ACADEMIC STUDIES IN ARCHITECTURE, ENGINEERING PLANNING AND DESIGN 2019/2

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IN ENGINEERING ARCHITECTURE, PLANNING AND DESIGN 2019/2

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Editors

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Cetinje 2019

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Contents

PREFACE

Nowadays, although the importance of detailed studies in various fields of expertise remains important, beyond the scientific research done in this way, it is much more meaningful to solve the engineering problems by taking interdisciplinary approaches and to take a practical view to addressing different perspectives. The number of scientists working on multidisciplinary research is increasing day by day, and with multi-perspective studies, new, result-oriented and realistic solutions to fundamental engineering problems are achieved. Although it is possible to solve the problems based on simple basic fundamentals of each engineering branch in the engineering approach, it is possible to produce these individual fundamentals with high synergies obtained by interdisciplinary studies or to adapt one logic to another in another engineering branch to figure out qualified studies and solutions. In this regard, examining the studies in various disciplines and encouraging the synthesis of these studies will create different perspectives and will shed light on multidisciplinary studies and ideas that produce creative and practical solutions.

The main objective in this book, "Academic Studies in Architecture, Engineering Planning and Design", is to bring together multidisciplinary researchers and to create new ideas for future research. In line with these objectives, this book includes individual and interdisciplinary studies including Computer Engineering, Environmental Sciences and Engineering, Industrial Engineering, Food Engineering, Chemical Engineering, Mechanical Engineering, Textile Engineering, Mechatronic Engineering And Architecture. We would like to thank the authors who contributed to the creation of the book and the referees who contributed to the evaluation of the book, and we wish success in the research that sheds light on the future.

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COMPUTER ENGINEERING

ARTIFICIAL INTELLIGENCE APPLICATIONS IN SMART CITIES

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1. Introduction

The importance given to smart cities is increasing day by day. The reason for this is that people migrate to big cities for better life and comfort, and as a result of this migration, the big cities become crowded. Because while the area of the cities remains the same, the population density increases.

Cities need to be clever in order for the increasing number of people to live comfortably on the same surface area. There are many types of intelligent systems that constitute smart cities. Many different technologies are used to implement these systems. Thanks to these technologies, data is obtained from smart cities, and inferences and analyzes are made from the dense data obtained and decisions are made about the city.

Artificial intelligence techniques are also used in this decision-making process. With the help of artificial intelligence techniques, inference from information can be faster and more accurate. This section describes the use of artificial intelligence in smart cities. Smart cities are mentioned in the second part and artificial intelligence is mentioned in the third part. In the fourth part, the current literature review of the use of artificial intelligence in smart cities is analyzed and given. The last section contains the results of the study.

2. Smart Cities

As a result of detailed research we have done before, we classified smart cities in eight categories. These are Smart Transportation, Smart Governance, Smart Economy, Smart Environment, Smart Health, Smart Industry, Smart Security, Smart Life.

Smart city is a city that has smart technologies with economic and social benefits it provides to people and institutions. In a smart city, both the

environment becomes more beautiful, the standard of living of the people increases and it creates positive privileges for the people.

There are hundreds of intelligent systems in smart cities. Some of them can be given as smart waste management system, smart energy management, smart water management, smart junction system, smart house, crowd management, emergency applications, smart lighting systems.

3. Artificial Intelligence

Artificial intelligence is the ability of the computer or computer-controlled tasks and processes to perform various activities in the same way as living things. Artificial intelligence, computer vision, deep learning, fuzzy logic, genetic algorithm, machine learning, neural network, image-video processing, robotics can be counted as artificial intelligence.

Thanks to artificial intelligence, machines can make the right decisions in every process without the need for people. In this way, errors and defects that may occur from human beings are prevented. Artificial intelligence is now part of smart cities.

4. Artificial Intelligence Applications

In this section, artificial intelligence applications in smart cities and current literature review are analyzed and shared.

The studies in the Artificial Intelligence category are as follows.

The authors (Allam and Dhunny, 2019) state that the data collected in smart cities bring new possibilities to the management of the city. They stated that while artificial intelligence and big data contribute significantly to the city, the dimensions of sustainability and livability should not be neglected. This study aims to inform the Policy Makers, Data Scientists and Engineers who want to improve the integration of Artificial Intelligence and Big Data in Smart Cities in order to increase the viability of the urban fabric.

The authors (Rojek and Studzinski, 2019) stated that systems such as urban transport, heating systems, energy systems, telecommunications, water and sewage management are related to the municipal economy. In particular, the study aimed to identify and locate leaks in the water supply network, including hidden leaks in the urban water supply network. In this study, leak detection and location algorithm has been developed by using

neural networks. The developed algorithm was tested on hydraulic models of various municipal water networks.

The authors (Chui, 2018) have worked on energy sustainability. The electrical consumption loads of the electrical devices were monitored. In order to ensure energy sustainability in urban areas, hybrid genetic algorithm support vector machine multiple kernel learning approach has been proposed.

The authors (Guo, 2018) stated that there are many devices that produce data in smart cities. They stated that these devices often have interaction control problems as they have different manufacturers. In order to to support intelligent services with different systems, a novel artificial intelligence-based semantic IoT (AI-SIoT) hybrid service architecture to integrate heterogeneous IoT devices was proposed. Flexible connections can be provided between the proposed architecture and heterogeneous devices.

The authors (Voda and Radu, 2018) state that high urbanization rates and increasing population growth have a negative impact on the quality of life of citizens. They stated that artificial intelligence techniques should be used in cities to eliminate this. The aim of the study is to analyze the public attitude towards the effect of artificial intelligence on smart cities.

The authors (Khan, 2018) stated that Microgrids are important building blocks for the development of smart cities. The importance of Microgrid and the challenges faced are discussed. To solve these problems, they developed an Artificial Intelligence application.

The authors (Batty, 2018) stated that the solution of problems in cities should be smart. They described solutions using artificial intelligence for the safety and security of cities.

The authors (Srivastava, 2017) stated that smart cities are very complex, with ever-changing multi-level dynamics and large amounts of data. They stated that the way to eliminate this complexity is Multi-Agent Systems, which combines machine learning and distributed computing. The study explores how Multi-Agent Systems can respond to smart city-level challenges ranging from sensor networks to ambient intelligence.

The authors (Nigon, 2016) stated that technological, economic and environmental changes have increased the interest of people in creating a technologically smarter and safer world. Developed and maintained by artificial intelligence, Smart Cities not only improves people's lifestyle, but

also makes society stronger and more consistent. This article gives an idea of the realization of such thoughts.

The authors (Yang, 2019) have developed a Computer Aided Measurement of Smart City Multi-Source Information Synergy Structure Dependent on Adaptive Artificial Immune Network Algorithm.

The studies in the Fuzzy Logic category are as follows.

The authors (Lazaroiu, 2018) described the real-time monitoring, analysis, control and modification of information between interested parties in order to optimize the efficiency and reliability of the network, and to optimize consumption and energy costs for all participants in the energy market. For a better customer experience, they proposed a model of control, through the fuzzy logic, for better prosumer experience.

The authors (Melo, 2016) proposed a new method for urban flood monitoring based on fuzzy logic for issue alerts on a geographic map. The proposed model is designed to receive information from the remote sensing water level based on fuzzy rules, to include flood warning situations and to provide free access to information.

The studies in the Computer Vision category are as follows.

The authors (Ho, 2019) stated that traffic conditions were adversely affected by roadside stops or loading-unloading. Therefore, they have developed a fully integrated solution for monitoring these adverse roadside activities by equipping high-resolution smart cameras with wireless communication. With the developed system, roadside activities are captured automatically. The system is designed and tested in Hong Kong.

The authors (Garcia, 2017) stated that people use IP cameras for control in security areas in cities or homes. However, they said that these cameras need people who watch, evaluate and direct camera images. To this end, they proposed analyzing pictures with Computer Vision to identify people in the pictures.

The studies in the Genetic Algorithm category are as follows.

The authors (Alamaniotis, 2019) stated that greener, safer and more human-friendly environments will be created by using information produced in smart cities. According to the authors, one of the most important city assets is power plants. They stated that daily electricity consumption behaviors of people with smart networks can be seen by third parties. In the study, using a genetic algorithm, they proposed a new

method aimed at increasing consumer confidentiality and suggesting the clever collection of the expected demand models of multiple consumers to hide individual characteristics.

The authors (Morell and Alba, 2017) state that today there are a large number of portable devices such as smartphones and tablets, and everyone can use them. In this study, numerical behavior of distributed genetic algorithms in portable devices is analyzed. The behavior of the algorithm is examined when the number of interconnected devices changes and the devices with different performances work together.

The authors (Alaguvelu, 2016) stated that the transportation infrastructure of a city significantly affects the quality of life of people. Accordingly, they have used a fuzzy genetic algorithm approach for a smart, safe and efficient city transport infrastructure.

The authors (Fujdiak, 2016) investigated waste collection systems in smart cities. In waste collection systems, genetic algorithms are used to calculate the routes of garbage trucks more efficiently.

The authors (Alamaniotis, 2015) conducted studies on smart meters used in smart cities. According to the authors, the connection of the meters can allow the formation of groups that are physically close, as a result of which individual consumption can be collected in a common consumption. The study presents an approach to disclose shared electricity consumption and to draw conclusions about established personal use.

The studies in the Neural Network category are as follows.

The authors (Ullah, 2019) stated that smart city infrastructure is one of the most important parameters for lightning detection. In this study, they developed an smart lightning detection system for smart city infrastructure using artificial neural network.

The authors (Yuan, 2019) stated that the demand for wind energy, a renewable energy source, increased. They noted significant increases in the annual installation of wind turbines. However, according to the authors, factors such as power losses and changing wind speeds affect the stability of the system. In this context, they propose back propagation neural network clustering architecture for wind turbines for smart cities to improve stability and harmonic suppression.

The authors (Pan, 2019) propose a different evolutionary back propagation neural network traffic prediction model that is valid for predicting traffic in smart cities.

The authors (Struye, 2018) stated that it is very important to provide an experimental evaluation of existing and new technologies in realistic conditions for the development of smart cities. In this study, CityLab tester is introduced in which researchers can experience various smart city network technologies in parallel, including IEEE 802.11, IEEE 802.15.4 and GHz sub-protocols. In addition they predict interference in a future using a neural network based on a Gated Recurrent Unit.

The authors (Garlik, 2018) applied neural networks and evolutionary algorithms as solutions for energy optimization in smart cities and shared experimental results.

The studies in the Machine Learning category are as follows.

The authors (de Souza, 2019) stated that computational methods are necessary for decision making, policy making or analysis as a result of data collected in smart cities. In this respect, the current literature review has been made and an investigation has been made regarding the approaches of data mining and machine learning. They found that most of the work focused on smart mobility and the smart environment.

The authors (Preciado, 2019) worked on the detection of the possibility of leakage at Smart Water Networks. They state that the existing algorithms have failed in this regard. To address these failures, they offer an approach to predicting water demand based on pattern recognition and pattern-similarity techniques.

The authors (Pawlowicz, 2019) stated that it is possible to create a traffic monitoring system in smart cities thanks to developing technologies such as 5G, RFID, machine learning and cloud infrastructure. They say that the system will have functions such as preventing traffic congestion, minimizing fuel consumption and directing the driver to a certain road. In this study, the idea of such a traffic monitoring system is given.

The authors (Reid, 2018) stated that as population increases rapidly, traffic delays and noise pollution increase rapidly. In this study, they investigate the application of a multi-networked Internet network in a network, distributed along the road to collect and share vehicle data, and then equipped with sensors to process the data using a machine learning algorithm.

The authors (Estrada, 2018) recommend that any model visualize productivity measurement tools using machine learning for key performance indicators of a smart city. The study consists of several stages. These include examining metrics, researching the data model, developing the tool.

The authors (Mohammadi and Al-Fuqaha, 2018) stated that with the development of smart cities, a large amount of data has never been seen before. In this context, the approaches and difficulties of activating cognitive smart cities by using big data and machine learning are explained in this study.

The authors (Bilen, 2018) stated that as a result of the good position of a business, not only the satisfaction levels of the customers will increase, but also the profits of the entrepreneurs will increase. They say that finding the best place for a business is a complex and challenging process. In this context, an intelligent business application using machine learning techniques is proposed to estimate the location of an enterprise.

The authors (Bakhshil and Ahmed, 2018) stated that waste collection and management is a challenge for municipalities. To this end, they proposed a new waste monitoring system using machine learning analytics. The proposed system helps to optimize long-term waste policies in smart urban environments.

The authors (Martinez-Espana, 2018) state that air pollution is one of the main threats to developed societies. In this study, various machine learning methods were analyzed to estimate the ozone level (O-3) in the Region of Murcia (Spain).

The authors (Chin, 2017) explore the potential of Machine Learning (ML) and Artificial Intelligence (AI) to use the Internet of Things (IoT) and Big Data in developing personalized services in Smart Cities.

The authors (Belhajem, 2017) stated that the positioning of vehicles was determined by Global Positioning System (GPS). However, in case of any GPS malfunction or no position information from GPS, they have received the last GPS data and worked on it to estimate the vehicle's position. They proposed a low-cost approach based on hybrid machine learning to predict real-time vehicle position in a smart city.

The authors (Belhajem, I., 2016) stated that one of the smart city solutions is to create an effective fleet management for the use of a vehicle fleet (eg ambulances and police vehicles). According to the authors, the

most basic function in a fleet management system is the real-time vehicle tracking component. In order to cope with situations such as GPS signal loss, a Kalman Filter and Evolutionary Machine Learning was proposed.

The authors (Rossini, 2016) expressed the need to establish and manage large-scale Wireless Sensor Networks (WSNs), which are geographically distributed sensors for smart cities. It was emphasized that manually managing and monitoring each of the nodes in the WSN is very expensive, error-prone, and time-consuming. The study presents a distributed system that combines an increased machine learning technique with a non-linear Kalman Filter estimator and automatically recalibrates sensors that correlate with measurements made by neighboring sensors.

The authors (Ertugrul and Kaya, 2016) stated that the estimation of energy efficiency is one of the main issues in smart city planning and they have made estimation energy efficiency of buildings by extreme learning machine.

The studies in the Deep Learning category are as follows.

The authors (Baba, 2019) stated that citizen security is very important in modern urban environments. According to the authors, for security, the analysis of data from high-bandwidth video streams provided by large-scale distributed sensor networks is difficult. Therefore, the study proposes an effective method for automatic severe behavior detection designed for video sensor networks.

The authors (Zhao, 2019) proposed a deep empowerment learning perspective for crowd management in smart cities.

The authors (Chakrabarti and Saha, 2019) state that as the population density of cities increases and traffic becomes congested, government agencies like the Ministry of Transport need to perfect their management systems with new efficient technologies. In this respect, a new traffic management system based on Neural Network and computer vision technology and Deep Learning basis of object detection through various methods and algorithms is proposed.

The authors (Kinoshita, 2019) describe Fujitsu's deep learning technologies that enable smart city watching.

The authors (Mohammadi, 2018) focused on intelligent buildings and applied the proposed deep amplification learning model to the problem of indoor localization based on bluetooth low energy signal strength.

According to the authors (Jindal, 2018), demand response management in smart cities is one of the most challenging tasks of home users. Since the current recommendations in the literature cannot observe the hidden patterns in the load profile of these users, the study uses the concept of deep learning for intelligent energy management in a smart city.

The authors (Obinikpo and Kantarci, 2017) review deep learning techniques that can be applied to perceived data to improve predictive and decision-making in intelligent health care.

The authors (He, 2017) propose an integrated framework with A Big Data Deep Reinforcement Learning Approach, which allows networking, caching and dynamically organizing computing resources to improve the performance of applications for smart cities.

The authors (Kok, 2017) proposed a new deep learning model to analyze smart city data. A new model based on Long Short Term Memory (LSTM) networks is proposed to predict future air quality values in an smart city.

The authors (Ghoneim, 2017) proposed a new in-depth learning-based ozone-level prediction model that considers air pollution and weather as integrative. Experiments show that the proposed method for ozone level estimation has superior performance.

The authors (Gkania and Dimitriou, 2016) propose a framework for estimating traffic characteristics between a predefined Destination Destinations (O-D) locations, taking into account the existing segregated traffic data. Deep learning mechanisms were used in the study. The proposed practice has been tested on a realistic road system in Cyprus.

The authors (Polishetty, 2016) stated that the license plate recognition system plays an important role in smart city initiatives such as traffic control and traffic management. In this context, they proposed a new generation of secure cloud-based deep learning plate recognition system.

The studies in the Robotics category are as follows.

The authors (Grigorescu, 2019) talked about the importance of services provided by robots with unique functionality in smart cities. In this study, a robotic platform was designed to serve in the field of health.

The authors (Wang, 2019) stated that robotic sensor systems play a vital role in the intelligent operation of robots. Thanks to the information coming from robotic sensors, perception, decision, planning and control

operations can be realized. In this study, 3D walking applications of robotic sensor systems are investigated. Using sensory feedback control, offline gait planning and online gait modification programs have been proposed.

The authors (Abbasi, 2018) stated that multi-agent robotic platforms are increasingly used for various commercial applications. In this study, deep cross altitude visual service for smart robotic agents is presented.

The authors (Grau, 2018) describe ECHORD ++, one of the new robotic solutions for smart cities.

The authors (Beigi, 2017) stated that smart mobile devices are one of the main factors in realizing smart cities. In this study, researches were made to make existing cheap mobile devices such as robots more intelligent and cooperative. Introducing the C2RO cloud robot platform, which uses real-time flow processing technology to connect energy-efficient and low-cost city mobile devices or sensors virtually.

The authors (Rahman, 2016) propose a general cloud robot framework, taking into account various complexities while realizing the vision of a smart city. Specifically, an integrated framework is provided for the crowd control system, where cloud-enhanced robots are deployed to perform the necessary tasks.

The authors (Ermacora, 2016) propose a cloud robot service for emergency management in a smart city scenario.

The authors (Ermacora, 2016) propose an implementation of a cloud-robot service in an smart city scenario where small Unmanned Aerial Vehicles (UAVs) are used for emergency management operations.

The authors (Samani and Zhu, 2016) stated that time is a critical issue when dealing with people who have had a sudden heart attack, which unfortunately can prevent because of inaccessible emergency treatment. In this context, an ambulance robot was designed and developed.

The authors (Rahman, 2016) propose a general cloud robot framework to realize the vision of a smart city, taking into account various complexities.

The authors (Scaradozzi, 2016) stated that it is of great importance to encourage young generations of education and to equip them with the most useful and powerful methods. They emphasized the importance of helping children develop their Science, Technology, Engineering and Math skills.

The studies in the Image-Video Processing category are as follows.

The authors (Hernandez-Aguilar, 2019) have worked on a technological platform using graphics processing units, webcams and videos, CUDA and free software to improve real-time images in smart cities.

The authors (Tian, 2018) state that too much video data from city security cameras creates storage and analysis problems. According to the authors, the consolidation of smart city-generated video data can be used to support city management and city policy. In this context, a block-level background modeling algorithm is proposed to efficiently support the long-term reference structure.

The authors (D'Aniello, 2018) discuss the use of flow reasoning models and techniques to represent, manage and process data streams generated in the context of the Smart City, to better understand city phenomena, and to obtain useful information. The study proposes a semantic reasoning approach to support decision processes in smart cities.

The authors (Rathore, 2018) state that monitoring and controlling city traffic is one of the major challenges facing authorities, that city traffic is monitored by static network cameras deployed on several highways, and monitoring and controlling city traffic by manpower using these thousands of cameras is very difficult. In this context, an architecture was proposed to efficiently handle high-speed large-volume videos of real-time videos. An automated system has been proposed to control city traffic by continuously monitoring city traffic, detecting illegal traffic behavior such as illegal U-turn.

The authors (Nasiri, 2018) examine the applicability of the use of distributed flow processing frameworks in the data processing layer of smart cities, the adoption of smart city use cases, and the assessment of the current state of maturity.

The authors (Lozano-Garzon and Donoso, 2018) stated that there was a significant growth in voice and data traffic due to the communication infrastructure, including mobile communications, and the greatly increasing subscribers, as well as new services and / or applications implemented to provide the necessary services in a smart city.

The authors (De Maio, 2017) recommend online application of Temporal Fuzzy Concept Analysis to an Apache Storm-based real-time computing system to face large data flow analyzes in the smart city context.

The authors (Chilipirea, 2017) stated that data processing for smart cities becomes difficult as they face different processing steps.

The authors (Silva, 2017) state that complex urban networks are greatly challenged by continuous growth, real-time data processing and intelligent decision-making capabilities. Therefore, an smart city framework based on Big Data analytics was proposed in the study. The proposed framework operates at three levels: (1) heterogeneous data collection and generation level for city operations, (2) data filtering, analysis and storage to autonomously take decisions and events, and (3) application level for conducting events corresponding to decisions taken.

5. Conclusions

The matching of the studies is given in Table 1.

Table 1. Matching of the studies

	Artificial Intelligence	Fuzzy Logic	Computer Vision	Genetic Algorithm	Neural Network	Machine Learning	Deep Learning	Robotics	Image - Video Processing
Smart Transportation			+	+	+	++++	+++		+
Smart Governance	+++++			+	+	++++	++		++++
Smart Economy						+			
Smart Environment	+++	++		+++	+++	+++++	+++		+
Smart Health							+	+	
Smart Industry								++	
Smart Security	++		+				+	+++	+
Smart Life							++	++++	+

As shown in Table 1, most of the studies carried out with artificial intelligence in smart cities are in the field of Smart Transportation, Smart Governance and Smart Environment. Through this study, artificial intelligence technologies used in smart cities have been explained and the current situation on this subject has been revealed.

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DETECTION OF THE SUBLIMINAL MESSAGES IN VIDEOS FROM THE EEG SIGNALS USING FAST FOURIER TRANSFORM

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1. Introduction

The number of images displayed in one second is called frame per second (fps) (Davis, Hsieh, & Lee, 2015; Özcan, Taşkın & Baysal, 2015). If it is desired to make a video that does not tire the human eye, using at least 24 picture frames in one second of the video has become a standard. Film strips usually leave a gap called 'control-track' after 24 frames. If this interval is filled with a picture frame, the so-called 25th frame effect will appear. Generally the 25th frame effect is processed subconsciously and it is known that the subconsciousness is reflected in our behavior and mood (Karremans, Stroebe, & Claus, 2006; Küçükbezirci, 2013; Florea, 2016). In the literature, this situation, which is called the 25th frame effect, is usually used by advertising companies to influence the viewer through subliminal message delivery.

The aim of this study is to exemine whether the brain will detect hidden pictures in videos thought to affect people's subconscious. The brain signals are taken using the Emotiv EPOC + device receiving a non-invasive signal from the scalp. The recorded signals are filtered by FFT and classified by the KNN classifier.

In the past studies, changes of human emotions were determined by electroencephalogram (EEG) recordings which is bioelectric based signals obtained as a result of neural activity of the brain. EEG signals are widely used in emotion estimation applications. In the studies, emotion analysis and classification procedures were performed for different types of stimuli using EEG signals and facial expressions. (Murugappan, Rizon, Nagarajan, Yaacob, Hazry, & Zunaidi 2008; Soroush, Maghooli, Setarehdan, & Nasrabadi 2018; Dasdemir, Yildirim & Yildirim 2017; Atasoy, Kutlu, Yıldırım, Yıldırım, 2014). Participants evaluated the audiovisual stimuli in studies that aimed to determine whether emotions

were reflected in body language, facial expression and tone of voice. Accordingly, EEG findings were classified according to their positive and negative conditions (Soleymani, Asghari-Esfeden, Fu, & Pantic, 2016; Liu, Sourina & Nguyen, 2010; Özerdem & Polat, 2016). In some studies, it has been examined how brain performance is affected by music, picture and meditation by looking at brain signals of patients who have psychological trauma or chemotherapy treatment (Bhattacharya & Lee 2016; Tan, Dienes, Jansari & Goh, 2014; Fidan & Özkan 2018). Numerous of studies have been accomplished to assist in the analysis of EEG signals in epilepsy patients and the features of EEG signals depend to frequency and time domains are gathered from results of the FFT (Wu, Tsai, Hsu, Huang, & Chen, 2019; Al Ghayab, Li, Siuly & Abdulla, 2019).

With the transfer of data from neurological research to marketing discipline, the field of neuro-marketing has emerged and the effect of advertising and marketing in the brain was investigated. (Wang, Huarng, & Chuang, 2018; Yücel & Coşkun, 2018). While watching the ads, brain waves produced by participants were measured and emotional reactions were examined (Elden, 2009).

2. Materials and Methods

This study was conducted in three stages as data acquisition, signal processing, feature extraction and classification. The working flow chart is depicted in Figure 1.

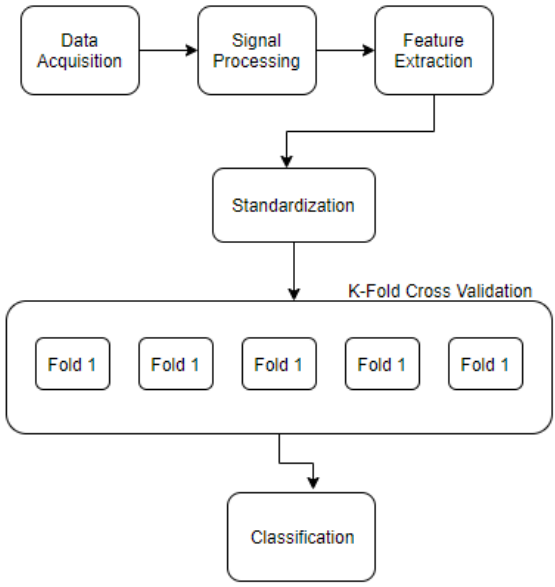

Figure 1. Flow diagram of the study

Data Acquisition and Fast Fourier Transform (FFT)

In the study, six different videos including animal, plant and nature themes were prepared and hidden pictures were added to these videos. As a result of the created videos, two types of videos were shown to the participants: raw video and hidden pictures containing the original video. EEG signals were received from 50 participants with 16 channel Emotiv EPOC + device. Male participants were chosed for this study because long hair reduces the efficiency of the device sensors. Considering every situation that may affect brain signals such as light, sound, movement, recordings were performed in a dark and sound isolated environment. The average age of the participants was 23.20.

The time series of the signal, all changes that occur outside the frequency range of the signal can be called noise. You need to destroy these noises before classifying the signals. Therefore, the most common spectral analysis method, Fast Fourier transform (FFT), was used. FFT is applied to find the frequency components of a noise embedded signal (Coşkun & İstanbullu, 2012; Wu et al., 2019). In FFT, raw EEG signals are compared to sine waves that generate specific frequencies (Isa, Amir, Ilyas, & Razalli, 2019). FFT of a periodic signal is shown in Eq. (1).X_k coefficients

represent DFT's k^{th} coefficient, x(n) which is an input sign of time domain represents n^{th} sample of time series consisting of N samples.

$$X_{k=} \sum_{n=0}^{N-1} x(n) \exp\left(-jkn \frac{2\pi}{N}\right) \quad (1)$$
$$k = 0, \dots, N-1$$

Feature Extraction

In the feature extraction stage, statistical feature extraction algorithms were applied on EEG signals which were filtered with FFT. These features; difference between maximum and minimum values, mean, median, standard deviation, power, variance, energy, kurtosis, skewness, interquartile range values.

The formulas of the features are shown in Eq. (2-11). Where,$x_n = 1, 2, 3 \dots n$ is a time series, *N* is the number of data points, *th* ordinal number, *AM* is the mean of the sample.

- **Maximum Minimum Values Difference:**

$$MaxV = max[x_n], MinV = min[x_n], max[x_n] - min[x_n] \quad (2)$$

- **Mean(AM):**

$$AM = \frac{1}{N} \sum_{n=1}^{N} x_n \quad (3)$$

- **Median(MN):**

$$MN = \left(\frac{N+1}{2}\right)^{th} \quad (4)$$

- **Standard Deviation(SD):**

$$SD = \sqrt{\frac{\sum_{n=1}^{N} x_n - AM^2}{N-1}} \quad (5)$$

- **Power(P):**

$$P = \lim_{N\to\infty} \frac{1}{N} \sum_{n=0}^{n=N-1} |x_n^2| \tag{6}$$

- **Variance (V) :**

$$V = \frac{\sum_{n=1}^{N} x_n - AM^2}{N-1} \tag{7}$$

- **Energy(E):**

$$E = \int_{-\infty}^{\infty} |x_n|^2 \tag{8}$$

- **Kurthosis (K):**

$$K = \frac{\sum_{n=1}^{N} x_n - AM^4}{(N-1)SD^4} \tag{9}$$

- **Skewness (S):**

$$S = \frac{\sum_{n=1}^{N} x_n - AM^3}{(N-1)SD^3} \tag{10}$$

- **Interquartile Range(IQR):**

$$IQR = Q_{3-}Q_1\,, Q_1 = \left(\frac{N+1}{4}\right)^{th} \qquad Q_3 = \left(\frac{3(N+1)}{4}\right)^{th} \tag{11}$$

Classification

During the classification phase, the EEG signals obtained from raw and 25th frame effect videos were compared. The closest neighbor (KNN) classifier, one of the most important classification methods, was used in the study. When classifying, the biggest disadvantage in calculating distance measurements from the training set is that the variables have different measurement scales. Therefore, the values are standardized before the classification data was applied. The standardization process is shown in Eq.(12).The standardization process is formulated with the

maximum and minimum values from the features in the dataset where any X values are contained.

$$X_s = \sum_{i=1}^{N} \frac{X_i - X_{min}}{X_{max} - X_{min}} \quad (12)$$

The training for the KNN classifier was provided by the k-fold cross validation method. The purpose of cross-validation is to provide a variety of test data. In a data set with a total of n samples, the k-part verification method is divided into separate discrete parts, each with n / k. Each time a different set of data sets is left for testing, the remaining k-1 data set is used for training (Altan et al. 2019; İşçimen et al., 2014). In this study, 5- fold cross validation method was used.

KNN is a nonlinear classifier used for classification. It measures distance by comparing test data with training data available in a dimensional area. (Vimala, Ramar, & Ettappan, 2019). Its aim is to decide its class by looking at nearest k neighbor (Bahari & Janghorbani, 2013). Determining the value 'k' here means the number of closest neighbors to look at (Piotrowski & Szypulska, 2017). The class with the most instances is considered the class of the samples being tested (Atasoy et al., 2014). In the study, the value of 'k' was 1,3,5,7,9. The method uses Euclidean relation when calculating distances. Euclidean method is shown in Eq.(13). x represents the data entry classified, y represents the training set data, n is the number of the data set. Euclidean measure is calculated according to the equasition x to measure the linear distance $C = (x_1, x_2, x_3 \dots x_n)$ and $D = (y_1, y_2, y_3 \dots y_n)$ between two points in space (Kresse & Danko, 2012; Eraldemir, Arslan, & Yıldırım, 2017).

$$d = \sqrt{\sum_{i=1}^{n} (x_i - y_i)^2} \quad (13)$$

3. Results

The aim of this study is to examine whether the brain will detect hidden pictures in videos thought to affect people's subconscious. Signals are generated using an Emotiv EPOC+ device mounted on a wireless hood and connected to the computer via Wi-fi. Six different videos were shown to

50 participants. The EEG signals generated as a result of viewing videos containing the raw and 25th frame effect are recorded. EEG signals were filtered by FFT and statistical feature extraction algorithms were applied to the results. The KNN classifier was used to compare the EEG signals of videos containing the raw and 25th frame effect. The training was provided by applying the k-fold cross-validation method. The learning sample numbers (k) of the KNN classifier were tested as 1,3,5,7,9. Table 1 shows the success of the features using the KNN classifier with different k values.

Table 1. The success of features using the KNN classifier

Distance metrics	*k=1*	*k = 3*	*k=5*	*k=7*	*k=9*	*Achievement Average*
Max-Min Values Difference	82.83%	57.20%	62.89%	57.82%	58.82%	63.91%
Mean	83.71%	57.90%	63.40%	57.71%	59.08%	64.36%
Median	84.69%	56.46%	62.51%	57.48%	58.89%	64.01%
Standard Deviation	83.38%	58.27%	62.72%	59.40%	59.47%	64.65%
Power	84.25%	59.27%	63.22%	58.84%	60.01%	65.12%
Variance	84.10%	59.54%	62.86%	60.15%	59.26%	65.18%
Energy	84.22%	59.28%	63.21%	58.85%	60.01%	65.11%
Kurtosis	83.07%	56.83%	61.64%	57.44%	58.97%	63.59%
Skewness	83.28%	57.41%	60.55%	57.51%	58.17%	63.38%
İnterquartile Range	83.17%	56.97%	62.20%	57.13%	58.65%	63.62%

As a result of the classification alone features that show high success; standard deviation, power, variance, energy. The standard deviation is a statistical measure used to summarize the spread of data values and to what extent the data is close to the average. The standard deviation value is small if the data is scattered near the average and the standard deviation value is big if they are scattered in the distant places. Mathematically, the square of the standard deviation gives the variance value. The concept of variance is related to how far each value of the distribution is from the mean of the distribution. The reason why these features show a distinctive feature is that the frequencies of the signals become more prominent by the FFT method. Power and energy are interrelated structures. Power is described as the energy consumed per unit time. The power and energy characteristics of the complex EEG signals for the KNN classifier yielded high success.

For all features, KNN classifier has achieved overall accuracy rates of; 69.65% for the overall accuracy, 69.66% for the recall, 69.60% for the F1

score, 68.64% for the precision. Table 2 shows the overall success of the KNN classifier.

Table 2. KNN classifier performance on all features

Distance Metrics	***k=1***	***k= 3***	***k=5***	***k=7***	***k=9***	***Achievement Averages***
Overall accuracy	89.00%	62.45%	68.76%	63.28%	64.75%	69.65%
Recall	89.00%	62.50%	68.70%	63.30%	64.80%	69.66%
F1 Score	89.00%	62.40%	68.70%	63.20%	64.70%	69.60%
Precision	89.00%	62.60%	63.40%	63.40%	64.80%	68.64%

4. Conclusion

As a result, it was found that there is difference between EEG signals of videos containing the 25th frame effect and the EEG signals of raw videos. Some of the images in the videos we are watching can pass at the speed that our eyes cannot detect. These images that we see unintentionaly are affecting the subconscious. Identifying this situation will create an awareness. The 25th frame effect on the videos can be determined by looking at the EEG signals of the participants watching the videos.

The number of best learning examples of KNN classifier was determined as 1 and 5. In the cross-validation method, it was observed that the performance of the classifier decreased as the number of folds increased. The characteristics of the standard deviation, power, variance and energy values have been highly successful in the classifier. The future work of the study is to develop different classification methods and cross-filtering processes.

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COMPARISION OF MODULATION TECHNIQUES IN SATELLITE COMMUNICATIONS SYSTEM

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1.Introductıon

Communication systems have become important because of the great war in the world. The efforts to establish the supremacy of countries during the 1st and 2nd World War contributed significantly to the development of communication and microwave systems. Since terrestrial communication systems were not sufficient in the military area, more efficient systems were needed to be developed over time.

Satellite communication systems that were developed during the Cold War period were opened for civil uses after the cold war. As a result of the widespread use of the Internet and mobile phones and technological advancement for the more effective use of existing communication techniques, development of modulation types in Satellite Communication Systems has become a necessity.

(Couch, 2001; Haykin and Moher 2007; Lathi,1998; Roden, 2000; Sklar, 2001) contain detailed information on how to use analog and digital modulation types or how can be modifed in the most efficient way. In (Mishra, Saxena and Sharma, 2010), authors have given a brief overview of the different analog and digital modulation techniques is provided through a comprehensive survey to analyze the superiority of a given modulation technique at a glance.

In this paper, an overview of analog and digital modulation types used in satellite communication system is presented.

The rest of the paper is organized as follows: in Section 2, analog modulation types are mentioned; in Section 3, digital modulation types are presented and the comparison of analog and digital satellite data transmission in NON-LINEAR transmission are made in Section 4 and finally in Section 5, the results of the comparison process are given.

2.Analog Modulatıon Types

Analog modulation is the type in which the response to the analog information signal is continuously transmitted. In analog modulation, the carrier is transmitted the modulated instantaneous signal values (the

answer) by continuously and appropriately modulating (Eldem, 2015). Main analog modulation types are amplitude, frequency and phase that are shown in Figure 1.

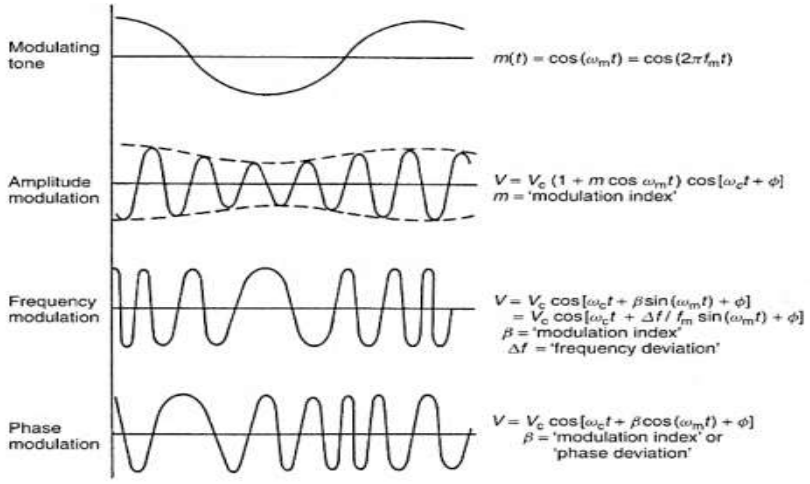

Figure 1. Types of analog modulation (Hanninen&Praks, 2019).

Amplitude modulation (AM) is the modulation type of the carrier signal that varies according to the instantaneous amplitude of the modulating signal. Being very sensitive to noise is the main problem of amplitude modulation. Un-solicited amplitude modulations can cause phase or frequency modulations in non-linear devices. Especially when AM/PM or AM/FM conversions are performed, it is not possible to make desired modulations due to noise factor. As other modulation types are more advantageous than Analog Modulation type, AM Modulation is very rarely used in Satellite Communication. AM modulation is usually preferred in AM Radios, Analog TVs and Optical Communication. In addition, AM is used in inter-laser satellite connections (Inter Satellite Link ISL) in an alternative form called "ON-OFF" Link keying ("Modulation systems used", 2019). Figure 2 shows a schematic representation of ISL.

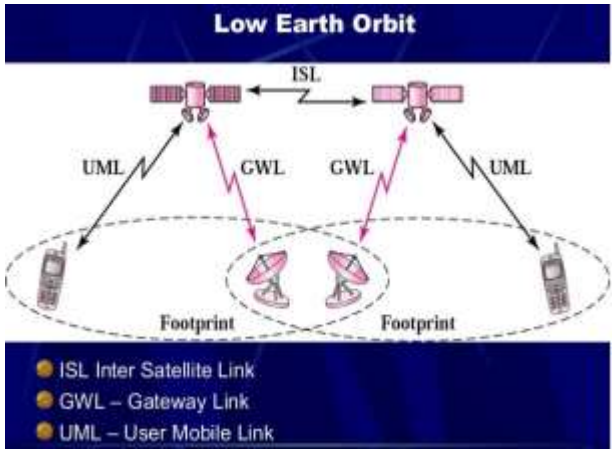

Figure 2. Schematic representation of ISL system (Kaur, 2019).

One of the most widely used modulation methods for analogue signals is Frequency Modulation (FM) ("Modulation systems used", 2019). FM is also one of the angular modulation types. FM is the process of shifting the frequency of an amount of the received information carrier signal relative to the location of the amplitude on the carrier. As with AM, the frequency of the carrier signal varies with the instantaneous amplitude of the modulating signal. In fact, the carrier frequency is replaced by the signal information.Technical receive FM systems used in different applications in satellite communications is simple and affordable. For example, the Inmarsat Paging system, which uses FM, works with a simple and inexpensive receiver. Figure 3 shows the FM modulation of the Inmarsat GEO satellite.

Figure 3. Frequency Modulation of Inmarsat GEO Satellite (Ilčev, 1979).

Phase Modulation (PM) is the modulation type where the phase shift of the carrier signal varies depending on the instantaneous amplitude of the modulating signal. PM is also a modulation form that encodes information such as carrier waves, phase change. PM is one of two main forms of angular modulation like FM. PM's Digital Communication environments are used in many types. PM is widely used, especially in the transmission of radio waves. PM is also an integral part of many digital transmission coding programs that underlie a variety of technologies such as Wi-Fi, GSM and satellite television. Using bandwidth effectively, especially in satellite communication systems and having very low Bit Rate makes PM an integral part of satellite communication systems ("Phase Modulation-PM", 2019).

Digital Video Broadcasting (see Figure 4) is widely used in Interactive Satellite Systems in terms of performance and robustness, as Analog PM designed in Satellite Communication exhibits excellent durability against non-linear (non-linear) distortion in low and medium spectral efficiency **(**Beidas and et al., 2013).

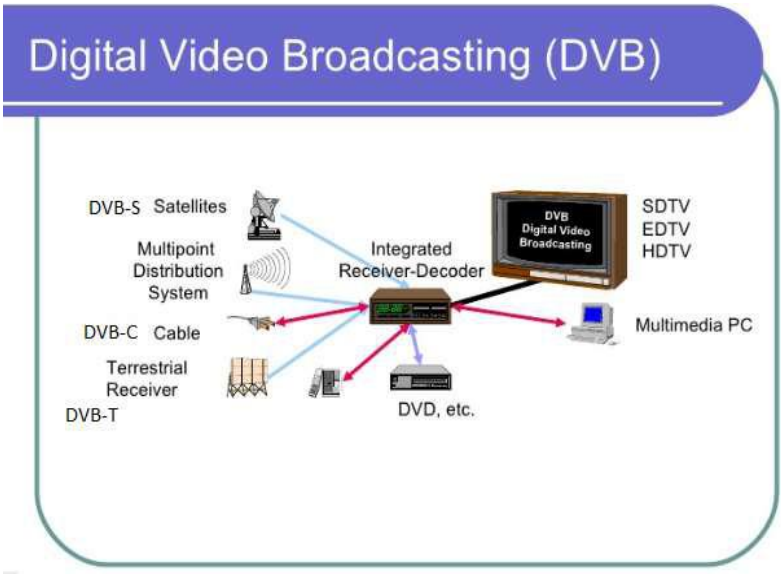

Figure 4. Schematic representation of Digital Video Broadcast (DVB) ("Schematic representation of", 2019).

3.Digital Modulation Types

Digital modulation is the process of transmitting the digital communication information signal as the digital data (1 and 0) not the continuous waveform over the communication channels ("Sayısal Modülasyonda İletişim", 2018). As analogue modulation systems, carrier parameters such as phase, frequency or amplitude are replaced by information signals in digital modulation systems.

The most fundamental digital modulation techniques are PSK (phase shift keying), FSK (frequency-shift keying), ASK (amplitude-shift keying), QAM (quadrature amplitude modulation) shown in Figure

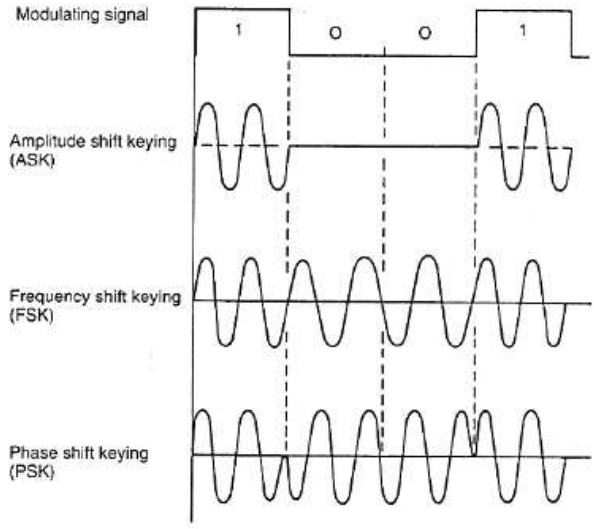

Figure 5. Types of Digital Modulation (Hanninen&Praks, 2019).

There are many variations and combinations of these techniques. The combination of ASK and PSK is also known as QAM (Quadrature Amplitude Modulation) (Eldem, 2015). Figure 6 shows the block diagram of the ASK modulator.

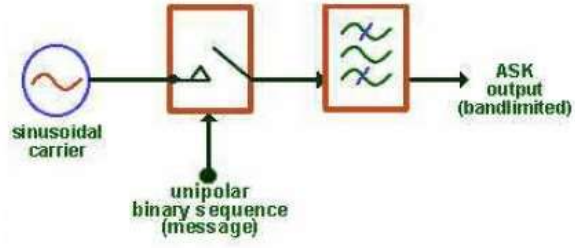

Figure 6. Block diagram of ASK Modulator ("Blok Diagram of", 2019)

ASK modulation is generally used as a binary message in the optical systems of Satellite Communications (Hausman, 2018).

FSK is the digital modulation technique, which is the shifting of the modulated signal between predetermined values and the output frequency. The FSK modulation uses two different frequencies indicated by 1 and 0 values ("Modulation Techniques in", 2019).

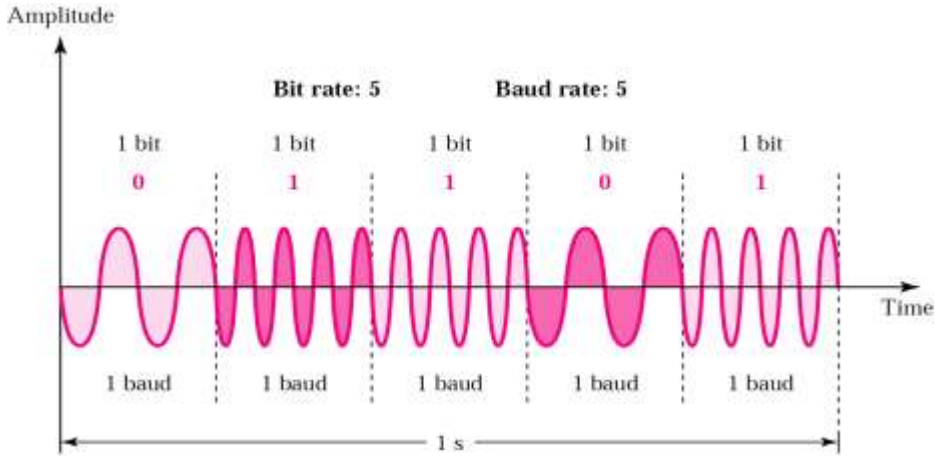

Figure 7. Baud Bit Rate of FSK Modulation ("Analog Transmission", 2004)

FSK systems in satellite communication are not preferred because they do not provide sufficient bandwidth (See Figure 7). Since FSK alone is not sufficient, M-FSK (Multiple frequency-shift keying) is one of the modulation techniques in which efficiency can be increased by increasing frequencies (M) in additional complications and less bandwidth efficiency. At the same time, the FSK is used at low data rates and in low-power applications such as Global call via satellite communication using M-FSK.

