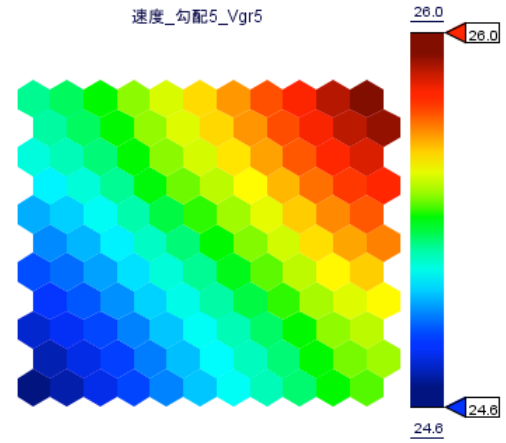

Figure 4: Map of speed at gradient 5% [km/h]

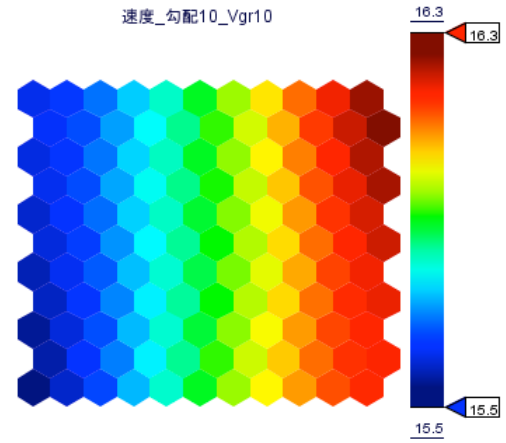

Figure 5: Map of speed at gradient 10% [km/h]

Approximate equations described above indicate that the air resistance force dominates when the gradient is low. As the result, the coefficient of drag affects strong and the weight of bike affects low at low gradient. On the other hand, the climbing resistance force dominates when the gradient is high. As the result, the weight affects strong and the coefficient of drag affects low at high gradient. Though these relationships are clearly natural, these results are meaningful. Because it shows that even if we do not know approximate equations or physical phenomena, we could find out some relationship among some data set by visualizing it by using SOM.

In this section, a result of visualization of virtual testing data set by using SOM was shown as a concrete example. Though this result was same as commonly accepted theory, this result shows that even if some data set has unknown relationship, we can find out the hidden relationship visually by comparing distribution of each SOM map. So we can consider this visualization method is effective.

Road Testing

In this section, a case study for assessing road bike wheels was carried out. The objective of this case study was a verification of the effectiveness of the SOM visualization at actual road testing. The physical records of a rider and the driving records of a bike were measured at the testing rides. Then the driving properties were analyzed by visualizing these records on the SOM maps.

Testing equipment

Here, two types of road bike wheels shown in table 2 were evaluated. Firstly, It was inspected that how the difference of these wheels were represented on the SOM maps. Then the changing of the driving properties was analyzed. The driving records were measured by using a power meter, a cycle computer and a heart rate monitor. A road bike shown in fig. 6 (left) was used at the road testing. The driving power was calculated by using torque and rotation angular velocity of a crank. The torque and the rotation angular velocity was measured by the power meter which was attached on a spider arm shown in fig. 6 (right). The measuring equipment and measured items are shown in table 3.

Figure 6: Road bike and Power meter

Table 2: Data table of testing wheels

Wheel	Material of Rim	Rim height [mm]	#Spoke	Weight [g]
Type A: ALX630 (Alex Global Technology, Inc.)	Aluminum alloy	23.7	Front: 20 Rear: 24	Front: 624 Rear: 806
Type B: WH-7900-C35-TU (Shimano Inc.)	Carbon FRP	35	Front: 16 Rear: 20	Front: 602 Rear: 737

Table 3: Measuring equipment and measured item

Measuring equipment	Name	Measured item
Road bike	TCR Alliance 2009 (Giant Manufacturing Co. Ltd)	
Power meter	Cinqo Saturn (Quarq Technology, Inc.)	Average driving power [W] Average cadence [rpm]
Cycle computer	Edge 800 (Garmin Ltd.)	Average speed [km/h]
Heart rate monitor	Premium Heart Rate Monitor (Garmin Ltd.)	Average heart rate [bpm]

Testing method

Map of the testing road is shown in fig. 7. The testing was carried out from point A to point B on the map. The distance of the road was 5.2km. The road profile was a straight and flat. Rider kept a constant speed with fixed gear ratio of 3.13 at the testing. While going back to the start point, the rider took rest by riding at low speed.