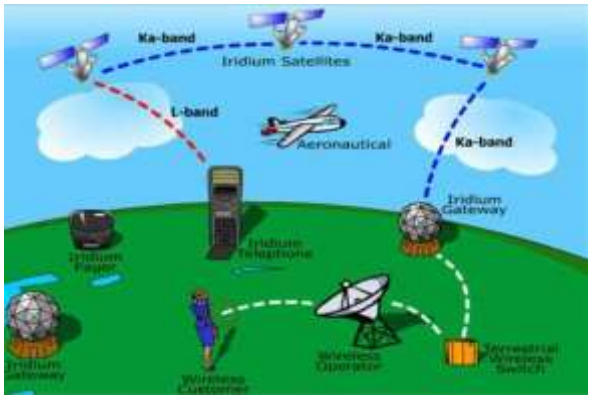

Figure 8. Use of M-FSK Modulation in Iridium Satellites (Siddiqui, 2019)

M-FSK can be used in land mobile satellite communication where the number of users is fixed. It is also used in applications requiring low data rate, such as searching over satellites as Figüre 8 ("Modulation systems used", 2019).

PSK is a special modulation technique and depends on specific system configurations. Important parameters are power efficiency, bandwidth efficiency, hardware and operability cost, and crosstalk sensitivity. RF signal amplitude is constant. PSK modulation is suitable for advanced performance and multi-phase modulation. So, PSK modulation is used very frequently in digital satellite communication systems (“Modulation systems used”, 2019).

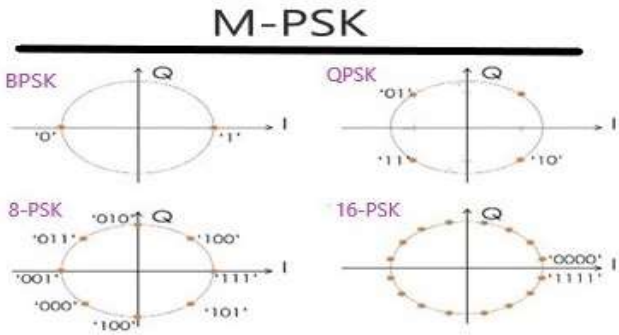

Figure 9. Bitwise Expression of PSK Methods

Number of bits can be changeble based on needs in PSK moduls shown in Figure 9. As PSK modulation is suitable to be developed, numerical modulation methods have been developed according to needs.

The MSK(Minimum Shifting Keying), which is one of the methods developed in the 1950s and 1960s, which requires more power than the PSK methods, and which is essentially a variant of FSK, was accepted as the standard (“Continıous phase modulation”, 2019). However, PSK Modulation is preferred in nonlinear satellite communications since it uses less power than MSK. MSK modulation is used in satellite communications that have standards such as GSM.

In data communication, QPSK is an optimal modulation technique and uses bandwidth effectively (Majeed&McLane, 1997). Different methods have been developed over time to reduce bit losses in QPSK Modulation. The OQPSK (Off-Set QPSK) and π /4 QPSK methods are among the most effective methods used in data communication that are developed according to the needs. As the PSK's modulation level increases, the BER ratio is increasing. Effective use of bandwidth and low BER are expected to be in data communication. The lowest BER value among PSK methods is observed as Shifted QPSK (π/4 QPSK), as can be seen on Table 1 (Belce, 2003; “Spectral efficiency for”, 2019).

Table 1. Spectral Efficiency For Popular Digital Modulation Methods

Modulation Types	*Spectral Efficiency(Bits/s/Hz)*
FSK	<1 (depends on modulation index)
GMSK	1.35
BPSK	1
QPSK	2
8PSK	3
16QAM	4
64QAM	6
OFDM	>10 (depends on the type of modulation and the number of subcarries)

Because of needs occur over time in the satellite communications, QAM (Quadrature Amplitude Modulation) method has been developed by using ASK and PSK methods. However, QAM is experiencing more distortion in non-linear satellite communication channels (Benedetto, Pent and Zhang, 2002). QAM is suitable for GEO (Geostatic Trajectory Satellites) channels with only Gaussian attenuation due to amplitude and phase modulated signal. It is more susceptible to interference and attenuation effects than MPSK and used in mobile radio satellites ("Modulation systems used", 2019; "Modulation Techniques in Satellite", 2019).

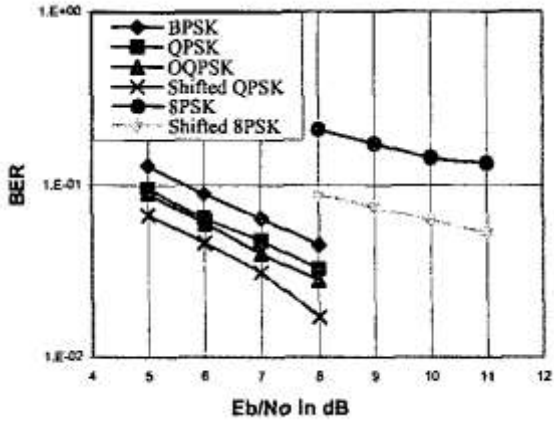

Figure 10. BER and effective bandwidth ratio (Belce, 2003)

QAM is preferred in digital modulation techniques of satellite communication systems where spectrally high efficiency is expected.

4.Comparision of Analogue and Numerical Satellite Data Transmission in Nonlinear Transmission

The data which are transmitted in Broadband Satellite communication systems are generally non-linear. In non-linear transmissions, decreasing of the level of transmitted signals is inevitable situation. In order to help to the modulation techniques in Non-linear transmissions Wave Tube (TWT) is used as a amplifier for satellite transponders. For example, there are AM / AM and AM / PM changes at 16 QAMs, which have both a digital communication method and a connection to analog communication. The use of TWT in analog and numerical terms varies according to the type of modulation. According to numerical modulated pre-distortion data, while digital modulation is made via the previous data, analog modulated twt is edited via any data. Basic simulation model of Transmission Channel is shown in Figure 11.

In digital modulated twt, we need to know the previous data. In addition, the use of digital modulated twt data loss 23 percent less than analog modulation ("Communication in Digital", 2018; Hausman, 2018).

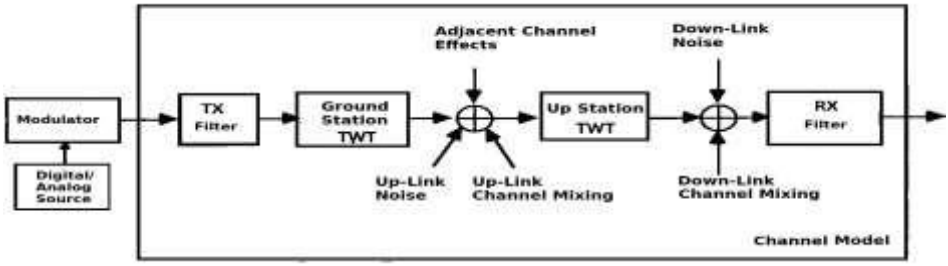

Figure 11:Basic Simulation Model of Transmission Channel ("Basic Simulation Model of", 2019).

5. Conclusions

Since today's communication technology is developing each passing day, the communication technology needs increase day by day. The communication process that started with Analog Modulation has shifted to broadband digital modulation with image and video transmissions. Digital modulation has evolved into different forms with the increase of needs. Since the satellite launch process is cost-effective, hardware components are minimized considering the communication efficiency.

Satellite Communication Modulation Techniques continue to develop ergonomically for more effective use.

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ENVIRONMENTAL SCIENCES AND ENGINEERING

THE AWARENESS LEVEL OF BURSA ULUDAG UNIVERSITY STUDENTS ON ENVIRONMENTAL POLLUTION

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1. Introduction

Environmental issues have become one of the most important areas of discussion today. Because environmental problems; population growth, industrialization, urbanization, use of pesticides, as well as the lack of environmental awareness in people has increased gradually (Erdal et al., 2013).

The focus of environmental education programs has generally been to improve attitudes towards the environment through increased knowledge of the environment (Pooley and O'connor, 2000). In the framework of formal education in Turkey, although there is no specific environmental education curriculum, within the necessary information about the environment are given in primary and secondary education programs. As regards higher education, there is no specific environmental education policy adopted or implemented nationally (Oğuz et al., 2011).

It is of utmost importance that university students, who will take part in the solution of current and future environmental problems and have an essential place in the transfer of information to future generations, are able to apply environmental knowledge to their daily lives and comprehend the danger (Erdal et al., 2013).

Family, educational institutions, mass media, and non-governmental organizations play an essential role in the development of environmental awareness, which has a dynamic structure that can develop throughout life (Karataş, 2011).

In this study, the environmental awareness of the associate degree students studying at three vocational schools in Bursa Uludag University Gorukle Campus was evaluated with a survey.

2. Materials and Methods

The main material of the study consists of associate students studying at Bursa Uludag University Gorukle Campus. The total number of associate degree students in Gorukle Campus is 3779 in the academic year of 2016-2017. Table 1 shows the number of students participating in the study.

Table 1. Number of students participating in the study

Vocational School (VS)	Number of students
Health Service VS	175
Technical Sciences VS	174
Mennan Pasinli VS	8

In this study, the level of environmental consciousness of students was determined by using face-to-face survey method consisting of 20 questions.

3. Results

The gender distribution of the survey participants in terms of VSs is given in Table 2.

Table 2. Gender distribution according to VS

VS	Female	Male
Health Service VS	127	48
Technical Sciences VS	28	146
Mennan Pasinli VS	4	2

According to Table 2, it is seen that female students have higher participation in Health Services VS and Mennan Pasinli VS and male students in Technical Sciences VS. In Mennan Pasinli VS, 8 students participated in the survey, but 2 students were not included in the gender distribution because they did not specify gender.

The distribution of the survey participants by age is shown in Table 3. As seen from Table 3, the highest age distribution in all three VS is in the 19-20 age group.

Table 3. Age groups by VS

VS	Age Groups											
	15	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**33**	**34**
Health Service VS		7	56	48	23	28						
Technical Sciences VS	2	17	33	46	16	26	8	6	4	4	7	5
Mennan Pasinli VS			6	2								

The surveys were examined on the basis of VSs and the results obtained in this study are given in the graphs (Figure 1-20) below.

1. According to you, which is the main cause of environmental problems?

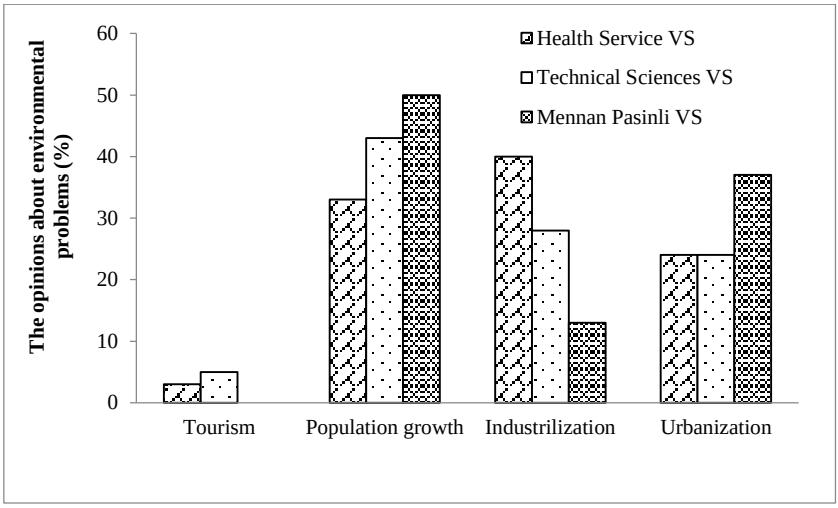

Figure 1. The opinions about environmental problems

According to the students, population growth is the basis of environmental problems. The students think that population growth brings other environmental problems. In addition, industrialization is thought to be the basis of environmental problems in the Health Service VS.

As shown in Figure 1, population growth is the most significant environmental problem according to the students of Mennan Pasinli VS. None of the students at Mennan Pasinli VS have thought the tourism. The ratio of urbanization is 24% in both Health Service VS and Technical Sciences VS.

2. Do you think the studies for solving environmental problems are sufficient?

When the students of the survey were asked about their opinion about finding an adequate solution to environmental problems, more than 50% of the students in the three VSs say that the studies for the solution of environmental problems are not enough (Figure 2).

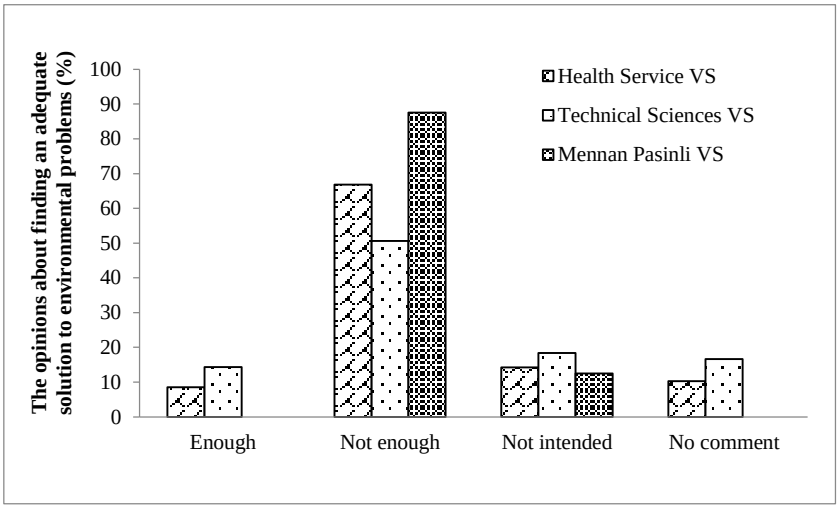

Figure 2. The opinions about finding an adequate solution to environmental problems

3. Would you like to participate in the events organized for the environment?

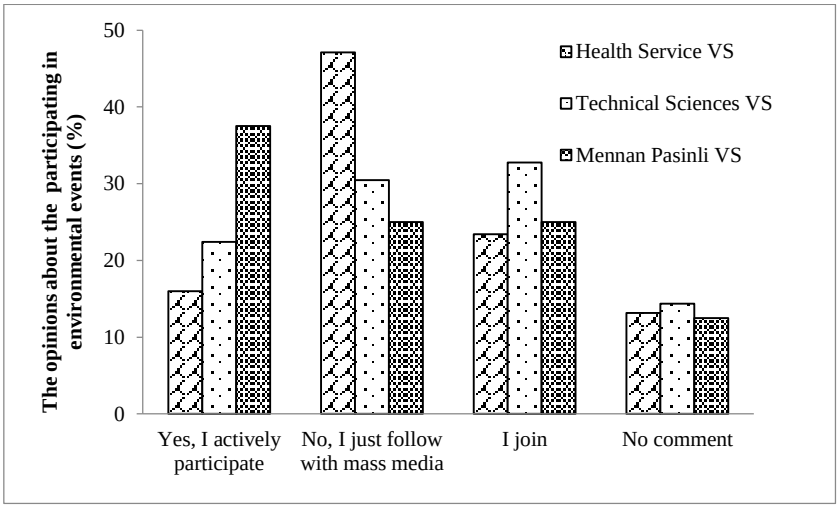

Figure 3. The opinions about the participating in environmental events

When asked about participating in environmental events, the students studying at the Health Services VS are interested in the environment, but instead of participating, they follow the mass media (Figure 3). Most of the students at Technical Sciences VS, do not participate in environmental events. 37.5% of the students at Mennan Pasinli VS answered this question yes. This result shows that the students in the VS are more closely related to the environment than the other VS students.

4. Which of the following methods is more effective for raising environmental awareness to society?

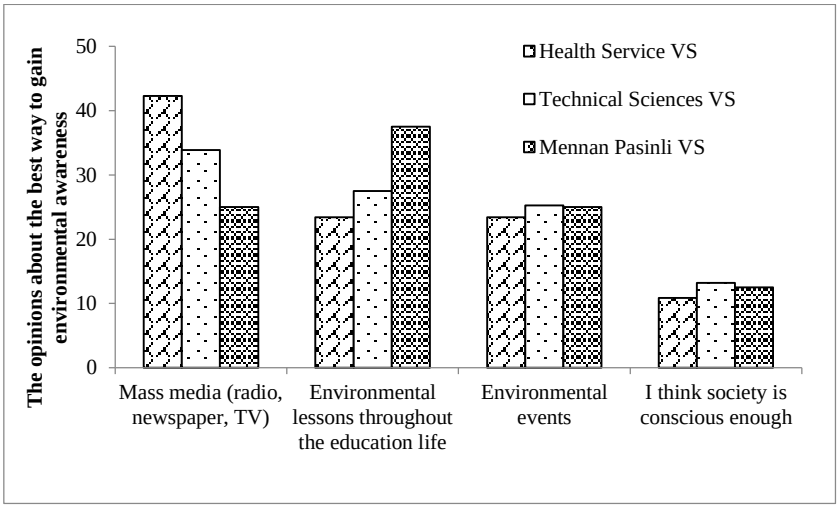

Figure 4. The opinions about the best way to gain environmental awareness

When asked the best method to gain environmental awareness to the society, the students preferred mass media (Figure 4). Few think that society is conscious enough. Due to the Mennan Pasinli VS's course contents are different, the responds are different compared to the other two VSs.

5. According to you, what is the definition of erosion?

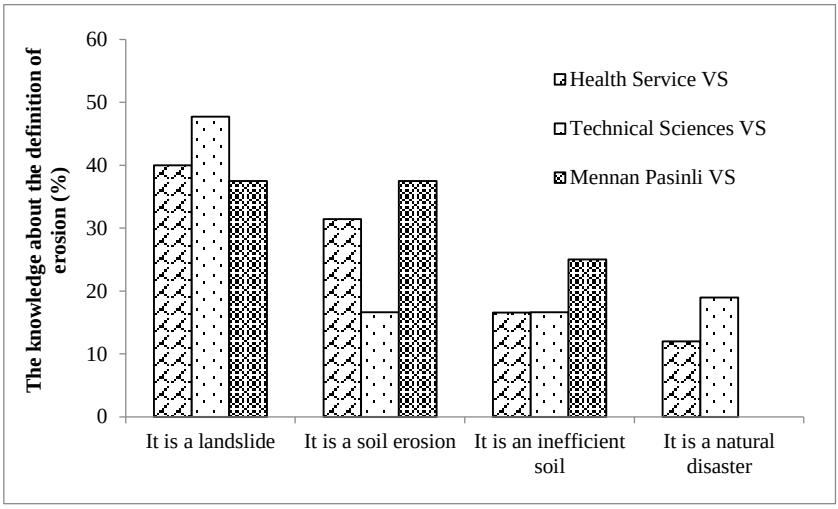

Figure 5. The knowledge about the definition of erosion

As seen from Figure 5, the students studying at Health Service and Technical Sciences VSs define the erosion is soil erosion. 37.5% of the students at Mennan Pasinli VS answered both soil erosion and landslide. The majority of the students confuse erosion with landslides.

6. According to you, what is the reason of soil pollution?

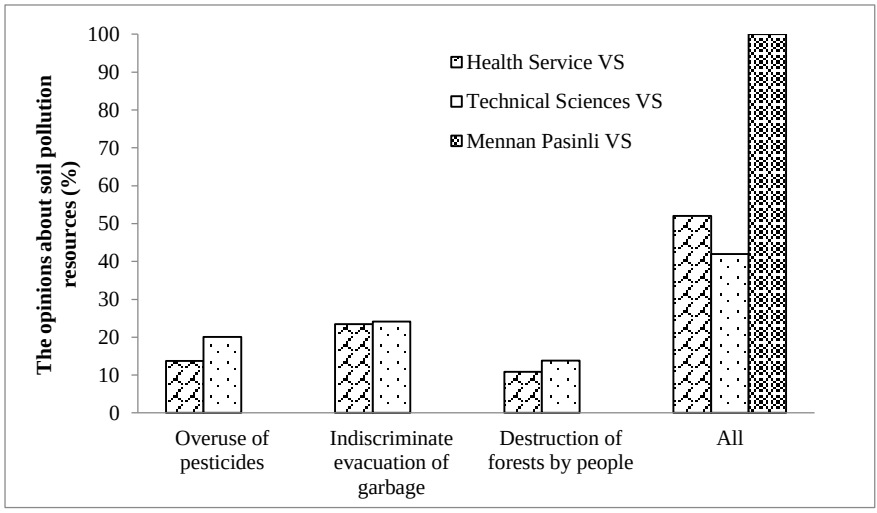

Figure 6. The opinions about soil pollution resources

According to the results of the survey, students think that the source of soil pollution is the effect of using agricultural pesticides, random disposal of garbage and destruction of forests by people (Figure 6). 52% of Health Services VS, 41.9% of Technical Sciences VS and 100% of Mennan Pasinli VS think that all of these effects are the source of soil pollution.

7. What do you prefer to buy products when you shopping?

The opinions about choosing the products when shopping according to Figure 7, fewer students prefer products with recycling marks in their packaging, and the majority prefer economically appropriate products or pay attention to purchasing as many products as they need. In Mennan Pasinli VS, the number of students who prefer economic products is the highest, and this constitutes 50% of all of them.

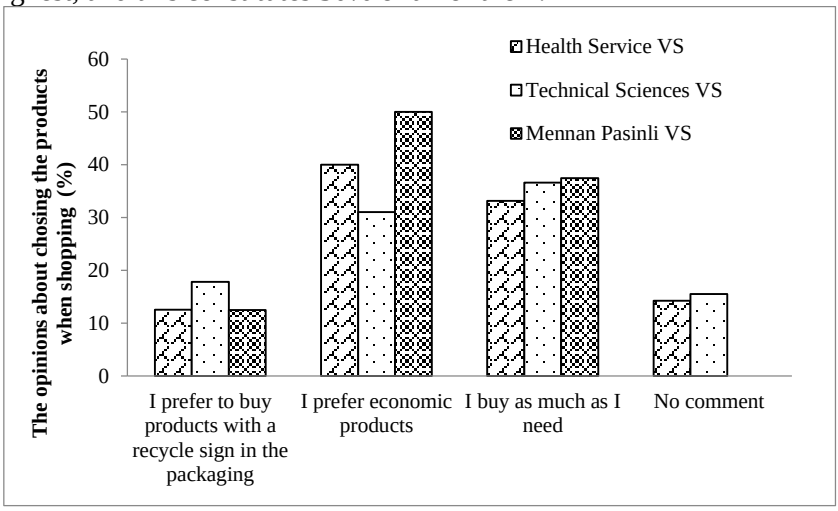

Figure 7. The opinions about chosing the products when shopping

8. How to remove the glass, paper, plastic, metal, battery wastes from your house?

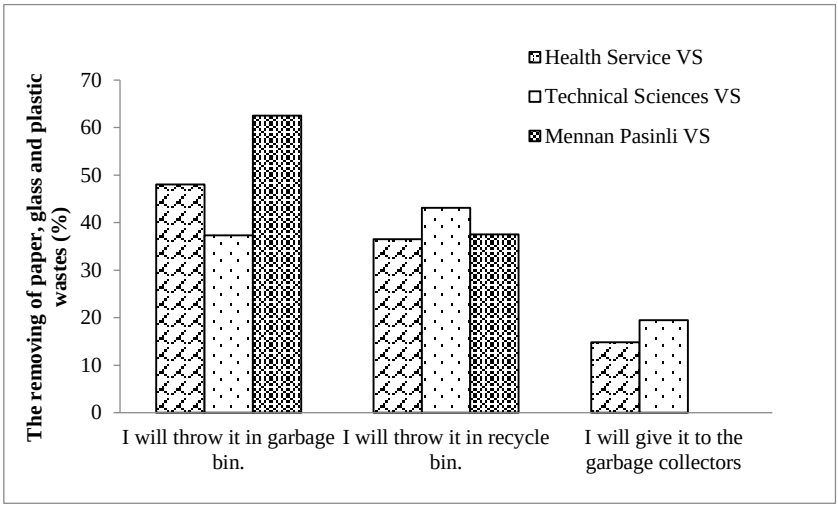

Figure 8. The removing of paper, glass and plastic wastes

The majority of the students at the Health Service and Mennan Pasinli VS throw the recyclable wastes into the garbage bin, while the students at the Technical Sciences VS dispose to the recycle bin (Figure 8). There are few students give the recyclable wastes to the garbage collectors.

9. According to you, which are the most important sources of air pollution?

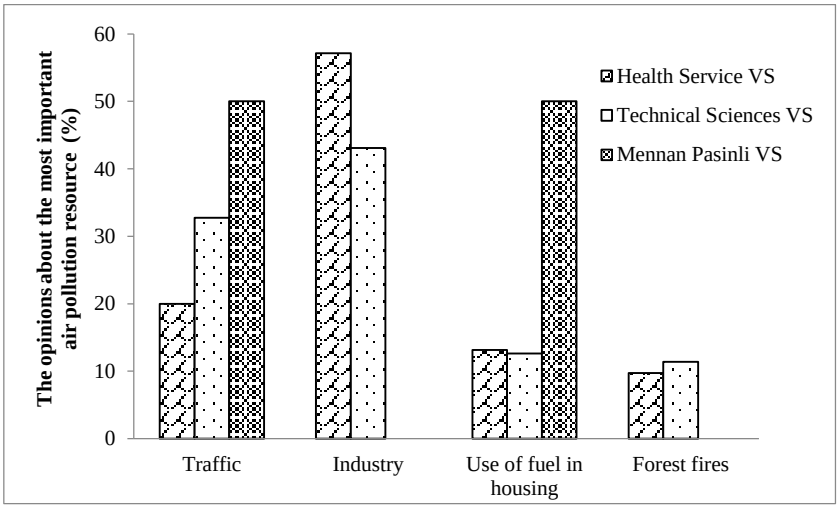

Figure 9. The opinions about the most important air pollution resource

As seen from Figure 9, 57% of the Health Service VS students think the resource of air pollution is industry. In Mennan Pasinli VS, the students answer the fuel usage in traffic and housing are half.

10. Which of the following expresses your opinion about base stations?

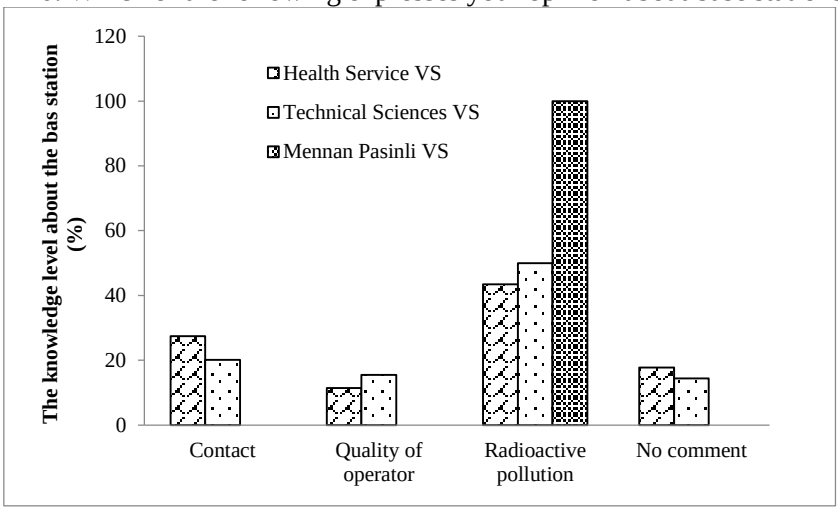

Figure 10. The knowledge level about the bas station

In question 10, the knowledge level about the bas station was asked, for the majority of students base stations refer to radioactive pollution (Figure 10).

11. According to you, how is our country in terms of water resources?

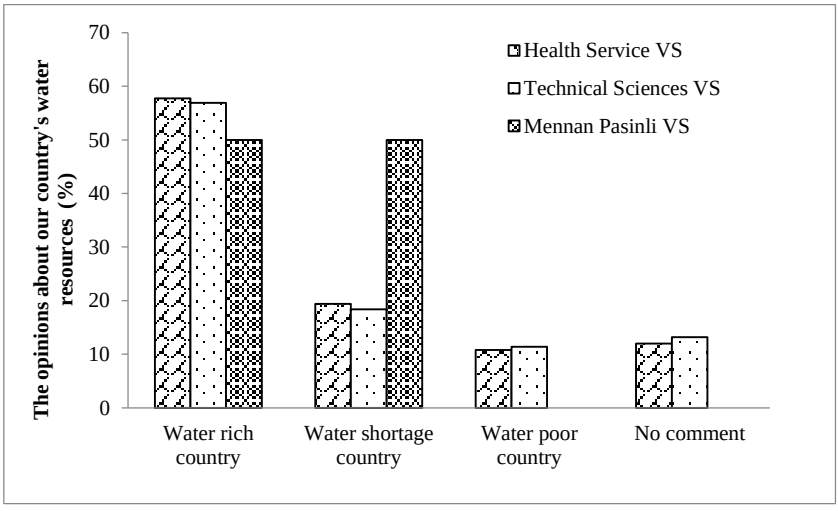

Figure 11. The opinion about our country's water resources

As seen from Figure 11, our country is seen as a water rich country by the students studying at the three VSs. The fact that three sides of our country is surrounded by seas makes the students think that our country is a water rich country.

12. What do you think about clean production applied in factories?

The opinions about clean production applied in factories were asked to the students, Technical Sciences and Mennan Pasinli VS students stated that it is an application for water and energy saving (Figure 12). It is thought that the students of Technical Sciences VS take courses that are more related to the industry.

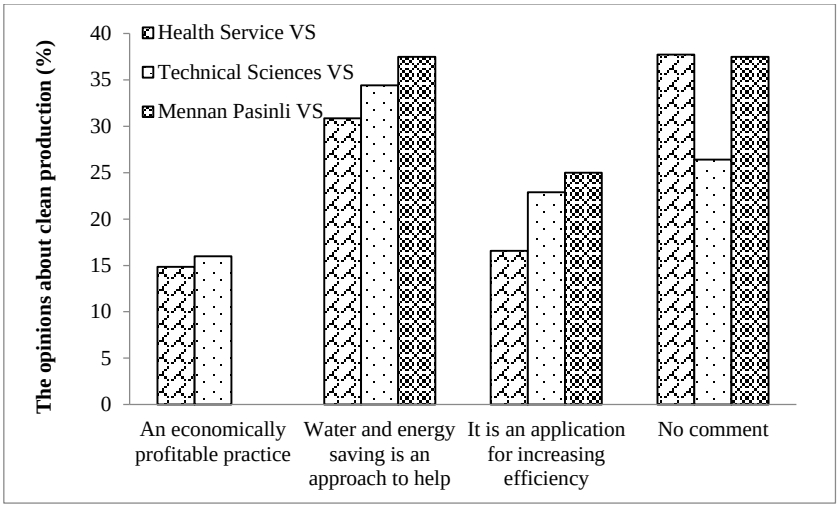

Figure 12. The opinions about clean production

13. How do you react to the activities that cause environmental pollution of individuals, institutions or factories?

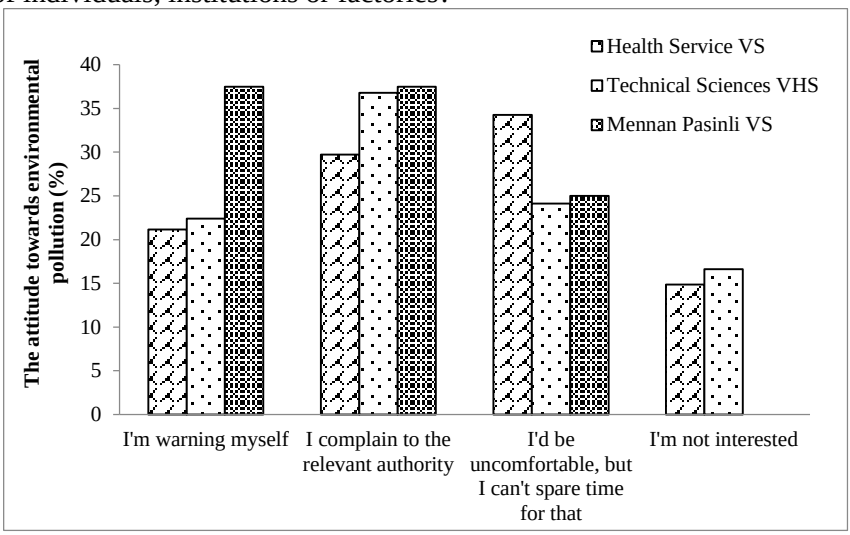

Figure 13. The attitude towards environmental pollution

When the students were asked what are their behaviours to the environmental pollution, the students studying at Technical Sciences VS would complain to the relevant authority and the students studying at Mennan Pasinli VS warn them at their own expense or would complain to the relevant authority (Figure 13). These results show that students are more sensitive to the environment.

14. What is the reason of water pollution?

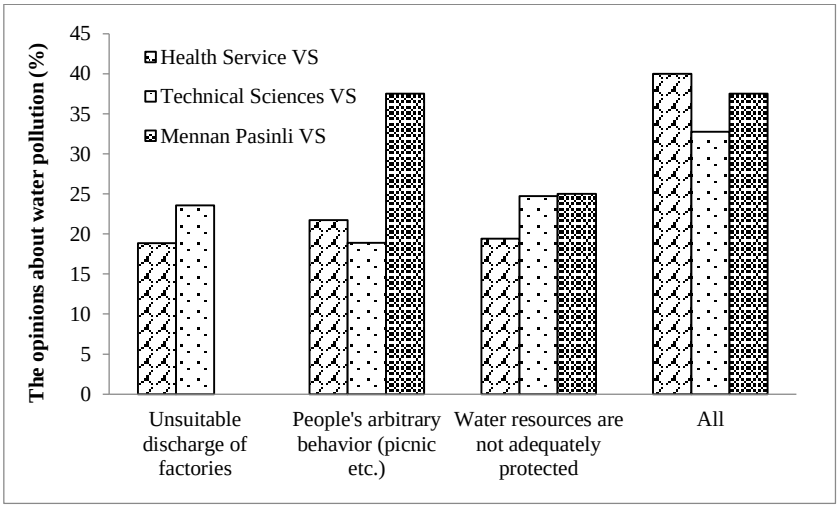

Figure 14. The opinions about water pollution

As seen from Figure 14, the majority of students in all three VSs stated that water pollution reason is the improper discharge of factories to water pollution sources, inadequate behaviour of people and insufficient protection of water resources.

15. Do you think that the treatment of drinking and wastewater treatment plants is adequate in Bursa?

According to the survey results, drinking and wastewater treatment plants work in Bursa are not enough (Figure 15).

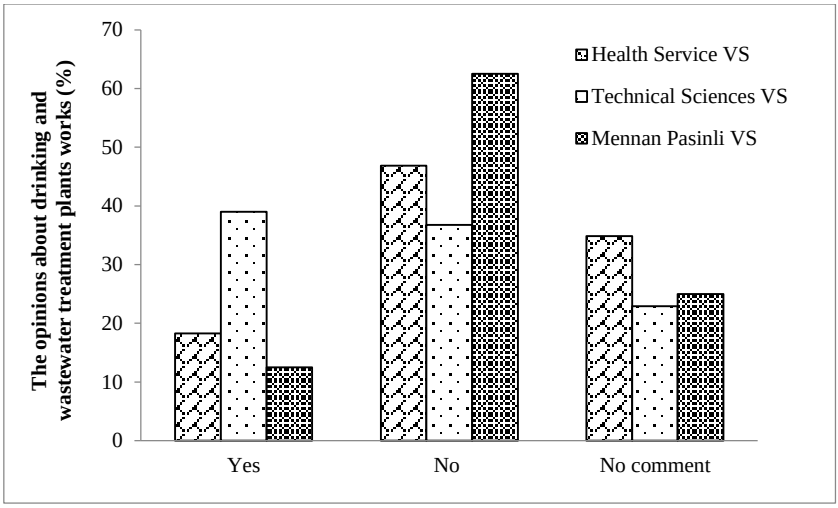

Figure 15. The opinions about drinking and wastewater treatment plants works

16. According to you, what is the reason of image pollution?

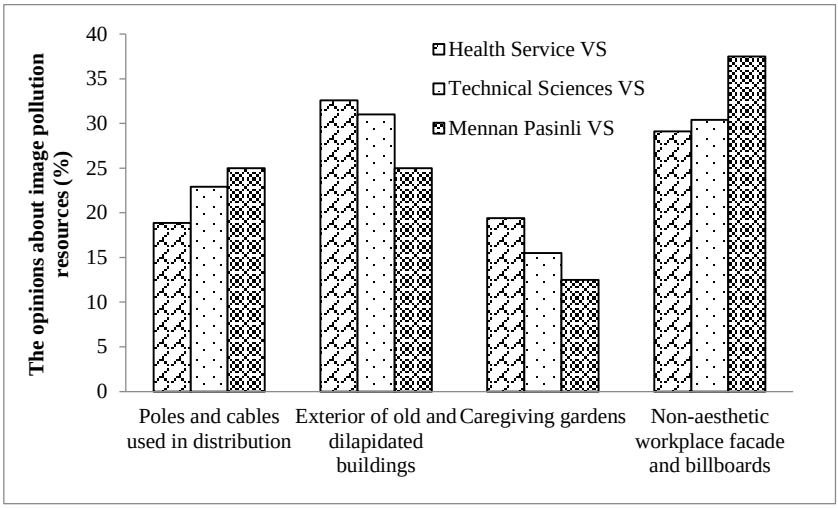

Figure 16. The opinions about image pollution resources

When the resources of image pollution were asked, the students Mennan Pasinli VS has stated that there are workplace facades and billboards without aesthetics (Figure 16). On the other hand, students studying at Technical Sciences and Health Services VSs think that old and ruined buildings caused image pollution.

17. What is the environmental problem that significantly affects Bursa?

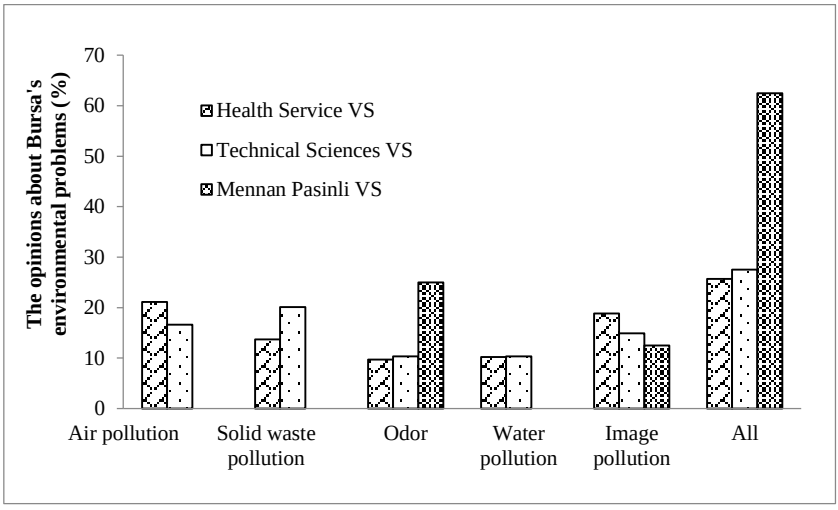

Figure 17. The opinions about Bursa's environmental problems

The students state that air pollution, solid waste pollution, odor, water pollution and image pollution when they were asked what are the environmental problems of Bursa (Figure 17).

18. How often the municipality of the place collects garbage?

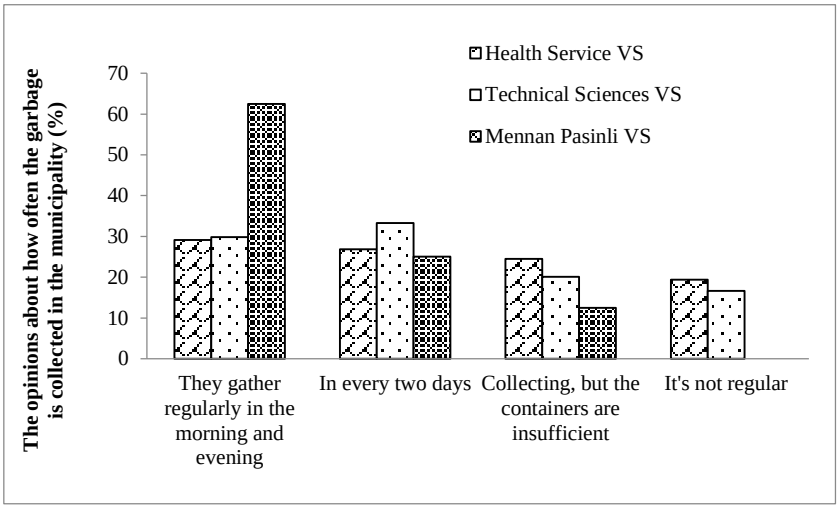

Figure 18. The opinions about how often the garbage is collected in the municipality

According to the survey results, the students studying at Health Services and Mennan Pasinli VSs say that the garbage is collected morning and evening. Technical Sciences VS students indicate that the garbage is collected in every two days (Figure 18)

19. What do you prefer to be near the place where you live?

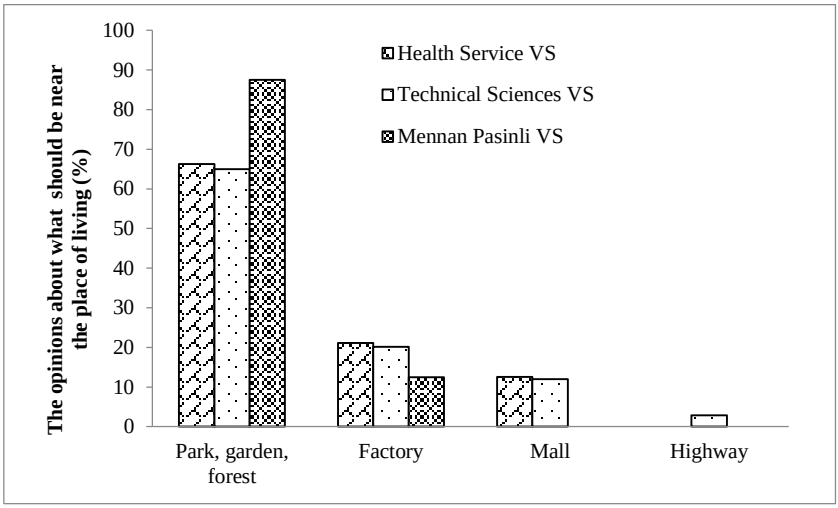

Figure 19. The opinions about what should be near the place of living

As seen from Figure 19, the students want to live near the park, garden and forest. A few students want to live near highway.

20. Do you have any idea about green houses, which are more valuable in the construction sector, respectful to nature, ecological, comfortable and reduce energy consumption?

Between 40% and 63.5% of the students do not know the green houses (Figure 20), 25-27% of the Health Service and Technical Sciences VSs students heard, but do not know what the green house means.

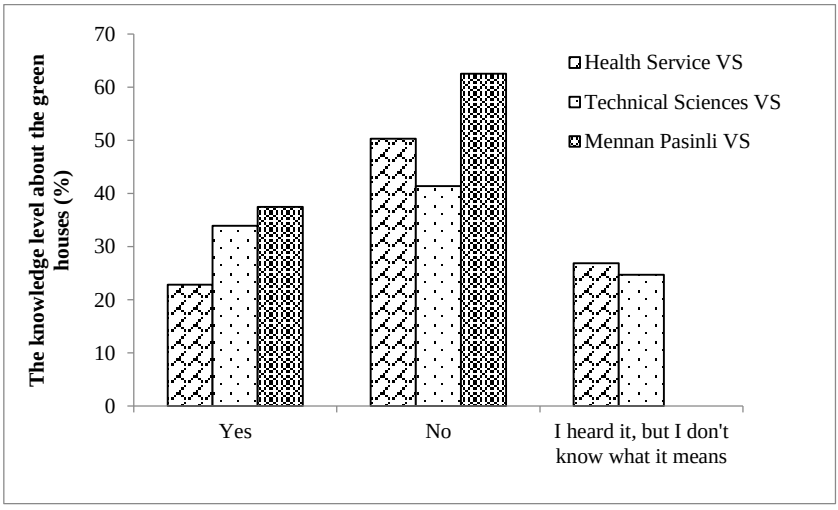

Figure 20. The knowledge level about the green houses

4. Conclusions

In this study, a survey was applied to determine the environmental awareness of associate students at Bursa Uludag University and the results are summarized below.

- It was determined that the male students were not interested in the environment and the female students were more interested in the subject.
- It was determined that the subjects including the relation of industry and environment as clean production have changed according to the VS, and that the lessons learned by the students increase the level of knowledge about the subject.
- When the answers were evaluated, it was determined that Mennan Pasinli VS students were more sensitive about the environment and higher level of consciousness. The courses such as Hara Hygiene and Biosecurity, Horse Hardware, Equipment and Facilities and Course and Field Arrangement at this VS are related to environmental issues and this shows that the environmental lessons learned have a great effect on environmental awareness.

Acknowledgement

The author would like to thank Environmental Engineer Aylin YÜCEKAYA for her valuable effort on applying the survey.

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THE AWARENESS OF PUBLIC ON COLLECTION OF USED CLOTHES IN BURSA, TURKEY

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1. Introduction

The wastes arising from the development of technology, industrialization, and urbanization constitute severe problems for the environment. Considerable amounts of financial expenditure must be made for the disposal of wastes separated into three groups as solid, liquid and gas without harming the environment (Doğan, 2012).

The textile industry in our country is one of the most developed sectors, and its impact on environmental pollution is also significant (Tüfekçi et al., 2007). Textile products that people use and need in their daily lives are disposed of as household waste by consumers after their usage period is completed (Ar and Tokol, 2010). Since there will be a flow of clothes as long as people exist in the world, used clothes will be a problem for the environment and can be evaluated in the solid waste group. However, if the textile wastes can be recycled without damaging the environment, the contribution can be made to the national economy. The amount of used water and chemicals, energy spent for the reuse of textile wastes, which are processed for use in the textile industry, in the same sector, is less than that of new production. Also, the employment of people in this field will be created (Eser et al., 2016).

Textile wastes, which are less in terms of material quantity but of great importance in terms of consumption and recycling, are clothes that are created by consumers and not worn as they are shrunk, worn linens, covers, shoes and bags. Collecting these wastes and delivering them to the needy is also a part of the recycling.

In this study, a survey was applied to 600 people who were randomly selected in Osmangazi, Nilüfer, and Yıldırım, which are the central districts of Bursa, to determine their awareness of the collection of used clothes from their houses and the data were evaluated.

2. Recycling and Collection of Textile Wastes

Textile wastes from factories, production facilities, and consumers are classified according to the type, color and quality of the fabric. It is crucial to be done this classification with the required precision. Because the product to be obtained varies according to the type of waste. Secondary raw material, textile recycling machines and other equipment according to

the category to which it belongs, are sold to buyers according to the usage area and brought back to the economy (Anonymous, 2019a).

The recycling of textile wastes is riskier and more competitive than other recycling areas and is mostly carried out by medium-sized companies. The color, type and foreign matter content of the fabric are of great importance in textile recycling (Anonymous, 2019b).

To collect textile wastes from users, waste collection campaigns have been initiated in our country. These waste clothes are intended to be collected from the boxes put by municipalities. The products that can be disposed of in waste collection boxes are used clothes, shoes, bags, old linens, bedspreads, and other textiles.

3. Waste Clothes Collection Boxes in Our Country

Waste clothes collection boxes, which is a new application in our country, has attracted significant attention from people. In most of our cities, there are no waste clothes collection boxes, but some of our cities have. Some of these are given below:

- Ankara Altındağ Municipality, in cooperation with the Turkish Red Crescent, puts clothes boxes at specific points in Altındağ and transports the usable ones to the needy after separating the second-hand clothes (Anonymous, 2019c).
- Ankara Sincan Municipality has placed 30 clothes collecting boxes in 20 different points of the city to support the disabled people with the financial situation and provides a collection of fitting clothes, toys, and textiles. The items left to the sharing points are transferred to the needy through the Association of Civil Visually Impaired Persons (Anonymous, 2019d).
- Within the scope of a recycling project carried out by Mersin Metropolitan Municipality, a total of 296 clothes collecting boxes are placed in the points determined in the center of Mersin and put into operation to provide clothes for the needy citizens (Anonymous, 2019e).
- Istanbul Beşiktaş Municipality collects waste textile products within the scope of the "Friendly Hands Project" and sends the available ones to the countries and aid organizations in Africa. Non-usable textile wastes are delivered to the world's leading charity organizations for use in blanket and tent fabric production in India (Anonymous, 2019f).
- Manisa Yunusemre Municipality put the boxes on specific points of the district and collects unused clothes and hand them to needy (Anonymous, 2019g).
- To collect used clothes within the scope of a social responsibility project in Izmir, waste clothes boxes are placed all over the city.

The collected clothes are collected in the factories determined by Kızılay after being taken from the boxes by Kızılay staff. Here, very ancient, non-wearable clothes are separated from others in detail, and are sold abroad for specific fees for recycling purposes and scholarships are provided to students with the income from this recycling. The clothes that can be worn are cleaned and ironed by the cleaning companies contracted by Kızılay and delivered to the needy (Anonymous, 2019h).

- Antalya Muratpaşa Municipality has initiated a project to ensure that the old clothes are collected and transferred to the needy or include to the textile recycling network and have placed 600 boxes in different points of the district. The clothes collected are separated once a week and are transported to the needy citizens after the cleaning-ironing process (Anonymous, 2019i).
- The 63 pieces of clothes/shoe collection boxes are put on different points of the district for collecting used clothes and shoes for the first time with the "Waste Clothes Collection Project", which has been started by Osmangazi Municipality in Bursa. It is aimed to provide non-used shoes and clothes to the citizens who do not have enough money to buy clothes within the scope of the project, which aims to prevent direct waste disposal of clothes, on the other hand, recycling of waste is provided (Anonymous, 2016j).

4. Survey Study

In order to determine the level of public awareness about collecting used clothes/shoes in Bursa, a survey was conducted in Osmangazi, Nilüfer and Yıldırım, which are the central districts of Bursa. The survey applied to 600 people in total, including 200 randomly selected from each district voluntarily basis, consists of 14 questions given in Table 1.

Table 1. Survey questions

PERSONAL INFORMATION	
Gender	Woman ( ) Man ( )
Education level	Primary school ( ) High school ( ) University ( ) MSc ( ) PhD ( )
Age	18-25 ( ) 26-35 ( ) 36-45 ( ) 46-60( ) > 60( )
The district where you live	Osmangazi ( ) Nilüfer ( ) Yıldırım ( )
SURVEY QUESTIONS **1.** How would you evaluate your old clothes? a) I throw them in the garbage. b) I give them to the needy.	

c) I repair and use them again.
d) Dispose in used clothes collection boxes.

2. What do you think about the contribution of recycling to the national economy?
a) I think it contributes.
b) I don't think it contributes.
c) I'm not interested.
d) No idea.

3. What is your opinion about recycling clothes?
a) I would like to raise the people around me.
b) I think people around me are knowledgeable.
c) I think that municipalities should make awareness.
d) Product labels should contain information about recycling.

4. Do you pay attention to the ecological label when buying clothes?
a) I pay attention to the ecological label.
b) I don't pay attention to the ecological label.
c) I don't know what the ecological label is.
d) No idea.

5. How often do you buy clothes, shoes or bags?
a) Once a week b) Once a month
c) Once every three months d) Twice a year

6. How many kilos of worn out clothes come out of your house in a year?
a) Less than 5 kg b) 5-10 kg
c) 10-15 kg d) More than 15 kg

7. Are you aware of the used clothes/shoe collection boxes in various neighbourhoods in Osmangazi?
a) Yes, I know.
b) Yes, but I didn't use them.
c) I saw, but I don't know what they are.
d) No, I don't know.

Table 1. Survey questions (continued)

8. Would you like to have the collected clothes delivered to those in need?
a) I want definitely.
b) Absolutely no.
c) I'm not interested.
d) No idea.

9. How many times have you used the used clothes/shoe collection boxes?
a) I've never used.
b) I have used them 1-2 times.
c) I've used more than three.
d) I don't want to use them.

10. What is your opinion about the used clothes/shoe collection boxes?
a) It is a kind of social responsibility project.
b) I think the clothes are going to be recycled.
c) I think it is a project created for the needy.
d) It is a project designed for both needy and recycling purposes.

11. Which publication can be better to introduce the clothes/shoe collection project according to you?
a) Television b) Billboard c) Hand brochure d) Newspaper

12. What is your confidence in the used clothes/shoe collection project?
a) I believe that clothes go to recycling or those in needy.
b) I don't believe that clothes go to recycling or those in needy.
c) I am not sure.
d) No idea.

13. What is your opinion about the interest of people against the used clothes/shoe collection project?
a) I think they will pay attention to this project.
b) I don't think they will pay attention to this project.
c) I think the public needs to be made conscious.
d) No idea.

Table 1. Survey questions (continued)

14. What is your opinion on this survey? a) The survey introduces the used clothes/shoe collection project. b) The survey provides awareness for the recycling of clothes. c) I heard the first time of the used clothes/shoes collection project with this survey. d) After this survey, I will try to put my used clothes in the boxes.

5. Results

The results of the survey were evaluated under two headings.

5.1. Personal Information

The gender information of the surveyed people is given in Table 2, and it is seen that the survey participants in the districts of Osmangazi and Yıldırım are mostly women.

Table 2. Gender segregation of people according to districts

Districts	Woman	Man
Osmangazi	122	78
Nilüfer	90	110
Yıldırım	130	70

When the Table 3, which gives information about the education levels, is examined, it is understood that the participants of the survey are primary schools graduates in Osmangazi and Yıldırım districts with 44.5% and 52%, respectively and university graduates in Nilüfer with 44%. It is observed that the ratio of MSc and PhD graduates is between 1.5-6.5% in all three districts.

Table 3. The education level of people according to districts

Districts	Primary school	High school	University	MSc	PhD
Osmangazi	89	76	29	6	0
Nilüfer	25	74	88	9	4
Yıldırım	104	55	38	2	1

The age groups of participants who are attending the survey are given in Table 4. It is observed that the survey is mostly applied to people under 60 years of age.

Table 4. Age groups of people according to districts

Districts	Age Ranges				
	18-25	**26-35**	**36-45**	**46-60**	**>60**
Osmangazi	44	46	54	41	15
Nilüfer	51	56	43	39	11
Yıldırım	54	34	61	43	8

5.2. Used Clothes Collection Information

The people who are participating in the survey, living in the central districts of Bursa were asked about how they evaluate their old clothes. When Figure 1 is examined, it is seen that the participants in the three districts give the oldest clothes to the needy (66-78%), throw them (1.5-6.5%) or repair and reuse (10-20.5%). The people who used the used clothes/shoe collection boxes are living in Nilüfer district with the highest rate of 11%. Although these boxes located in Osmangazi district, they have been preferred by people living in Nilüfer. This shows that the level of education and consciousness are higher in Nilüfer. Those who use the least of used clothes/shoe collection boxes are the people living in Yıldırım district, and this situation is thought to be because the people of Yıldırım do not know about these boxes.

In the question of whether recycling contributes to the national economy, the participants of all three districts stated that recycling contributes to the national economy at a rate of 68.5-87.5% (Figure 2). The ratio of those who think that recycling does not contribute to the national economy is 21% in Yıldırım, 8.5% in Osmangazi and 2.5% in Nilüfer.

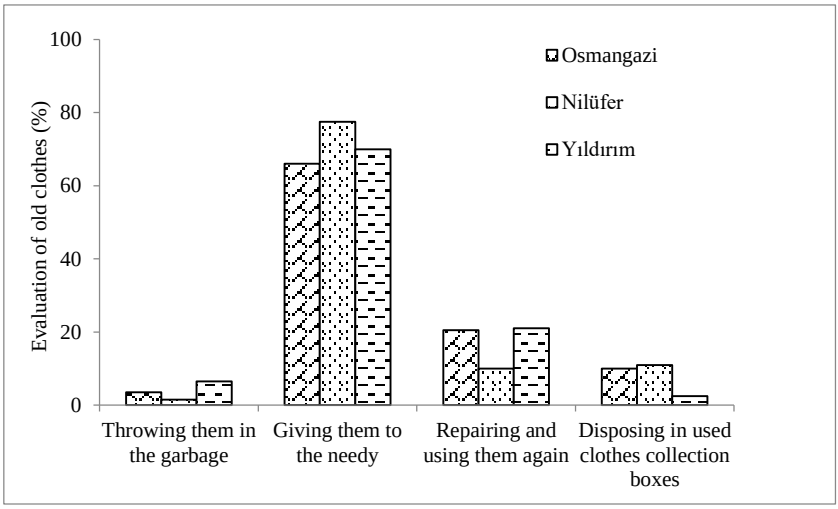

Figure 1. Evaluation of old clothes according to districts

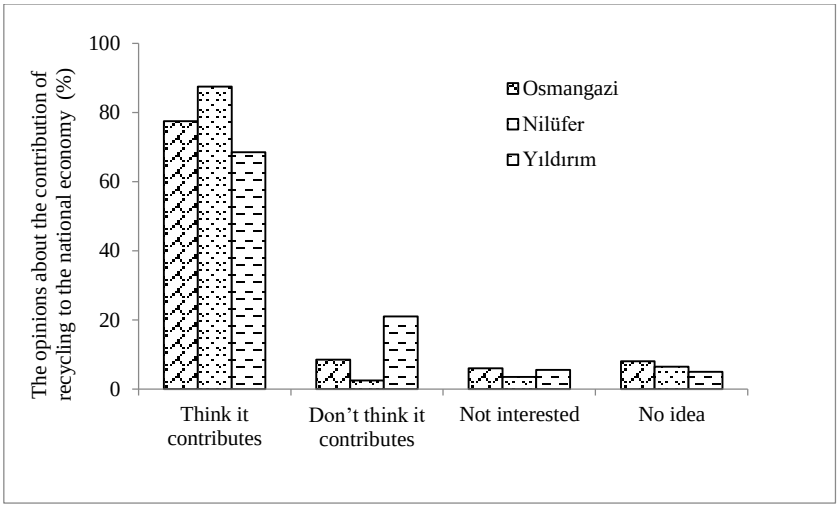

Figure 2. The opinions about the contribution of recycling to the national economy according to districts

When asked people their opinion about the recycling of clothes, more than 50% of the participants in Osmangazi and Yıldırım think that municipalities should inform about the recycling of clothes. 43.5% of the participants from Nilüfer want to raise other people's awareness of this issue voluntarily. Participants mostly living in Osmangazi think that the information about recycling in product labels should take place (Figure 3).

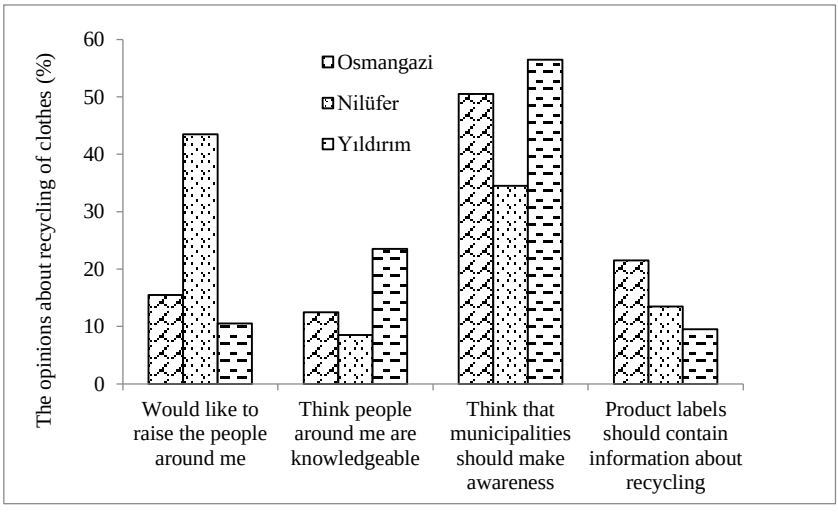

Figure 3. The opinions about the recycling of clothes according to districts

In question 4, when questioned if the ecological label on the clothing is taken into consideration or not, the number of people who do not know what the ecological label is in each of the three districts is high (Figure 4). However, the percentage of those who pay attention to the ecological label in Nilüfer is 41%.

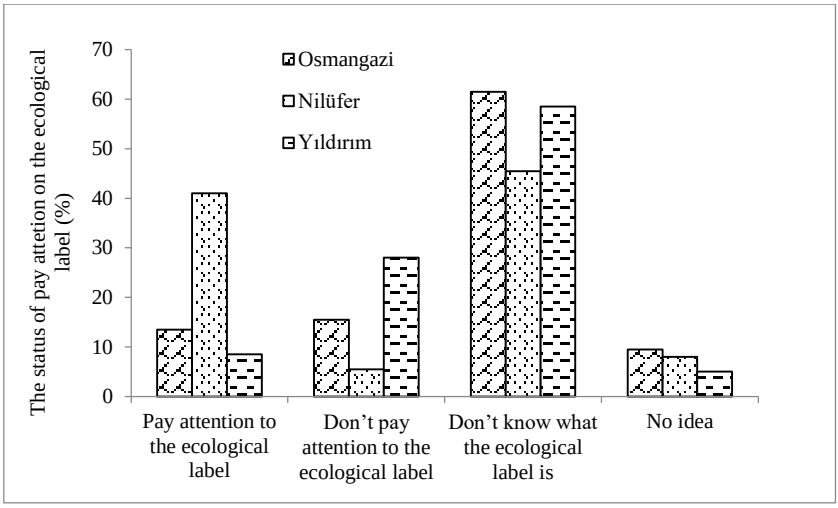

Figure 4. The status of pay attention to the ecological label according to districts

When the participants of the survey were asked about how often they were going to exchange their clothes, shoes or bags, the ones living in Nilüfer stated that they were going out once a month or once every three months (Figure 5). The rate of those who went shopping once a week was 14% in Nilüfer compared to the other two districts. The participants living in Osmangazi are shopping twice a year, and the least shoppers are those who live in Nilüfer. Those who shop twice a year are living in Osmangazi and at least in Nilüfer.

When the amount of worn out clothes coming from the houses in one year was asked in the sixth question, 55% of the participants living Yıldırım has stated that less than 5 kg old clothes out of their houses. According to Figure 6, while the participants living in Nilüfer wear out 5-10 kg clothes in a year, Osmangazi participants wear out 10-15 kg. The rate of participants who explain existing not more than 15 kg old clothes in one year from their houses is 1-4%.

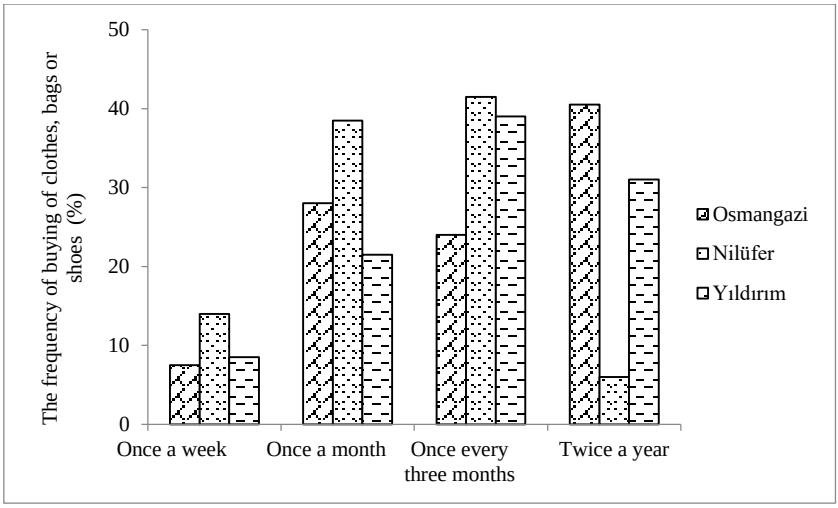

Figure 5. The frequency of buying clothes, bags or shoes according to districts

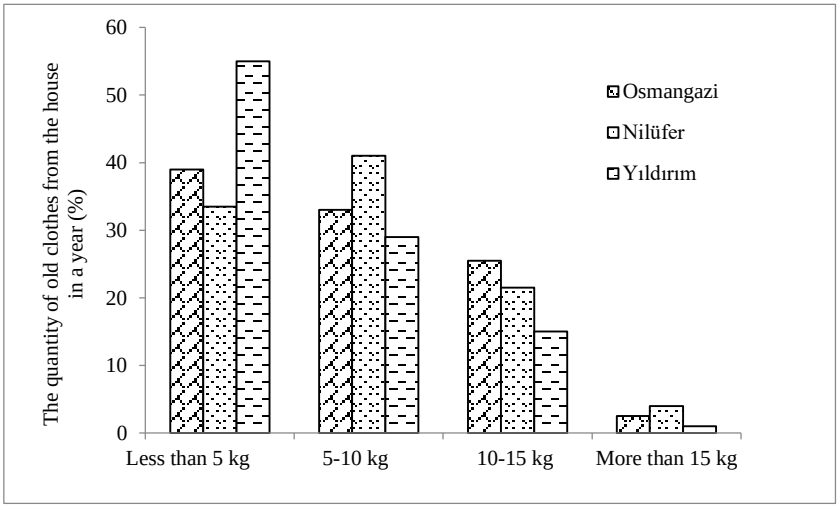

Figure 6. The quantity of old clothes from the house in a year according to districts

Although the used clothes/shoe collection boxes are located in Osmangazi district, it is seen in Figure 7 that the other two districts are partially aware of this application. Although who are aware of the boxes, but do not use them mostly live in Nilüfer. The participants who have seen the boxes, but do not know them are living in Yıldırım and Nilüfer with a

rate of 25% and 20,5%, respectively. Those who do not know the boxes are 36% of the people living in Yıldırım.

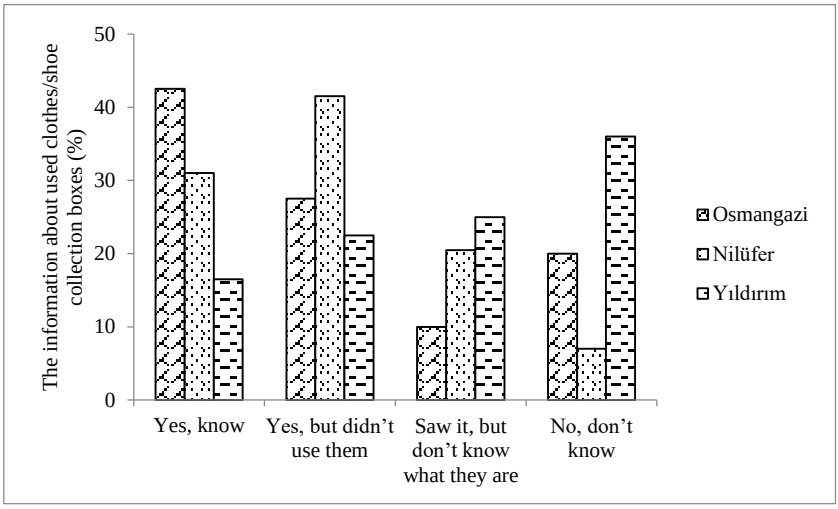

Figure 7. The information about used clothes/shoe collection boxes according to districts

When the participants were asked whether they would like them to be available to the needy from the used clothes collected, 87.5-95% of them were positive in all three districts (Figure 8). The percentage of those who stated that they were not interested or had no idea about this subject remained below 10% for all three districts.

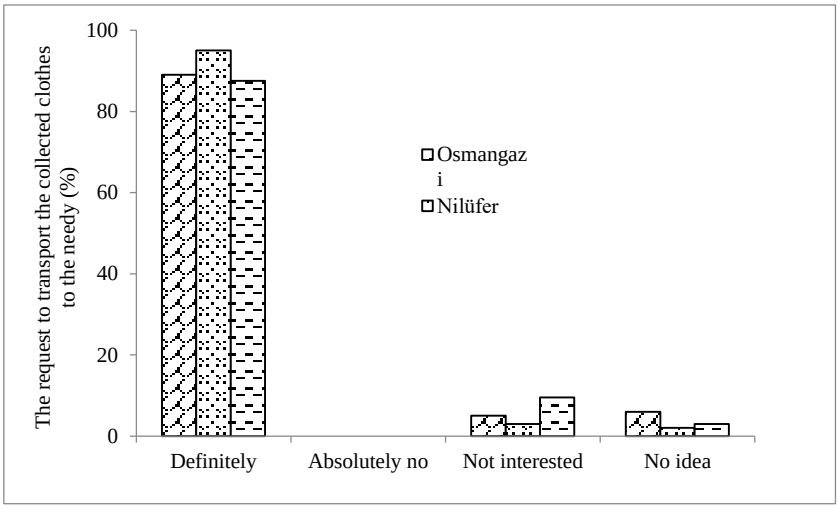

Figure 8. The request to transport the collected clothes to the needy according to districts

When asked the participants how often they use the used clothes/shoe collection boxes, the people living in Yıldırım (69%), Nilüfer (54%) and Osmangazi (29%) stated that they never used them (Figure 9). In Osmangazi, those who use these collection boxes 1-2 times are over 40% and more than three times is 29%. The request not to use the boxes varies between 2-5%.

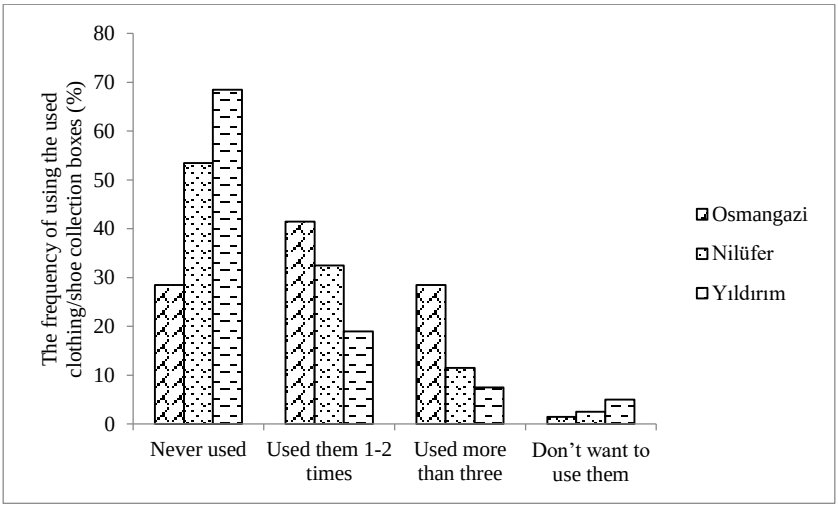

Figure 9. The frequency of using the used clothing/shoe collection boxes according to districts

When asked to the participants what their opinions about the used clothes/shoe collection boxes, it can be said that according to the results given in Figure 10, the majority of the people do not know the primary purpose of the used clothing/shoe collection project, the 40% of people living in Yıldırım and Nilüfer districts thought that the used clothes/shoe collection project was designed for needy, those who believe that this is both for needy and designed for recycling are people live in Osmangazi district with a rate of 17%. In three districts, the proportion of those who think that the project is a kind of social responsibility project and for needy are more than 30%.

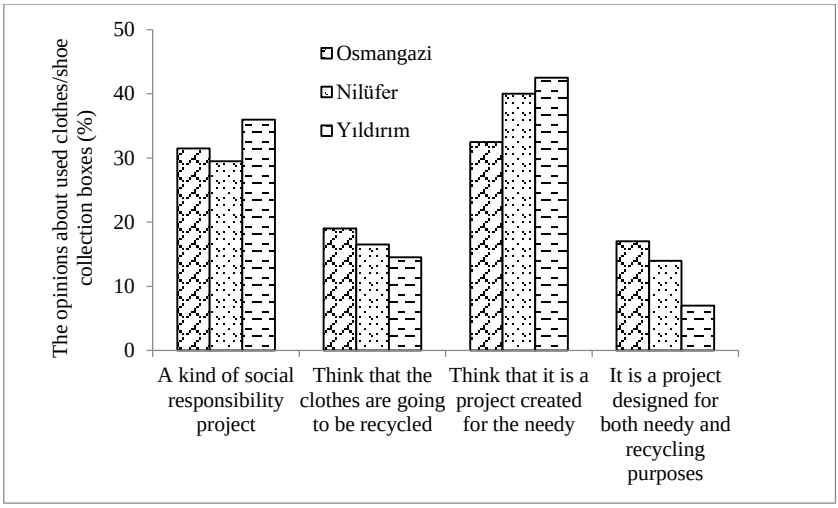

Figure 10. The opinions about used clothes/shoe collection boxes according to districts

The participants were asked about which publication could be better to introduce this project, and in general, all three districts did not think that this project could be introduced by the newspaper (Figure 11). Survey participants in Nilüfer think that this project can be best introduced with the billboards and hand brochures, whereas the participants in Osmangazi and Yıldırım think that it can be introduced with television.

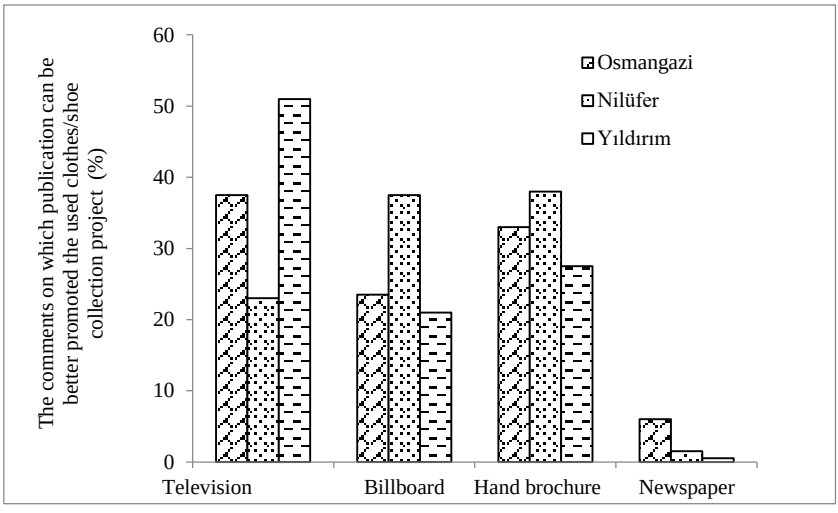

Figure 11. The comments on which publication can be better promoted the used clothes/shoe collection project according to districts

When asked about the trust of the survey participants in the used clothes/shoe collection project, it was determined that the people living in Nilüfer did not trust the project or were unsure about the project with a ratio of upper 65% (Figure 12). While the district that has the most trust in the project is Osmangazi, those who declare that they do not have any idea are living in Yıldırım with a rate of 42%.

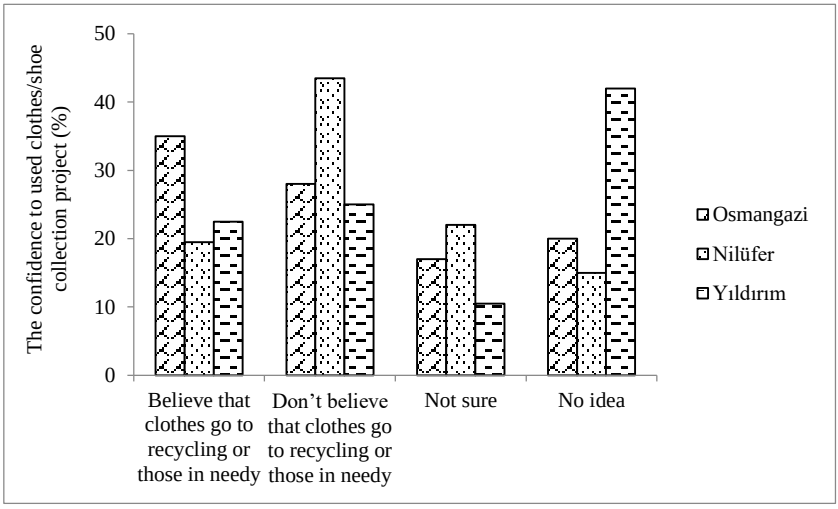

Figure 12. The confidence to used clothes/shoe collection project according to districts

When asked what people think about the public's interest in this project, the majority of the participants in Nilüfer think that the public should pay attention to this project and raise awareness (Figure 13). In the survey, 36.5% of the participants from Yıldırım stated that they did not have any opinions, while the people living in Osmangazi stated that the public should be made aware of this issue. In all three districts, the rate of those who do not think that the public will be interested in the project remains below 15%.

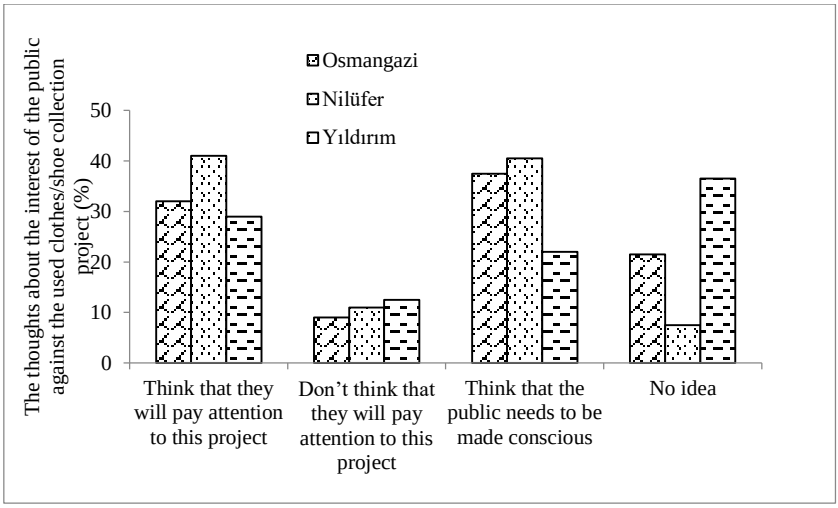

Figure 13. The thoughts about the interest of the public against the used clothes/shoe collection project according to districts

When asked to participants what their opinions about this survey in the last question, the participants in Nilüfer and Osmangazi stated that the survey introduced the used clothes/shoe collection project, but the ones who heard the project for the first time were living in Yıldırım (Figure 14). While the ones who think that this survey provides the awareness for the recycling of clothes are mostly in Osmangazi, who say that they will take care to throw their used clothes in the boxes after the application of this survey is mostly living in Nilüfer.

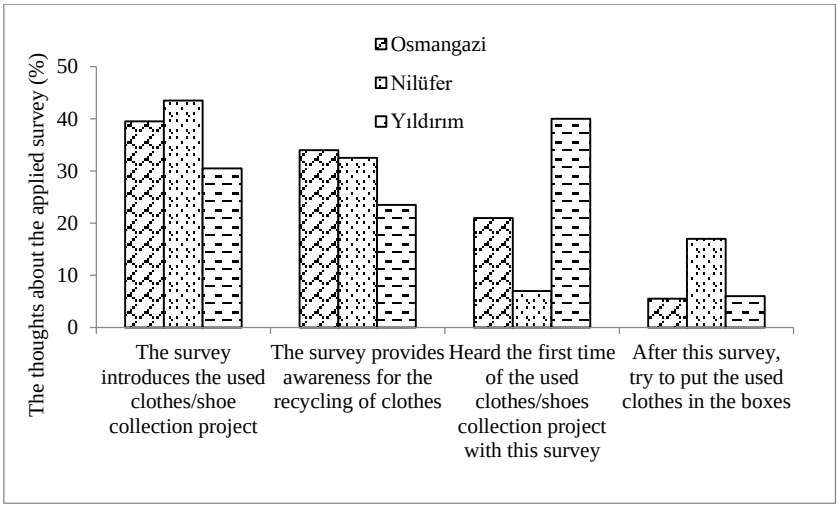

Figure 14. The thoughts about the applied survey according to districts

6. Conclusions

In this study, a survey was applied to the people living Osmangazi, Nilüfer, and Yıldırım, which are the central districts of Bursa, 200 people from each district, a total of 600 people. This survey aimed to determine the level of knowledge of the people related to "Waste Clothes Collection Project", which was started by Osmangazi Municipality in 2016.

When the surveys are evaluated, the results are summarized below:

- The people of Osmangazi use more these boxes, due to relying more on this project than the participants of the other two districts. However, some people are unaware of these boxes.
- The majority of Nilüfer people do not trust this project and think that the clothes will not be recycled or not to send needy.
- The people of Yıldırım have not been aware of this project, and they are not interested in such a project. As there is no project to collect clothes previously in Yıldırım, it is thought that the level of public awareness is lower in this regard.
- Although the used clothes/shoe collection project has officially started for the first time in Osmangazi, the people who know the purpose of the project is only 17% in this district, it is 14% in Nilüfer and 7% in Yıldırım. The reason why Nilüfer is close to Osmangazi with a rate of 14% can be shown as the similar social responsibility project of this project, which was previously created for the needy in Nilüfer. It is thought that the people in Nilüfer were interested in the project in Osmangazi, by gaining consciousness with this social responsibility project.

As a result of this study, the used clothes/shoe collection project started in Osmangazi district was introduced by television, hand brochures or billboards, and it was thought that more people could hear and use boxes. Thus, old clothes could be recycled, or available to be used by needy. Also, if similar projects are implemented by other district municipalities, a social problem related to the environment can be solved.

Acknowledgement

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INDUSTRIAL ENGINEERING

UNDERSTANDING A COMPREHENSIVE HOLISTIC APPROACH FOR WORK-SYSTEMS: MACROERGONOMICS

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1. Introduction

Changes facing today in the world increase the complexity of working systems. Workforce is becoming more diverse that people from different social, cultural, geographical and[1] technical backgrounds. Moreover, increase in the number of older workers, requires the attention of designers, because they are different in many ways. These issues increase the complexity of organizational systems and there is a need to develop new strategies where human variations are well understood and then emphasized during organizational design process.

In the past, top priority of companies was to make more production and more money which lead them to develop the quality and number of productions demanded by the market and neglected the human phenomenon. This process caused to overload people's capacities, and employees had to undertake tasks beyond their physical and mental capacities and consequently sometimes they were exploited and had to work in disturbing environments that they did not want to. This situation emerged some incompatibilities with the environment they work with (Özkul, 1996).

Actually, organizations wish to hold skillful and experienced workers for a longer time so that they can get maximum benefit from them. However, efficient use of human capital is possible only if a healthy, safe and productive working environment is provided where workers feel themselves valued and empowered.

There is another way that designs based on human physical abilities and capacities can increase work efficiency. In order not to wear out the human factor and to prevent it from becoming inadequate against the developing machines and methods, studies have been started to determine the human talent and characteristics and make the best use of them. Through these studies, which we would call ergonomic approach, the relationship between human and working environment has been the subject of scientific investigation. Ergonomic approaches that were previously considered only

for work environments have become widespread to cover all environments where people are present.

In the working environment, people are making continuous efforts to design, manufacture, operate and develop all kinds of tools, machines and industries. However, humans have certain structural features (anatomical) and dimensions (anthropometric). As biological entities, the central nervous system of human beings operates on a unique basis (biochemical and neurophysiological). Human beings' intelligence, skills and physiological abilities have personal dimensions. Perception organs of human organism are sensitive within certain limits. Biomechanics of the skeletal-muscular system, the biochemical energy requirement of the muscles, and the healthy functioning of the respiratory and circulatory systems are important factors for the physical work efficiency and mechanical efficiency of humans. Compared to machines, Human beings' physical work capacity appears to be significantly limited. Therefore, the jobs to be given to Human beings must remain at a level that they can perform throughout the day. Human beings who are forced to do business above their power get tired. Fatigue can have negative impacts on employees' work efficiency, health, safety and psychological balance (Özkul, 1996).

When Humans work, they use a variety of hand tools, mechanical tools and equipment, construction machines, and systems that are programmed for a particular job (such as robots, computers and remote control systems). The aim of this cooperation is to support people's physical and mental abilities. The most effective use of all kinds of tools and equipment used by people requires the consideration of posture, sitting, general health, safety and compliance with the system. Therefore, it is necessary to take into consideration the physical and mental requirements of human existence, to define their behaviors, and to think of all systems designed for human use as systems that are suitable and superior to them. In industrial environments, people may be exposed to various environmental stresses such as cold, hot, high or low pressure and humidity. The work environment may also contain various drawbacks, such as dust, smoke, toxic gases and vapors, toxicants, ionizing, radiation. In the meantime, environmental factors such as industrial noise, vibrations, insufficient or excessive light can also affect human health and work efficiency (ICOH Organization, 2009).

In this study it is aimed to give detailed explanations by compiling from various sources about macroergonomics, sociotechnical approach and two methods of macroergonomics which are Macroergonomic Analysis of Structure (MAS) and Macroergonomic Analysis and Design (MEAD) to understand how to cope with complex work-systems' functional interactions.

2. Ergonomics

As a result of problems encountered in previous section it has gained importance to make necessary arrangements for humans to work in a healthy and productive way. Studies in this field have been the reason for the development of ergonomics. Ergonomics can play an important role in working environment to reduce risks of injury or disease while enhancing the quality of working life, improving productivity and morale of workers and decreasing injuries, sick leave, staff turnover and absenteeism. Ergonomics focuses on the appropriate design of workplaces, systems, equipment, work processes and environments to accommodate the workers. The aim is to achieve compatibility between the needs of people with real limitations and the demands of their jobs.

2.1. Definitions of Ergonomics

- Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions between humans and the other elements of a system, and the profession that applies theory, principles, data, and methods to design, in order to optimize human well-being and overall system performance (International Ergonomics Association, 2016).
- Ergonomics is the study of physical and mental stresses on workers resulting from operation or interaction with machines.
- Ergonomics is the science of fitting the job to the worker.
- Ergonomics is a means of improving working conditions and reducing illness at work.
- Ergonomics attempts to 'Fit the Job to the Man' rather than 'Fit the Man to the Job'.
- Ergonomics is concerned with the design of systems in which people carry out work.
- Ergonomics optimizes Efficiency, Health, Safety and Comfort of people through better designs of products and work places.

Ergonomics is the only discipline that seeks to optimize both performance and well- being. Ergonomics can be grouped under three groups namely Physical Ergonomics, Cognitive Ergonomics and Organizational Ergonomics.

Physical ergonomics is concerned with human anatomical, anthropometric, physiological and biomechanical characteristics as they relate to physical activity. (Relevant topics include working postures, materials handling, repetitive movements, work related musculoskeletal disorders, workplace layout, safety and health.)

Cognitive ergonomics is concerned with mental processes, such as perception, memory, reasoning, and motor response, as they affect interactions among humans and other elements of a system. (Relevant topics include mental workload, decision-making, skilled performance, human-computer interaction, human reliability, work stress and training as these may relate to human-system design.)

Organizational ergonomics (also known as macroergonomics) is concerned with the optimization of sociotechnical systems, including their organizational structures, policies, and processes. (Relevant topics include communication, crew resource management, work design, design of working times, teamwork, participatory design, community ergonomics, cooperative work, new work paradigms, virtual organizations, telework, and quality management.)

3. Microergonomics

Microergonomics deals with human-machine, human-task, human-interface, usability, and safety-type issues in the workplace. Much of ergonomics has focused on people working with tools, machines and other equipment. This is what we call the "human-machine" interface and is now often referred to as microergonomics.

Any incompatibility between task requirements and the capabilities (mental and/or physical) of the worker may lead to errors, accidents and injuries. Microrgonomists can identify and prioritize problem areas and propose possible solutions. If necessary, they may recommend a redesign of the workplace, the tasks and/or the organization of the work (Özkul, 1996).

4. Macroergonomics

Macroergonomics is a perspective, a methodology, and recognized subdiscipline of ergonomics (Hendrick &Kleiner, 2001).

Ergonomists have recognized the need to make an assessment of the overall working environment. Microrgonomists might fail to achieve overall system effectiveness if there is a lack of attention to the larger picture or the design of the complete system. To solve this problem Hendrick (1986) proposed the concept of macroergonomics, which he defined as a "top-down socio-technical systems approach to organizational and work-system design".

Larger work systems have to be considered when there is a need to better understand human–technology interaction, capabilities, and limitations. Macroergonomics (also known as organizational ergonomics) is an approach which attempts to achieve a fully harmonized work system at both the macro- and microergonomic levels by integrating principles and

perspectives from industrial, work, and organizational psychology (Hendrick & Kleiner, 2001).

Macroergonomics integrates principles and perspectives from industrial, work and organizational psychology. Macroergonomics is the study of work systems where a work system comprises two or more people working together (i.e. personnel sub-system), interacting with technology (i.e. technological sub-system) within an organizational system that is characterized by an internal environment (both physical and cultural) (Hendrick & Kleiner, 2001).

Macroergonomics is concerned with the optimization of sociotechnical systems, including their organizational structures, policies and processes. Examples of relevant macroergomonic topics include communication, human resource management, teamwork, participatory work design, community ergonomics, computer-supported cooperative work, virtual organizations and quality management. (Karwowski 2005.)

There are three criteria which are essential for an effective work system design:

- A joint design purpose of the personnel subsystem and the technological subsystem, which should be developed simultaneously and supported by employee participation throughout the entire design process;
- Humanized task approach concerned with human functions and tasks in the work system, prior to the decision to allocate tasks to workers or devices;
- Consideration of the organization's sociotechnical characteristics (personnel subsystem, technological subsystem, organizational design and external environment), which should be evaluated and integrated into the design process of the work system. When the selected development methodology fulfils the three criteria mentioned above, the design is human-centered and macroergonomic (Hendrick & Kleiner 2001).

Table 1. Guidelines for macroergonomic intervention.

1. Participatory design	Description Design is supported by employee participation throughout the entire design process.
2. Joint design	A personnel subsystem and a technological subsystem are developed simultaneously.
3. Human-centered design	Human functions and tasks in the work system are considered prior to the decision to allocate tasks to workers or devices. Apply ergonomic principles to fit work to human resources.
4. Systems design	Organization's sociotechnical characteristics (personnel subsystem, technological subsystem, organizational structure and external environment) should be evaluated and integrated into the design process of the work system.

The aim of macroergonomics is to ensure that the processes and structure of the business system are compatible with the main characteristics of the external environment, the personnel subsystem, and the technological subsystem of the organization. Secondly, by moving the characteristics of a well-designed system to the design of microergonomic elements reaching the target having a fully harmonized system. A fully compatible system can be improved at 60-90% levels of organizational performance when compared to a poorly designed system such as reducing lost time and injuries caused by accidents, reducing complaints and scrap.

A macroergonomic effort is most feasible under these four conditions:

- First, when a new organization is being formed.
- Second, when there happens a major work system change such as changing technology or equipment.
- Third, when a major change need to applied about the goals and scope of the organization.
- Fourth when an organization has a chronic problem that can not be solved with microergonomic approach.

Macroergonomic has the potential to improve organizations by ensuring that their work system designs harmonize with their critical sociotechnical characteristics. A widely accepted view among system scientists is that for all complex systems the whole is more than the simple sum of its parts. Accordingly, when organizations have been effectively designed macro ergonomically, and that effort is carried through to the

micro ergonomic design of jobs, and related human-machine and human-software interfaces, improvements, such as reducing accidents and injuries by 50% to 90%, or greater, should be possible (Hendrick & Kleiner 2001).