Figure 7: Map of the testing road

Results and discussion

Number of the total testing rides was 26 times, thus two types of the wheels were tested 13 times each. The result of the testing is shown in table 4. The measured items were average speed, average heart rate, average cadence and average driving power. The "Map ID" in the table means a location of each record on the SOM maps which described below section.

Table 4: Result of the testing rides

Wheel	Date	Data ID	Map ID	Speed [km/h]	HR [bpm]	Cadence [rpm]	Power [W]
Type A: ALX630	2011.11.29	0	53	34.2	156	88	166
		1	31	34.3	170	89	187
		2	23	36.9	172	95	190
	2012.1.12	3	12	34.9	181	90	216
		4	1	34.1	183	88	210
		5	0	32.4	186	84	210
	2012.1.29	6	63	33.7	156	87	147
		7	83	32.3	152	83	136
		8	74	34.0	154	88	131
	2012.3.6	9	50	32.5	174	84	173
		10	80	30.5	158	79	130
		11	90	30.0	155	77	127
		12	90	29.2	157	75	128
Type B: WH7900C35	2011.11.23	13	57	34.6	166	88	177
		14	27	35.2	174	90	197
		15	39	35.3	173	90	191
		16	9	36.4	177	93	199
	2011.11.27	17	38	35.4	173	90	196
		18	48	35.4	168	90	194
		19	17	35.2	176	90	211
	2012.1.22	20	8	35.9	182	92	200
		21	6	35.1	185	89	207
		22	6	34.8	184	89	198
		23	97	32.3	169	82	140
		24	79	34.2	171	87	137
		25	99	32.1	172	82	134

Visualization of testing data by using ordinary 2D graph

Firstly, two types of the wheels were compared by using an ordinary 2D graph shown in fig. 8. Where horizontal axis represents average driving power and vertical axis represents average speed. Regression equation of each wheel was calculated by the least-square method. The regression equation of the type A, ALX630, was the following eqn (6) and that of the type B, WH7900C35, was the following eqn (7) respectively.