Macro ergonomics is not only reducing accidents and injuries happen in a company, but also offers personnel-related and material-equipment benefits. The personnel-related benefits from implementing macro ergonomics are:

- Increased output per worker.
- Reduced accidents, injuries, and illness
- Reduced training time.
- Reduced skill requirement.
- Reduced maintenance time.
- Reduced absenteeism.

4.1. Socio-technical Approach

Sociotechnical refers to "joint optimization", with a shared emphasis on achievement of both excellences in technical performance and quality in people's work lives.

A sociotechnical system is the synergistic combination of humans, machines, environments, work activities and organizational structures and processes that comprise a given enterprise. This concept primarily covers complex systems in which many humans collaborate towards a common goal. The operations in socio-technical systems generally involve in high-risk/high-hazard activities. The consequences of safety breakdowns are often catastrophic in terms of loss of life and property.

Examples of socio-technical systems are smart cities, air traffic management systems and payment systems, i.e. systems where banks, payment services and e-shops interact to transfer monetary values. Subsystems in socio-technical systems are autonomous, heterogeneous and weakly controllable, but they highly depend on each other. For example, in the payment system the banks and payment services are autonomous but without interacting with each other, both of the systems will not be able to transfer monetary values. (Salnitri&Paja, 2015)

A sociotechnical work system consists of four interacting subsystems:

1. The technical subsystem including tools, processes, methods, all the things required to perform the work. When making technological subsystem analysis there are two dimensions which one of the is task variability concerns number of exceptions encountered in one's work and another is task analyzability concerns the type of search procedures that

are available for responding to task exceptions. There are four levels of definition for these considerations:

- Routine technologies: they have well-defined problems with few exceptions. Mass production units can be listed in this category because of having repetitive manner.
- Nonroutine technologies: they have many exceptions and problems that are difficult to analyze. Aerospace operations is a good example for this category. Flexibility is important for them so they need to be decentralized and high standards.
- Engineering technologies: have many exceptions but can be handled using well-defined processes.
- Craft technologies: have fairly routine tasks but problem solving relies on experience, judgement and intuition of individual. This needs decentralization and low level of standardized procedures.

2. The personnel subsystem comprised of the workers who are needed to do the work, including their demographic and psychosocial characteristics. The personnel subsystem interplays with the technological subsystem. There are three dimensions of personnel subsystem.

- Degree of professionalism: It forms internal standards in a work system. When there is low level of standards in a work system there must be a high level of employee expertise.
- Cultural factors: values, perceptions and attitudes are important in assessing work system. For example, if individualism is important for a work system then wok system design must be done according to individual recognition for accomplishment.
- Psychosocial factors: When time passes cognitively concrete individuals tend to the world static and unchanging and they become upset or stressed when thing change including organizational structural or procedural changes. However more cognitively complex individuals see the world dynamic and expect thing to change including organizational structures.

3. The environmental subsystem, which can be divided into two elements; external and internal. External refers to the elements outside the work system in focus, and internal refers to social and physical characteristics. Survival of organizations depends on the adaptation rate of its external environment. Organizations need to monitor their external environment and make required changes accordingly. External world influences positively or negatively the organization's effectiveness. There are five types of external factors that have impact on organizational functioning.

- Socioeconomic: particularly the degree of stability, nature of competition, and availability of materials and qualified workers.

- Educational: the availability of facilities and programs, and the educational level of workers.
- Political: governmental attitudes toward business friendly or hostility, and control of prices
- Cultural: social status and caste system, values and attitudes toward work, management etc. and union-management relationships.
- Legal: degree of legal controls, restrictions, and compliance requirements

4. Organizational structure and management processes belong to the organizational subsystem, which is the fourth element of the sociotechnical work system, including core dimensions of centralization, formalization and complexity. All work systems operate within larger systems, and thus they are systems within systems and very challenging to analyze and design from the management point of view (Stanton& Hedge, 2005).

4.2. Macroergonomic Methods

In this section, detailed information is given about two major macroergonomics methods which are Macroergonomics Analysis of Structure (MAS) and Macroergonomics Anaysis and Design (MEAD).

4.2.1. Macroergonomic analysis of structure (MAS)

The macroergonomic analysis of structure (MAS) provides guidance on how to correct the structure for more optimal work system functioning. This, in turn, sets the stage for the related analysis and refinement of the work system's processes and ultimately for more successful human factors and ergonomics design, intervention, or implementation.

Macroergonomic analysis of structure (MAS) combines three major sociotechnical system elements which are technological subsystem, personnel subsystem and external subsystem. By analyzing these three subsystems work system's structure can be determined. Then MAS analysis results can be with the existing structure of the work system to find discrepancies for corrections. This resulting model not only aid in identifying discrepancies but also provide guidance on what to do to correct them for more optimal work system functioning (Hendrick & Kleiner 2001).

According to MAS, the structure of a work system is conceptualized as having three core dimensions (Stanton& Hedge, 2005):

- Complexity refers to the degree of differentiation and integration.

  Differentiation: Vertical Differentiation refers to the number of hierarchical levels separating the chief executive position from the jobs directly involved with the system's

output, Horizontal differentiation refers to the degree of departmentalization and specialization within a given work system.

Integration: refers to the number of mechanisms designed into a work system for ensuring communication, coordination, and control among the differentiated elements.

- Formalization refers to the degree of job standardization. Highly formalized designs are characterized by explicit job descriptions, extensive rules and clearly defined procedures for work processes.
- Centralization refers to the extent to which decision-making authority is shared. In a highly centralized work system, formal decision making happens among few individuals in the organization. Lower level employees have only minimal or no input in decision making process (Hendrick & Kleiner 2001).

Advantageous of MAS

- Enables ergonomists to determine optimal work system by taking account of sociotechnical characteristics of the organization.
- By comparing MAS results with current work system structure, discrepancies can be identified and MAS results gives guidance to correct the discrepancies.

Disadvantageous of MAS

- Using MAS needs training and experience in conducting organizational assessment.
- It has subjective manner in assessment procedure.

An Example of MAS Application and Interpretation of Results

In this section a MAS example for an organization is given for a better understanding of the procedure (Hendrick & Kleiner 2001).

Table 2. MAS Results for Each Key Sociotechnical Variable for Organization.

Sociotechnical Variable	**Rating (1- Low 3-Intermediate 5- High)**
Technological Subsystem	
Task variability	5
Task analyzability	3
Personnel Subsystem	
Level of professionalism	5
Cultural factors	4
Psychosocial factors	4
External Environment	
Environmental complexity	4
Environmental uncertainty	5

Table 3. Work-System Structure Indicated by the MAS for Organization

Structural Dimensions	Technological Subsystem	Personnel Subsystem	External Subsystem	Weighted Rating
Vertical differentiation	3	2	2	2.2
Horizontal differentiation	4	4	4	4.0
Integrating mechanism	4	3	4	3.7
Formalization	2	1	1	1.2
Centralization: Tactical	2	1	1	1.2
Centralization: Strategic	4	3	4	3.7

Weights are assigned as (The weights may change from case to case): Technological subsystem:1, Personnel subsystem:2, External subsystem:3

Table 4. Comparison of the MAS Results with the Current Work System

Structural Dimensions	MAS	Current	Difference
Vertical differentiation	2.3	4	+1.7
Horizontal differentiation	4	4	0
Integrating mechanism	3.7	2.5	-1.2
Formalization	1.2	3	+1.8
Centralization: Tactical	1.2	3.5	+2.3
Centralization: Strategic	3.7	4	+0.3

Results indicate that the organization has too many hierarchal levels (vertical differentiation=+1.7), not enough integrating mechanisms, needs to decentralize making tactical decision making processes. Corrections of these gaping points should result a better improvement for organization functioning.

The tools needed for recording data can be very helpful to develop forms for each type of data required (e.g., for each sociotechnical dimension, listing the key variables and providing space for recording the data collected for each). For large, complex organizations, it might be advisable to supplement interviews, records, and direct observation by developing and administering a questionnaire survey to obtain some of the needed data (Bedeian & Zammuto, 1991)

4.2.2. *Macroergonomic Analysis and Design (MEAD)*

Another methodology is Macroergonomic Analysis and Design (MEAD) methodology can guide institutional data collection and analysis to determine the risks and causal factors leading to experiments that will help with new design and intervention strategies. The approach integrates sociotechnical systems (STS) theory and ergonomics (Hendrick & Kleiner 2001).

MEAD is both a methodology and a unifying framework for macroergonomics. It formalizes the principles and methods of sociotechnical systems theory and ultimately provides the organizational support needed for the design and implementation of an effective work system.

MEAD is an attempt to solve the problem associated with sociotechnical systems (STS) being too broad and human factors analysis being too specific through integration and attention to matters such as optimal allocation of function to human and machine, as well as support through techniques such as training (Hendrick & Kleiner 2001).

Important methods such as participatory ergonomics and/or work domain analysis can be performed within MEAD or can stand alone because they were also developed with the sociotechnical systems perspective. Participatory ergonomics is a validated approach that focuses on actively involving workers or users in implementing ergonomic knowledge, procedures, and changes with the objective of improving such performance criteria as working environment, culture, safety, productivity, quality, and attitudes. For product design, a similar method is participatory design (Haines & Wilson, 2002).

10- Step Process of MEAD

5. **Scanning the environmental and organizational design subsystem**:

In system scan, formal statements of the organization such as missions, visions, and principles are identified and evaluated. The organization's mission is detailed in system terms such as; inputs, outputs, processes, suppliers, customers, internal controls, and feedback mechanism.

In environmental scan, organization's subenvironments are identified. Their expectations identified and evaluated. Conflicts and ambiguities are seen as opportunities for improvement. Gaps are evaluated to determine redesign constraints (Hendrick &Kleiner, 2001).

Table 5. An Example of System and Environmental Scan

Item	Current	Desired
Purpose	Produce products for national security and make profit for company	Be national model restoration and application of advanced restoration technologies
Philosophy	Management controls Do everything for output	Emphasize quality and safety Respect the environment
Objectives		
Technical	Make a profit, maintain contract with customer, reduce cost	Restore the environment for profitable use (education, agriculture, business) Comply with environmental regulations Develop marketable environmental technologies
Social	Avoid strikes or stock products for supply interventions	Develop cooperation among employees and stakeholders High levels of quality and safety
Outputs	Products	Environmental expertise Reservation environment for profitable use
Input	Raw materials, unprocessed materials, components	Contaminated environment People willing to work and learn
Expectations		
Union- to-system	Able to contract Do not interrupt work	Work together to increase capabilities safety and contribution to employees and families
System news media	Give information for big story	Help change our image publicity
Customer	Products whenever needed	No political embarrassment
Future scenario	Realistic: site closes, we get lawsuits, stock value depressed	Idealistic: get new contract, favorable impact on stock value

6. Defining production system type and setting performance expectations:

The work system's production type can help determining optimal levels of complexity, centralization, and formalization. System scan should help

this phase. Key performance criteria related to organization's purpose and technical processes are identified. This requires determination of success factors and performance measures.

Organizational performance can be measured by using seven criteria which are;

- Efficiency: focuses on input or resource utilization,
- Effectiveness: focuses on whether objectives are realized,
- Productivity: is output/input,
- Quality: refers to inclusion of all desired characteristics of a product,
- Quality of work life: is effective perception of total work environment,
- Innovation: refers to creative changes to process or product that result in performance gains
- and, profitability: is a standard business management criterion. For not-for-profit organizations, "budgetability" term replace the profitability criterion (Hendrick &Kleiner, 2001).

7. Defining Unit Operations and Work Process:

For each unit operation or department, the purpose/objectives, inputs, transformations, and outputs are defined. If the task exceeds the allotted schedule, then work groups or shifts may be needed. Ideally, resources for task performance should be contained within the unit, but interdependencies with other units may complicate matters. In these cases, job rotation, cross training, or relocation may be required.

The current work flow of the transformation process should be flowcharted, including material flows, workstations, and physical as well as informal or imagined boundaries. In linear systems, such as most production systems, the output of one step is the input of the next. In nonlinear systems, such as many service or knowledge work environments, steps may occur in parallel or may be recursive. Unit operations, functions and subfunctions (tasks) are identified.

The purpose of this step is to assess improvement opportunities and coordination problems posed by technical design or the facility. Identifying the work flow before proceeding with detailed task analysis can be helpful. Once the current flow is charted, the macroergonomist or analyst can proceed with a task analysis for the work-process functions and tasks (Hendrick &Kleiner, 2001).

8. Identifying Variances

A variance is an unexpected or unwanted deviation from standard operating conditions, specifications, or norms. STS distinguishes between input and throughput variances.

For the ergonomist, identifying variances at the process level as well as the task level can add important information for job and task redesign to improve safety and quality performance (Hendrick &Kleiner, 2001).

9. Creating the Variance Matrix

Key variances are those variances that significantly impact performance criteria and/or may interact with other variances, thereby having a compound effect. The purpose of this step is to display the interrelationships among variances in the transformation work process to determine which ones affect which others.

The variances should be listed in the order in which they occur on the y-axis and the horizontal x-axis. The unit operations (groupings) can be indicated, and each column represents a single variance. The ergonomist can inspect each column to see if this variance causes other variances. Each cell thus represents the relationship between two variances. A blank cell implies that two variances are unrelated. The analyst or team also can estimate the severity of variances by using a Likert-type rating scale (e.g., 5- or 7-point scale). Severity would be determined on the basis of whether a variance, or combination of variances, significantly affects performance. This should help identify key variances (Hendrick &Kleiner, 2001).

10. Creating the Key-Variance Control Table and Role Network

The purpose of this step is to discover how existing variances currently are controlled and whether personnel responsible for variance control require support. The key-variance control table includes: the unit operation in which variance is controlled or corrected; who is responsible; what control activities are currently undertaken; what interfaces, tools, or technologies are needed to support control; and what communication, information, special skills, or knowledge are needed to support control.

A “job” is defined by the formal job description that is a contract or agreement between the individual and the organization. This is not the same as a work role, which comprises the actual behaviors of a person occupying a position or job in relation to other people. These role behaviors result from actions and expectations of a number of people in a role set. A role set is a group of people who send expectations and reinforcement to the role occupant. Role analysis addresses who interacts with whom, about what, and how effective these relationships are. This relates to technical production and is important because it determines the level of work-system flexibility (Hendrick &Kleiner, 2001).

11. Performing Function Allocation and Joint Design

After specifying system objectives, requirements, and functions, it now is time to systematically allocate functions and tasks to human and machine or computer. It is helpful to review the environmental scan data to check for any subenvironment constraints before making any mandatory allocations.

Technical changes are made to prevent or control key variances. Human-centered design of the following may be needed to support operators as they attempt to prevent or control key variances: interfaces, information systems to provide feedback, job aids, process control tools, more-flexible technology, redesigned workstation or handling system, or integrating mechanisms (Hendrick &Kleiner, 2001).

12. Understanding Roles and Responsibilities Perceptions

It is important to identify how workers perceive their roles documented in the variance control table. Through interviews, role occupants can participate in an analysis of their perceptions of their roles. Variances can be managed through training and selection as well as technological support.

Essentially, two role networks are operating: the one needed and the one perceived. Any variation between the two can be reduced through participatory ergonomics, training, communication, interface design, or tool design (Hendrick &Kleiner, 2001).

13. Designing/Redesigning Support Subsystems and Interfaces

Now that the work process has been analyzed and jointly designed, other internal organizational support subsystems may require redesign. Especially at the team and individual levels of work, the internal physical environment should be ergonomically redesigned if necessary to promote human well-being, safety, and/or effectiveness. Evaluating the technical and personnel variance analyses, we can assess whether there are physical environmental changes that will promote improvement (Hendrick &Kleiner, 2001).

14. Implementing, Iterating, and Improving

It is time to execute or implement the work-process changes prescribed, design interfaces, and allocate functions. Proposals with recommendations for change may be required for presentation within the formal organizational structure. These proposals should be consistent with the macroergonomic principles and should include, for example, both technical and social objectives; will likely include participatory ergonomics; and should predict multidimensional performance improvement.

Based on the proposal feedback, modifications to the proposal may be necessitated, which will require a return to the previous step that represents a challenged assumption or design (Hendrick &Kleiner, 2001).

Advantages of MEAD

- Integrates organizational analysis with ergonomics analysis.
- Systematic, comprehensive methodology that reflects the principles of macroergonomics.
- Unlike microergonomics, MEAD addresses the larger system's environmental and organizational issues.

Disadvantages of MEAD

- Because of its comprehensive nature, it takes time to execute.
- May need additional reliability and validity testing in a diverse domain.

15. Conclusion

Today, we have high level of knowledge about the factors of economic success, managerial success and technical success, but we do not know enough knowledge about the interactions of these factors with human dimension. The harmonization of human organization and human-environment interaction seems to be a missing component.

In this study the aim is to give detailed information about macroergonomic and its methodologies to understand the need to handle the work-system as a whole. The macroergonomic approach can enrich work-system and its outcomes by offering new concepts for a complex system. In the near future, macroergonomics approach may be extended to megaergonomics approach which may find better solutions for multi work-systems interacting among themselves.

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FOOD ENGINEERING

SAFETY AND RELIABILITY IN FOOD PROCESSING

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1. Introduction

Reliability is a characteristic feature and examines whether a material or design can perform the life expectancy determined in its own conditions or characteristics expected from it (Birolini, 2010). The idea of reliability was put forward for the first time in the war vehicles used in World War II. After the war, this idea developed and started to be applied in designs. Any technical system is designed for a specific purpose in order to undertake a given function under certain conditions within a specified time period. Reliability addresses the possibility of achieving the purpose expected of this technical system itself. Construction, manufacturing-assembly, quality control, use, maintenance cases directly affect the usefulness of the technical system (Akkurt, 1997).

Reliability is a concept in which product properties, tests applied to the product and the service life of the product are examined (Condra, 2001). Reliability theory is a mathematical approach to solve reliability problems in statistical and scholastic ways. Reliability encompasses a wide range of applied disciplines and measurement reliability is among these areas. Reliability also analyzes the statistical reliability of the whole representation of a certain number of measurements (tests) obtained from only some parts of the materials (Klaassen & Van Peppen, 1990).

The fact that the products produced as a result of food production processes are direct consumption products and that the potential negative effects on human health are addressed with sensitivity makes this factor to be used. Food analysis for these processes ensures that the minimum requirement specified for the relevant legislation is fully met, taking into account certain safety factors. For example, a 6-logarithm reduction in the

number of bacteria in commercial sterile food production is considered sufficient (Rahman, 2002).

One of the important elements in food processing is the safety of the products. In the food industry, a company has an obligation to ensure that the food products it produces are safe while expanding its market share commercially. However, the promised quality should not be ignored. The way to do this is to establish a proper food management system in the enterprise. The proper operation of the system can only be ensured with the reliability of the equipment. Maintenance engineering plays an important role in ensuring equipment reliability. Failure to fully perform the maintenance activities may lead to risks that may adversely affect consumer health (Riccetti, 2013; van Donk & Gaalman, 2004).

In this study, food safety and reliability of production process equipment are discussed in the light of the above information. In this respect, HACCP (Hazard Analysis Critical Control Point) management system and GMP (Good Manufacturing Practice) are discussed. The relationship between these two concepts and equipment reliability in the production system is discussed. In addition, reliability and damage analysis of food production processes and potential to be made are examined.

2. Food Safety

There are some concepst about food industry such as food safetly and food security. Food security is a term which explains the food supply for healty and safe feeding of living population on the World. Food security relies on food sustainability and safety. In this case safe food production is major concept for health and sustainability as well (King et al., 2017).

Food safety means that it does not cause any harm to the consumer as a result of consuming food. The guarantee of such a production is systematic and controllable production. The Hazard Analysis and Critical Control Points (HACCP) system contains the necessary equipment, hygiene standards and guidance on the food processing environment related to food safety management. The first point of origin is the production of safe food for astronauts, which involves the identification and process management of critical points in food processing (Garayoa, Abundancia, Díez-Leturia, & Vitas, 2017; van Donk & Gaalman, 2004). HACCP is also a system that complies with ISO 9001: 2000, which is the organization's quality management system (International Organization for Standardization).

Hazard analysis and control is carried out with HACCP so that both quality and safety issues can be assured. In addition, the concept of good agricultural practices (GMP) includes efficient production and effective control mechanisms and practices to ensure that the products meet customer expectations. GMP is the guarantee of documented and defined

practices (van Donk & Gaalman, 2004; Varzakas, 2016). The HACCP system sets out the basic steps for reliable food production thanks to its seven principles. These; hazard analysis management, determination of critical control points, determination of critical limits, observation and control of critical points, identification of corrective measures to be taken in case of deviation from control, identification of procedures to guarantee smooth and efficient operation of HACCP system and documentation of the whole process (Garayoa et al. 2017; Riccetti, 2013; van Donk & Gaalman, 2004; Varzakas, 2016).

Food management systems define the characteristics of the equipment to be used and the relevant procedures. In this case, the recommendations regarding the equipment are as follows; all production equipment must be designed and installed to ensure the necessary hygiene conditions, cleaning procedures and maintenance processes should be planned so as not to be hazardous for safe production, preventive activities should include repairs and pauses, controlling systems of the system's operation should be positioned and maintained so as not to be affected by environmental factors, equipment in contact with food and production must be selected having non-hazardous properties, machine-specific chemicals should be selected to not to contaminate food, calibration and maintenance of measuring devices should be done and recorded regularly, all history of use and maintenance related to the equipment must be recorded (Riccetti, 2013; van Donk & Gaalman, 2004). In this context, it is possible to measure values such as temperature, flow rate, fluid cleaning agent concentration for the determination of errors and problems in the clean in place “CIP” system to determine whether it is operating properly or not. Hovewer, occured problems due to lack of reliability about pumps and valves could cause drastic hazardous such as chemical contamination should not be ignored.

When we consider the tomato paste production line (Figure 1), the possible risks begin with raw materials according to the HACCP plan. The critical control points selected here focus particularly on the pasteurisation part. The main reason for this is that microbiological safety is the most critical part of food safety.

As shown in Figure-1, many processes are subject to raw material through end product. However, the HACCP plan considers and mostly focus on microbiological risks or physical and chemical risks that may enter the system by raw material or streams rather than physical and leakage risks that may arise from the equipment. The reason for this is that the HACCP management established in the factories is based on the acceptance of the healthy working systems and the proper functioning of the equipment. On the other hand, food processing systems have a large

number of moving parts, fittings, gears, stirrers, which can be worn or even broken after a certain use. In this case, there is a risk of important metal parts remaining in the product. To prevent this, all products will be passed through the metal detector after final packaging, but it is not possible to identify where the broken part originates from with the existing HACCP plans.

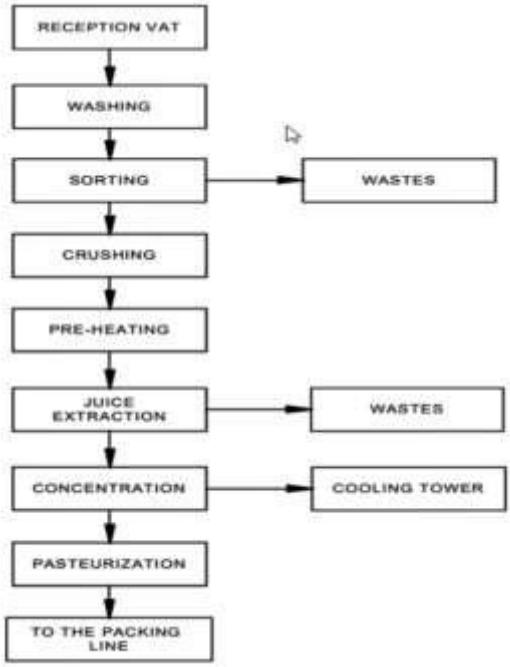

Figure 1. Flow chart of tomato paste production

For better inwestigation of whole risks on processing, equipment reliability should be considered and in this context Reliability, availability and maintainability (RAM) analysis should be done carefully. The purpose of RAM analysis, which is a multi-faceted analysis, is to investigate the reliability of systems in operational sense and to identify possible improvements in the production system. In the field of food, the performance of production lines can be evaluated and the effect of the changes that can be made in order to increase production speed and prevent losses caused by malfunctions can be examined. Risky machines can be identified in this way and measures can be taken and the life of the system can be extended. With the models to be developed in this sense, a more efficient maintenance and repair systematic can be developed for manufacturing equipment by evaluating the existing conditions. In addition, RAM will contribute to improving the operational management of food production lines by providing actual and up-to-date data on the

actual state of the plant. It should therefore be seen as an ongoing process that needs to be continually improved and improved (Birolini, 2010; Riccetti, 2013; P. Tsarouhas, 2012; P. H. Tsarouhas & Arvanitoyannis, 2010). As an example, the statistical model developed in an analysis of bread production revealed that the errors in dough kneading, cooling and sizing machines on the production line may pose significant risks (P. H. Tsarouhas & Arvanitoyannis, 2010).

3. Reliability Analysis for Equipment and Machines Used in Food Production Processes

When food safety analyzes are examined, the safety and reliability studies of microbiological analyzes that take into account hygienic concerns during production processes such as pasteurisation, sterilization, filling and packaging are critical (Riccetti, 2013). There are also studies on measuring reliability for food quality control (Cafiero, Melgar-Quiñonez, Ballard, & Kepple, 2014). However, The reliability of the equipment is an extremely important criterion for food safety. Therefore, in order to prevent quality and product loss in food production, safety and reliability calculations of the equipments used for timely intervention should be made.

Reliability-R and Failure-F define probabilistic success and failure rates in a system. As seen in Equation (1), when the cumulative functions of distributions are considered, damage and reliability values can be obtained.

$$R(x) = 1 - F(x) = 1 - \int_{-\infty}^{a} f(x)dx \qquad (1)$$

As shown in Figure 2, damages in food production processes occur over time. For time-based damage, the exponential distribution can be calculated for the distribution of damage (Riccetti, 2013).

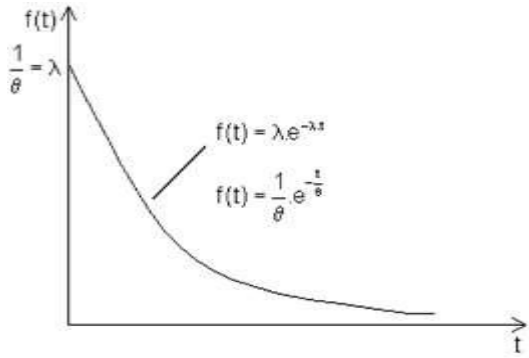

Figure 2. Approach for Reliability Analysis of Food Processing Equipment

$$F(t) = \int f(t).dt \quad (2)$$

Failure function;

$$R(t) = 1 - F(t) \quad (3)$$

Reliability function including;

Equation of the cumulative damage curve is shown in (4)

$$F(t) = \int_0^t f(t).dt = \int_0^t \frac{1}{\theta} e^{-\frac{t}{\theta}}.dt \quad (4)$$

$$F(t) = \left[-e^{-\frac{t}{\theta}}\right]_0^t = -e^{-\frac{t}{\theta}} - (-e^0) \quad (5)$$

Consequently;

$$F(t) = 1 - e^{-\frac{t}{\theta}} \quad (6)$$

$$R(t) = e^{-\frac{t}{\theta}} \quad (7)$$

Equations are obtained. The distributions herein may be regarded as a preliminary approach for the prediction of time-dependent damage. This means that maintenance schedules can be estimated before damage occurs.

4. Results and Discussion

Food safety is directly related to the reliability of food processing equipment. However, studies examining these two concepts together are limited in the literature.

When the current analyzes are examined, it is observed that there are generally analyzes that take safety factors into consideration in terms of food products. In terms of reliability, it is seen that the analyzes are inadequate. Further studies should provide more detailed approaches for the detection of time-related damage to equipment producing food products.

In addition to the safety of food products in future studies, risk analysis on production equipment will prevent many possible problems in terms of preventing commercial losses and consumer health. Reliability analyzes, corrosion and fatigue life analysis of the equipment in the food production process, keeping the necessary stocks due to these analyzes, preventing production from stopping, preventing contamination on food with certain changes will both ensure the production of reliable products and prevent commercial lossees.

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CHANGES IN NITRATE AND NITRITE COMPOUNDS DURING FOOD PROCESSING AND DIGESTION

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1. Introduction

In recent years, parallel to the developments in science and technology, improvements in production practices prolonging shelf life, and improving the quality and organoleptic properties of foods, changes in nutritional habits have caused widespread use of food additives (Fan, 2014). Microbial activity is a major risk factor for shelf life in safe food production. Therefore, preservative additives, in other words, antimicrobial agents prevent the growth of microorganisms such as viruses, yeasts, molds, bacteria and prevent losses due to food spoilage. However, the World Health Organization (WHO) reports that toxic effects can be shown by the continuous intake of additives, especially due to increased consumption of processed food (Chong et al., 2018; Rangan, 2008).

The concentrations of nitrogen-containing compounds such as nitrate and nitrite have increased in our food and beverages. Increasing levels of these compounds are mainly due to the production of soil organic materials, nitrogenous fertilizers and herbicides from industrial agriculture, animal husbandry and sewage and chemical industries, domestic and other organic wastes (Bories & Bories, 1995; Hallberg, 1989; Johnson & Kross, 1990; Leeuwen, 2000).

2. Nitrite and Nitrate

In general terms, nitrite and nitrate are compounds formed by decomposition of organic materials of human and animal origin (Mikuška & Večeřa, 2003). Nitrite and nitrates are routinely added for curing of some meat products during curing process to improve curing color, improve flavor, provide antimicrobial and antioxidant effects, and extend shelf life (Ağaoğlu, S., Alişarlı, M., Alemdar, S., Dede, 2007; Kroupova, Machova, & Svobodova, 2005; Kyriakidis, N. B, Tarantili-Georgiou, K., Tsani-Batzaka, 1997; Topçu, A., Topçu, A.A., Saldamli, I., Yurttagül, 2006).

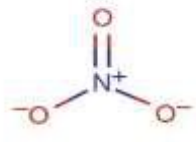
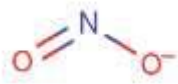
	
Chemical Structure of Nitrate (Gutiérrez, Rubio, Caballero, & Hardisson, 2014)	Chemical Structure of Nitrite. (Kroupova et al., 2005)

Figure 12. Chemical Structure of Nitrite and Nitrate

Nitrate, which is the end product of biochemical oxidation of organic nitrogen, has no direct toxic effect and is converted to harmful nitrite ions by bacterial nitrate reductase (NR) activity (Bories & Bories, 1995; Özdestan & Üren, 2010).

Nitrite inhibits the development of *Clostridium botulinum* and acts as an antioxidant (Gökalp, 1983). In addition, nitrates slow the potential release of botulinum toxin by *Clostridium botulinum* (Gutiérrez et al., 2014). However, nitrite may also have a strong oxidant effect in the "Fenton reaction" which causes the formation of hydroxyl radicals in the presence of iron. Furthermore, the reaction of nitric oxide with superoxide radical anions may result in the formation of "peroxynitrite" which initiates lipid oxidation (Ağaoğlu, S., Alişarlı, M., Alemdar, S., Dede, 2007).

Nitrite and nitrates are used in processed foods from meats and cheeses. Since meats are perishable products, they are mostly consumed in processed forms such as salami, sausage, sausage, ham and smoked. However, processed meats are responsible for 39% of daily nitrite intake. In a study performed, a ratio of 67.4% for one of the most widely consumed meat Turkish sausages(Siriken, Özdemir, Yavuz, & Pamuk, 2006) which are researched in Turkey and collected from the market 100 Turkish sausage samples was analyzed. In the study, nitrate was found to be higher than the permissible rate of 250 mg / kg in 18% of the samples and more than 100 mg / kg in 11% of the samples (Gökalp, 1983). In addition, fish and seafood are not considered as sources of NO_3 and NO_2, despite the amount of nitrite and nitrate they receive from water, but are toxic substances for live fish. The application of NO_3 and NO_2 as additives for the preservation of food in seafood is generally not permitted (Bedale, Sindelar, & Milkowski, 2016). In addition, production techniques that cannot be applied correctly during cheese production in small dairies and failure to control hygienic conditions lead to deterioration in cheese. Therefore, these small businesses may use nitrate to prevent cheese loss due to microorganisms (Topçu, A., Topçu, A.A., Saldamli, I., Yurttagül, 2006). Also, *Clostridium spp.* spores cause butyric fermentation a few weeks after cheese making, causing late swelling and gaseous defect in cheese. In order to prevent these defects, in some countries such as France and Italy, it is encouraged to add nitrates to milk for cheese production (Üçüncü, 2005). If nitrate is to be used in the production of cheeses, the amount to be added must not exceed “200 mg / L milk" ve and the cheese should be ripened. Some

of the nitrate added to the milk processed in the cheese is separated with the whey, the remainder is separated during the ripening process and decreases to extremely low concentrations (530 mg / kg) in about 4-5 weeks (Alimentarius, 1990). Codex Alimentarius refers to the safe use of sodium nitrate alone or in combination with potassium nitrate in some cheeses and permits the use of up to 50 mg / kg (Anonymous, 2002). The Turkish Food Codex permits 50 mg / kg (in terms of sodium nitrate) at the point of sale in hard and semi-hard cheeses and milk-based cheese analogues (Anonymous, 2002). Nitrate content is very high not only in processed foods but also in natural foods. Nitrate, which is naturally present in the soil from nitrate and fertilizer, can be used by plants in the synthesis of proteins and other biological compounds. Therefore, nitrate is necessary for plants to develop well (Gökalp, 1983). Vegetables are the main source of nitrate and nitrite intake in the human diet (Gangolli, S. D., Brandt, P. A., Feron, V. J., Jankowsky, C., Koeman, J. H., Speijers, G. J. A., Spiegelhalder, B., Walker, R., Wishnok, 1994). The National Academy of Sciences estimates that vegetables provide 87% of nitrate in a normal diet. The remaining 13% is derived from synthetic nitrate sources such as meat and cheese (Topçu, A., Topçu, A.A., Saldamli, I., Yurttagül, 2006). Studies have reported that high levels of nitrate are present in green leafy vegetables such as spinach and lettuce (Ekici, K., Alişarlı, M., Sancak, 2005; Wolff & Wasserman, 1972). Industrial and agricultural wastes increase contact with nitrosamines and other carcinogenic compounds. The reason for the increase in nitrate and nitrite in foods and beverages is due to organic materials in the soil, the use of nitrogen fertilizers and pesticides, and chemical industry wastes (Johnson & Kross, 1990).

The risk of nitrate and nitrite in foods still leads to controversy in the scientific world. Many studies suggest that high intake of nitrate and nitrite is an etiological factor in the development of some cancers (Bryan, Alexander, Coughlin, Milkowski, & Boffetta, 2012). However, some authors have taken this risk down and claimed that nitrate and nitrite may have potential effects on human health by reducing the risk of hypertension and cardiovascular diseases (Öztürk, B., Serdaroğlu M., Ergezer, 2015; Sindelar & Milkowski, 2012).

Although nitrate ions (NO3-) are not directly toxic, they are converted to harmful nitrite ions (NO2-) by bacterial nitrate reductase (Phillips, 1971). Nitrite is an important indicator of faecal contamination in natural waters and is easily oxidized to nitrate by dissolved oxygen, thus reducing oxygen levels in the water. In addition, nitrite may also interfere with the hemoglobin-forming metahemoglobin by oxidation of ferrous iron (Fe2 +) to the ferric state (Fe3 +), which prevents or reduces the ability of blood to carry oxygen, a condition defined as metahaemoglobinaemia, which is particularly dangerous in infants (Bruning-Fann & Kaneene, 1993; Connolly & Paull, 2001; Jones, 1993; Phillips, 1971). However, nitrites can have many negative effects on human health. For example, in vivo reaction between nitrite and secondary or tertiary amines produces N-nitrosamines which are potentially carcinogenic, mutagenic and / or teratogenic (WHO, 1998). Research on N-nitroso groups (NOCs) such as N-nitrosamine formed by the reaction of nitrate with N2O3 and other amine groups

has shown that it causes tumor formation in experimental animals (Gilchrist, Winyard, & Benjamin, 2010; Pandey, Kumar, & Roy, 2014).

3. N-Nitroso Compounds

Nitrosamines which may have carcinogenic activity may occur in the presence of nitrite and secondary or tertiary amines (Lijinsky, Epstein, 1970; Wolff & Wasserman, 1972).

Some of the N-nitroso compounds are Nitrosodimethylamine (NDMA), Nitrosodiethylamine (NDEA), Nitrosopyrrolidine (NPip), Nitrosopiperidine (NPyr). N-nitroso compounds (NOCs) play a role in the formation of cancer of the liver, lung, kidney, larynx, stomach and pancreas (Ağaoğlu, S., Alişarlı, M., Alemdar, S., Dede, 2007; Çakmak, Ö., İşleyen, A., Usca, 2009; Erkmen, 2010). Human exposure to N-nitroso compounds generally occurs in two ways. First, these compounds are formed endogenously in the body by the metabolism of food additive or naturally occurring nitrate and nitrite as a result of various biological steps. The second is the intake of nitrite salts added to meat products, fish and cheeses as a result of the reaction with amines in the foods in order to increase microbial resistance (Çakmak, Ö., İşleyen, A., Usca, 2009). In the literature, NPIP, NMOR, NPYR were found in the samples taken from tap water and fruit juice (Pirinçci, İ., Acet, E. A., Batı, 1986). In addition, it was determined that drinking water and high doses of nitrate could cause chromosome damage (Prasad & Chetty, 2008). Mutagenic N-nitroso indoles have been identified in fava beans and in Chinese cabbage and soy sauce, commonly used in Columbia and Japan Yang, Tannenbaum, Büchi, & Lee, 1984). Table 1 shows some N-nitroso compounds and their sources.

Table 1. Some N-nitroso compounds and their sources (Pirinçci, İ., Acet, E. A., Batı, 1986)

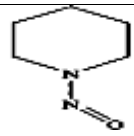
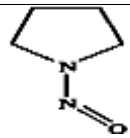
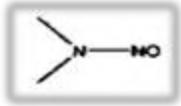
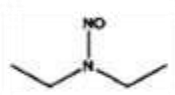
N-Nitroso compound	**Resources**
N-nitrosopiperidine (NPIP)	Cigarette smoke, bacon, bologna, smoked cod, spices, drinking water.
N-nitrosomorpholine (NMOR)	Foods, alcoholic beverages, cigarettes.
N-nitrosopyrrolidine (NPYR)	baby bottle, drinking water.

Humans are exposed to N-nitrosamines from exogenous sources and endogenous synthesis. Exogenous N-nitrosamines are obtained directly from processed food, salted or smoked fish and certain types of food, such as brine and dried vegetables (Tricker & Preussmann, 1991). The endogenous N-nitrosamines are formed from the nitrosation of secondary amines or amides, both nitride

nitrated agents, with N_2O_3 and $H_2NO_2^+$(Carboni, M., Guadagni, S., Pistoia, M. A., Amicucci, G., Lolli, D., Palumbo, G., Ludovico, C., Walters, C., Smith, P., Viti, G., Marrano, 1988). Some micronutrients are known to affect endogenous NOCs formation (Higashimoto, Akada, Sato, & Kinouchi, 2000). Vitamin C, which is abundant in antioxidants, especially fruits and vegetables, inhibits NOC formation (S. S. Mirvish, 1986). However, both iron, often found in red meat, increases endogenous NOC formation (Vermeer, Pachen, Dallinga, Kleinjans, & Van Maanen, 1998).

Some N-nitroso compounds and their chemical structures are given in Table 2.

Table 2. Some N-nitroso compounds and their chemical structures

N-Nitroso Compound	Chemical Structure
Nitrosopiperidine (NPyr) (Chong et al., 2018)	
Nitrosopyrrolidine (NPip) (Chong et al., 2018)	
Nitrosodimethylamine (NDMA)(Ripollés, Pitarch, Sancho, López, & Hernández, 2011)	
Nitrosodiethylamine (NDEA) (Ripollés et al., 2011)	

For example, nitrosamines are a group of N-nitroso compounds derived from the reaction of nitrite with amines *in vitro* or *in vivo* and have adverse effects on human health (Challis & Kyrtopoulos, 1977; Sidney S. Mirvish, 1975). These effects can occur both during the process and during digestion. The most important causes of these adverse effects are the pre-formed N-nitroso compounds and nitrosatate precursors which can be converted to N-nitroso compounds in the human gastrointestinal tract (Lin, 1990). Nitrosation of many drugs occurs by reacting pharmaceutical preparations with nitrogen oxides in the air or nitrite in the gastrointestinal tract (Lijinsky, 1974; Lijinsky W, 1972). In addition, industrial and agricultural wastes increase contact with nitrosamines and other carcinogenic compounds (Cemek et al., 2007).

3.1. N-nitroso Compounds Formed During Process

Sodium nitrate and nitrite can produce potentially carcinogenic substances such as N-nitroso compounds (NOCs) during cooking, fumigation or drying (Kim & Hur, 2017). Studies on the formation of nitrosamines (DMNA, DENA) in meat and meat products have evaluated concentration levels of $\sim 10\ \mu g kg^{-1}$, but can be found in large quantities as a result of various transformation processes (fried bacon or smoked meats) (Fernández-Alba, A. R., Agüera, 2005).

Fiddler et al. Showed that the inclusion of ascorbate or erythorbate in components used to cure Frankfurt sausages greatly reduces the amount of dimethylnitrosamine in the final product (Fiddler, Pensabene, Piotrowski, Doerr, & Wasserman, 1973).

$$Amine + N_2O_3 \overset{k_1}{\rightarrow} Nitrosamine + NO_2^- + H^+ \quad [1]$$

$$Ascorbate + N_2O_3 \overset{k_2}{\rightarrow} Dehydroascorbate + 2NO + 2H_2O \quad [2]$$

Archer et al. In a study they conducted, [1] and [2] reactions were examined, k2> k1 conditions, the reaction [2] was found to be completed before the start of the reaction [1]. When the ascorbate / nitrite ratio is 0.5 and the conditions are anaerobic, it is stated that all of the nitrite is consumed and nitrosamine formation is not observed (Archer, Tannenbaum, Fan, & Weisman, 1975). When the pH in foods is normally high (4.0-8.0), the rate of nitrosamine formation is very low, as shown in the reaction [1], and as long as another compound, such as Ascorbate, can consume N_2O_3, as shown in reaction [2], They stated that nitrosamine would not form even at pH or higher temperatures. In addition to the role of ascorbate in increasing pigment formation in dried meat, Herring recommended the addition of ascorbate to bacon to reduce nitrite and prevent nitrosamine formation (Fox & Ackerman, 1968; Herring, 1973). Archer et al. According to their study, this would be possible under anaerobic conditions (Archer et al., 1975). This shows that the use of ascorbate in the process reduces the formation of N-nitroso compounds.

3.2. N-nitroso Compounds Formed During Digestion

Nitrates can be reduced to nitrites in the saliva and gastrointestinal tract. Nitrides may react with secondary or tertiary amines in the stomach or may react with amides present in foods such as cheese or meat to form potentially carcinogenic N-nitroso compounds (Bryan et al., 2012; Kyriakidis, N. B, Tarantili-Georgiou, K., Tsani-Batzaka, 1997; Topçu, A., Topçu, A.A., Saldamli, I., Yurttagül, 2006). Dietary nitrate, which is found in the gastrointestinal tract and converted to nitrite, has a protective mechanism against pathogens.

Recently, ascorbic acid has been shown to inhibit the formation of N-nitroso compounds *in vitro* from reactions between nitro acid and various amines (Mirvish, S. S. , Wallcave, L., Eagen, M., Shubik, 1972). Mirvish et al. Suggested

that the danger of potentially ingestible drugs or certain food compounds that can be nitrous can be reduced by the addition of ascorbic acid (Mirvish, S. S. , Wallcave, L., Eagen, M., Shubik, 1972).

3.3. Determination of N-nitroso Compounds

The determination of N-nitrosamines in foods is very difficult and requires very sensitive analysis. The most difficult issue in the analysis of N-nitrosamines; extracting N-nitrosamines dispersed in the complex matrix of food (Ekici, K., Alişarlı, M., Sancak, 2008). Methods such as gas chromatography-mass spectrometry (GC-MS) and thermal energy analyzer (TEA) are widely used in the chemical determination of N-nitrosamines (Gray, Irvine, & Kakuda, 1979).

In a study performed by Pirinçci et al., It was detected NPyr (N-nitrosopyrrolidine), NDMA (N-nitrosodimethylamine), NDEA (N-nitrosodiethylamine) and Npip (N-nitrosopiperidine) in Turkish sausages by gas chromatography with flame ionization detector (Pirinçci, İ., Acet, E. A., Batı, 1986).

Some N-nitroso compounds and detection methods are given in Table 3.

Table 3. Detection methods of some N-nitroso compounds

Study	Samples	N-nitroso Compounds	Method	source
Determination of N-nitrosamines in water by nano iron-porphyrinatedpoly(amidoamine)dendrimerMCM-41 generation-3throughsolidphasemembranetipextraction and HPLC	Hospital waste water, tap water, lake water	N-nitrosopyrrolidine (NPYR) N-nitrosomorpholine (NMOR) N-nitrosopiperidine (NPIP)	HPLC	(Chong et al., 2018)
Characterization of New Nitrosamines in Drinking Water Using Liquid Chromatography Tandem Mass Spectrometry	Drinking water	N-Nitrosodimetilamin (NDMA), N -nitrosopyrrolidine (NPyr), N -nitrosopiperidine (NPip), N -nitrosodiphenylamine (NDPhA)	SPE-LC-MS	(Zhao, Boyd, Hrudey, & Li, 2006)
Analysis of N-nitrosamines by high-performance liquid chromatography with post-column photohydrolysis and colorimetric detection	gastric water, beer	Mide suyu - N-Nitrosodimetilamin (NDMA), nitrosodietilamin (NDEA) N nitrosodi-n-butilamin (NDBA), N –nitrosopyrrolidine (NPYR) Bira - N-Nitrosodimetilamin (NDMA), N-nitrozomorfolin (NMOR) , N -nitrosopyrrolidine (NPYR), N-nitroso-n-dipropilamin (NMPA), N-nitrosopiperidine (NPIP), N-nitroso-n-dipropilamin (NDPA) , N-nitroso methylphenylethyl amine (NMPhEtA) , N-nitrosodi-n-butilamin (NDBA)	HPLC	(Bellec, G., Cauvin, J. M., Salaun, M. C., Le Calvé, K., Dréano, Y., Gouérou, H., Ménez, J. F., Berthou, 1996)

Analysis of nitrosamines in water by automated SPE and isotope dilution GC/HRMS Occurrence in the different steps of a drinking water treatment plant, and in chlorinated samples from a reservoir and a sewage treatment plant effluent	Drinking water, waste eater	İçme suyu - nitrosodietilamin (NDEA) Atık su - N-Nitrosodimetilamin (NDMA), N-nitrosodietilamin (NDEA)	gas chromatography/high resolution mass spectrometry (GC/HRMS)	(Planas, Palacios, Ventura, Rivera, & Caixach, 2008)
Determination of eight nitrosamines in water at the ng L−1 levels by liquid chromatography coupled to atmospheric pressure chemical ionization tandem mass spectrometry	Drinking water	N-nitrosodimetilamin (NDMA), N-nitrozomorfolin (NMor), Nnitrosometiletilamin (NMEA), (N-nitrosopirrolidin (NPyr), N-nitroodieti (N-nitrozodilamin) (N-nitrozolamin) , N nitrosopiperidin (NPip), N-nitroso-n-dipropilamin (NDPA), N nitrosodi-n-butilamin (NDBA)	LC MS/MS	(Ripollés et al., 2011)
Determination of N-nitrosamines in processed meats by liquid extraction combined with gas chromatography-methanol chemical ionisation/mass spectrometry	Meat Products (cooked ham, dry ham, cooked sausage, dry sausage and bologna)	N-nitrosodimethylamine (NDMA), N nitrosomethylethylamine (NMEA), N-nitrosodiethylamine (NDEA), N-nitrosopyrrolidine (NPyr), N-nitrosodipropylamine (NDPA), N-nitrosomorpholin (NMor), N-nitrosopiperidine (NPIP), N-nitrosodibutylamine (NDBA), N-nitrosodiphenylamine (NDPhA)	positive ion mode gas chromatography-chemical ionization / mass spectrometer (GC CI / MS)	(Scheeren, Sabik, Gariépy, Terra, & Arul, 2015)
Determination of volatile nitrosamines in cheese and cured meat products. Model study of a temperature and pH-dependent artefact formation phenomenon in alkaline medium	cheese	nitrosodimetilamin (NDMA)	gas chromatography and thermal energy analyzer (GC / TEA)	(Groenen, Busink, & Wandelen, 1987)

4. Legislation on Nitrite and Nitrate Consumption

In many sources, benefited from ADI (Acceptable Daily Intake-mg / kg) which is the accepted daily consumption. ADI is the dose that can be safely consumed on a given day, assuming that the substance will be consumed for life (Akbulut, 2011).

According to the Joint FAO/WHO Expert Committee on Food Additives (JECFA), the ADI value of Nitrite (E-250 Sodium salt) was determined to be 0.07 in mg / kg / human (Erdem, 2014).

Supportive studies show that nitrate and nitrite cause toxicity when given to the organism at high doses (Prasad & Chetty, 2008). According to a risk-benefit analysis of Nitrate (Sodium Nitrate - E251), the accepted daily intake was 12-17 mg/kg. Although most of the researches have low risk levels of the free forms of these chemicals, they draw attention to the disadvantages of reactions during food processing and digestion (Chong et al., 2018; Hunault, van Velzen, Sips, Schothorst, & Meulenbelt, 2009).

According to Codex Alimenterius, sodium nitrate is allowed to be used alone or in combination with potassium nitrate in different cheese varieties such as Edam, Gouda, Danbo, Havarti in a maximum amount of 50 mg / kg (Gray et al., 1979; Kyriakidis, N. B, Tarantili-Georgiou, K., Tsani-Batzaka, 1997). According to the World Health Organization (WHO), the maximum permissible nitrate and nitrite concentrations in drinking water are respectively 50 mg / L and 0.1 mg / L (Dehghan, Mohammadi, Mohammadzadeh-Aghdash, & Ezzati Nazhad Dolatabadi, 2018).

5. Bioavailability of Nitrite, Nitrate and Nitrosamines

Although experiments on humans and animals give the most accurate results, in vitro methods are one of the methods used to successfully simulate human digestion in the pharmaceutical and food industry for ethical and financial reasons. These systems can simulate processes in the mouth, stomach, small intestine and large intestine. Conditions such as digestive enzymes, pH, digestion time, salt concentrations are provided to provide physiological conditions. Thus, during digestion, complex and vital information such as the bioaccessibility of a component in the food matrix that may pass through the intestinal wall or in other words its bioavailability can be obtained (Minekus, M., Alminger, M., Alvito, P., Ballance, S., Bohn, T., Bourlieu, C., Carrière, F., Boutrou, R., Corredig, M., Dupont, D., Dufour, C., Egger, L., Golding, M., Karakaya, S., Kirkhus, B., Le Feunteun, S., Lesmes, U., MacIerzanka, A., MacKie, A., Marz, 2014). The bioavailability of nitrite was determined by a study. In this study, it was found that nitrite showed 95-98% bioavailability when taken orally, and that nitrite intake at a level of 0.12 mmol per mmol of total

hemoglobin had negative effects on the body (Chiesa, Arioli, Pavlovic, Villa, & Panseri, 2019; Hunault et al., 2009).

6. Conclusions

It is stated in many sources that nitrite and nitrate taken through nutrition are directly or indirectly harmful to human health. In particular, it has been proved by studies and studies that nitrate is converted to nitrite and nitrite forms N-nitroso compounds. Studies have shown that these N-nitroso compounds show carcinogenic effects in experimental animals and humans.

When environmental conditions and food properties were taken into consideration, it was confirmed that the negative effects of nitrite and nitrates could be reduced with substances such as Ascorbate.

In terms of human health, it is necessary to investigate the harmful effects that may occur due to long-term consumption, and to determine the cumulative effects *in vitro* studies. In this context, it may be necessary to reconsider the ADI values.

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CHEMICAL ENGINEERING

ADSORPTION OF HEAVY METAL ONTO FUNCTIONALIZED MESOPOROUS SILICA: APPLICATION TO ENVIRONMENTAL WATER PURIFICATION

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1. Introduction

The toxic heavy metal ions pollute the environment with natural ways and also are released to the environment by industrial plants (Sheela et al., 2012). The levels of metal ions such as nickel, chromium, copper and zinc discharged into the environment have an increased effect in wastewater in recent years. Activated carbon, silica, clays and ion-exchange resins as adsorbents are usually efficient for the disposal of heavy metal ions from industrial plants (Pérez-Quintanilla et al., 2009; Hajiaghababaei, 2011).

Although activated carbon is mostly preferred as an adsorbent to dispose these metal ions, it has a high cost. Therefore, various inexpensive adsorbents are being investigated (Jeon, 2011).

The ordered mesoporous silica's are one of the most effective adsorbents due to large surface area, porous diameter, and thicker pore walls. They can be usually used to capture larger molecules and chemical pollutants from the wastewater (Kanthasamy et al., 2007; Nooney et al. 2000; Mercier & Pinnavaia, 1998).

Also, mesoporous silica materials can be functionalized with mercaptopropyl (Xue & Li, 2008) or amino propyl (Lam et al., 2006) which are organic groups for effective removal of metal ions and organic compounds such as dyes (Ehsan et al., 2018; Tafti et al., 2018; Mirzaie et al., 2018). Mesoporous silica's are used as potential materials in the area of heterogeneous reactions, adsorption, sensors, drug release, and optical devices (Eswaramoorthi & Dalai, 2006; Jana et al., 2003; Vinu & Hartmann, 2004; Erdem et al., 2013).

Diffusion inside the entire porous structure and the existence of microporous interconnecting hexagonally ordered mesoporous of the SBA15 make SBA15 more suitable (Kruk et al., 2000). In recent years, the discharge of heavy metals from both natural and human sources such as the chemical and electronics industries, the contamination of heavy metals in water supplies has become a serious environmental problem. The most abundant harmful metals in wastewater discharge and the liquid effluents from many industries (Veli & Alyuz, 2007; Rafatullaha et al., 2009; Liu et al., 2010; Wang et al., 2006) include metals such as lead (Pb), chromium (Cr), copper (Cu), mercury (Hg), and zinc (Zn). Among these metals, Zn^{2+} and Cu^{2+} are the most common heavy metals in industrial waters resulting

from metal coating, mining and battery production, etc. (Cheremisinoff, 1995). High levels of zinc among these metals cause health problems such as a risk of pancreatic problems, hardening of the arteries, skin irritation, and stomach cramps (EPA-738-F-92-007). The accumulation of Zn^{2+} is on the list of serious poisonous pollutants designated by the U.S. Environmental Protection Agency as an increasing risk to health (Jain et al., 2004).The heavy metal levels in wastewater and other water sources must be decreased to the maximum permissible value (Kocaoba, 2007; Gonzalez-Davila et al., 1990; Bereket et al., 1997). Therefore, effective precautions are required to prevent heavy metal pollution in the ecosystem. Many technologies have been developed in the removal of heavy metals from contaminated wastewater effluents, such as filtration, solvent extraction, membrane technology, adsorption, and ion exchange (Bektaş et al., 2004; Ozcan et al., 2009; Feng et al., 1997; Monteagudo & Ortiz, (2000). Adsorption onto solid materials is a valuable technique because of its simplicity, highly efficient process for the removal of these contaminants, and low cost (Mureseanu et al., 2008; Yang et al., 2005; Liu et al., 2000; Kim et al., 2015). Activated carbon is commonly used in industrial wastewaters for the removal of heavy metals (Veli & Alyuz, 2007; Ramos et al., 2002; Veli & Öztürk, 2005; Ferro-García et al., 1988; Marzal et al., 1996), but its high cost limits. Therefore, many studies have been performed to find effective and low cost adsorbents that can be used to remove zinc effectively (Allen & Brown, 1995; Mishra & Chadhury 1994).

This study examines the kinetic of adsorption of Zn (II) ions onto SBA-15-functionalized organosulfonic acid materials prepared via a one-step co-condensation synthetic route as described previously (Katiyar et al., 2006). Sulfonic acid-functionalized mesoporous silica SBA-15 (SBA15-$PrSO_3H$) was characterized by powder X-ray diffraction, BET surface area and pore size distribution, and TGA analysis. The effect of pH, initial concentration, temperature, adsorption equilibrium, and adsorption kinetics of zinc as well as thermodynamic parameters for adsorption, such as Gibb`s free energy, enthalpy, and entropy were investigated using the SBA15-$PrSO_3H$. To observe the temperature effect on adsorption of SBA15-$PrSO_3H$ for zinc, different temperatures such as 25, 30, 35, and 40 ^oC were tested.

2. Materials and Method

2.1. Synthesis of the Propylsulfonic Acid-functionalized Mesoporous Silica (SBA15-$PrSO_3H$)

SBA15 was synthesized using tetraethoxysilane (TEOS, 98%, Aldrich) as the silica precursor. Pluronic P123 (BASF), a triblock copolymer of polyethylene oxide–polypropylene oxide–polyethylene oxide with the

molecular structure PEO_{20}-PPO_{70}-PEO_{20} (MW = 5800) was used as purchased to tailor the textural properties of the mesoporous materials, and (3-mercaptopropyl) trimethoxysilane (MPTMS, 85%, Acros) was used without further purification as the organosulfonic acid source. The mesoporous silica SBA15 was synthesized using the procedure exactly as reported previously (Thu et al., 2010; Zhao et al., 1998; Tang et al., 2010; Miao & Shanks, 2009).

The acid-functionalized monofunctional catalyst, SBA15-$PrSO_3H$ as adsorbents, was synthesized using the co-condensation method. In a typical synthesis of propyl sulfonic acid-functionalized mesoporous silica, Pluronic P123 (8 g, 1.4 mmol) was dissolved in HCl solution at room temperature under stirring with subsequent heating to 40 ◦C before adding TEOS and was allowed for pre-hydrolysis of TEOS before the addition of x mol of MPTMS and y mol of H_2O_2. The resulting mixture was agitated for a day at 40 ◦C and then aged for a day at 100 ◦C. The solids were collected by filtration and air-dried. The template was extracted in 10% v/v HCl in ethanol and refluxing for a day (Mbaraka & Shanks, 2005).

2.2. Adsorption Testing

The adsorption experiments of Zinc ions onto SBA15-$PrSO_3H$ were carried out in batch method. The adsorption studies were carried out batch wise in 100 mL stirred Erlenmeyer flasks at 140 rpm for 48 h in a temperature-controlled water bath with a shaker (MEMMERT) at constant temperature. Adsorption kinetics experiments were conducted at 25 ◦C in capped volumetric flasks with 50 mg L^{-1} of aqueous Zn^{2+} solutions with 0.01 g of dry adsorbents per 50 mL keeping pH 6.22. Then, the samples were centrifuged at 5000 rpm for 10 min. The obtained supernatant solutions were analyzed spectrophotometrically using a Hach DR-2000 Spectrophotometer. The concentration of zinc ions left in the bulk solution in the desorption experiments was performed using an atomic absorption spectrophotometer technique (AAS) (Perkin Elmer, Analyst A400). To study pH effects on zinc adsorption, the different pH levels (3.8-7.3) of the $ZnCl_2$ solutions were adjusted by adding 0.1 N NaOH and HCl solutions and measured using a pH meter (Ino Lab). The effect of the adsorbent doses was conducted using different amounts of adsorbents (0.01- 0.1 g). The effect of initial zinc concentrations was evaluated at different concentrations (5-100 mg Zn^{2+} L^{-1}) and keeping 25 ◦C and pH 6.22. The experiments performed to determine the effect of temperature were studied at four different temperatures of 25, 30, 35, and 45 ◦C under isothermal conditions. Langmuir and Freundlich isotherm models were applied in order to determine the efficiency of the propyl sulfonic acid-functionalized mesoporous silica (SBA15-$PrSO_3H$) used as an adsorbent. Kinetics studies for Zinc were performed by agitating the known initial Zn^{2+} concentration

(50 mg L^{-1}) for retention times varying from 5 to 30 min keeping 25 ˚C and pH 6.22

2.3. Characterization of the Prepared SBA-15-$PrSO_3H$

Surface area and porosity of the catalyst were measured by the nitrogen adsorption and desorption method at -196 ˚C with a Micrometrics ASAP 2020 apparatus. The surface area, pore volume and pore size distribution were calculated using the BET and BJH methods, respectively. Surface area was measured for the linear relative pressure range between 0.01 and 0.99. Sample was degassed at 100 ˚C for 5 h before measurement.

The acid strength and the number of acid sites of the catalyst were examined by acid–base titration. The relative pKa values of the sulfonic acid functional groups were determined by the Gran plot analysis (Cinlar & Shanks, 2011).

Powder X-ray diffraction was measured by on a Rigaku Rotaflex D/Max-C X-ray diffractometer using Cu Ka radiation at 40 kV and 120 mA. The data were collected from 0.5 to 5^o (2θ) with a resolution of 0.02^o.

The organic composition and thermal stability of the solids were appraised by thermogravimetric analysis (TGA) with a Perkin-Elmer TGA7 instrument using heating from 42 to 670 ˚C at a rate of 10 ˚C min^{-1} under air flow.

3. Results and Discussion

3.1. Adsorbent Characterization

Figure 1 shows the low angle X-ray powder diffraction (XRD) pattern for SBA15 and MPTMS-functionalized SBA15-$PrSO_3H$. The three diffraction peaks observed, one very intense peak and two weak peaks, indicated well resolved characteristics, which are indexable as (100), (110) and (200) diffractions with the ordered 2D hexagonal symmetry.

The N_2 adsorption-desorption isotherms and the pore size distributions of the catalyst sample are shown in Figure 2 and Figure 3. The sample had type IV isotherms according to the classification by IUPAC as shown in Figure 2 (Buchmeiser, 2003). Textural properties of the synthesized mesoporous material are listed in Table 1. All calculations were obtained using an Autosorp 1C analyzer. The textural properties such as the medium porosity and the surface area of the mesoporous material SBA15-$PrSO_3H$ were maintained to carry out zinc adsorption in the aqueous solution as shown in Table 1.

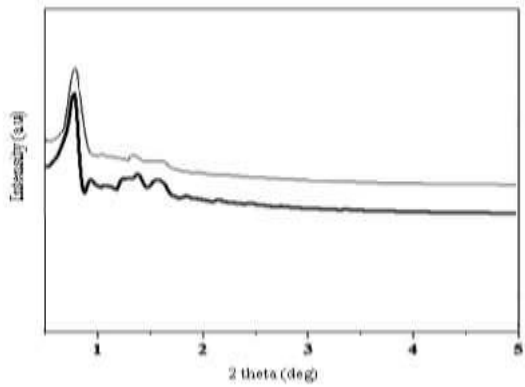

Figure 1. X-ray powder diffraction patterns of the catalyst samples. ▬SBA15; ─SBA15-$PrSO_3H$

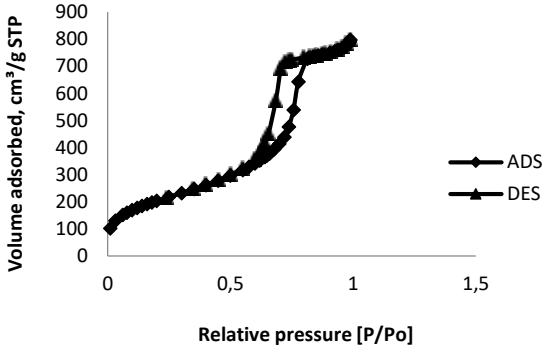

Figure 2. Nitrogen sorption isotherms of SBA-15-$PrSO_3H$ material.

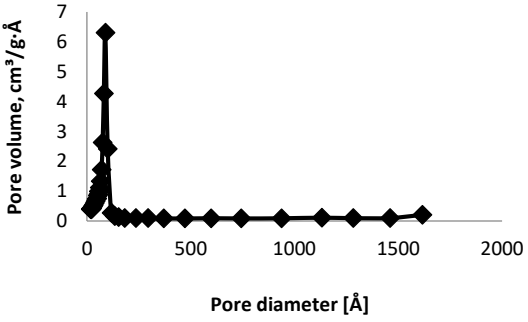

Figure 3. Pore size distributions of the SBA-15-$PrSO_3H$ material

Table 1. The textural properties of SBA15-$PrSO_3H$

Textural properties			Chemical properties	
BET (m^2/g)	BJH Ads. Average Pore Diameter (Å)	Ads. Total Pore Volume $V_{T,}$ (cm^3/g)	Acid Sites (mmol/g)	pKa
746.83	63.310	1.218	1.0326	3.001

3.2. Effect of Initial Solution pH

The initial pH value of the $ZnCl_2$ solution has a key role in the whole process. Figure 5 shows the effect of initial pH on the adsorption of zinc onto mesoporous material (SBA15-$PrSO_3H$). As a seen in Figure 5, pH 6.22 shows a maximum intake of zinc.

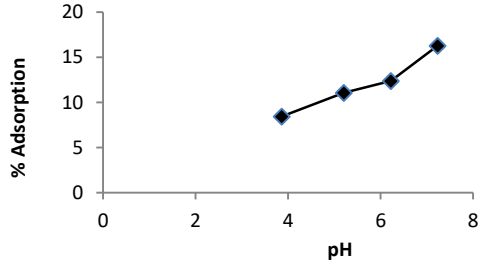

Figure 5. Effect of pH on the adsorption of Zinc (II) ions onto SBA15$PrSO_3H$

3.3. Effect of Mesoporous Silica Dosage.

In experimental studies applied to determine the optimum adsorbent dosage, adsorbent dosage was varied from 0.01 to 0.1 g 50 mL^{-1}. The effect of the amount of SBA15-$PrSO_3H$ on the zinc removal is shown in Figure 6. As shown, the removal of zinc is increased with increasing adsorbent dosage, which can be explained by the increase in surface area of the adsorbent. Optimum adsorbent dosage was chosen 0.075 g per 50 mL for removal of zinc.

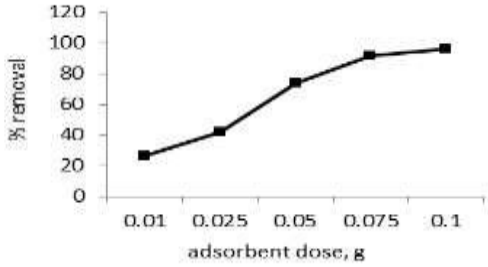

Figure 6. Effect of adsorbent dose on the percent removal of zinc (25 °C, C_o: 50 mg L^{-1}, pH: 6.22)**.**

3.4. Batch Adsorption Experiments of Zinc Metal Ion

Adsorption kinetics were studied to explain the adsorption mechanism.

3.4.1. Pseudo-first-order reaction kinetics

The rate constant of adsorption was determined from the following pseudo-first-order rate expression given by Lagergreen (Lagergreen & Sven, 1898), and Ho (Ho, 2004) in Equation 1:

$$\log(q_e - q_t) = \log q_e - \frac{k_1}{2.303} \quad (1)$$

where k_1 is the adsorption rate constant for the first order adsorption [min^{-1}],

q_t is the amount of zinc metal adsorbed at any time t [mg g^{-1}],

q_e is the amount of zinc metal adsorbed at saturation time [mg g^{-1}].

To calculate the values of k_1 and q_e for zinc, the first order reaction kinetics model was tested. The curve in the plots of the log ($q_e - q_t$) against time was linear. The values of k_1 and q_e can be obtained from the slope and intercept of the plot in Figure 7, respectively. The calculated k_1, q_e and the linear regression correlation coefficient (R^2) are listed in Table 2.

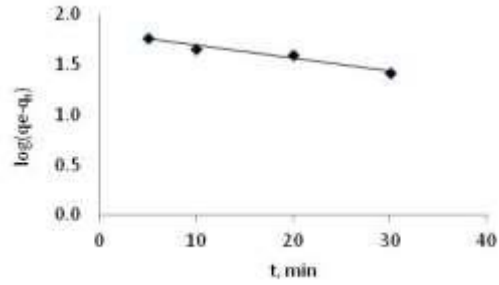

Figure 7. Pseudo first-order kinetics model.

3.4.2. Pseudo-second-order reaction kinetics

The rate constant of adsorption was determined from the following pseudo-second-order rate expression given by Ho and McKay (Ho & McKay, 1998).

$$\frac{t}{q_t} = \frac{1}{k_2 q_e^2} + \frac{1}{q_e} t \qquad (2)$$

where k_2 is the adsorption rate constant for the second-order adsorption (g/mg/min).

To calculate the values of k_2 and q_e for zinc, the second-order reaction kinetics model was tested. The curve in the plots of the t q_t^{-1} against time was linear. They can be obtained from the slope and intercept of the plot in Fig. 8. The calculated k_2, q_e and the linear regression correlation coefficient (R^2) are listed in Table 2.

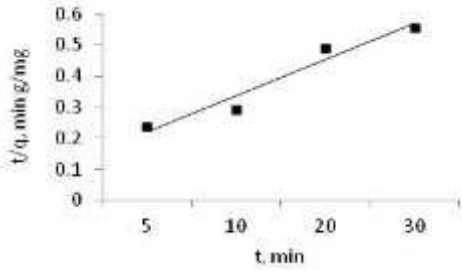

Figure 8. Pseudo-second-order kinetics model.

Table 2. The Kinetics Parameters for Adsorption of Zn(II) on SBA15-$PrSO_3H$ Mesoporous Material.

Pseudo-first-order constants			Pseudo-second-order constants			Experimental q_e (mg/g)
q_e (mg/g)	k_1(min^{-1})	R^2	q_e (mg/g)	k_2(g/mg/min)	R^2	
66.54	0.0302	0.964	8.613	0.129	0.95	80

Table 2 lists the pseudo-first-order rate constant k_1, pseudo-second-order rate constant k_2, calculated equilibrium adsorption capacity q_e and experimental equilibrium adsorption capacity q_e for the zinc metal ions at an initial concentration of 50 mg L^{-1}. The q_e value calculated from the pseudo-second-order kinetics model did not agree with the experimental q_e value. However, in the pseudo-first-order kinetics model, the calculated q_e is very close to the experimental q_e value for the zinc metal ions. The value of the correlation coefficient (R^2) of the pseudo-first-order model was better than the value of the correlation from the pseudo-second-order model. The pseudo-first-order model is therefore more acceptable than the pseudo-second-order model.

3.5. Adsorption Isotherms

Experimental adsorption data are expressed using many adsorption isotherm models such as Langmuir and Freundlich as the most frequently used models (Rao et al., 2002). Both of models were described to show the relationship between the adsorbed amount of zinc and equilibrium concentrations. The Langmuir isotherm is represented by the following equation:

$$\frac{C_e}{q_e} = \frac{1}{q_o b} + \frac{C_e}{q_o} \qquad (3)$$

where the constant qo denotes the adsorption capacity (mg g^{-1}), and b is related to the energy of sorption (L mg^{-1}). The plot of C_e q_e^{-1} versus C_e is shown in Figure 9.

Additionally, the Freundlich isotherm model is given by the following equation for the removal of zinc by adsorption.

$$\log q_e = \log k_f + \frac{1}{n} \log C_e \qquad (4)$$

where k_f and n are Freundlich adsorption isotherm constants related to the adsorption capacity and intensity of adsorption. The plot of $\log q_e$ versus

$\log C_e$ is shown in Figure 10. The constants of Langmuir and Freundlich are presented in Table 3.

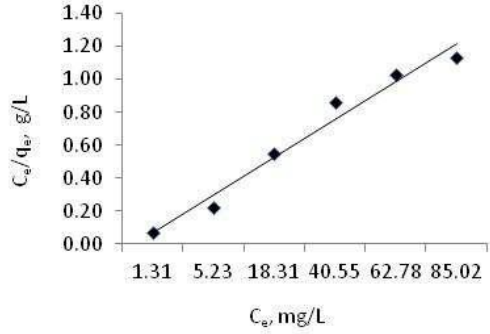

Figure 9. Langmuir plot for adsorption of zinc(II) onto SBA15-$PrSO_3H$.

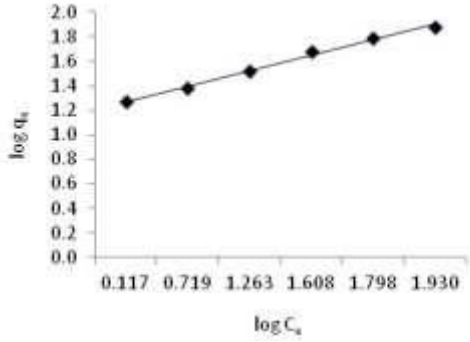

Figure 10. Freundlich plot for adsorption of zinc (II) onto SBA15-$PrSO_3H$.

Table 3. Adsorption Isotherm Model Parameters for Adsorption of Zn (II) onto SBA15-$PrSO_3H$

Langmuir			Freundlich		
q_o [mg g^{-1})	b [L mg^{-1}]	R^2	k_f [mg g^{-1}]	1/n	R^2
6.176	8.55	0.9462	13.87	0.1262	0.9934

3.6. The Effect of Initial Zinc Concentration

To determine optimum initial zinc concentration on zinc adsorption, various initial zinc concentrations (5-100 mg Zn^{2+} L^{-1}) were studied using 0.01 g adsorbent per 50 mL solution at pH 6.22 and 25 ˚C. The results obtained from the experimental data are shown in Figure 11. The efficiency of the amount of zinc adsorbed at equilibrium (q_e) on adsorbent is affected by the initial zinc concentration, increasing in driving force as the initial concentration increases from 5 to 100 mg Zn^{2+} L^{-1}.

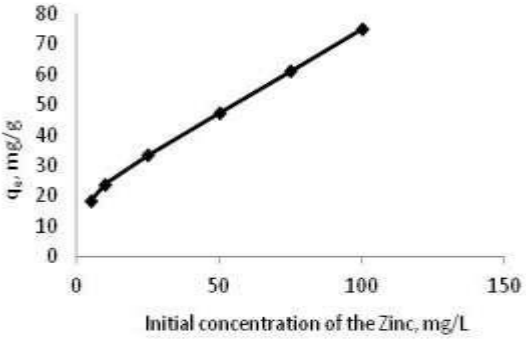

Figure 11. The effect of initial metal concentration on the removal of Zn (II) by SBA15-PrSO_3H.

3.7. Thermodynamics for Adsorption and Effect of Temperature

To observe the effect of temperature on the adsorption capacity of zinc on SBA15-PrSO_3H, four different temperatures of 25, 30, 35, 40 ˚C were tested. The plot of zinc adsorption (%) versus temperature is shown in Figure 12. The zinc adsorption percentage followed the order of 25 ˚C > 30 ˚C > 35 ˚C > 40 ˚C, indicating that the decrease in adsorption capacity with an increase in temperature was an exothermic process. The decrease in the adsorption rate can be attributed to the weakening of the attractive forces between the active sites of the mesoporous material and zinc ions.

The change in thermodynamic parameters such as Gibbs free energy (ΔG^o), enthalpy (ΔH^o), and entropy (ΔS^o) for the adsorption of zinc on the mesoporous material have been calculated using the following equation:

$$\Delta G^o = -RT\ln K \quad (5)$$

where R is the gas constant, K is the equilibrium constant, and T is the temperature in Kelvins. According to the Van't Hoff equation:

$$lnK = \frac{\Delta S^{\circ}}{R} - \frac{\Delta H^{\circ}}{RT} \quad (6)$$

The value of the enthalpy of adsorption (ΔH^{o}, kJ mol^{-1}) and the entropy of adsorption (ΔS^{o}, J mol^{-1} K^{-1}) obtained from the slope and the intercept of the Van't Hoff plot of lnK versus 1/T is shown in Figure 13. All these thermodynamic parameters are listed in Table 4. The negative value of ΔH^{o} shows the exothermic nature of the adsorption process. The negative value of ΔS^{o} shows that the system exhibits random behavior. The ΔG^{o} values were negative at lower temperatures (from 25 to 30 ˚C) and positive at higher temperatures (>30 ˚C). The adsorption efficiency of Zn (II) on mesoporous materials therefore decreases with an increase in temperature. The negative values of ΔG^{o} at lower temperatures prove that the adsorption processes are spontaneous (Sen & Gomez, 2011; Dolatyari et al., 2016; Wang et al., 2015; Shafiabadi et al., 2016).

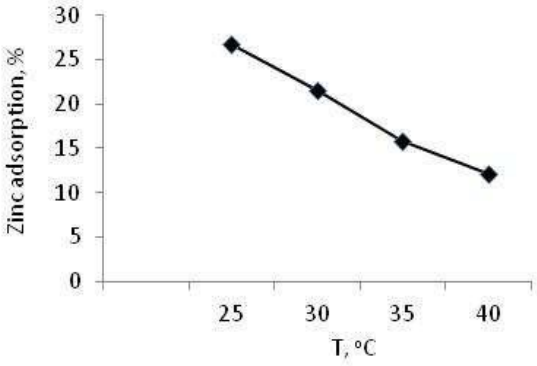

Figure 12. The effect of temperature on the adsorption of zinc(II) onto SBA15-PrSO_3H.

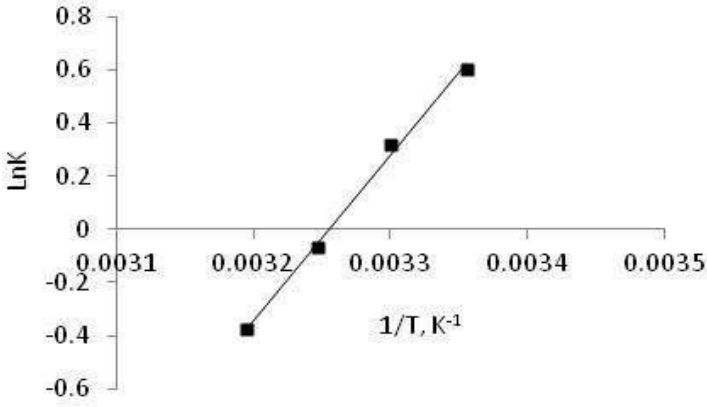

Figure 13. lnK versus 1/T.

(0.01 g SBA15-SO_3H, C_o:50 mg/L, pH: 6.22)

Table 4. Thermodynamic Parameters for Adsorption of Zinc(II) onto SBA15-$PrSO_3H$.

	ΔG^o [kJ mol^{-1}]			ΔH^o [kJ mol^{-1}]	ΔS^o [J mol^{-1} K^{-1}]
25 °C	30 °C	35 °C	40 °C		
-1.492	-0.794	0.170	0.972	-51.296	-166.97

3.8. Desorption Studies

Desorption studies of Zn (II) ions were carried out to explain the facility of recycling of mesoporous material as well as recovery of the zinc metal ions, Zn (II). The solution of 2 M HCl, 0.05 M EDTA, and 1 M NaCl was tested as a complexing agent. The filtrate obtained was analyzed to determine the desorbed zinc (II) ions by atomic absorption spectrophotometry (AAS). The desorption of Zinc (II) metal ions is 43.6% for all complexing agents. As a result, the retained amount of zinc ions on the mesoporous material after zinc ions are desorbed using one of complexing agents is 56.4%.

4. Conclusions

The present study represents the mechanism of adsorption of Zn (II) onto SBA15-functionalized organosulfonic acid material. SBA15-functionalized organosulfonic acid materials were therefore synthesized via the one-step co-condensation, and SBA15-$PrSO_3H$ was tested as an adsorbent for removal of zinc (II) metal ions from aqueous solution. The effects of parameters such as pH, amount of adsorbent, contact time, temperature, and initial concentration of metal ion on removal of zinc metal ions from aqueous solutions as well as desorption were studied. The Zn (II) adsorption capacity of the adsorbent is highly dependent on pH, the ratio of Zinc (II) ion/adsorbent and temperature.

The thermodynamic studies revealed that the adsorption is exothermic for zinc metal ions onto adsorbent. The adsorption efficiency of Zn (II) on mesoporous materials decreases with increase in temperature.

The Freundlich adsorption isotherm was fitted better with the experimental data than the Langmuir isotherm. Kinetics studies indicated that the adsorption kinetics followed the pseudo-first-order rate model.

The maximum adsorption of Zn (II) on the adsorbent was approximately 80 mg of Zn (II) per gram of the adsorbent. The desorption rate for zinc ions was 43.6%. In this work, the SBA15-$PrSO_3H$ mesoporous material was demonstrated to be an excellent adsorbent for zinc removal from aqueous solutions.

Acknowledgements

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AN ECO-FRIENDLY ADSORBENT FOR ADSORPTIVE REMOVAL OF REACTIVE RED 2 DYE FROM AQUEOUS SOLUTION: *Sardina pilchardus* FISH SCALE

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1. Introduction

Various problems to living organisms, human health, and ecosystem result from large amounts of toxic dyes discharged from the rubber, dyeing, electroplate, tannery, plastic, and textile industries (Wang et al., 2015). In order to overcome these problems, many treatment techniques such as ion exchange, coagulation, adsorption, electro-dialysis, precipitation, membrane separation, photochemical/chemical oxidation, degradation, and filtration have been used for disposing of the hazardous dyes from industrial wastewaters (Chen et al., 2015). Among these methods, adsorption has been particularly attracted intensive attention as an effective and affordable method in so far as its several advantages, like low cost, ease of operation, the flexibility of design, and high resistance against toxic chemicals in water[1]. Up to now; due to its large specific surface area, adsorption using activated carbon is the most common and effective wastewater treatment method. However, many researchers have recently focused on investigating low cost, easily acquirable, and readily available materials for adsorption process because using activated carbon have the expense of material, treatment and regeneration costs (Hor et al., 2016). In this respect, a large number of either natural or waste materials such as, carbon slurry waste (Gupta et al., 2016), waste longan shell (Wang et al., 2016), fly ash (Singh et al., 2016), montmorillonite (Sarma et al., 2016), wheat bran (Özer et al., 2004), and chitin (Sismanoglu et al., 2015) were studied as the low-cost adsorbents. In this study, adsorptive removal of Reactive Red 2 (RR2) from aqueous solutions by *Sardina pilchardus* fish scales (*SFS*), which are thrown as waste materials from the fishery industry, was evaluated in batch mode. Generally, fish scales are considered unworthy and impracticable as a waste. However, they involve lots of precious organic and inorganic constituents, primary hydroxyapatite (HAp) and collagen (Uzunoglu and Özer, 2016). So, it is thought that *SFS* is an alternative eco-friendly and effective adsorbent for the dye adsorption from aqueous solutions.

2. Experimental Procedure

Preparation and characterization of adsorbent, the isoelectric point of the adsorbent (pH_{ip}) determination, adsorption and desorption studies were carried out as in our previous study[10]. Briefly, the desired amounts of *SFS* were added to 100 ml dye solution at the desired initial pH and initial dye concentration in Erlenmeyer flasks. They were shaken on an agitation vessel at required temperature for 240 min for reaching to the equilibrium. Samples were taken at predetermined time intervals and were centrifuged to separate supernatant and solid phase. Then, to determine the residual dye, the absorbance was recorded by UV-vis spectrophotometer at 538 nm wavelength. Experiments were replicated for different temperature, initial dye concentration, initial pH, and adsorbent concentrations.

The adsorbed dye amount per unit mass of adsorbent at equilibrium (q_e) and the adsorption percentage were calculated as follows:

$$q_e\,(mg/g)=(C_o-C_e)/X_o \quad (1)$$

$$\text{Percent adsorption } (\%) = ((C_o-C_e)/C_o)x100 \quad (2)$$

Besides, the *SFS* characterization before and after the adsorption was conducted by Scanning Electron Microscope (SEM- Zeiss/Supra 55, Germany), X-ray Diffractometer (XRD- Philips XPert, Netherlands), Energy Dispersive X-ray Spectroscopy (EDX- Zeiss/Supra 55, Germany).

3. Results and Discussion

3.1. Characterization of *Sardina pilchardus* Scales (*SFS*)

Elemental analysis pre- and post-adsorption was done by using EDX analysis method and the results were presented in Table 1. It was concluded from Table 1 that calcium (Ca) and phosphate (P) showed the existence of HAp while nitrogen (N) arose from collagen structure. Also, as seen from Table 1; carbon (C) and nitrogen (N) contents of *SFS* increased, and presence of sulphur (S) and chlorine (Cl) was observed after dye adsorption, indicating the adsorption of RR2, whose chemical formula is $C_{19}H_{10}Cl_2N_6Na_2O_7S_2$, onto surface of *SFS*.

Table 1. EDX analysis results pre- and post- adsorption

Elements	% mole	
	Before adsorption	**After adsorption**
Ca	22.60	0.720
P	8.08	-
C	11.00	54.500
O	42.16	19.310
Na	0.20	0.075
N	3.77	9.930
S	-	3.040
Cl	-	0.470

FT-IR analysis was performed in order to get information about chemical structure of *SFS* pre- and post-adsorption and FTIR spectrums were given in Fig. 1 (a) and (b), respectively. According to Fig. 1(a), the pre-adsorption FTIR spectrum exhibited characteristic peaks relating to the organic constituents, namely amide I, II, and III bands of collagen at 1,641, 1,537, and 1,232 cm^{-1}, respectively. The carbonate peak at 1,400 cm^{-1} and the phosphate peaks at 1,017, 870, 598, and 556 cm^{-1} came from inorganic content of *SFS* that indicating the existence of hydroxyapatite. As seen from Fig. 1(b), the post-adsorption FTIR peaks did not display significant changes with regard to the pre-adsorption FTIR spectrum of *SFS*, demonstrated that the RR2 adsorption onto *SFS* occurred physically[10].

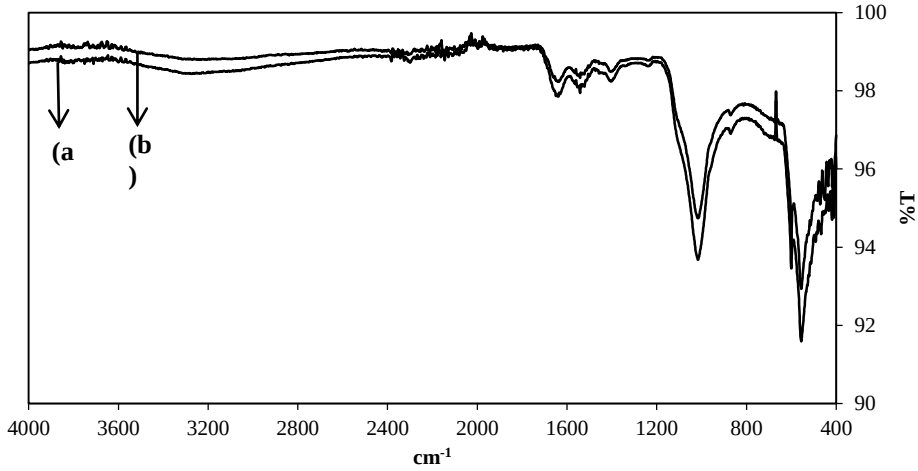


Figure 1. FT-IR spectrums for *SFS* (a) pre- and (b) post-adsorption

XRD analysis results for pre- and post-adsorption were given in Fig. 2. The *SFS* had a broad peak at $2\theta_{211}$ and a small shoulder peak at $2\theta_{002}$ which corresponded to the collagen structure and HAp, respectively (Muhammad et al., 2016).

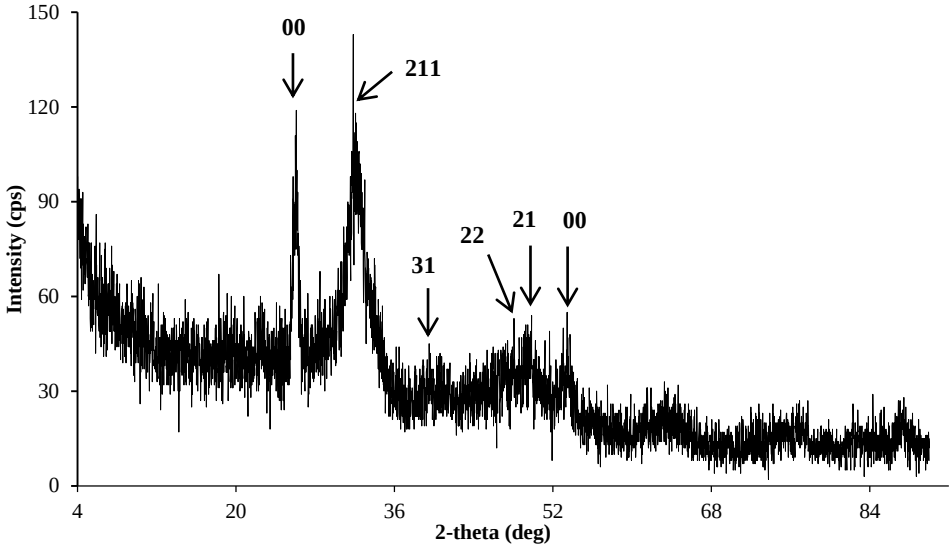


Figure 2. XRD pattern for *SFS* pre-adsorption

SEM images of *SFS* pre- and post-adsorption were presented in Fig. 3 (a) and (b), respectively. Surface of *SFS* exhibited remarkable irregularity and there were notable pores on the surface as seen from Fig. 3(a) while the porous surface was covered by RR2 anions substantially after the adsorption process as shown in Fig. 3(b).

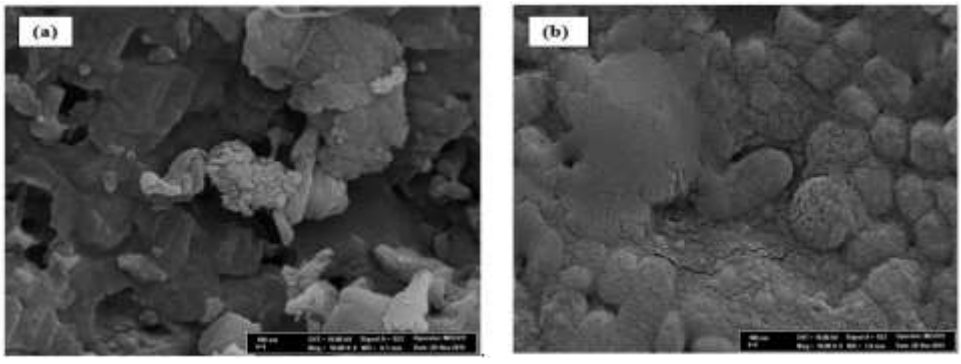
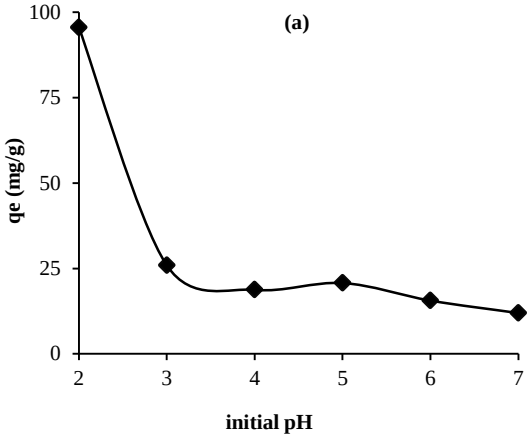
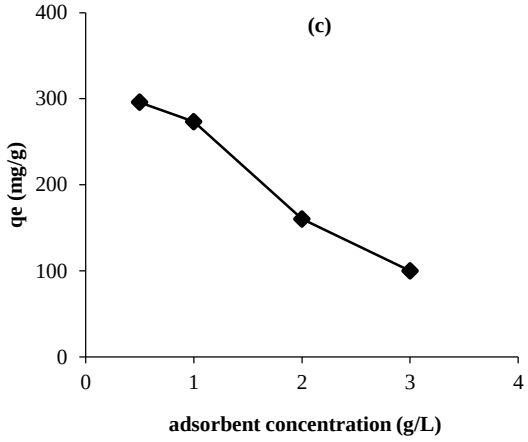


Figure 3. SEM images for *SFS* (a) pre- and (b) post-adsorption

3.2. Effects of Environmental Conditions on Reactive Red 2 Adsorption by *SFS*

The effects of temperature, initial pH, initial RR2 concentration, *SFS* concentration, and contact time on RR2 adsorption by *SFS* were done in a batch process and the related plots were presented in Fig. 4 (a-d).