$$y = 0.0394x + 26.5 \quad (6)$$

$$y = 0.0391x + 27.6 \quad (7)$$

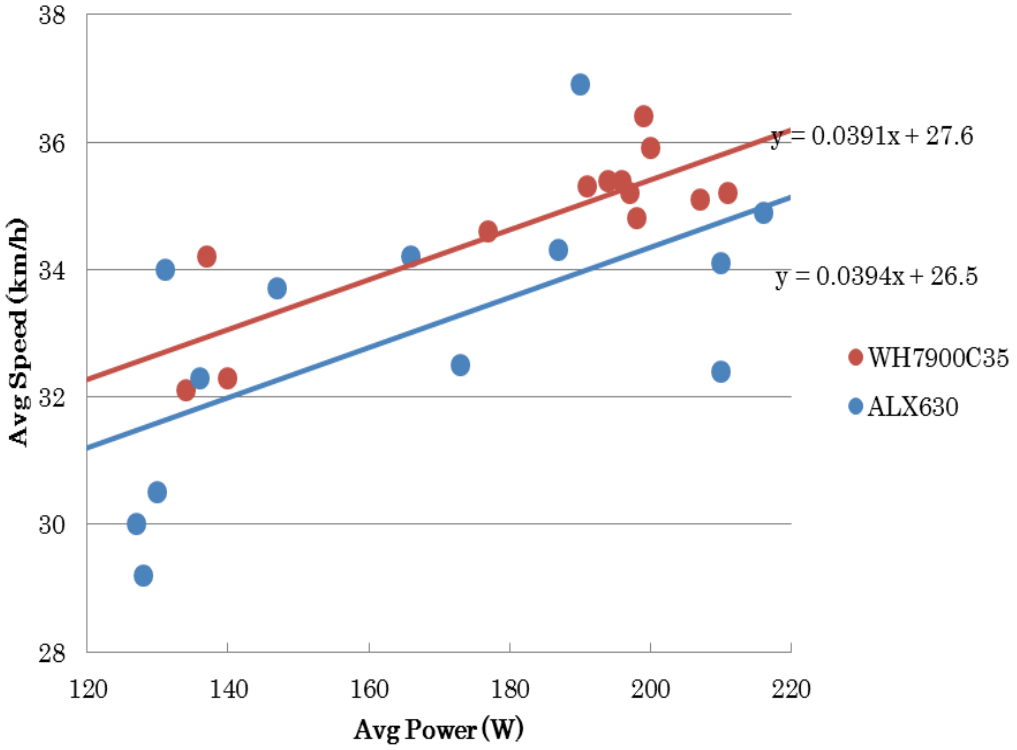

Figure 8: Average Driving Power vs. Agerage Speed

By comparing eqn (6) and eqn (7), the slope of the line was approximately equal. The type B, WH7900C35, was faster about 1km/h than the type A, ALX630. The characteristic differences of the two wheels were the rim height and the number of spoke. The rim height, the number of front and rear spoke of the type B were 35mm, 16 and 20 respectively. On the other hand, those of the type A were 23.7mm, 20 and 24 respectively. The air resistance force generated by rotation of wheels is strongly affected by turbulence which occurred from spokes. The type B had higher rim height, thus it was shot spoke length, and the number of spokes less. Therefore, the air resistance force of the type B was lower than that of the type A. The testing road was flat and thus the air resistance force dominated the total resistance force. It considered that this caused the clear difference between two wheels.

Visualization of testing data by using SOM

Secondly following to the previous section, the two types of wheel were compared by using the SOM maps which generated from the same testing data. The SOM maps of the wheel, the driving power, the cadence, the speed and the heart rate are shown in fig. 9, 10, 11, 12 and 13 respectively. In addition, the location of each record in the SOM maps is shown in fig. 14.

In the wheel map of fig. 9, the type B, WH7900C35, was located on the upper side and the type A, ALX630, was located on the lower side. And in the driving power map of fig. 10, transition from high power to low power was mapped from left side to the right side. By using the above two maps, dividing areas of the other maps on the border of the wheel map and comparing the transition from the left side to the right side, the influence of the difference of the wheels and the transition of the driving power to the other properties are able to understand visually.

The cadence map of fig. 11 and the speed map of fig. 12 seem to similar configuration, since the cadence and the speed had proportional relationship by fixed gear ratio while the road testing. In addition, from the left side to the right side at the upper area of the map where the type B wheel, WH7900C35, was located, the cadence and the speed shifted from high to low by corresponding to the transient of the driving power.

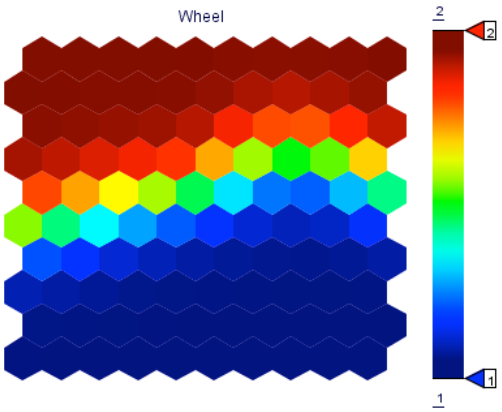

Figure 9: Map of the type of wheel where the type A, ALX 630, is represented as 1, and the type B, WH7900C35, is represented as 2.

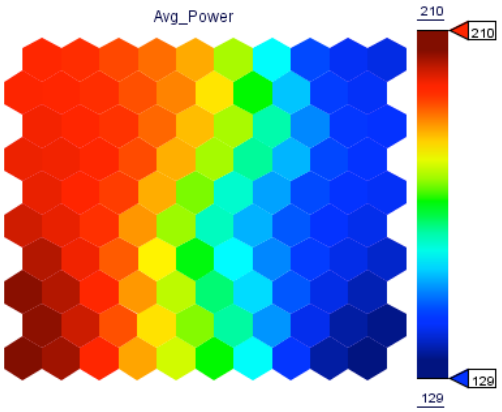

Figure 10: Map of the average driving power [W]