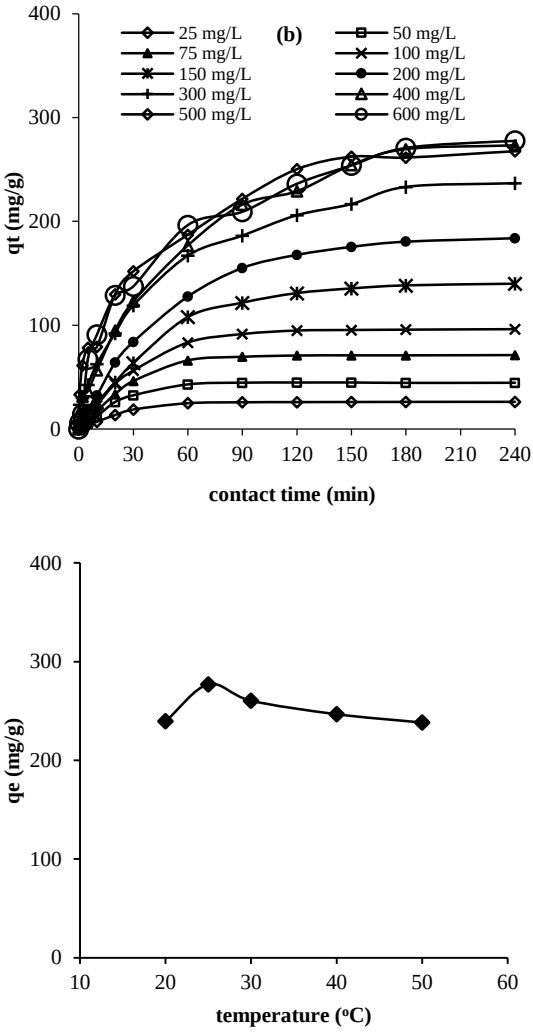


Figure 4. The effects of experimental conditions on RR2 adsorption by *SFS*

The effect of initial pH for RR2 adsorption by *SFS* was investigated in the initial pH range of 2.0-7.0 at 25°C temperature, 100 mg/L initial RR2 concentration, and 1.0 g/L *SFS* concentration for 240 min contact time. According to Fig. 4(a), the adsorbed dye amount at equilibrium decreased with increasing initial pH. It can be explained by isoelectric point (pH_{ip}) of *SFS*. The pH_{ip} of *SFS* was determined as 7.25 by solid addition method[10]. As expected, $pH<pH_{ip}=7.25$ favoured the uptake of anionic RR2 by electrostatic interaction via positively charged surface of *SFS*. There was a considerably high electrostatic attraction between the positively charged surface of *SFS* and RR2 anions particularly at initial pH 2.0; hence, the

optimum initial pH was found as 2.0 for the adsorption of RR2 onto *SFS* as can be seen in Fig. 4(a). In case where $pH>pH_{pzc}=7.25$, the removal capacity decreased due to the abundance of negatively charges on surface of *SFS* which lower down the affinity of RR2 anions for the surface (Cobas et al., 2015). The effect of initial RR2 concentration on the adsorption process was investigated over the range of 25-600 mg/L at 2.0 initial pH, 1.0 g/L *SFS* concentration, and 25°C temperature. As seen from Fig. 4(b), the equilibrium uptakes increased with increasing the initial RR2 concentration up to 400 mg/L, and then did not alter with farther increase in initial RR2 concentration, and also the removal capacity increased by increasing contact time up to 90 min for low concentrations (25-100 mg/L), 180 min for high concentrations (150-600 mg/L) and then remained constant indicating that a maximum removal was attained. These cases showed that the surface of *SFS* reached saturation by RR2 anions as the driving force, the concentration gradient, and contact time rose. The effect of *SFS* concentration on the adsorption process was investigated over the range of 0.5-3.0 g/L at 2.0 initial pH, 400 mg/L initial RR2 concentration, and 25°C temperature for 240 min contact time. As can be seen in Fig. 4(c), the uptake capacity decreased with increase in adsorbent concentration. This case may result from the particle interaction, such as aggregation that would lead to the increasing diffusional path length and the decreasing active surface area of adsorbent.

The effect of temperature on the adsorption process was evaluated over the range of 25-40 °C at 2.0 initial pH, 400 mg/L initial RR2 concentration, and 1.0 g/L *SFS* concentration for 240 min contact time. According to Fig. 4(d), the maximum adsorption capacity was obtained at 25 °C while the uptake capacities decreased at higher temperature values. It revealed towards the exothermic nature of the system. Besides, the dependence of RR2 adsorption on temperature was validated by Van't Hoff plot. So, the thermodynamic parameters includes entropy change (ΔS), enthalpy change (ΔH), and Gibbs free energy change (ΔG) were computed as follows:

$$\Delta G = -RT\ln(K_c) \quad (3)$$

$$\ln(K_c) = (\Delta S/R) - (\Delta H/RT) \quad (4)$$

The calculated parameters were tabulated in Table 2. As seen in Table 2, the negative value of ΔH affirmed that RR2 adsorption on *SFS* was exothermic, as discussed in the effect of temperature studies. The negative value of ΔS suggested the decreasing stochasticity at the adsorbent/dye solution interface. The negative values of ΔG clearly showed that RR2 adsorption on *SFS* was a spontaneous.

Table 2. Thermodynamic parameters for RR2 adsorption on *SFS*

T (ºC)	ΔG (kJ/mole)	ΔH (kJ/mole)	ΔS (J/mole.K)
25	– 2.08		
30	– 1.75	– 21.9	– 66.4
40	– 1.09		

3.3. Equilibrium Modelling of Reactive Red 2 Adsorption by *SFS*

The equilibrium data for RR2 adsorption by *SFS* at different temperatures was subjected to Langmuir, Freundlich, Temkin and Dubinin-Radushkevich (D-R) isotherm models (linear forms of isotherm equations were given in Table 3), and the isotherm model parameters were given in Table 3.

Table 3. Adsorption isotherm model constants with regression coefficients

(a) Langmuir isotherm model: $1/q_e=1/(Q_o.b.C_e)+1/Q^o$				
T (˚C)	**Q˚ (mg/g)**	**b (L/mg)**	**R_L**	**R^2**
25	303.0303	0.2012	0.0122	0.9990
30	256.4103	0.2349	0.0105	0.9989
40	238.0952	0.1463	0.0168	0.9970
(b) Freundlich isotherm model: $\ln q_e=\ln K_F+(1/n).\ln C_e$				
T (˚C)	**1/n**	**K_F [(mg/g)/(L/mg)$^{1/n}$]**		**R^2**
25	0.5946	56.7156		0.9948
30	0.5770	53.5338		0.9862
40	0.6154	38.7065		0.9874
(c) Dubinin – Raduskevich isotherm model: $\ln q_e=\ln q_m-\beta\varepsilon^2$, $E=1/\sqrt{2\beta}$				
T (˚C)	**q_m (mg/g)**	**E (J/mole)**		**R^2**
25	160.2764	901.7430		0.9998
30	161.3943	875.5104		0.9921
40	151.4412	766.3792		0.9994
(d) Temkin isotherm model: $q_e=B.\ln K_T.+B.\ln C_e$				
T (˚C)	**K_T (L/g)**	**B (J/mole)**		**R^2**
25	76.8710	32.1130		0.9940
30	62.3420	32.6780		0.9908
40	66.4190	10.9340		0.9909

Adsorption isotherms allow estimating the maximum adsorption capacity of the adsorbent, evaluating the applicability of the adsorption system, and getting information about the nature of the adsorption system. Langmuir isotherm model can be successfully used for characterizing the monolayer adsorption processes while Freundlich isotherm model can be

applied to multilayer adsorption. As seen from Table 3, Langmuir isotherm model best described the experimental equilibrium data due to its higher regression coefficients values than Freundlich isotherm model. Accordingly, the maximum monolayer coverage capacity for RR2 adsorption on *SFS* was found as 303 mg/g at 25 ^{o}C, which was optimum temperature. Several researchers investigated the maximum adsorption capacities of many fish scales calculated from Langmuir model, and the comparison of adsorption capacity of *SFS* with the literature was given in Table 4. Accordingly, *SFS* exhibited remarkable potential for dye removal from aqueous solutions. Besides, R_L value was obtained over the range of 0.0105–0.0168 confirming that RR2 adsorption onto *SFS* was favourable.

Table 4. The maximum monolayer coverage capacities of various fish scales in the literature

Adsorbent	**Adsorbate**	**Q° (mg/g)**	**Reference**
Sardina pilchardus fish scales	Reactive Red 2	303.03	This work
Dicentrarchus labrax fish scales	Acid Blue 121	300.66	(Uzunoglu and Özer, 2016)
Labeo rohita fish scales	Pb(II)	196.80	(Nadeem et al., 2008)
Gadur morhua fish scales	Pb(II)	80.00	(Basu et al., 2006)
Oreochromis niloticus fish scales	Cu(II)	58.00	(Villanueva-Espinosa et al., 2001)
Labeo rohita fish scales	Malachite Green	38.46	(Chowdhury et al., 2012)
Catla catla fish scales	Cr(VI)	6.48	(Srividya et al., 2009)
Tilapia nilotica fish scales	Selenite	1.02	(Kongsri et al., 2013)

Also, the adsorption energy (kJ/mole) values (E) calculated from D-R isotherm model gives the information about adsorption type, physical or chemical. As seen from Table 3(c), E values at all temperatures were lower than 8.0 kJ/mole, indicating that the adsorption of RR2 onto *SFS* proceeded through physical adsorption. Otherwise, according to Temkin isotherm model assumption; the increase in coverage of adsorbent would result in the linear decrease in heat of adsorption. According to Table 3(d), B values, relating to adsorption heat, increased with decreasing temperature, showing exothermic nature of RR2 adsorption onto *SFS*.

3.4. Kinetics and Mass Transfer Modelling of Reactive Red 2 Dye by *SFS*

The kinetics of RR2 adsorption onto *SFS* were evaluated by the pseudo-first order [linear form: $\log(q_e-q_t)=\log(q_e)-k_1.t/2.303$] (PFO) and the pseudo-second order [linear form: $(t/q_t)=(1/(q_e^2.k_2)+(1/q_e)]$ (PSO) kinetic models, and the model constants with regression coefficients for different initial RR2 concentrations were given in Table 5, and also the comparison of experimental q_e values ($q_{e,\,exp}$) with calculated q_e values from the kinetic models ($q_{e,\,cal}$) can be seen in Table 5. Accordingly, for PSO kinetic model, both the regression coefficients were higher and $q_{e,\,cal\text{-}PSO}$ values were more consistent with $q_{e,\,exp}$ values in comparison with PFO kinetic model. Hence, it was concluded that the RR2 adsorption onto *SFS* kinetics was in the best agreement with the pseudo-second order kinetic model.

In order to evaluate the mass transfer in this study, Weber-Morris model [$q_t=K_i.t^{0.5}+ I$] was applied to experimental data and the model constants were tabulated in Table 5. Based on Weber-Morris assumptions; a plot of q_t versus $t^{0.5}$ is a straight line from the origin if the adsorption mechanism proceeds through the intraparticle diffusion process only. However, if the plot is linear and also has intercept value, then the process is governed by both intraparticle and film diffusion According to Table 5, Weber–Morris model plots were linear and had intercept values; hence, it can be concluded that both film and intraparticle diffusion were effective on the adsorption and also K_i values increased with increasing initial dye concentrations causing positive impact to the adsorption capacities. Besides, the increase in intercept values (I) with increasing initial dye concentrations indicated the decrease in external resistance.

Table 5— The constants of the kinetics and mass transfer models

C_o (mg/L)	$q_{e,exp}$	PFO kinetic model: $\log(q_e-q_t)=\log(q_e)-k_1.t/2.303$			PSO kinetic model: $(t/q_t)=(1/(q_e^2.k_2)+(1/q_e)$			Weber-Morris model: $q_t=K_i.t^{0.5}+I$		
		$q_{e,PFO-cal}$	k_1 (min^{-1})	R^2_{PFO}	$q_{e,PSO-cal}$	k_2 (g/mg.min)	R^2_{PSO}	K_i (mg/g.min$^{0.5}$)	I	R^2
25	26.20	22.56	0.0350	0.971	27.04	0.00150	0.990	2.4123	4.318	0.902
50	44.73	38.44	0.0387	0.970	45.79	0.00121	0.992	3.7095	11.170	0.924
75	71.21	65.65	0.0359	0.966	73.58	0.000538	0.990	5.9621	15.481	0.906
100	96.22	93.60	0.0315	0.990	99.93	0.000298	0.991	7.0453	22.226	0.902
200	183.88	187.80	0.0214	0.996	190.94	0.000082	0.994	12.6270	31.595	0.974
400	276.92	281.64	0.0200	0.945	277.45	0.000062	0.997	16.4860	52.504	0.974

3.5. Recycling of *SFS*

The repeated usability of *SFS* for RR2 adsorption through many cycles of adsorption/desorption is quite vital for the application of *SFS* in the adsorptive RR2 removal. Therefore, the recycling of *SFS* in the adsorptive removal of RR2 was investigated via sequential adsorption/desorption cycles. First of all, the determination of optimum initial pH of desorption was done and the effect of initial pH on the desorption system was presented in Fig. 5 (a).

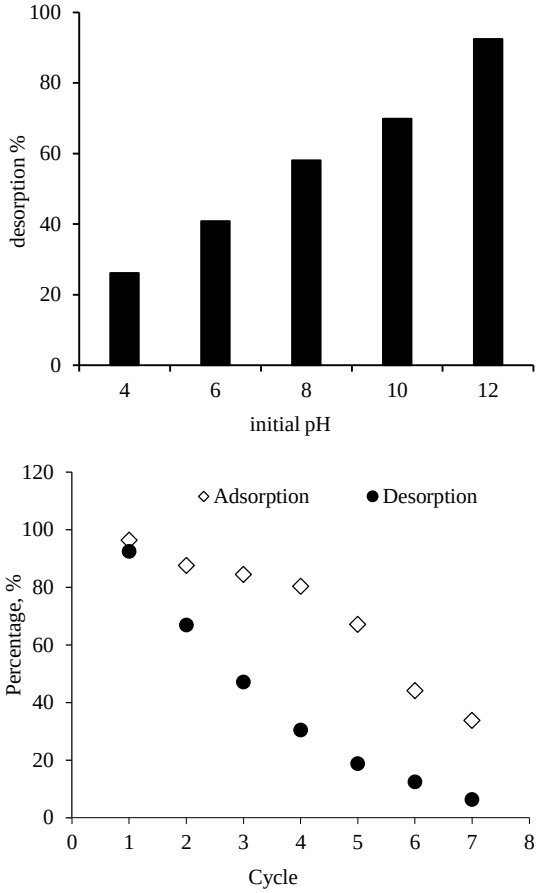


Figure 5. (a) The effect of initial pH on the desorption system, (b) The percentages of adsorption ((C_{ad}/C_o)x100)/desorption (($C_{e,des}/C_o'$)x100) vs cycle

As shown in Fig. 5 (a), the optimum initial pH of desorption was found out as 12, and the desorption studies were carried out at this initial pH value while the adsorption studies was conducted at initial pH of 2.0. The consecutive batch adsorption/desorption experiments were carried out for 7.0 cycles and the plots of the adsorption/desorption percentages vs these cycles were given in Fig. 5 (b). According to Fig. 5 (b), RR2 adsorption percentages of *SFS* decreased from 96 % to 34 % after seven cycles. As it was understood that *SFS* lost its removal efficiency by almost 62% while the desorption percentage diminished from 92 % to 6.0 after seven consecutive cycles of adsorption/desorption experiments. Besides, it was found that *SFS* was unable to adsorb any more RR2 anions after seven consecutive cycles due to its too low desorption ability thereafter. Consequently, the result of recycling study showed that *SFS* could be reused for a long period while maintaining its high removal efficiency.

4. Conclusions

In this study, *Sardina pilchardus* scales (*SFS*) was used as an adsorbent for adsorption an anionic dye, Reactive Red 2 dye (RR2), from aqueous solution. RR2 adsorption onto *SFS* depended on temperature, initial pH, initial dye concentration, adsorbent concentration, and contact time. Optimum temperature, initial pH, initial RR2 concentration, *SFS* concentration, and contact time were determined to be 25°C, 2.0, 400 mg/L, 1.0 g/L, and 240 min, respectively. EDX analysis showed that Ca, P, O, C, Na, and N elements were observed before RR2 adsorption while and S and Cl elements occurred after RR2 adsorption, indicating the adsorption of RR2 onto *SFS* surface. Accordingly, the elements of calcium, oxygen, carbon, and phosphate were resulting from HAp while nitrogen was indicating the collagen structure. FTIR analysis stated that *SFS* had organic components (collagen structure) and inorganic content (HAp). Besides, the lack of bond breaking or formation after adsorption showed that this process proceeded through physical adsorption. It was observed by XRD patterns that *SFS* represented characteristic peaks of collagen structure and HAp. The heterogeneous surface structure and remarkable pores of *SFS* were observed by SEM analysis, and also it was seen from SEM images after RR2 adsorption that the surface of *SFS* was covered by RR2 anions. The experimental equilibrium data for RR2 adsorption onto *SFS* best fitted to the Langmuir isotherm model with higher regression coefficient, and also the maximum monolayer coverage capacity was found as 303 mg/g. The adsorption energies calculated from Dubinin-Radushkevich model were lower than 8.0 kJ/mole, indicating that the adsorption of RR2 onto *SFS* occurred by physical adsorption. Weber-Morris showed that both external film and intraparticle diffusion were effective on RR2 adsorption. It was found that the pseudo second order kinetic model could be used for the prediction of RR2 adsorption kinetics. RR2 adsorption onto *SFS* was exothermic, the diminished randomness at the solid/solution interface throughout the adsorption system, and spontaneous. The results of this work showed that *SFS* may be used as a very effective adsorbent in anionic dye adsorption from aqueous solutions.

Nomenclature

A	Temkin constant about binding energy (L/g)
b	A constant related to the affinity of the binding sites (L/mg)
B	Activity coefficient related to adsorption mean free energy ($mole^2.J^2$)
C_{ad}	The adsorbed dye concentration (mg/L)
C_e	The unadsorbed dye concentration at equilibrium (mg/L)
$C_{e,des}$	The desorbed dye concentration at equilibrium (mg/L)
C_o	The initial dye concentration (mg/L)
C_o'	The adsorbed dye concentration onto adsorbent at adsorption equilibrium or the initial dye concentration for desorption system (mg/L)
E	Adsorption energy (kJ/mole)
K_c	(C_{ad}/C_e), equilibrium constant
K_F	Freundlich constant indicating adsorption capacity $(mg/g)/(L/mg)^{1/n}$
K_T	Temkin constant about adsorption heat (J/mole)
k_1	Pseudo-first order rate constant (1/min)
k_2	Pseudo-second order rate constant (g /(mg min))
R_L	Dimensionless equilibrium parameter (separation factor)
q_e	The adsorbed amount per unit mass of adsorbent (mg/g)
$q_{e,PFO\text{-}cal}$	The calculated adsorbed amount per unit mass of adsorbent by pseudo-first order kinetic model (mg/g)
$q_{e,PSO\text{-}cal}$	The calculated adsorbed amount per unit mass of adsorbent by pseudo-second order kinetic model (mg/g)
$q_{e,exp}$	The experimental adsorbed amount per unit mass of adsorbent (mg/g)
q_m	Maximum adsorption capacity (mg/g)
Q^o	Maximum monolayer coverage capacity of adsorbent (mg/g)
X_o	Adsorbent concentration (g/L)
$1/n$	Freundlich constant indicating adsorption intensity
ΔG	Gibb's free energy change (J/mole)
ΔH	Enthalpy change (J/mole)
ΔS	Entropy change (J/mole K)

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MECHANICAL ENGINEERING

WÖHLER CURVE BASED LIFE ANALYSIS OF MACHINE PARTS

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1. Introduction

When a material is subjected to repeated stresses, it fails at stresses below the yield point stresses. Such type of failure of a material is known as fatigue. The failure is caused by means of a progressive crack formation which are usually fine and of microscopic size (Khurmi & Gupta, 2005). Fatigue is one of the most important modes of failure in many mechanical components since it can occur even if the stresses in the critical regions are below the elastic limit(Mlikota, Schmauder, & Bo, 2018). In general, fatigue is an important problem that affects any structural component or part that moves (André Meyers, 2009). Fatigue damage has no obvious plastic deformation, and sudden damage often leads to catastrophic accidents, causing huge economic losses (Guo, Mao, Liu, & Liang, 2019). Wöhler is considered to be the first who performed systematic experimental investigations on fatigue strength and his investigations was the fracture of railway-vehicle shafts (Köhler, Jenne, Pötter, & Zenner, 2017). In these experimental process, Wohler established a material property, known today as the fatigue limit (Marczewska et al., 2006). The fatigue life can be represented through S-N curves which describe the relationship between load cycles up to failure and stress range applied in a structure. Providing these curves help the engineers to estimate design stress levels with a high reliability(Toasa Caiza & Ummenhofer, 2018). When the fatigue curve or S–N curve is defined, it is usually done in reference to carbon steels. The S–N curve is generally limited to 10^7 cycles, and it is admitted, according to the standard, that a horizontal asymptote allows one to determine a fatigue limit value for an alternating stress between 10^6 and 10^7 cycles. Beyond 10^7 cycles, the standard considers that the fatigue life is infinite. For other alloys, it is assumed that the asymptote of the S–N curve is not horizontal. However, some studies suggest that an infinite fatigue life concept on an asymptotic S - N curve is not correct (Bathias, 1999). Figure 1 refers a typical S-N curves of medium strength steel.

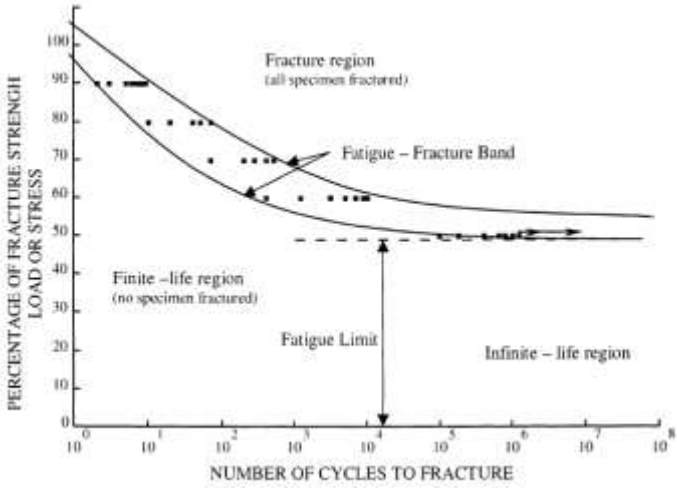

Figure 1. S-N curves of a typical medium-strength steel (Bathias, 1999).

It is of critical importance for all of the engineering fields to produce designs against the fatigue. Moreover, it is quite difficult to determine the initial damages of the fatigue by way of observation and the initial damages of the fatigue cannot be mostly recognized until a structural component becomes unusable. Therefore, the determination of fatigue life of the structural members during the stage of design and development results in a considerable decrease in unexpected damage risk that may occur during the use. Thus, reliable methods which can accurately predict the fatigue life are required (Şik, Atak, Yavuz, & ÖzdemİR, 2018). A lot of life prediction models were used for calculating life (Socie, 1977). On the other hand none of these can be universally accepted (Santecchia et al., 2016). The three major fatigue life methods used in design and analysis are the stress-life method, the strain-life method, and the linear-elastic fracture mechanics method (Shigley, 2011). These methods attempt to predict the life in number of cycles to failure, One of these approaches is Wöhler Curve-based life analysis. The simplified Wöhler (S-N) curves (Figure 2) are used in these analyzes and logarithmic life equations are obtained from these curves (Bayraktar, Guclu, & Tahrali, 2014; Bayraktar, Tahrali, & Guclu, 2010; Dikmen, Bayraktar, & Guclu, 2012; Tahralı, Atik, & Çivi, 2017).

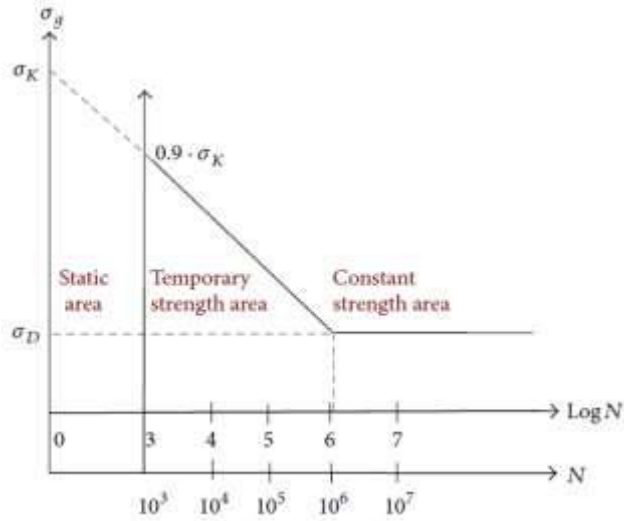

Figure 2. A simplified Wöhler (S-N) curve (Bayraktar et al., 2014)

In this study, Wöhler curve-based life analysis of machine components were discussed, calculations were analyzed and applications of machine parts different stress type such as combined stress or cumulative damage were investigated.

2. Fatigue Life Prediction Using S-N Diagrams

Simple logarithmic equations obtained from Wöhler curves are used in life calculations. This logarithmic life equations were given in (1)–(5). The simplified Wöhler diagram which obtained Logarithmic equations is given in Figure 2. N describes specific level of loading and $1 \leq N \leq 10^3$ cycles generally classified as low-cycle fatigue (static area) whereas $\geq 10^3$ high-cycle fatigue. 10^6 cycles describes endurance limit or fatigue limit (Shigley, 2011).

In this approach, logarithmic life values can be calculating as follow:

$$\frac{0{,}9\sigma_k - \sigma_g}{0{,}9\sigma_k - \sigma_D} = \frac{\log N - \log 10^3}{\log 10^6 - \log 10^3} \tag{1}$$

$$\log N = 3 + 3\left[\frac{0{,}9.\sigma_k - \sigma_g}{0{,}9.\sigma_k - \sigma_D}\right] \tag{2}$$

σ_k : Ultimate Stress

σ_D : Endurance limit

σ_g : Alternating stress

Log N: Logarithmic life value

The above equations are used for fatigue test specimens. When determining the life equations of machine parts, actual maximum stress should be described. Factors such as material (K_m), size (K_b), surface condition (K_a) temperature (K_d) and load modification factors (K_c), reliability (K_r) and miscellaneous factors (K_e) defined endurance limit at the critical location of machine part (Shigley, 2011).

$$\sigma_D{}' = \frac{K_m.K_b.K_a.K_d.K_c.K_{r.}K_e}{K_f}.\sigma_D \tag{3}$$

With similar approach, actual maximum stress ($\sigma_g{}'$) should be described as follow:

$$\sigma_g{}' = \frac{K_f}{K_m.K_b.K_a.K_d.K_c.K_{r.}K_e}.\sigma_g \tag{4}$$

Modified equation is obtained as follows

$$\log N = 3 + 3\left[\frac{0,9.\sigma_k - \sigma_g{}'}{0,9.\sigma_k - \sigma_D}\right] \tag{5}$$

Although the above equations are a good approach, they are insufficient to meet the stress conditions in which real machine parts are practically forced. Under real operating conditions, the machine parts are not forced under one and the same type of stress as in the above equations. Generally, machine parts are forced under compound stresses and they are often subjected to different stresses at different time intervals. Determination of fatigue damage is an important problem for components that are subjected to random loading at various stress levels (Miller & Zachariah, 1977). The following section deals with the relevant calculations. In the last section, the life calculations of machine parts under compound stress are examined.

3. Cumulative fatigue damage analysis

Fatigue damage increases with applied cycles in a cumulative manner which may lead to fracture (Fatemi & Yang, 1998). The problem of accumulation of fatigue damage due to different stress levels has great importance in applications(Lemaitre, 1996). The first cumulative damage theory was applied by A. Palmgren for predicting the life of roller bearings in 1920 in Sweden (Bayraktar et al., 2014). The Palmgren-Miner linear damage rule predicts fatigue failure of the component when the summation of the cycles of reversed stress amplitude (Kauzlarich, 1989). Though many damage models have been developed after Palmgren-Miner Rule, Palmgren-Miner is still dominantly used in design, in spite of its major shortcomings due to the complexity of the problem(Fatemi & Yang, 1998). When there are k different stress ranges, n_i load cycles corresponding to σ_i, σ_i stress value of N_i life, N_i is the number of loading cycles to failure under a constant stress range and c_i proportion factors ($c_i.N_{eq}=n_i$), N_{eq} is referred equivalent life value and σ_{eq} is referred equivalent stress value (Bayraktar et al., 2014; SAATÇI & TAHRALI, 2003b, 2003a). The Palmgren-Miner equations were given in (6)–(8).

$$\sum_{i=1}^{k} \frac{n_i}{N_i} = \frac{n_1}{N_1} + \frac{n_2}{N_2} + \frac{n_3}{N_3} + ... + \frac{n_i}{N_i} = K \tag{6}$$

In the equation, K is a constant ($0,7 \leq K \leq 2,2$) and $K \cong 1$ for Steel parts. The equation can be derived as follows.

$$\sum_{i=1}^{k} \frac{c_i}{N_i} = \frac{c_1}{N_1} + \frac{c_2}{N_2} + \frac{c_3}{N_3} + ... + \frac{c_i}{N_i} = \frac{1}{N_{eq}} \tag{7}$$

$$\sum_{i=1}^{k} \frac{c_i}{\sigma_i} = \frac{c_1}{\sigma_1} + \frac{c_2}{\sigma_2} + \frac{c_3}{\sigma_3} + ... + \frac{c_i}{\sigma_i} = \frac{1}{\sigma_{eq}} \tag{8}$$

N_{eq} :Equal Life, σ_{eq} : Equal stress

Using the Palmgren-Miner equations, equivalent life or equivalent stress determinations of machine parts operating at different stress levels can be realized. However, these equations are insufficient to meet the life analysis of real machine parts too. Machine parts are subjected to a combination of stresses that are very different from a single type of stress such as only tensile or only bending. In the following section, the calculations under compound stresses are explained.

4. Life analysis of components working under compound stresses

There are some failure theories for ductile materials such as maximum shear stress ,distortion energy, ductile Coulomb-Mohr (DCM) and for brittle materials such as maximum normal stress, brittle Coulomb-Mohr, modified Mohr (Shigley, 2011). Von Mises theory is plasticity theory that applies best to ductile materials, such as metals. The stress on machine parts is usually some combination of alternating normal stress and alternating shear stress rather than a simple stress. It is not feasible to test every material under all combinations of combined alternating stresses and combined static stresses, but some estimate must be made from the common laboratory tests on each material (Sines & Ohgi, 2016). An additional complexity is that different sources of cyclic loading may differ in phase or frequency or both (Norman, 2012). In this case, the problem becomes quite complicated. The simplest solution for this situation is to determine the compound and equivalent stresses with the damage criteria and cumulative damage calculations described above.

For example, in a common loading state, bending moment and torsion occur on the cylindrical shaft (Figure 3).

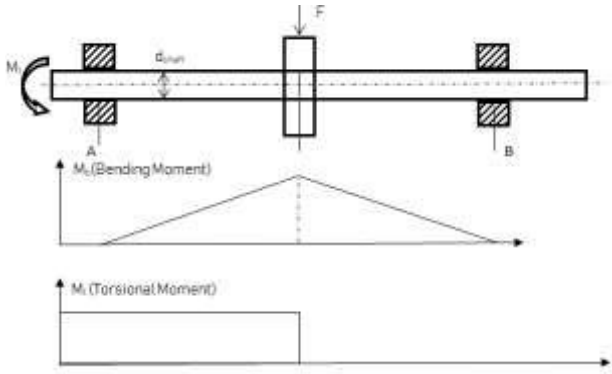

Figure 3. Rotating cylindrical shaft

In this case, the combined stress can be calculated using the von Mises damage criterion.

$$\sigma' = \left(\sigma^2 + 3.\tau^2\right)^{1/2} \tag{9}$$

If there is a variable amplitude stress, the equivalent stress determination is made with the Palmgren-Miner equations. As a result, fatigue equations based on Wöhler curve can be obtained by replacing in equation (5) and (8).

5. Results and Discussion

To determine the life value of a machine part is important before design of the part. However, one of the most important challenges here is the determination of equivalent and compound stresses because of a machine parts can work under different stresses at different durations. Palmgren-Miner rule is still most widespread model to define the equivalent stress or life values due to the complexity of other approaches. Also the von Mises criterion can be applied as a simple and important solution for the compound stress calculation. Considering all these equations together, Wöhler curve based fatigue equations can be obtained simply for almost all of the fatigue damage of machine parts. This provides great importance in terms of prevention of dangerous breaks and stock follow-up by carrying out life analyzes before design.

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TEXTILE ENGINEERING

FIBRES WHICH GROW in ANATOLIA and EVALUATION of THEIR RECENT SITUATION

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1. Introduction

Textile has a quite long history from the basic fibres to today's smart textiles which started with the human beings' need to cover and protect themselves from natural life conditions. Primitive men wore animal hides before neolithic age and then they found out textile fibres such as wool, linen around B.C. 8000s, and they began to spin these fibres to make yarn and then they began to weave these yarns to make cloth followed by making dresses. It is suggested that linen was possibly the first fibre discovered in the world, followed by wool (Dayıoğlu&Karakaş, 2007). It is suggested that cotton was discovered in India around B.C. 3000-3500, silk was discovered around B.C. 2600 in China. For nearly 8000 years, until the Industrial Revolution in A.C. 1900s, people were confined only to natural fibres such as wool, linen, cotton, mohair, angora, hemp, silk which were obtained from some natural vegetable or animal sources. After some period of the discovering natural fibres, people began dyeing to give colour to the cloth they used for cover. Over time, they printed patterns to embellish these materials and expressed their inner worlds and enthusiasm in this way. During the course of Industrial Revolution that began in the A.C.1900s, an all-around development in all fields took place including the textile industry, which was seen great advancements in terms of fibre, dye, machinery, chemistry, and energy. Chardonet silk was discovered in 1885 which is the first regenerated fibre and poliamid was discovered in 1939 which is the first synthetic fibre. Discovery of the other regenerated and synthetic fibres followed these fibres. Although only natural fibres were used in textile area until Industrial Revolution, by the discovering and the beginning of regenerated fibres such as viscose silk, copper silk, acetate silk, kazein, rubber fibres, alginate fibres , soya bean fibres, maize fibres, peanut fibres and also of synthetic fibres such as polyamide, polyester, polytetrafluoroethylene, polyacrylonitrile, polyvinylchloride, polyvinylidenechloride, polypropylene, polyethylene, polyurethane, polysytirene, polyvinylalcohol etc., the usage of natural fibres began to decrease gradually but did not finish (Uygur&Yüksel, 2013).

It is known that human societies lived in the paleolithic age in Anatolia. Natural fibres growing in Anatolia dated old times. Çayönü, Çatalhöyük, Hacilar which are the oldest village settlements in Anatolia, people made

fabric from plant fibres, linen was the first known fibre, and then beginning of clothing has been reported around B.C. 8000s (Türkoğlu, 2002). A number of woven pieces were found in the Çatalhöyük excavations, although they were charred. In addition to fine woven fabrics, thick woven fabrics such as sacks were also found. It has been determined that these fabrics are made of wool or mohair fibres (Melart, 1967). Çatalhöyük and Horoztepe are one of the oldest known centres of spinning fibres and weaving yarns. Since organic materials, such as textile fibres, have been completely or largely destroyed, this information is mainly provided on the basis of depicted documents or tools and equipments used in weaving. The usage of linen to weave fabric dated around B.C. 5000s, there are some determinations that it is used in Anatolia and Northern Iraq and spread to the all over the World from there (Yağan, 1978). Hemp was seen in Anatolia in B.C. 1500s. Cotton, which was cultivated and evaluated in India for the first time, was reported that it entered Anatolia through North Africa in B.C. 500-300. Silk was the most important and imported fibres as always (Türkoglu, 2002). Linen, hemp, cotton, wool and silk were grown in Anatolia in the A.C. 1300s. Cotton were grown in Western and Southeastern Anatolia; wool were growing in Central and Eastern Anatolia; silk were grown in Istanbul, Bursa and Antep; flax and hemp were grown in Kastamonu and Aegean (Turkoglu, 2002).

After the Turks came to Anatolia, It was seen that some goats species which started to mutate to endemic goat species in Ankara region around A.C. 1400s called Angora goat and mohair fibres obtained from Angora goat started to be used in textiles (Tamur, 2003).

Angora rabbit named since it is spread out from Ankara to the world and its wool generally named as Angora. Although motherland of Angora Rabbits is Ankara, raising Angora Rabbit is ended in Ankara region around 1723s. Although Angora wool production began in Turkey in 1960s, it is not enough amount today (Gate of Turkey, 2019).

2. Fibres Properties and the Region Where the Fibres Grown inTurkey

It is observed that linen, wool, hemp, cotton, silk, mohair, angora fibres were grown in Anatolia from the old times to recent times.

2.1. Endemic Fibres

Mohair and Angora rabbit hair are endemic fibres which spread out all over the world.

2.1.1. Mohair

Angora goats started to grow as an endemic goat species in Ankara region around A.C. 1400s and mohair fibres obtained from Angora goat started to be used in textiles (Tamur, 2003). Endemic Ankara Goat and its

product mohair had a great commercial importance until the a.c.1900s in the Ottoman period and Ankara was an important Ankara Goats and mohair centre. The Ottoman Sultans prohibited the export of raw mohair and Ankara Goat. Only export of processed mohair products, mohair yarn and mohair fabric were allowed to Europe. This protection continued until the 1838 Baltalimanı Treaty in A.C. 1838 which gives some capitulations to Great Britain, therefore the English took Ankara goats to specially established British farms in South Africa, and bred them in South Africa successfully. Today South Africa is the first mohair grower in the world while Turkey mohair grower decreases in a high ratio in its motherland Anatolia (Özakıncı, 2008).

Mohair fibres can be silver white, gray, brown and black colours. The fibres are brighter, curled, furry, more resistant to felting, and also more resistant to deformation. The length of the fibre can be 13-30 cm, and its fineness varies between 20-40 microns. It is elastic, soft and has high breaking strength. It absorbs 16-18 % moisture, and also gives moister outside of the garment supplying clothing comfort. It is resistant to sun rays and burning. It does not conduct heat, keeps warm in winter and keeps cool in summer. It can be easily painted, does not hold dirt easily or gives dirt easily with a light wash. The lint fibres are strong, like wool, show antibacterial properties and are lightweight, so they can be used in summer clothes (Harmancıoğlu, 1974),(Mohair USA,2019).

Angora goats are grown mainly in Ankara, Eskişehir, Bolu, Kastamonu, Siirt, Şırnak, Mardin etc. cities in Turkey (TUİK).

Figure 1. Angora goat and its wool- mohair

2.1.2. Angora Rabbit Hair (Angora)

Although motherland of Angora Rabbits is Ankara, breeding Angora Rabbit is ended in Ankara around A.C. 1723 s. Although Angora wool

production began again in Turkey in A.C. 1960s, it is not enough amount (Gate of Turkey, 2019). Angora rabbits are all grown all over the world called German Angora rabbit, Chinese Angora rabbit, French Angora rabbit etc. (Natural fibres, 2009).

Angora fibres are smooth, lustre, fluffy fibres of slippery silky softness. Thermal insulation is higher about 4-8 times than wool, mohair. Its electromagnetic property decreases the pain of rheumatism, it absorbs 16-17 % moisture, and also gives moister outside of the garment supplying clothing comfort. The length of the fibre can be up 6 cm, and its fineness varies between 10-16 microns (Angoplus, 2015).

Angora rabbit is grown mainly in Afyon, Sinop, Bursa, Manisa; Amasya, Kayseri, Denizli; İstanbul, Zonguldak, Bursa, Çankırı,Hatay, İzmir, Burdur, Kütahya, Konya, Samsun, Antalya, Burdur, Diyarbakır, Kocaeli, Ankara etc. cities which are not too hot in Turkey (Gate of Turkey, 2019).

Figure 2 . Angora rabbit

2.2. Non- Endemic Fibres

2.2.1. Cotton

Cotton is usually creamy white in colour, cheapest, soft, the length of the fibre can be 1,0-5,5 cm, and its fineness varies between 6-25 microns. It absorbs 8-10 % moisture. It has no thermal insulation. Durability of cotton increases when it is wet. Sunlight damages cotton. The average amount of elongation is 7-8%, it is not elastic (Başer, 1992)

Cotton is grown mainly in Adana, Antalya, Hatay, İzmir, Aydın, Mardin, Maraş, Gaziantep etc. cities in Turkey (Dayıoğlu&Karakaş, 2007)

Figure 3. Cotton boll

2.2.2. Linen

Linen is usually creamy or light brown in colour and generally shows similar properties that of cotton. The length of the fibre can be 20-75 cm, and its fineness varies between 14-25 microns. It absorbs 13 % moisture. Durability of linen increases when it is wet. It has no thermal insulation. Sunlight damages linen, it is not elastic (Başer, 1992).

Flax (linen plant) is grown mainly in Kocaeli, Diyarbakır, İnebolu, Ayancık, Sinop, Niğde, Kandıra, Afyon etc. cities in Turkey (Dayıoğlu&Karakaş, 2007).

Figure 4 . Flax plant

2.2.3. Hemp

Linen is usually yellow or light brown in colour. The main properties of fibres similar that of linen, but its fineness varies between 18-50 microns. It has no thermal insulation. Durability of hemp increases when it is wet. Sunlight damages hemp, it is not elastic (Başer, 1992)

Hemp is grown mainly in Kastamonu, Ünye, Fatsa, Samsun, Malatya, Urfa, Kütahya, Tire, Gediz, etc. cities in Turkey (Dayıoğlu&Karakaş, 2007).

Figure 5. Hemp (Cannabis) plant

2.2.4. Wool

Wool is usually creamy white, black, grey, brown in colour, curled, the length of the fibre can be 5-15 cm, and its fineness varies between 17-40 microns. It absorbs 16-18 % moisture. It is the unique felting natural fibre. It has resilience property and high thermal insulation. Durability of wool decreases when it is wet. The average amount of elongation is 30%. Electricity conduction is low (Harmancıoğlu, 1974)

Sheep is grown in Middle, East Anatolia, Aegean, Mediterranean region etc. in Turkey (Harmancıoğlu, 1974)(TUİK).

Figure 6. Sheep

2.2.5. Merino Wool

Merino wool properties are mainly similar that of wool. Only merino fibres are quite finer than coarse wool. Its fineness is between 18,8-23,3 microns and the length is 2,54-10,00 cm to make high quality products (Harmancıoğlu,1974).

Merino sheep is grown mainly in Ankara, Afyon, Eskişehir, Balıkesir, Konya, Karaman, Kütahya, Bursa, Tekirdağ Niğde, Kayseri etc. cities in Turkey (TUİK).

Figure 7. Merino sheep

2.2.6. Got Hair

Got hair properties are similar to that of Ankara goat, but its fibres are smooth and thicker. Got hair is usually creamy, white, black, brown, grey in colour. It is cheapest, soft, the length of the fibre can be 4-10 cm, and its fineness varies between 7-200 microns (Harmancıoğlu, 1974).

Hair got is grown mainly in Mediterranean, Southern East Anatolia, East Anatolia regions etc. in Turkey (Harmancıoğlu, 1974) (TUİK).

Figure 8. Hair got

2.2.7. Silk

Silk is usually creamy white in colour; treated silk is soft, brilliant, unique filament fibres amoung natural fibre, its fineness varies between 1-

4 dtex. It absorbs 11 % moisture. Durability of silk decreases when it is wet. Sunlight damages silk. it is not elastic. Its thermal insulation is moderate. Electricity conduction is low (Başer, 1992).

Silkworm cocoon is grown mainly in Diyarbakır, Antalya, Bilecik, Ankara, Sakarya, Eskişehir, Bolu, Bursa, Hatay, Bursa, Bilecik, Balıkesir, Muğla, Aydın cities in Turkey (Günbulut, 2013).

Figure 9. Silk worm, silk cocoon

3. The Production, Export, and Import of Fibres grown in Turkey

3.1. Endemic Fibres

3.1.1. Mohair

The amount of mohair production, export, import in Turkey between 2009-2018 years are given in 'Table1' as numeral and in ' Graph 1' as graphically.

Table 1. The amount of mohair production, export, import in Turkey between 2009-2018.

Year	Mohair Production (kg)	Mohair Export (kg)	Mohair Import (kg)
2009	173.954	-	87
2010	199.743	107.636	-
2011	194.292	60.274	24.120
2012	199.507	-	-
2013	260.233	-	10
2014	280.211	23.373	-
2015	325.311	-	2.750
2016	339.642	-	-
2017	356.398	-	-
2018	370.867	-	-

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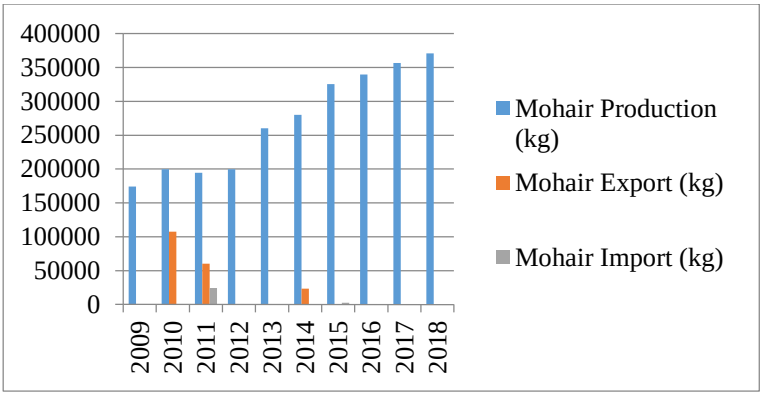

Graph 1. The amount of mohair production, export, import in Turkey between 2009-2018.