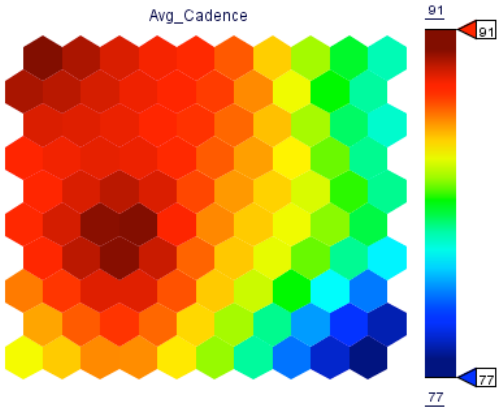

Figure 11: Map of the average cadence [rpm]

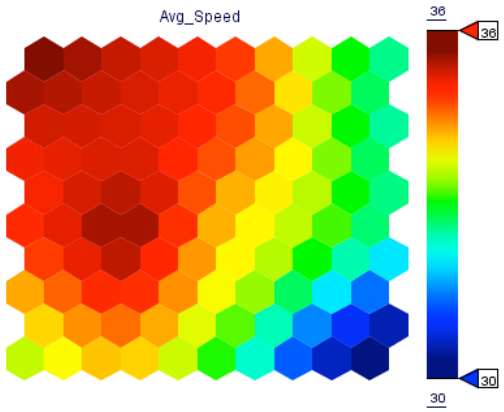

Figure 12: Map of the average speed [km/]

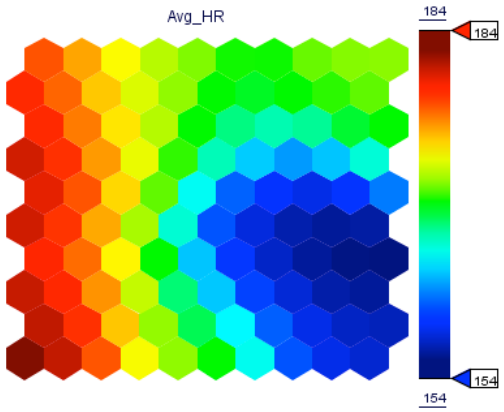

Figure 13: Map of the average heart rate [bpm]

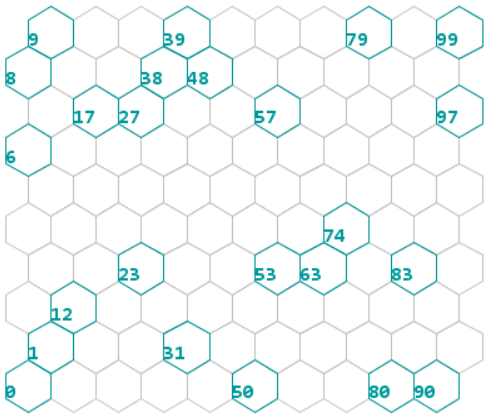

Figure 14: Map ID where the riding records were located on each SOM map

On the other hand, at the lower area of the map where the type A wheel, ALX630, was located, though the maximum driving power was located on the lower left, the location was not represent the highest cadence and the highest speed. According to fig. 8 of the above section, measured data of the type B wheel did not stray from the regression line, but those of the type A wheel strayed from the regression line relative to the type B. It is considered that this is the reason of the above. In fig. 13 of the heart rate map, from the left side to the right side, it seems that the heart rate transitioned from high to low, similar to the driving power.

From the results so far, it was confirmed that the qualitative relationships among variables of the measured data could be understood by treating the data as a high-dimensional data set and visualizing it by using SOM. Generally, it is difficult to understand the interaction relationship among high-dimensional data set without prior information or knowledge. Therefore, it is considered that before analyzing the quantitative relationship, grasping the qualitative relationship by using SOM is efficient.

Conclusions

In this paper, we described a case study for assessing two road bike wheels by using SOM. We measured various outputs such as the speed of the bike, the heart rate of the rider and the driving power from some test ridings. And then we assessed effectiveness of the wheels to the body of the rider and the running performance of the bicycle by visualizing these measured data by using SOM. We confirmed the efficiency of the SOM map for understanding qualitative relationship among high-dimensional data to a certain extent. As future work, we increase the measurement data by taking further road testing under more complicated conditions, and examine the measurement data in more detail.

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