3.1.2. Angora Rabbit Hair (Angora)

The amount of Angora rabbit hair (angora) production, export, import in Turkey between 2009-2018 years are given in 'Table 2' as numeral and in ' Graph 2' as graphically.

Table 2 . The amount of Angora rabbit hair production, export, import in Turkey between 2009-2018.

Year	Angora Rabbit Hair Production (kg)	Angora Rabbit Hair Export (kg)	Angora Rabbit Hair Import (kg)
2009	-	-	89.569
2010	-	727	58.726
2011	-	-	69.603
2012	-	13.491	65.132
2013	-	33.527	61.890
2014	-	5.462	24.880
2015	-	-	7.911
2016	-	-	9.866
2017	-	-	4.880
2018	-	-	6.317

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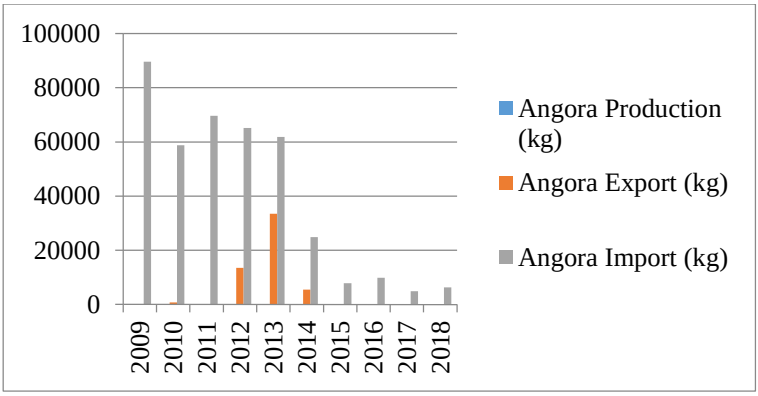

Graph 2. The amount of Angora rabbit hair (angora) production, export, import in Turkey between 2009-2018.

3.2.Non-endemic Fibres

3.2.1.Cotton

The amount of cotton production, export, import in Turkey between 2009-2018 years are given in 'Table 3' as numeral and in ' Graph 3' as graphically.

Table 3. The amount of cotton production, export, import in Turkey between 2009-2018.

Year	Cotton Unseed Production (kg)	Cotton Lint Production (kg)	Cotton Export (kg)	Cotton Import (kg)
2009	1.725.000.000	638.250.000	223.401.137	936.912.217
2010	2.150.000.000	816.705.000	210.623.955	1.158.664.688
2011	2.580.000.000	954.600.000	236.673.186	811.135.029
2012	2.320.000.000	858.400.000	266.856.834	780.515.909
2013	2.250.000.000	877.500.000	267.111.542	1.080.902.736
2014	2.350.000.000	846.000.000	268.339.949	1.136.617.294
2015	2.050.000.000	738.000.000	296.833.566	1.004.066.173
2016	2.100.000.000	756.000.000	296.833.566	1.004.066.173
2017	2.450.000.000	882.000.000	312.523.569	1.213.800.923
2018	2.570.000.000	976.600.000	380.232.412	1.000.124.434

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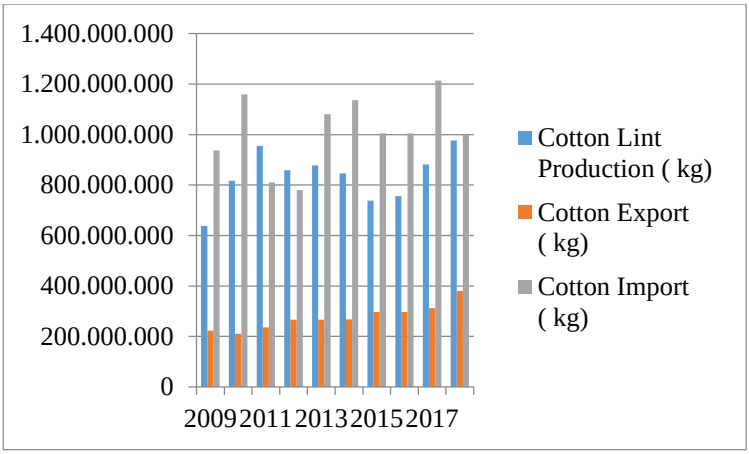


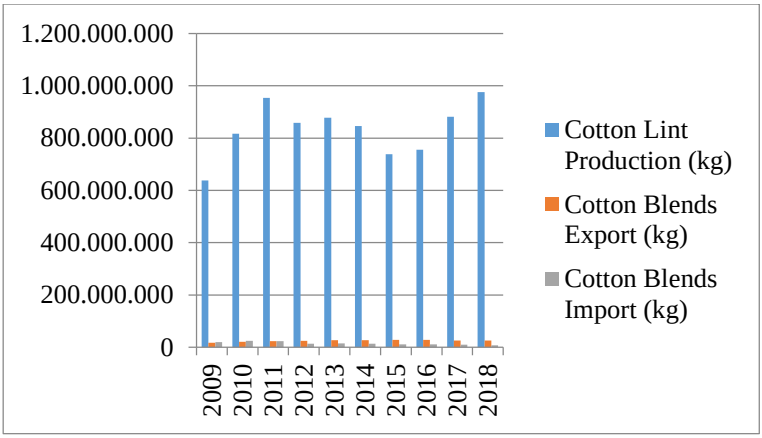
Graph 3. The amount of cotton production, export, import in Turkey between 2009-2018.

The amount of cotton blends production, export, import in Turkey between 2009-2018 years are given in 'Table 4' as numeral and in ' Graph 4' as graphically.

Table 4. The amount of cotton blends production, export, import in Turkey between 2009-2018.

Year	Cotton Unseed Production (kg)	Cotton Lint Production (kg)	Cotton Blends Export (kg)	Cotton Blends Import (kg)
2009	1.725.000.000	638.250.000	16.632.734	18.910.886
2010	2.150.000.000	816.705.000	20.034.908	24.846.153
2011	2.580.000.000	954.600.000	23.677.273	22.694.657
2012	2.320.000.000	858.400.000	24.726.003	12.737.052
2013	2.250.000.000	877.500.000	27.240.412	15.031.125
2014	2.350.000.000	846.000.000	27.347.847	13.649.369
2015	2.050.000.000	738.000.000	27.858.206	10.677.704
2016	2.100.000.000	756.000.000	27.858.206	10.677.704
2017	2.450.000.000	882.000.000	25.192.731	9.057.688
2018	2.570.000.000	976.600.000	25.275.989	7.300.445

www.tuik.gov.tr GTIP: 521011-521225



Graph 4. The amount of cotton blends production, export, import in Turkey between 2009-2018.

3.2.2.Linen

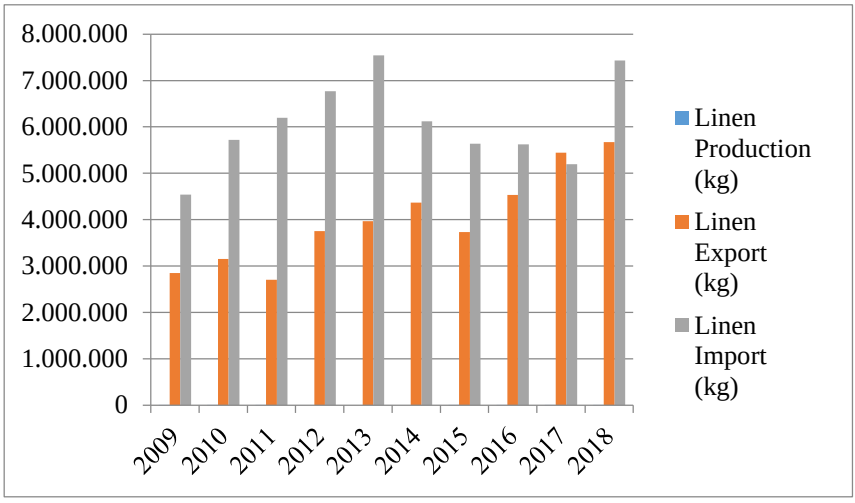
The amount of linen production, export, import in Turkey between 2009-2018 years are given in 'Table 5' as numeral and in ' Graph 5.1' as graphically: those of linen blends are given in 'Table 5' and 'Graph 5.2' below.

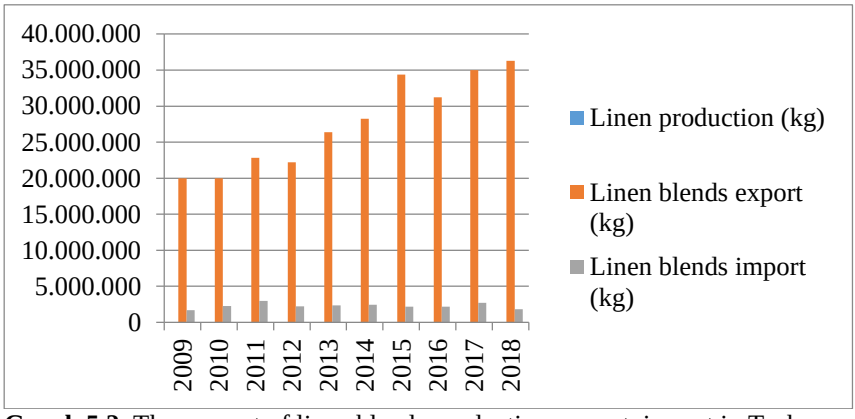
Table 5. The amount of linen, linen blends production, export, import in Turkey between 2009-2018.

Year	Linen Production (kg)	Linen Export (kg)	Linen Import (kg)	Linen Blends Export (kg)	Linen Blends Import (kg)
2009	1.000	2.851.599	4.538.156	19.983.052	1.669.465
2010	3.000	3.153.456	5.720.399	19.982.975	2.277.563
2011	4.000	2.703.208	6.193.665	22.819.396	2.960.396
2012	0.000	3.751.476	6.771.999	22.187.605	2.206.032
2013	0.000	3.966.751	7.539.013	26.368.182	2.349.218
2014	0.000	4.368.557	6.121.063	28.264.256	2.419.087
2015	1.000	3.730.291	5.638.287	34.362.552	2.178.749
2016	1.000	4.531.952	5.621.661	31.217.776	2.168.831
2017	2.000	5.443.174	5.195.714	34.982.366	2.686.878
2018	3.000	5.668.383	7.429.306	36.289.993	1.800.912

www.tuik.gov.tr GTIP linen: 530110-630299 GTIP linen blend: 580300-630419

Graph 5.1. The amount of linen production, export, import in Turkey between 2009-2018.





Graph 5.2. The amount of linen blends production, export, import in Turkey between 2009-2018.

3.2.3.Hemp

The amount of hemp production, export, import in Turkey between 2009-2018 years are given in 'Table 6' as numeral and in ' Graph 6' as graphically.

Table 6. The amount of hemp production, export, import in Turkey between 2009-2018.

Year	Hemp Production (kg)	Hemp Export (kg)	Hemp Import (kg)
2009	4000	11.051	335.708
2010	10.000	19.256	211.710
2011	16.000	22.678	309.290
2012	6.000	9.752	385.239
2013	1.000	6.635	697.288
2014	1.000	21.504	1.065.696
2015	1.000	20.158	415.371
2016	7.000	58.245	444.499
2017	7.000	107.560	474.084
2018	7.000	224.786	368.406

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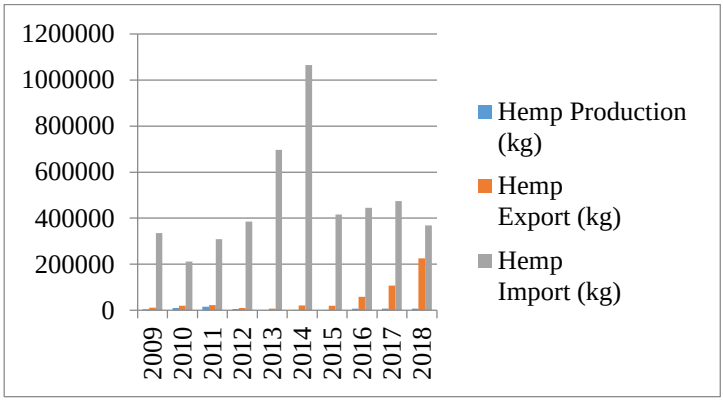


Graph 6. The amount of hemp production, export, import in Turkey between 2009-2018.

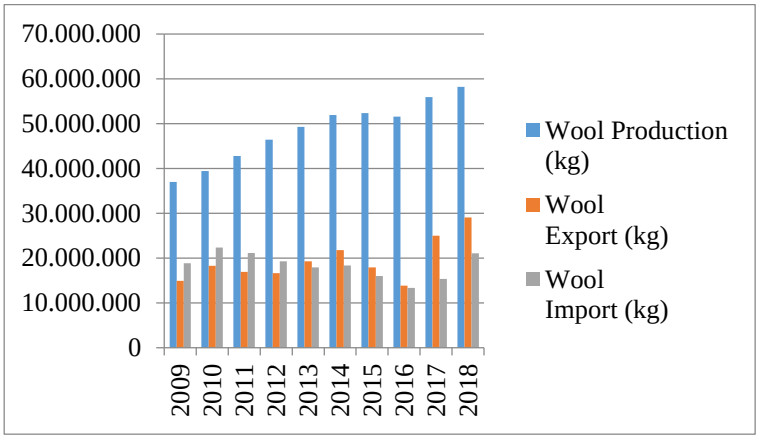
3.2.4.Wool

The amount of wool production, export, import in Turkey between 2009-2018 years are given in 'Table 7' as numeral and in ' Graph 7.1' as graphically; those of wool blends are given in 'Table 7' and 'Graph 7.2' below.

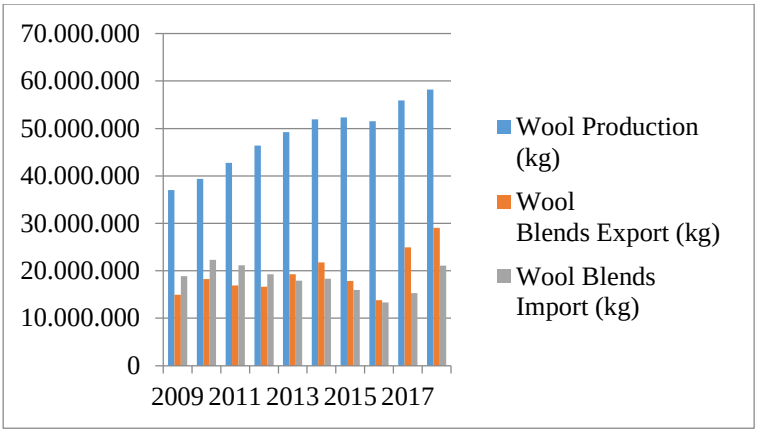
Table 7 . The amount of wool, wool blends production, export, import in Turkey between 2009-2018.

Year	Wool Production (kg)	Wool Export (kg)	Wool Import (kg)	Wool Blends Export (kg)	Wool Blends Import (kg)
2009	37.011.718	14.934.778	18.850.949	3.386.753	6.804.435
2010	39.390.431	18.248.556	22.308.800	3.423.338	8.877.045
2011	42.739.409	16.888.662	21.125.507	2.802.269	8.952.758
2012	46.392.031	16.640.819	19.274.141	2.817.605	8.116.375
2013	49.236.320	19.257.633	17.900.516	3.597.071	7.366.585
2014	51.898.859	21.784.112	18.321.506	2.384.634	5.356.385
2015	52.357.000	17.868.642	15.980.374	1.858.904	4.267.732
2016	51.522.975	13.828.306	13.320.060	2.207.842	3.391.000
2017	55.911.050	24.941.627	15.297.763	2.489.410	4.608.062
2018	58.201.512	29.036.527	21.057.241	2.024.322	4.099.033

www.tuik.gov.tr GTIP: 510130- 511219



Graph 7.1. The amount of wool production, export, import in Turkey between 2009-2018.



Graph 7.2. The amount of wool blends production, export, import in Turkey between 2009-2018.

3.2.5.Merino Wool

The amount of merino wool production, export, import in Turkey between 2009-2018 years are given in 'Table 8' as numeral and in ' Graph 8' as graphically.

Table 8 . The amount of merino wool production, export, import in Turkey between 2009-2018.

Year	Merino Production (kg)	Merino Export (kg)	Merino Import (kg)
2009	3.257.972	13.451	498.494
2010	3.432.325	-	444.876
2011	3.846.670	50.372	356.590
2012	4.787.565	17.336	136.018
2013	5.547.511	-	549.488
2014	6.503.439	-	854.175
2015	6.839.000	-	660.174
2016	6.644.788	169.550	834.609
2017	7.404.382	272.315	3.819.264
2018	8.226.024	99.642	2.669.277

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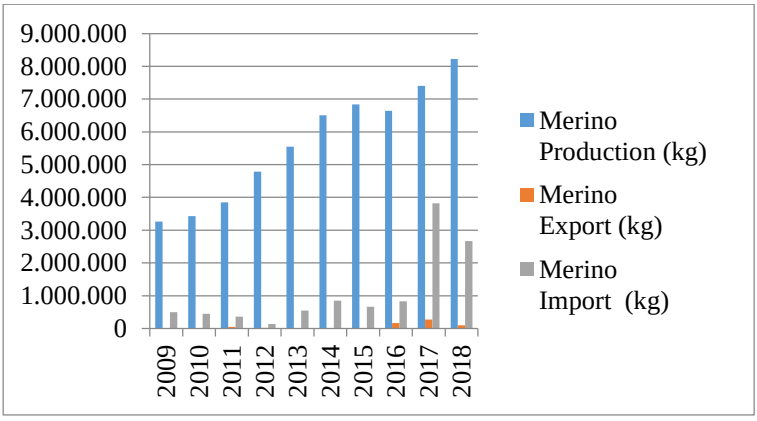

Graph 8. The amount of merino wool production, export, import in Turkey between 2009-2018.

3.2.6.Got Hair

The amount of got hair production, export, import in Turkey between 2009-2018 years are given in 'Table 9' as numeral and in ' Graph 9' as graphically.

Table 9 . The amount of got hair production, export, import in Turkey between 2009-2018.

Year	Got Hair Production (kg)	Got Hair Export (kg)	Got Hair Import (kg)
2009	2.002.474	593.346	12.804
2010	2.607.100	1.901.577	339.670
2011	3.062.048	2.227.978	262.720
2012	3.569.617	3.026.016	158.43
2013	4.901.707	2.825.558	98.469
2014	5.459.546	1.572.390	64.962
2015	5.568.602	1.935.994	297.116
2016	5.517.626	2.749.969	78.048
2017	5.796.511	2.358.615	57.535
2018	5.999.283	3.554.820	12.031

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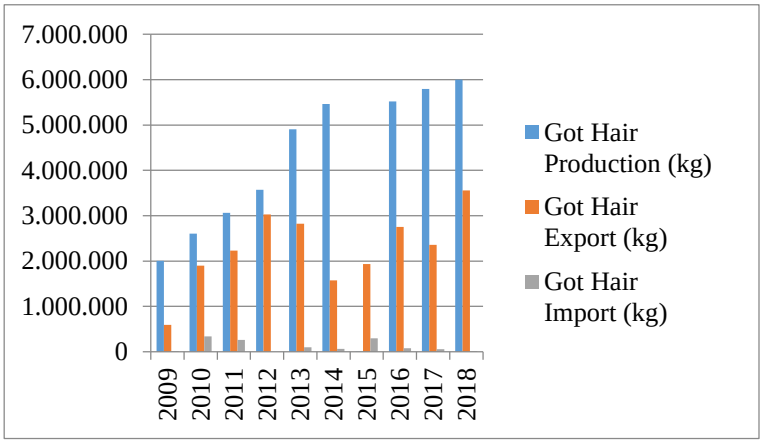


Graph 9. The amount of merino wool production, export, import in Turkey between 2009-2018.

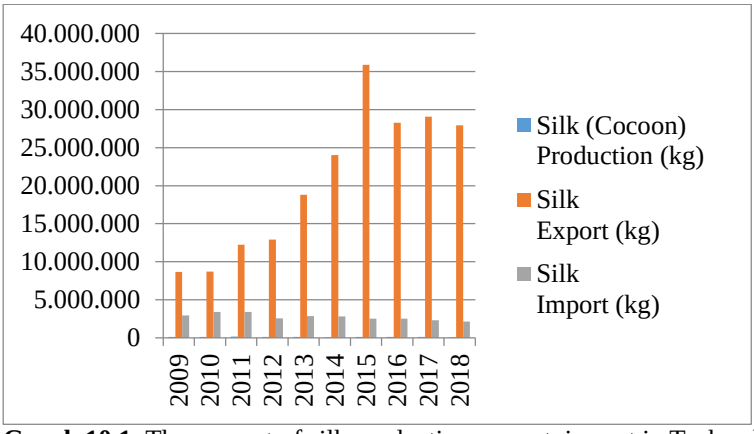
3.2.7.Silk

The amount of silk production, export, import in Turkey between 2009-2018 years are given in 'Table 10' as numeral and in ' Graph 10.1' as graphically; those of sik blends are given in 'Table 10' and 'Graph 10.2' below.

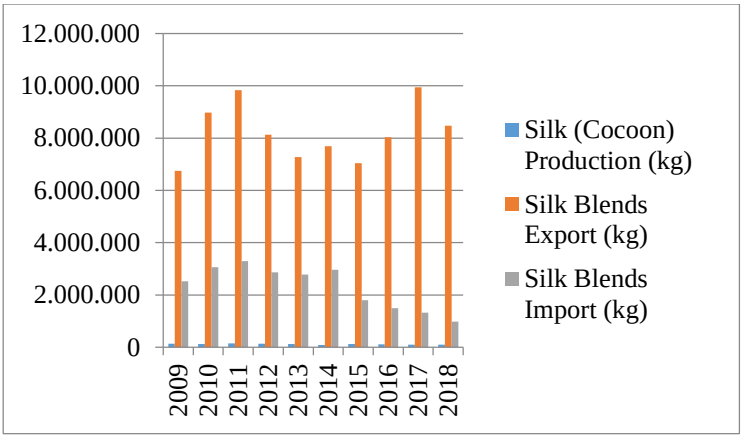
Table 10 . The amount of silk and silk blends production, export, import in Turkey between 2009-2018.

Year	Silk (Cocoon) Production (kg)	Silk Export (kg)	Silk Import (kg)	Silk Blends Export (kg)	Silk Blends Import (kg)
2009	136.461	8.648.339	2.918.375	6.748.871	2.516.749
2010	126.313	8.696.453	3.406.991	8.971.659	3.065.169
2011	150.647	12.245.854	3.405.493	9.839.016	3.297.545
2012	133.707	12.920.903	2.552.354	8.128.900	2.864.363
2013	121.479	18.792.397	2.862.524	7.272.501	2.772.916
2014	80.054	24.036.798	2.817.345	7.694.867	2.966.155
2015	114.785	35.896.240	2.530.522	7.037.198	1.802.974
2016	102.832	28.286.595	2.507.630	8.031.956	1.492.113
2017	101.821	29.081.736	2.320.503	9.948.211	1.315.007
2018	93.695	27.934.166	2.133.563	8.473.444	978.184

www.tuik.gov.tr GTIP : 500100-621510 GTIP blends: 511190- 580430



Graph 10.1. The amount of silk production, export, import in Turkey between 2009-2018.



Graph 10.2. The amount of silk blends production, export, import in Turkey between 2009-2018.

4. Conclusions

Natural textile fibres have been grown in Anatolia for thousands of years. Since the production of fibres varies according to the years and demands of textile production, it is outlined the production, export, import of textile fibres grown in Anatolia between 2009-2018 ten yearly period.

The production of Angora goat (mohair) and Angora rabbit fibres (angora), which are endemic textile fibres, have decreased considerably in our country and decreased to almost negligible levels recently as can be seen on production tables and graphs. Ankara-Turkey was the unique centre in the World in mohair production in the past century has ceased to have a say in the world today. Ankara rabbit fibres are imported even for domestic production. However, these endemic fibres have special importance both for the history and promotion of our country.

Non-endemic textile fibres are prefixed with 'cotton', is the most produced fibres in Anatolia and the most widely used fibres in the Anatolia. Although from domestic cotton production met for the whole of Turkey textiles demand in the 1980s, abolishment of quotas in recent years, less a reasonable cost level for their ability to provide imported cotton to meet the process was initiated. It is observed that, much more cotton was imported than produced cotton during the last 10 years. Cotton blends proportions were in a small ratio when it is compared to cotton lint. It is observed that linen is imported and exported to a great extent but linen domestic production does not supply this requirement. Hemp also was imported in a significant amount, similar that of linen, hemp domestic production does not supply its requirement.

Domestic production of merino wool which is grown in our country is at high level, but a significant proportion of wool is imported. It is thought that wool quality properties are distinctive factor to buy wool type. It is observed that there is got hair production in some degree. The sum of production and import of silk does not meet exports, it is thought to be a typo.

Textile fibres are the main sources of textile and are our natural riches. Textile industry components, Ministry of Agriculture, Ministry of Commerce, Ministry of Tourism and so on, should supply the necessary conditions for providing domestic production by textile fibres grown in Anatolia for thousands of years and should address these issues importantly.

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MECHATRONIC ENGINEERING

REVIEW FOR PATH PLANNING FOR ROBOTS AND ITS APPLICATION

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1. Introduction

Due to increased product and product diversity, productivity needs to be raised in order to protect competitiveness (Fang *et al.*, 2014). For this reason, the use of robots in automation is a suitable solution. In the 1930's, industrial robots were first made for painting the walls with spray paint. In the 1960s, the first industrial robots were used for transporting. Today, industrial robots are frequently used in many industrial sectors such as agriculture, underwater and food industry (Abu-Dakka *et al.*, 2013).

Increased use of robot arms have made path planning an important process. The path planning process affects the accuracy and stability of the robots. The main purpose of the path planning is to reach the desired point with the correct calculation (Švejda and Čechura, 2015). The path planning is divided into two types: Cartesian space planning and joint space planning. Design parameters play an important role for joint space planning and requires inverse kinematic analysis. Even though implementation of motion constraints are simple, it is difficult to understand the movements of the robot intuitively.

Cartesian space planning is visual and easy to perceive by people intuitively. Kinematic analysis is needed in order to plan path in Cartesian space (Gasparetto and Zanotto, 2010). Path planning in Cartesian space is more preferred in research because of its intuitive. Both two path planning types need a kinematic analysis, so it is necessary to understand the robot kinematic solution firstly.

The kinematic analysis of the robots is done in two parts: forward and inverse kinematics. The forward kinematic solution is developed to define the relationship between the first and last joints (Huang *et al.*, 2012). The forward kinematic provides a transition from joint space to Cartesian space. There are many solutions for forward kinematic, but the most

commonly used method is the Denativ-Hartenberg (D-H) method. D-H parameters are found and written as a table. Then the inverse kinematic solution is used to find the equations of the joint variables (Aghajarian and Kiani, 2011). The transition from Cartesian space to joint space is provided by inverse kinematic. In Figure 1, relationship between joint space and Cartesian space is illustrated (Küçük and Bingül, 2004).

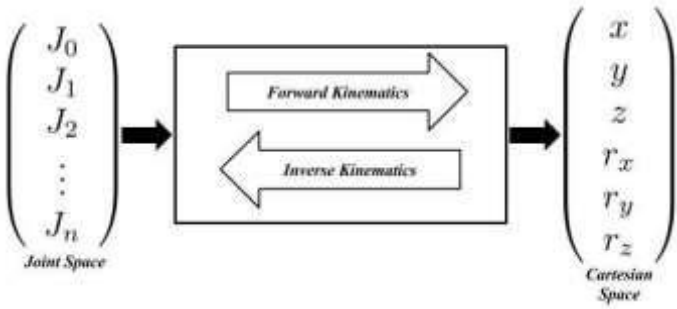

Figure 1. The schematic representation of forward and inverse kinematic (Küçük and Bingül, 2004)

Different algorithms are used in path planning research. In the literature, topics such as minimum energy, shortest path, obstacle detection and acceleration profile investigated. Cartesian space planning has been used more frequently in applications. Especially as the number of joints increased, the use of Cartesian space planning made the movements more understandable.

In this paper, a summary of trajectory planning is presented. Chapter 2 summarizes the kinematic analysis required for path planning. Chapter 3 discusses path planning and studies in the literature are mentioned. Finally, Section 4 presents the concluding remarks of this review.

2. Kinematic analysis of robots

The kinematic is a branch of science that examines the movement of an object. The forward kinematic examination of the robot arms provides solutions according to the determined design parameters. The design parameters of the robot arms directly affect the forward kinematic analysis. Inverse kinematic analysis allows to find joint variables depending on the forward kinematic solution. The inverse kinematic analysis consists of complex equations and solution is not always possible (Raza, Khan and Abbas, 2018).

2.1. The Forward Kinematic

A robot manipulator consists of serial links which are connected to each other as revolute or prismatic joints. Each joint location is defined to relative previous joint. If the coordinate system insert in each joint, the relationship between the two adjacent joints is represented by a ${}^{i-1}T_i$ which called transformation matrix. The relationship between the main frame and the tool frame is defined by multiplying the transformation matrices. This association is called forward kinematic and expresses the orientation and position of the tool frame relative to the base frame. The forward kinematics equations are given Cartesian space position using set of joint angles. The transformation matrix of a joint of the robot is obtained with the joint variables by using Equation 1.

$$ {}^{base}_{end-effector}T = \begin{bmatrix} c\theta_i & -s\theta_i & 0 & a_{i-1} \\ s\theta_i c\alpha_{i-1} & c\theta_i c\alpha_{i-1} & -s\alpha_{i-1} & -s\alpha_{i-1}d_i \\ s\theta_i s\alpha_{i-1} & c\theta_i s\alpha_{i-1} & c\alpha_{i-1} & c\alpha_{i-1}d_i \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad (1) $$

For the forward kinematic solution, joint variables should be determined, and the D-H method is usually used for this. D-H method uses four main variables. These variables are the bond length between two axes (a_{i-1}), the bond angle between axes (i-1) and i (α_{i-1}), the joint misalignment between overlapping bonds (d_i), and the joint angle between two bonds θ_i. In Figure 2, a robot which has three rotary joint (RRR) with inserting Cartesian coordinate systems according to the D-H method is shown. The D-H table consisting of D-H variables of the robot given in Figure 2 is given in Table 1 (Demir, 2019).

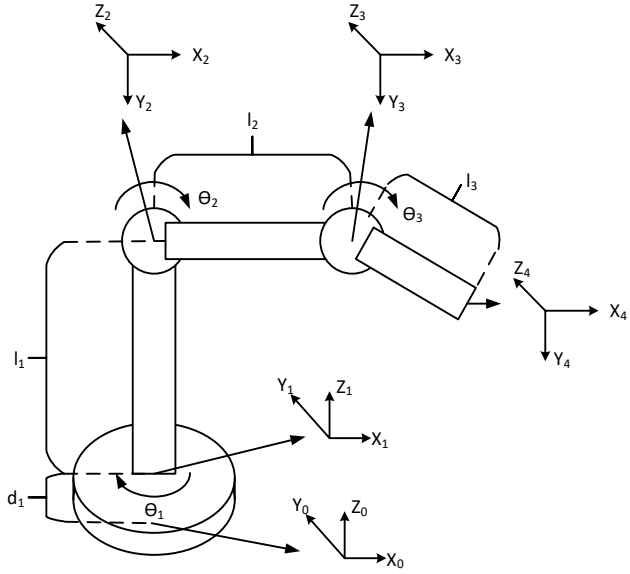

Figure 2. A RRR robot with inserting Cartesian coordinate system according to the D-H method (Demir, 2019)

For each line in the D-H table so a transformation matrix for each Cartesian coordinate system is written. By multiplying the transformation matrices of each joint, a general transformation matrix is obtained.

Table 1. D-H variables for the robot (Demir, 2019)

Number of axes	D-H variables				Joint variables
i	α_{i-1}	a_{i-1}	d_i	θ_i	d_i or θ_i
1	0	0	d_1	θ_1	θ_1
2	-90	0	l_1	θ_2	θ_2
3	0	l_2	0	θ_3	θ_3
4	0	l_3	0	0	0

$$ {}^{0}_{n}T = {}^{0}_{1}T\,{}^{1}_{2}T\,{}^{2}_{3}T\,{}^{3}_{4}T \ldots {}^{n-1}_{n}T = \begin{bmatrix} r_{11} & r_{12} & r_{13} & p_x \\ r_{21} & r_{22} & r_{23} & p_y \\ r_{31} & r_{32} & r_{33} & p_z \\ 0 & 0 & 0 & 1 \end{bmatrix} \qquad (2) $$

In the general transformation matrix there are 9 rotation ($r_{11,}$ $r_{12,}$ $r_{13,}$ $r_{21,}$ $r_{22,}$ $r_{23,}$ $r_{31,}$ $r_{32,}$ r_{33}) and 3 position (p_x, p_y, p_z) specifying elements.

The transformation matrices for each joint which obtained using D-H variables in Table 1 are given in Equation 3 (Demir, 2019).

$$
{}^{0}T_{1}=\begin{bmatrix} c_1 & -s_1 & 0 & 0 \\ s_1 & c_1 & 0 & 0 \\ 0 & 0 & 1 & d_1 \\ 0 & 0 & 0 & 1 \end{bmatrix},{}^{1}T_{2}=\begin{bmatrix} c_2 & -s_2 & 0 & 0 \\ 0 & 0 & 1 & l_1 \\ -s_2 & -c_2 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}
$$
$$
{}^{2}T_{3}=\begin{bmatrix} c_3 & -s_3 & 0 & l_2 \\ s_3 & c_3 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix},{}^{3}T_{4}=\begin{bmatrix} 1 & 0 & 0 & l_3 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad (3)
$$

While a robot arm can always have a forward kinematic solution, the inverse kinematic solution cannot always be found. The inverse kinematic equations are represented as a set of joint angles using the Cartesian space position.

2.2. The Inverse Kinematic

When the joint angles are given, finding the position and orientation of the end effector of a robot manipulator in Cartesian space is called a forward kinematic problem (Craig, 2004). There is always a solution for the forward kinematic problem which is very easy compared to the inverse kinematic problem. The inverse kinematic problem is defined as the existence of joint variables with the help of position and orientation data of the end effector given to the base frame in the Cartesian space (Wang and Chen, 1991). The characteristics of inverse kinematic problems are given below (Bingül and Küçük, 2009).

- It contains complex and nonlinear equations.
- As the number of rotational joints increases, the solution becomes increasingly difficult.
- The mathematical solution does not always happen physically.
- There are more than one solution to reach a point.

The inverse kinematic problem can be solved completely either analytically or solved using numerical methods where analytical solution is not possible. Due to the slower performance of numerical analysis than analytical solutions, robot designers usually focus on designs where analytical solution is possible. Today, industrial robots are often produced with simple structures that can be solved analytically (Bingül and Küçük, 2009).

By using analytical solution approach, the joint transformation inverse is passed to the other side of the equation, in order to find the joint variables as in Equation 3. In Equation 4, both sides of the equation are multiplied by $[{}^{0}_{1}T]^{-1}$.

$$
\begin{aligned}
{}^{0}_{n}T\left[{}^{0}_{1}T\right]^{-1} &= \left[{}^{0}_{1}T\right]^{-1}\,{}^{0}_{1}T\,{}^{1}_{2}T\,{}^{2}_{3}T.....{}^{n-1}_{n}T \\
{}^{0}_{n}T\left[{}^{0}_{1}T\right]^{-1} &= {}^{1}_{2}T\,{}^{2}_{3}T.....{}^{n-1}_{n}T
\end{aligned}
\tag{4}
$$

The forward kinematic matrices of the robot given in Figure 2 were found in Equation 3. The inverse kinematic equations of the robot given in Figure 2 using these equations were given by (Demir, 2019),

$$
\begin{aligned}
{}^{0}_{4}T\left[{}^{0}_{1}T\right]^{-1} &= \left[{}^{0}_{1}T\right]^{-1}\,{}^{0}_{1}T\,{}^{1}_{2}T\,{}^{2}_{3}T\,{}^{3}_{4}T \\
{}^{0}_{4}T\left[{}^{0}_{1}T\right]^{-1} &= {}^{1}_{2}T\,{}^{2}_{3}T\,{}^{3}_{4}T
\end{aligned}
\tag{5}
$$

When the operation on the left side of the equation is performed:

$$
{}^{0}_{4}T\left[{}^{0}_{1}T\right]^{-1} = \begin{bmatrix} r_{11} & r_{12} & r_{13} & p_x \\ r_{21} & r_{22} & r_{23} & p_y \\ r_{31} & r_{32} & r_{33} & p_z \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} c_1 & s_1 & 0 & 0 \\ -s_1 & c_1 & 0 & 0 \\ 0 & 0 & 1 & -d_1 \\ 0 & 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} . & . & . & c_1 * p_x + s_1 * p_y \\ . & . & . & -s_1 * p_x + c_1 * p_y \\ . & . & . & p_z - 1 \\ . & . & . & 1 \end{bmatrix} \tag{6}
$$

When the operation on the right side of the equation is performed:

$$
{}^{1}_{2}T\,{}^{2}_{3}T\,{}^{3}_{4}T = \begin{bmatrix} . & . & . & l_2 * c_{23} + l_2 * c_2 \\ . & . & . & l_1 \\ . & . & . & -l_3 * s_{23} - l_2 * s_2 \\ . & . & . & 1 \end{bmatrix} \tag{7}
$$

Where c_{23} is $c_2 * c_3 - s_2 * s_3$ and s_{23} is $s_2 * c_3 + s_3 * c_2$.

Equation 8 is obtained as follows:

$$
\begin{gathered}
{}^{0}_{4}T\left[{}^{0}_{1}T\right]^{-1} = {}^{1}_{2}T\,{}^{2}_{3}T\,{}^{3}_{4}T \\
\begin{bmatrix} . & . & . & c_1 * p_x + s_1 * p_y \\ . & . & . & -s_1 * p_x + c_1 * p_y \\ . & . & . & p_z - 1 \\ . & . & . & 1 \end{bmatrix} = \begin{bmatrix} . & . & . & l_2 * c_{23} + l_2 * c_2 \\ . & . & . & l_1 \\ . & . & . & -l_3 * s_{23} - l_2 * s_2 \\ . & . & . & 1 \end{bmatrix}
\end{gathered}
\tag{8}
$$

Equations 9, 10 and 11 are obtained if the matrix elements are equalized in Equation 8.

$$c_1 * p_x + s_1 * p_y = l_2 * c_{23} + l_2 * c_2 \quad (9)$$

$$-s_1 * p_x + c_1 * p_y = l_1 \quad (10)$$

$$p_z - 1 = -l_3 * s_{23} - l_2 * s_2 \quad (11)$$

The following trigonometric equations which is used an inverse kinematic solution is given in Equations 14, 16, 17 (Demir, 2019).

$$\cos(\theta) = a \Rightarrow \theta = A\tan 2(\mp\sqrt{1-a^2}, a) \quad (12)$$

$$a\sin(\theta) + b\cos(\theta) = c \Rightarrow \theta = A\tan 2(a,b) + A\tan 2(\mp\sqrt{a^2+b^2-c^2}, c) \quad (13)$$

If Equation 10 is similar to Equation 13, θ_1 which is first joint variable is obtained.

$$\theta_1 = A\tan 2(-p_x, p_y) + A\tan 2(\mp\sqrt{p_x^2 + p_y^2 - l_1^2}, l_1) \quad (14)$$

If we take the squares of Equations 9, 10 and 11 together and make the necessary simplifications, Equation 15 is obtained.

$$(p_x^2 + p_y^2)(s_1^2 + c_1^2) + (p_z - d_1)^2 = l_3^2(c_{23}^2 + s_{23}^2) + l_2^2(c_2^2 + s_2^2) + 2l_3l_2(c_2c_{23} + s_2s_{23})$$

$$\cos(\theta_3) = \frac{p_x^2 + p_y^2 + (p_z - d_1)^2 - l_3^2 - l_2^2}{2l_3l_2} \quad (15)$$

Using Equation 12, Equation 15 is solved and Equation 16 is obtained. And θ_3 is third joint variable.

$$\theta_3 = A\tan 2(\mp\sqrt{1-\left(\frac{p_x^2 + p_y^2 + (p_z - d_1)^2 - l_3^2 - l_2^2}{2l_3l_2}\right)^2}, \frac{p_x^2 + p_y^2 + (p_z - d_1)^2 - l_3^2 - l_2^2}{2l_3l_2}) \quad (16)$$

When Equation 16 is solved, the second joint variable is found.

$$\theta_2 = A\tan 2(-l_3\cos(\theta_3) - l_2, -l_3\sin(\theta_3)) \mp A\tan 2(\sqrt{l_3^2 + l_2^2 + 2l_3l_2\cos(\theta_3) - (p_z - d_1)^2}, p_z - d_1) \quad (17)$$

After finding the joint variables, it appears that there are eight solution clusters. One or more than one of the solution clusters may be true or none of them may be true. To test the correctness of solution sets, joint variables can be substituted in the forward kinematic position vector. The forward kinematics position vector gives in Equation 18 (Demir, 2019).

$$\begin{bmatrix} p_x \\ p_y \\ p_z \end{bmatrix} = \begin{bmatrix} l_3\,c_{23}\,c_1 + l_2\,c_2\,c_1 - l_1s_1 \\ l_3\,c_{23}\,s_1 + l_2\,c_2\,s_1 - l_1c_1 \\ -l_3s_{23} - l_2s_2 + d_1 \end{bmatrix} \quad (18)$$

The inverse kinematic solution of a robot determines its position in Cartesian space. The path planning requires an inverse kinematic solution consisting of nonlinear equations. In the light of this information, the subject of path planning can be understood.

3. Path planning

The path planning is done in two different spaces: the Cartesian space and joint space. In both methods, the start and end points are combined with intermediate points. In the Cartesian space method, the robot's X, Y, Z position is found by using the inverse kinematic model described in the previous section. In the joint space, high-grade polynomials of each insert are used with the inverse kinematic.

3.1. Cartesian Space Planning

In Cartesian space planning, robot end-effector follows a linear path. However, when the end-effector passes through intermediate points, it cannot move linearly. Therefore parabolic parts are added to the start and end of the movement and the continuity of the position and speed is ensured. It is desirable that the added parabolic sections are symmetrical. Therefore, the realization times of the parabolic sections are the same and their accelerations are constant and the velocity in the linear section must be constant to achieve continuity in speed.

Kai Wu, Carsten Krewet, Bernd Kuhlenkötter presented a study called and focused the corner path in the Cartesian space. The CNC's control system was approached for a robot motion. The corner path in the CNC program was describe and the parameters in the corner path are shown Figure 3. a is the distance of start to corner. b is the distance of end to corner. e is deflection of corner. Both of a and b can be changed according to program (Wu *et al.*, 2016).

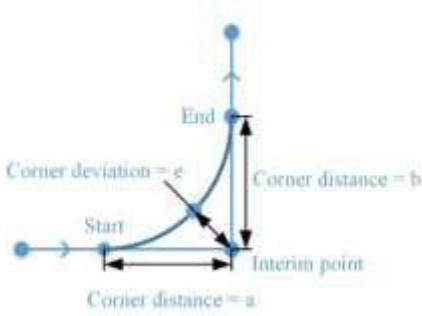

Figure 3. The corner path (Wu *et al.*, 2016)

The conventional robot controller compared with CNC controller. It has been found that the conventional robot controller algorithm moves faster but CNC algorithm runs more stable in the corners of the Cartesian space planning. While the industrial robot arms are used in machining operations, CNC control algorithm is preferred but it should be developed and used in the conventional robot control algorithms (Wu *et al.*, 2016).

In 2016, Xing Jin, Junfeng Kang, Jingjing Zhang and Xiang Yang performed a study called Trajectory Planning of a Six-DOF Robot Based on a Hybrid Optimization Algorithm. The ant colony algorithm, particle swarm optimization PSO and Genetic Algorithm GA was used for trajectory planning. A hybrid algorithm which was a combination PSO, the ant colony algorithm and GA was used. The PUMA 560 spot welding robot was used to create trajectory planning in the shortest path in Cartesian space for experimental study (Jin *et al.*, 2016).

The trajectory planning which existed crosses for optimal path with the ant colony algorithm remarked better solution. But the hybrid algorithm which is shown in Figure 4 is better than the ant colony algorithm (Jin *et al.*, 2016).

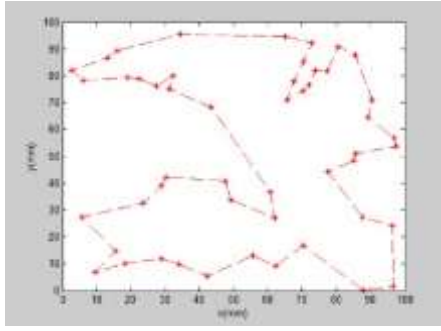

Figure 4. Trajectory planning for the hybrid algorithm (Jin et al., 2016)

To prevent from occasionality, both of algorithms are executed 1000 times each. The global best values obtained for 1000 times. The global best mean value of the hybrid algorithm was littler than that of the ant colony algorithm. This means that the hybrid algorithm's performance was better than the ant colony algorithm's performance (Jin *et al.*, 2016).

As a result, the initial solution was rapid and the optimal solution quality of the hybrid algorithm were better than the standard ant colony algorithm's. So, this study has proved the efficiency of the hybrid algorithm (Jin *et al.*, 2016).

Trajectory and velocity planning of the robot made for sphere-pipe intersection hole cutting with single-Y welding and cutting groove. Figure 5 shows the single-Y welding groove cutting process of a robot with 6 degrees of freedom. In order to increase the welding quality, trajectory and velocity planning method for robot in Cartesian space was done in the spherical single Y- groove welding process. Different path algorithms were used as a result of simulation studies. The processing time of the algorithms was measured and the shortest processing time was found (Liu, Liu and Tian, 2019).

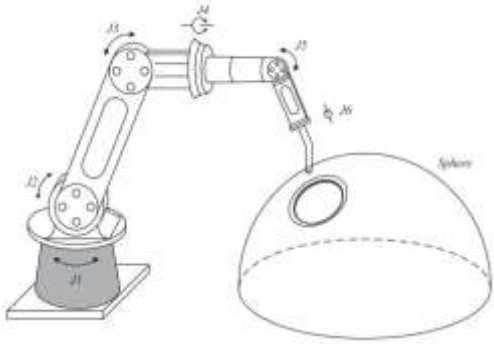

Figure 5. A 6 DOF robot for Y-groove cutting (Liu, Liu and Tian, 2019)

Planning in the Cartesian space is intuitive. The movements of the robot in 3D space are understandable. On the other hand, the joint space planning is a method used in the path planning.

3.2. Joint Space Planning

High-grade polynomials are used for planning in the joint space. The movement of the robot is circular. The initial and target positions of the end effector are found by applying inverse kinematics in joint space planning. If the end effectors velocities at the start and end is assumed to be zero, then the conditions necessary to create a third order polynomial which is shown in Equation 20 are obtained. The initial conditions are given in Equation 19 (Zhang *et al.*, 2018).

$$\begin{aligned}\theta(0) &= \theta_0 \\ \theta(t_f) &= \theta_f \\ \dot{\theta}(0) &= 0 \\ \dot{\theta}(t_f) &= 0\end{aligned} \tag{19}$$

$$\theta(t) = s_0 + s_1 t + s_2 t^2 + s_3 t^3 \tag{20}$$

The joint velocities and accelerations are obtained with taking the first and second derivatives of the path polynomial. And they are shown in Equation 21 and 22.

$$\dot{\theta}(t) = s_1 + 2s_2 t + 3s_3 t^2 \tag{21}$$

$$\ddot{\theta}(t) = 2s_2 + 6s_3 t \tag{22}$$

The initial conditions are replaced by position, velocity, and acceleration polynomials to determine the coefficients of the path polynomial. The equations for the coefficients of the path polynomial are given below.

$$s_0 = \theta_0 \tag{23}$$

$$s_1 = 0 \tag{24}$$

$$s_2 = \frac{3}{t_f^2}(\theta_f - \theta_0) \tag{25}$$

$$s_3 = -\frac{2}{t_f^3}(\theta_f - \theta_0) \tag{26}$$

The robot's path planning which is shown in Figure 2 are obtained using the Matlab package. The joint angles were found required to move the robot to the desired point in the Cartesian space with the inverse kinematic analysis. As an example, a movement has been performed and position graphics are given in the joint space. The start and target positions are given with joint variables in Table 2 (Demir, 2019).

Table 2. The start and target position and joint variables(Demir, 2019)

Position	X (cm)	Y (cm)	Z (cm)	θ_1 (deg)	θ_2 (deg)	θ_3 (deg)
I	6	9	7	34.6066	-30.1607	47.8226
II	6	9	10	34.6066	-30.5239	13.7391

The path equation for the motion of the first joint is given in Equation 27 (Demir, 2019).

$$\theta(t) = 34.6066 + 0t + 0t^2 + 0t^3 \quad (27)$$

The path polynomial of the second joint is given in Equation 28 (Demir, 2019).

$$\theta(t) = -30.1607 + 0t - 0.2724t^2 + 0.0908t^3 \quad (28)$$

Finally, the path polynomial of the third joint is given in Equation 29 (Demir, 2019).

$$\theta(t) = 47.8226 + 0t - 25.5701t^2 + 8.5234t^3 \quad (29)$$

After finding the polynomial of each joint position, velocity and acceleration polynomials can be obtained from positional derivatives. In the numerical analysis, when the movement of the robot is considered to be performed for 2 seconds, the position graphs in the joint space of each joint are given in Figure 6 (Demir, 2019).

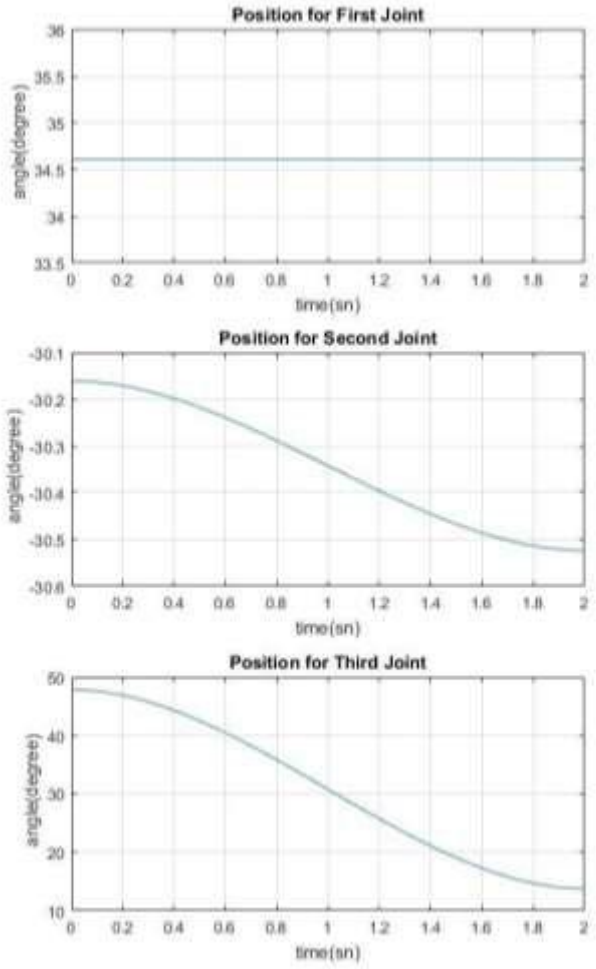

Figure 6. Joints position of the joint space (Demir, 2019)

In the study conducted about the path planning of humanoid robots, research was performed in the space of the task and in the joint space. In both methods, accuracy errors occur in the path planning. Lloyd's algorithm was used independently of time. The path planning in the joint space without dynamic time warping is done and is arranged with the Hidden Markov Model (HMM). As a result of the simulations and tests, modified HMM gave better results in the path planning with the Lyod algorithm in the joint space (Garrido, Yu and Li, 2016).

In 2018, Guantao Xuan and Yuanyuan Shao used new methods instead of traditional orbital planning approaches. Analyses were performed on the path obtained by using reverse driving method. As a result, a continuous

and smooth profile was obtained in angular displacement, angular velocity, angular acceleration for each joint (Xuan and Shao, 2018).

In 2019, a study was done for optimal path planning for a spherical robot. The path planning of the joint space was performed using the polynomial method of a robot arm with three degrees of freedom. Path planning has been optimized using genetic algorithm. The path has the minimum processing time and the minimum joint traveling distance which are shown in Figure 7. Optimal path coefficients were found as a result of optimization (Haiek *et al.*, 2019).

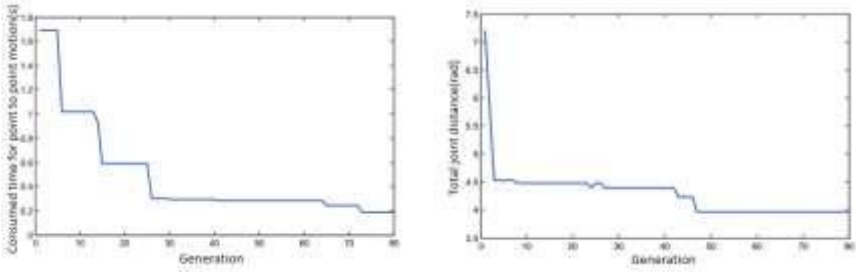

Figure 7. Consumed time for motion and total joint distance(Haiek *et al.*, 2019)

4. Conclusion

The rapid advances in technological development continuously increases industrial robot arms requirements. In this study, path planning, which is an important part of industrial robots is discussed. Firstly, kinematic analysis has been mentioned in order to carry out path planning. The path planning consists of two main methods: Cartesian space planning and joint space planning. In both methods, some parameters such as processing time, accuracy, stability, velocity and shortest distance have been improved. In the literature, there are more studies on planning in the Cartesian space, since the Cartesian space planning is intuitive. However, some studies have shown better results using the joint space approach. The studies on the path planning have enabled the industrial robot arms to move faster, more accurately and in the shortest time in the desired path.

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PHOTOVOLTAIC SYSTEMS: A REVIEW

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1. Introduction

Today, there are many government incentives to generate of renewable energies. The renewable energy is an alternative to fossil fuels. Estimated that fossil fuels will soon be exhausted. For this reason, a large part of energy needs must be met from other sources of energy. One of the most important sources of alternative energy sources is solar energy. Photovoltaic (PV) panels convert incident photons coming from light source into electric current. Thus, PV panels generate electricity by using solar energy. Recently, there has been an increased interes to the PV systems owing to having a lot of advantage like:available energy source to all over the world, does not pollute the environment, no sound when generating electricity, easy to install and modular structure, reliable energy conversion and usage of the building (Mellit,Tina and Kalogirou, 2018).

It is known that solar energy has been used since ancient times. For the first time, Socrates (BC 400) stated that the south side of the houses should have more windows to benefit the sunshine. Archimedes (BC 250) burned the ships in Sirakuza by focused solar radiation with concave mirrors. In 1725, Belidor developed a solar water-powered water pump. During the First World War, petroleum gained importance, so the work towards solar energy has diminished. At the beginning of the 1960s, solar energy was understood as an alternative energy source in our country and studies have started (Yerebakan, 2010). PV was successful in its early missions of powering the space satellites (Jazayeri, 2012). According to the International Energy Agency, global use of PV has been increasing since the 2000s with 40% growth rate per year. Also it is states that, around 11% of global electricity generations will provided by PV Plants until 2050 and it is corresponding to 4500 TWh per year (IEA, 2010). With all these developments and expectations, an efficient real time monitoring and fault detection strategy is very important, to detect faults in solar energy generation plants so there are a lot of study about it in the literatüre .According to R. Hariharan, M. Chakkarapani, G. Saravana Ilango

monitoring of the PV plants could be categorized into 2 groups: model-based methods and history-based methods. The model-based method includes comparison of real time data and simulations. In the other, data is collected first and then machine learning and computational intelligent procedures are used to fault detection on PV plants(Harrou, Sun and Saidi, 2017). In the study by Kian Jazayeri, by the means of artificial neural network technology, realized the intelligent fault detection system to detect shadows, damaged panels or cells, etc. based on the generate electric power by estimating the output power with according to the sun's position in the sky (Jazayeri, 2012). In the study by P. Jenithaa and A. Immanuel Selvakumar is thought to only fault current source is PV array because there is no utility inverter to produce overcurrent or overvoltage. Due to the no back feed current into PV array faults from utility grid, this consideration could be appropriate (Jenitha and Immanuel Selvakumar, 2017). In the study by Radu Platon, Jacques Martel, Norris Woodruff, and Tak Y. Chau the fault detection is realized that principle of the comparison from the ac power production between the measured and model prediction (Platon et al., 2015). In the study by Moath Alsafasfeh, Ikhlas Abdel-Qader, Bradley Bazuin, Qais Alsafasfeh and Wencong Su, is propose a quick fault detection in the PV panel with used thermal and CCD video camera mounted on drones (Alsafasfeh et al., 2018). In the study by Mohammed Tadj, Khalil Benmouiza, Ali Cheknane, Santiago Silvestre is propose a method to detect the occurrence of short-circuit failures in PV systems which is used fuzzy logic based approach (Tadj et al., 2014). In the another study by Elyes Garoudja, Fouzi Harrou, Ying Sun , Kamel Kara, Aissa Chouder, Santiago Silvestre is presented an innovative method that can be detected faults on the DC side of PV panel according to the shading of PV modules. This method detect incipient changes in a PV system (Garoudja et al., 2017). In the another study by Harun and Murat is the Estimation of the photovoltaic cell productivity. Artificial Neural Network tecnics is used for it due to the accurately estimates the productivity value of the PV cell as a percentage (Özkişi and Topaloğlu, 2017). In another study by Akif KARAFIL, Harun OZBAY, Metin KESLER the temperature of the panel affects the efficiency of the panel. When there are the high solar radiation and low temperature, high efficiency is obtained from the panel(Karanfil, Ozbay and Kesler, 2016). In another study by Tarak Salmi, Mounir Bouzguenda, Adel Gastli, Ahmed Masmoudi is developed a PV panel simulation and experiment which at different physical and environmental conditions. Short circuit current, maximum power and open circuit voltage data from simulations and experiments shows a good agreement (Salmi et al., 2012). In the

another study by Irwantoet al. cooling system is used to increase PV panel efficiency, thus efficiency of the PV panel increased from 10.3% to 14% (Irwanto et al., 2014). In the thesis study by Ye Zhao is realized fault analysis in solar photovoltaic arrays. It is mention about night-to-day" transition fault because in the night there is no solar irradiance but during the sunrise according to the solar irradiance PV panel voltage increases. At that time, the inverter starts minimum voltage and MPPT start to work. Then the PV system provide to max. power to utility grid This situation is leads to PV panel faults (Zhao,2010). In another study by Hariharanet al., is investigated to detect PV array faults and partial shading in PV systems. This study is about eficiancy of the PV panel under different irradiation conditions (Hariharan et al., 2016). In another study by Mohammed et al., presents a new method to detect the faults in the PV systems. It utilizes to satellite image for getting solar radiation data and calculating the generated power for detecting the failures (Tadj et al., 2014).

In this paper, a rewiev of pv panel system is presented. Chapter 1 is mentioned about pv studies in the literature. Chapter 2 is related to the solar cell materials and solar panel systems. Chapter 3 is related to the electrical behaviors of solar cells. Chapter 4 is related to the typical solar panel faults**.** Finally, last section presents the concluding remarks of this review.

2.1.Solar Cell Materials

In the solar cells there are a lot of different semiconductor materials. Depend on the used materials in the cells, the efficiency and cost of it increase or decrease. Today, monocrystalline silicon, polycrystalline silicon, amorphous silicon, Cadmium telluride and copper indium selenide/sulfide are generally used materials for solar cells. A large amount of available solar cells are made from bulk materials. Their size about 180-240 mm. Their processing is similar to the other semiconductor materials. Thin film layers, organic dyes and organic polymers materials are also available (Jazayeri, 2012).

2.11. Crystalline Silicon

Crystalline silicon is the most popular material used in solar cells. It has two important materials which are Silicon Wafers and Silicon Ribbons. The average energy conversion efficiency is about 12%-18 but recorded efficiency for some laboratory is about 24.7% (Solanki,2008). It has high production costs but it has reliability and stability operation under environmental factors. According to crystallinity and crystal size, this material could be divided into categories like Monocrystalline Silicon (C-

si), Polycrystalline Silicon or Multycrystalline Silicon (Poly –Si or mc-Si) Ribbon Silicon Mono-like-multi-silicon (Jazayeri, 2012).

2.1.2Thin Film Solar Cells

Thin film solar cells are heavier than crystalline cells and have lower efficiency. When the compared to crystalline silicon cells, it has needs a larger area per watt production. Cadmium Telluride (CdTe), Copper Indium Gallium Selenide (CIGS) and Amorphous Silicon (A-Si) generally used for outdoor solar power generation (Jazayeri, 2012).

2.1.3. Other Solar Cell Technologies

Different type of solar cells are available in market which are organic cells, dye-sensitized cells and light-concentration based GaAs cells. They have generally higher efficiencies and lower costs (Jazayeri, 2012). In the figure 1 is illustrated comparison PV modules according to different materials in PV and generation of electric inside a different sized area.

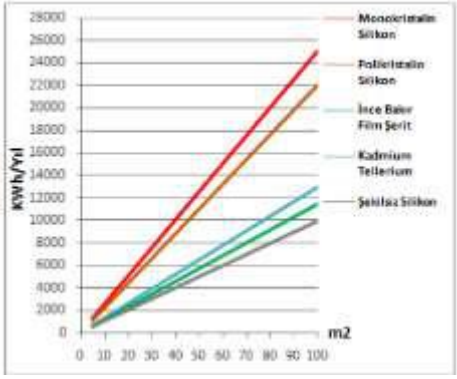


Figure 1. PV Type-Field-Generated Energy (www.yegm.gov.tr/)

2.2.Systems of solar panels

Nowadays, many applications are realized with photovoltaic (PV) modules in different areas such as buildings, aviation, solar power plants, land and sea transportations, etc (Coşgun, 2017). Individual solar cells are used in calculators to provide power (Zhao, 2010). The PV module can be used vertically and horizontally to generate electricity. PV system use solar cell to produce electricity depends primarily on the type and composition of the module, natural factor and also combined effect of the installation (Zsiborács et al., 2018). Solar energy is eco-friendly, renewable, clean and

there are no costs (Alsafasfeh et al., 2018). Solar photovoltaic system is one of renewable energy system which uses PV modules to convert sunlight into electricity. In the PV plants are used PV array to generate power to the utility grid (Zhao, 2010). Solar energy on the PV panel is converted to electrical energy with 6%-20% efficiency depending on the semi-conductor material used in the PV panel. There have been many factors leading to low panel efficiency such as panel tilt angle, shading, dust, solar radiation level, temperature and the other losses (Harrou et al., Jenitha et al., 2017). Among these factors, solar radiation level and the temperature have been more prominent. When the absorbs solar radiation from by PV modules, temperature of the modules increases, this situation leads to a decrease in productivity. When the temperature of PV modules increases efficiency of the PV module decreases about ~0.5%/°C and ~0.05%/°C (Irwanto, 2014). Arrays consist of modules and modules consist of cells such as illustrated in the figure 2. When the array is connected as series, thus generate an additive voltage. A PV module has a non-linear current vs. voltage (I-V) curve, as shown in Fig. 3. Short-circuit current (Isc), open-circuit voltage (Voc) and maximum power point (MPP) are three important points for the I-V curve. It provides the the max. possible voltage, max. possible current, and max. possible power and it is related to the under a specific environmental condition (Zhao, 2010).

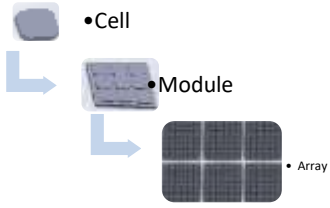


Figure 2. Illustrations of cell, module and array

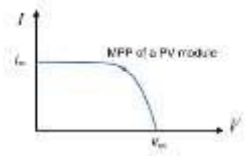


Figure 3. Illustrations of I-V curve of a PV module (Zhao,2010).

PV modules could be mounted in series and/or parallel to build a PV array. All of the PV module has an open-circuit voltage (Voc) and short-circuit current (Isc). Depends on the connecting situation of modules, could

be taken higher open-circuit voltage value and larger short-circuit current value. In Fig. 4. , connecting m modules in series will yield a PV string with a higher open-circuit voltage (m×Voc).

Figure 4. I-V curve of a PV string with m modules in series (Zhao,2010)

In Fig.5, putting n strings in parallel will create a PV array with a larger short-circuit current (n×Isc).

Figure 5. I-V curve of a PV string with n modules in parallel (Zhao,2010)

To get more power from PV array, could be used topological methods shown in figure and in figure . If an array has m and n identical modules, it could be named as “n x m” PV modules. Thus, PV array generates higher power like that short-circuit current n × Isc and an open-circuit voltage m × Voc (shown in Fig 6).

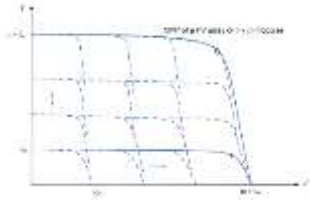


Figure 6. I-V curve of a PV array with comb. series and parallel (Zhao,2010)

3.The Electrical Behaviors of Solar Cells

The I-V characteristic of the solar cells is not linear. Therefore, their simply model is not appropriate as a constant current source or a constant voltage source. In the literature two different type model are used to describe the electrical behaviors of solar cells (Quaschning and Hanitsch, 1995),(Gow and Manning, 1999). The equivalent circuits for the one-diode model and the double-diode model are shown in Fig. 7(a) and Fig. 7 (b).

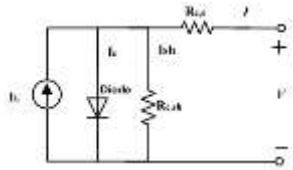


Figure 7(a) Equivalent circuits for the one-diode model

For the one-diode model in Fig. 7(a), the solar cell current equation is

$$I = I_L - I_S\left[\exp\left(\frac{V + IR_{c,s}}{AkT}\cdot q\right) - 1\right] - \frac{V + IR_{c,s}}{R_{c,sh}}$$

where

I = solar cell current (A)

V = solar cell voltage (V)

IL = light-generated current (A)

ID = diode current (A)

Ish = shunt resistance current (A)

IS = saturation current of the diode (A)

Rc,s= solar cell series resistance (ohms)

Rc,sh= solar cell shunt resistance (ohms)

q= electron charge = 1.6×10-19 C

k= Boltzmann's constant = 1.38×10-23 J/K

A= diode ideal factor (1≤ A ≤ 2)

T= ambient temperature (K)

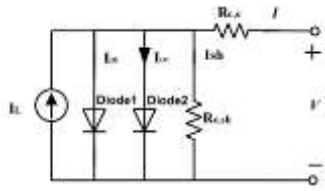


Figure 7 (b) Equivalent circuits for the double-diode model

For the double-diode model, the solar cell current equation is:

$$I = I_L - I_{S1}\left[\exp\left(\frac{V+IR_s}{kT}\cdot q\right)-1\right] - I_{S2}\left[\exp\left(\frac{V+IR_s}{2kT}\cdot q\right)-1\right] - \frac{V+IR_s}{R_{sh}}$$

Where

IS1 = saturation current for diode1 (A)

IS2 = saturation current for diode2 (A)

ID1 = diode1 current (A)

ID2= diode2 current (A)

4.Typical Solar Panel Faults

Many changes in performance of the solar panels couldn't be seen. It need to be inspected with more sophisticated tools like photodetectors (Report IEA-PVPS, 2014). photodetectors is an electronic device that converts incident photons into electric current. It is used by many consumer in scientific fields. According to their optical range, photodetectors are classified. Its working range is from Ultraviolet wavelength to until radio waves in the given by the Figure8.

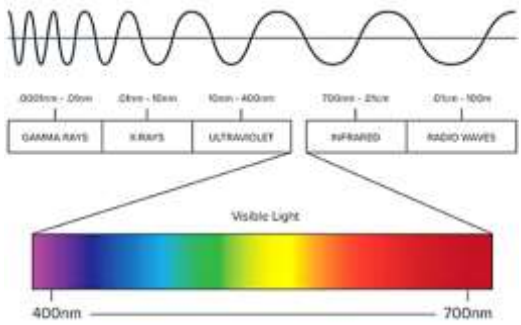
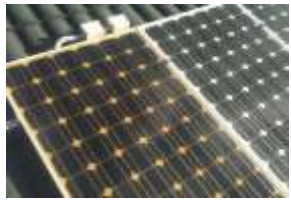


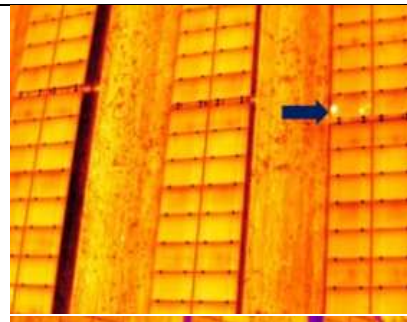
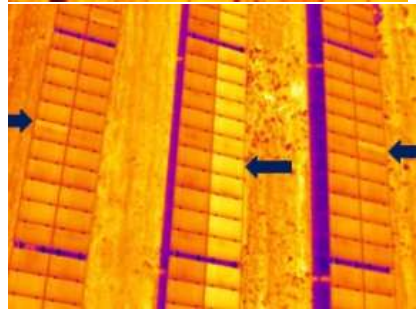
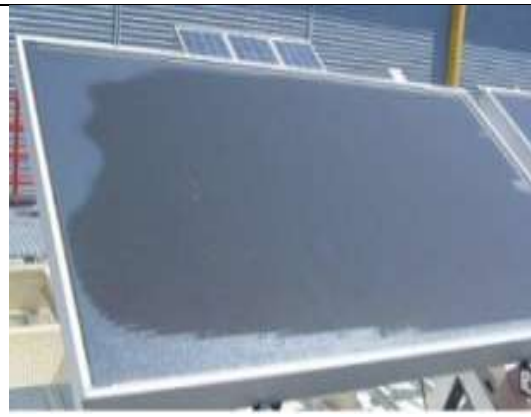
Figure 8. The electromagnetic spectrum

Also, there is another method to detect failure of the panel thermography or thermal image (Ancuta,2012). But visual inspection is one of the most effective ways for identifying browning or encapsulant yellowing, hot spots heating (burn marks), back sheet blistering, junction box failure, and many other problems (Report IEA-PVPS, 2014). Due to the simplicity of visual inspections, it is highly preferred. The most common types of faults on solar panels are given in Table 1.

Table 1. Types of faults on solar panels

Type	Image
Owning or Encapsulant Yellowing: The uncontrolled chemical reaction causes browning or yellowing of plastic materials on the panel.	 

Back Sheet Blistering: The reason for this is that the air and moisture find a way into the solar panel.	 
Delamination of a multicrystalline Si and c-Si module: Delamination occurs when the bond between the plastics (on the back) and the glass (on the front) separate. The reason for this is that the air and moisture find a way into the solar panel.	

Hot Spot Heating: Hot-spot heating problems occurs when there is one low current solar cell in a string of at least several high short-circuit current solar cells.	  
Electrochemical corrosion of a thin-film module and associated delamination: Electrochemical corrosion effects are sometimes observed in the area of thin film PV modules on glass surfaces coated with tin oxide (Sugimura et al., 2003).	

Thin-film glass breakage: Main failures of thin film modules in the field seems to be from mechanical nature as glass breakage.	
Burn marks at the backsheet: A higher local temperature on PV panel, could be reach hundreds of degrees Celsius, which can damage the backsheet (Kaplani, 2012)**.**	
Junction Box Failure: Some environmental factors may cause the Junction Box Failure.	

4.1 Hot Spot Heating Problems

It is the most common type of fault on PV panels in all these faults. Therefore, computer simulation was performed to the reproduction of the behavior of Hot Spot Heating Problems. Proteus 8.1 program was used to do this. There are 10 solar panel cells connected to each other in series in the Figure 9. All of the cells work in full efficiency (The current sources provide 1 amp power). There is no any shaded cell. The shaded cell is represented faulty.Total voltage generated from 10 cells is +8.34 V.

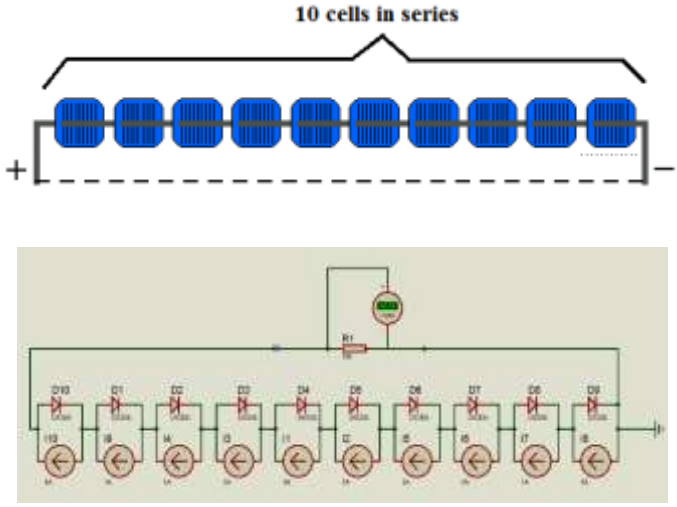


Figure 9. Full efficient series solar cells

Although, inefficient series solar cells circuit in the given by the Figure 2, 1 cell is faulty that is shaded (The current sources provide 0 amp power). Total voltage generated from 10 cells is 0V. Also, when looked at the voltage on the last cell in the Figure 10, negative voltage (-7.5 V) is observed. This is the reason for the Hot Spot Heating Problems in the panel and it is undesirable.

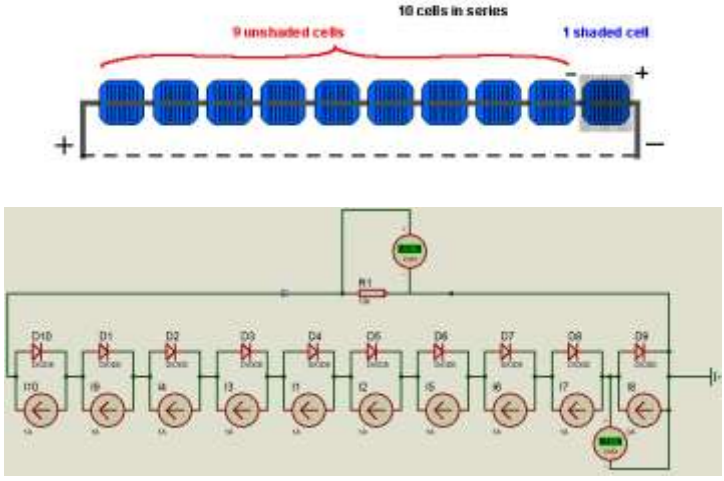


Figure 10. Inefficient series solar cells

5. Conclusion

In this paperwork, an overview of PVs are exposed. Last decade, there has been an increased interes to the PV systems owing to having a lot of advantage such as: their reliability, efficiency and operating cost. Also, there is another reason of it is lack of energy resources. As shown in this paper there are many kind of fault that occur on PV panel. Especially hot spot fault is one of the most common fault on the panel. In adition to, in this paper, different fails detection methods in a PV system existing in the recent literature is exposed. And PV panel material and systems are exposed.

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BLOCKCHAIN&AI: CONVERGENCE OF FUTURE POWER

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1. Introduction

The simple concept of Blockchain technology is; it is a digitized, decentralized, distributed ledger technology maintaining a continuously growing list of data records. On the other hand, Artificial Intelligence (AI) is another revolutionary technology that can learn on its own by analysing and discovering patterns in massive amounts data (Makridakis, Polemitis, Giaglis, & Louce, 2018). While Blockchain helps to store and transmit safely, AI provides huge amounts of data that helps in decision making, assessment, understanding and recognizing. While the machine learning methods that are a part of AI help to find opportunity and improve decision making, smart contracts and Blockchain can automate verification of the transactional parts of the process (Makridakis et al., 2018). Therefore, there is a natural complementarity between these technologies. The advantages of combining Blockchain and Artificial Intelligence technologies, difficulties and current projects will be discussed.

2. Methodology

2.1. Combining Blockchain and AI

The combination of artificial Intelligence and Blockchain is rewarding from many perspectives from solving major business, social problems to economic. With combination of these technologies, the vulnerabilities of both technologies can be weakened. Instead of seeing these two technologies as serve competing purposes; technology and business leaders should realize that combining Artificial Intelligence and Blockchain could increase the potency of both the technologies, catalysing the pace of innovation and introducing radical shifts in many industries.

Figure 1. *Blockchain and Artificial Intelligence (Price, 2018)*

2.1.1. Benefits of Using Artificial Intelligence Technology with Blockchain

- ***Energy consumption:*** Mining requires a ton of energy to be completed. For example, mining of Bitcoin. Today, computers are taking a brute force approach to mining a block. Essential trying to guess every single possible combination until the right one is found (Yli-Huumo, Ko, Choi, Park, & Smolander, 2016). AI has already proven to be very efficient in optimizing energy consumption, so similar results can be achieved for the Blockchain as well. This could also result in lower investments in mining hardware. By bringing AI into the mix, a part of the guesswork could be taken out of the equation. AI could learn how to more efficiently mine blocks, so less computing power will be required.
- ***Scalability:*** Blockchain is growing at a steady pace of 1MB every 10 minutes and it already adds up to 85GB and as a possible solution, Satoshi mentioned deleting unnecessary data about fully spent transactions in order to not hold the entire Blockchain on a single laptop. However, AI can introduce new decentralized learning systems such as federated learning, for example, or new data sharing techniques to make the system more effective.
- ***Security:*** Data held on a Blockchain is by its nature highly secure, what this means is that Blockchain is ideal for storing the highly sensitive, personal data, thanks to the cryptography which is inherent in its filing system (Marr, 2018). Even if the

Blockchain is highly secure, its further layers and applications are not so secure. The businesses that deal in it must put up large amounts of money to meet the security standards expected and AI has plenty to bring to the table in terms of security. An emerging field of AI is concerned with building algorithms which can work with (processing or operating with) data while it is still in an encrypted state. As any part of a data process, which involves exposing unencrypted data, represents a security risk, reducing these incidents could help to make things much safer (Marr, 2018). The incredible progress made by machine learning in the last two years makes AI a fantastic ally for the Blockchain to guarantee a secure applications deployment, especially given the fixed structure of the system.

- **Efficiency:** Deloitte estimated the total running costs associated with validating and sharing transactions on the Blockchain to be as much as $600 million a year (Tim Swanson, 2016). An intelligent system might be eventually able to compute on the fly the likelihood for specific nodes to be the first performing a certain task, giving the possibility to other miners to shut down their efforts for that specific transaction and cut down the total costs. In addition, even if certain structural constraints exist, improved efficiency and lower energy consumption can reduce the latency of the network, allowing faster transactions.

2.1.2.How Blockchain Can Affect Artificial Intelligence

Blockchain have also impact on the development of artificial intelligent systems. There are areas that tracking, understanding and explaining decisions made by AI. Sometimes decisions made by AI's can be difficult for human beings to understand. This is because AI can evaluate many variables separately and "learn" which is important for the overall task they are trying to accomplish. As an example, AI algorithms are expected to increasingly be used in making decisions about whether financial transactions are fraudulent and should be blocked or investigated. For some time, however, it will still be necessary for these decisions to be audited for human accuracy. Moreover, because of the enormous amount of data that can be taken into account, this can be a complex task. Walmart, for example, feeds a months worth of transactional data across all its stores into its AI systems which make decisions on what products should be stocked, and where. When decisions are recorded on a data point-by-data point basis on a Blockchain, they are much easier to audit with the confidence that the record has not been altered between the information being recorded and the beginning of the audit process. These examples are only the tip of the iceberg. Both technologies can add tremendous value to all aspects of life and combination of these two technologies could be an even greater leap forward (Marr, 2018).

2.2. Fields of Applications

Potential benefits are expected in many fields such as Medicine, Autonomous Vehicles, Smart Contracts, Internet of Things (IoT), Decentralized Autonomous Organizations (DAO) and many more. In many cases, Artificial Intelligence provides the assurance of the safety and reliability of the data provided by Blockchain, besides the value of many Blockchain applications will be limited without AI.

For example, a Smart Contract application that its correct execution depends on certain environmental assumptions. Such a contract would be outdated if some of these assumptions were not fulfilled, making AI monitoring imperative to enable learning and to determine when the environment has changed on its own (Makridakis et al., 2018).

Figure 2. *Blockchain and AI (Bahrynovska, 2017)*

2.2.1.Health

Although Blockchain can guarantee safety and reliability, the addition of AI capabilities can benefit the health sector considerably. Currently, AI is used primarily to detect abnormalities in X-Rays and CT scans, a task that is at least as accurate as humans are and to ensure a higher level of personalized medicine. According to experts, the future holds significant inventions given the momentous benefits that can be achieve by reducing medical costs and improving the quality of medical care. For these reasons Google, Microsoft, Apple and Amazon, as well as start-ups are actively exploring AI for medical applications, aimed at improving the more effective utilization of patients' data, the accuracy of diagnosis, providing better recommendations, based on evidence-based research findings, and several other possibilities. These applications are on top of improvements in robotic surgery and digital advice provided though smartphone applications (Makridakis et al., 2018). A good example are smart healthcare

systems that need to make accurate diagnoses based on our medical scans and records. With encrypting of AI, which is important when dealing with sensitive and personal data, data can be secure enough that no one know the records, but also smart healthcare system can make the right decision.

Google and some of the other companies are working toward Secure Precision Medicine. The deep learning platform of Google DeepMind has been experimenting with distributed ledger technologies to improve the safety of electronic medical records and patient information. In this example, Google develops an AI application to identify and possibly deal with kidney problems in patients. The US Food and Drug Administration (FDA) has recently collaborated with IBM Watson Health to conduct similar oncology-related AI experiments for Blockchain architecture. While AI and profound learning for the identification of suspect cells or disease signals could be a powerful tool for doctors (and life – saving for patients), records, rights and regulatory compliance remain sensitive but complex issues to be protected. In order to help resolve privacy, security and auditability risks while preserving the opportunity for AI based precision medicine, more and more companies are seeking to Blockchain.

2.2.2.The Banking and Financial Sector

The benefits of AI for the banks and money corporations are often widespread, as large histories of knowledge is offered. For a long time before AI was introduced, risk and fraud detection were predictive with great success using statistical decision rule. AI has improved such rules to a new level by allowing learning through the analysis of huge data to spot patterns and improve decision-making. Klarna, a Swedish e-commerce company, provides instant evaluation of customers' credit worthiness for buying goods without a credit card. In addition, AI technology can be used to find the speediest way to execute trades, to make bets on market momentum, and to scan press releases and financial reports for keywords that could signal that a stock will rise or fall.

A prime example of successful AI applications is Numerai, a San Francisco hedge fund that makes trades using machine-learning models, built by thousands of anonymous data scientists paid in bitcoin. Another is Polychain, a fund that buys bitcoin and other digital currencies and investing in a radically new breed of businesses owned, funded, and operated entirely by decentralized networks of anonymous online investors (Makridakis et al., 2018). Many hedge funds use machine learning and A.I already as part of their trading process. These systems tend to use historical data to predict future conditions, which can give these hedge funds an edge in the high frequency and speculative trading spaces.

Numerai

By collecting and processing data, Numerai can create a collective AI model to help the hedge fund determine its future investment strategy. Numerai incentivizes the regular submission of predictions by holding a weekly competition, where data scientists can submit their prediction models. These submissions can be backed with Numeraire (NMR) tokens to express confidence in their predictions. If after 4 weeks these predictions perform well, then the applicant is awarded a USD prize based on the amount staked.

State Street's Smart, Searchable, and Secure Data Analysis and Index Generation

State Street's Smart, Searchable, and Secure Data Analysis and Index Generation is another example. State Street is a bank that seeks to combine both Blockchain and AI to create new revenue streams through secure mining and customer data analysis. In particular, it wants to use Blockchain to streamline the processes involved in leveraging customer transaction data to create new searchable indexes (i.e. approvals, possession, mining, securing, etc.). The key is to analyse customer data by sector, country, customer type and global fund movement without revealing customer identity or assets. AI would be used to search for patterns within the data and better use unstructured data, while Blockchain would serve as an immutable data security structure, remain compliant and protect sensitive or private customer information using cryptography to enable access rather than ownership.

2.2.3.Supply Chain

Blockchain technology is already utilized in supply chain while its integrations with AI is still in its infancy apart from its logistic part, which is used extensively by some firms. The challenge is in the future to extend AI to the remaining parts of supply chain. Amazon, a pioneer in AI has moved beyond just responding to customer demands by developing a whole profile for each customer and using such data in its AI applications. Manish Chandra and Anand Darvbhe of Accenture point out, "The use of AI in supply chains will ultimately result in spawning an ecosystem where supply chains link themselves with each other, enabling seamless flow of products and information from one end to the other", completely automating the process and achieving significant benefits in the process (Chandra & Darbhe, 2016).

Namahe

One of the main objectives in most industries is to increase automation in order to improve efficiency and reduce costs. Whether this be on the hardware side (e.g. Robotics), or on the software and logistics side via A.I. Namahe is a platform that aims to massively overhaul the industries involved in the supply chain by incorporating an A.I. layer into the mix. Currently, supply chains are highly complex networks that connect consumers at the end of the chain, to the workers at start of the chain, via several intermediaries including manufacturers, suppliers and retailers. The problem with having so many layers is that; efficiency is often lost, partly due to lack of communication within the supply chain, and due to the speed at which it takes to respond to external events, such as changes in demand, or delays.

Namahe incorporates A.I. with Blockchain technology to produce a secure ecosystem, where businesses can save on costly audits and improve efficiency in their supply chains using the Namahe A.I. layer. Namahe looks to massively boost the efficiency of supply chains by allowing this A.I layer to seamlessly monitor the supply chain in real-time, looking for anomalies in the patterns to detect fraud, delays and unusual events, and flagging the data for review. Over time, this system will expand its skill-set using machine learning libraries, and is expected to quickly reach a level where it can act autonomously;

reacting to events much faster than previously possible based on the confidence of its observations, and eventually be capable of making predictions about future markets.

Figure 3. *Supply Chain and Security* (TechBullion, 2018)

IBM's Smart IoT Lifecycles and Cognitive Blockchain Smart Contracts

IBM is currently working on the AI, Blockchain and IoT intersection in projects and experiments that combine these three areas for comprehensive device life cycle management. The idea is to use Blockchain for device registration, update management, user management, compliance and joint ownership and authorized access through smart contracts. This would enable a "single version of the truth" for which manufacturers and service providers could monitor device performance and security, while managing AI software solutions deployed to devices remotely, especially if multiple companies were deploying such services to the same device.

IBM is experimenting with to turn smart contracts into "cognitive contracts" that can learn and adapt using AI. This can be done by identifying pattern changes in the data, recognizing interesting interactions, detecting suspect activities and so on to make recommendations for updating the smart contracts and taking specific actions based on insights gained from AI.

Digital Currencies

It is not clear how AI can be combined with the Blockchain technology used in bitcoins and other cryptocurrencies, although this can be done when robots will be introduced, owning property and holding assets. In such a case, they will have to use AI to make the necessary transactions with bitcoins (Makridakis et al., 2018).

Matrix Chain: Merging Blockchain and AI

Lately, efforts are being made to integrate the AI and Blockchain technologies into a single application. At the technical level, a new type of Blockchain called "MATRIX Chain" whose aim is to merge Blockchain and AI and set the path towards Blockchain 3.0 has attempted this. The benefits that such technology will bring to distributed ledger technology come down to making Blockchain smarter and adding its ability to evolve through self-learning without the need to introduce AI as a separate technology (Makridakis et al., 2018).

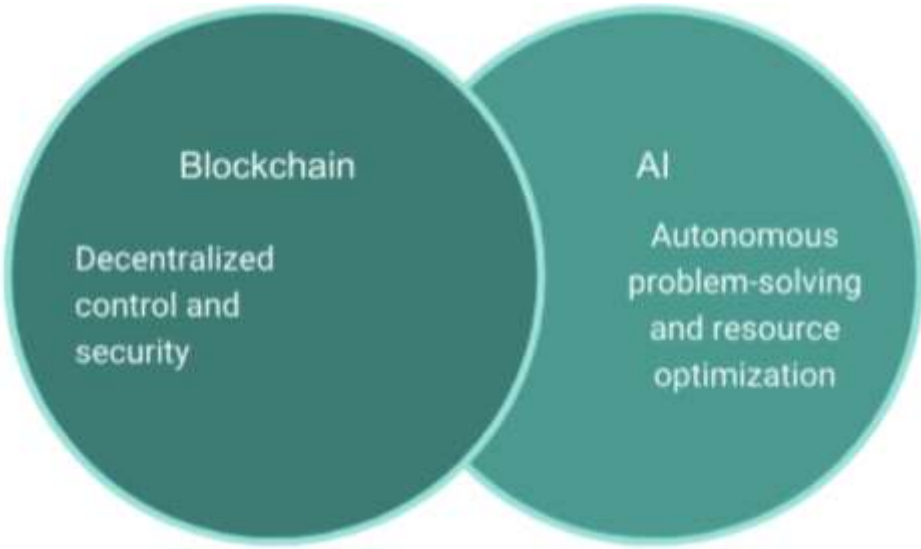

Figure 4. Blockchain and AI interaction (Makridakis et al., 2018)

Matrix AI Network

An open-source, public and intelligent Blockchain platform. The project is working on multiple innovative crossovers between Blockchain technology and AI. The platform and its Blockchain are actually designed with the help of AI algorithms, which will continuously iterate the platform, leading to autonomous self-optimization in the areas of security, efficiency, and flexibility. Matrix is also building applications that enable the mining power of the network to be used for large and complex AI computations.

An additional unique and highly promising innovation the Matrix wants to introduce is natural language smart contract creation. This means that smart contracts can be written in one's native tongue, after which a natural language-processing algorithm converts this into a smart contract. This could open up the complex process of developing smart contracts for a completely new group of entrepreneurs and businesses.

Figure 5. *Matrix AI Network (GoodAudience, 2018)*

2.3. Challenges

A traditional AI program follows the approach of "If A happens, then follow B approach." On the contrary, AI (deep learning and machine learning) uses probabilistic answers to follow a succeeding step. This feature makes AI the ideal technology for creating flexible solutions. Nevertheless, the trade-off is that some AI programs make mistakes and it is difficult for users to understand when it is wrong or what should be done when it makes a mistake (Pinto, 2018). However, when decisions are recorded on a Blockchain, they are much easier to audit with the confidence of record has not been changed. This new engaged technology approach can weaken the vulnerabilities of AI.

Compliance is another major concern in controlling AI solutions from going rogue or causing damage. AI and Blockchain solutions require aggregation of data, which is a challenge. However, Internet of Things (IoT) will be crucial to fulfil the data necessary for AI training. In this space, the security and privacy of privately-owned data will be crucial.

Talent is another challenge for merging Blockchain and AI. While data can be collected using IoT devices, which is the primary factor for training AI models, professionals will need to develop algorithms that run in a decentralized or distributed manner as required in Blockchain technology. Fortunately, organizations such as DeepBrain Chain and SingularityNET are continuously researching and creating innovative AI algorithms (Pinto, 2018).

2.4. Projects Combining Blockchain with Artificial Intelligence

Blockchain technology can be used as an infrastructural layer for data management in any industry. In view of this, the projects that combine Blockchain with other emerging technologies, in particular Artificial Intelligence, the Internet of Things, and Virtual Reality. These are some examples of combining Blockchain with Artificial Intelligence.

2.4.1.SingularityNET

The robot Sophia provided by officials of Saudi Arabia. The team behind this metal Saudi Arabian has created SingularityNET to power AI algorithms, which will ultimately feed the brain of Sophia and the AIs that come after her.

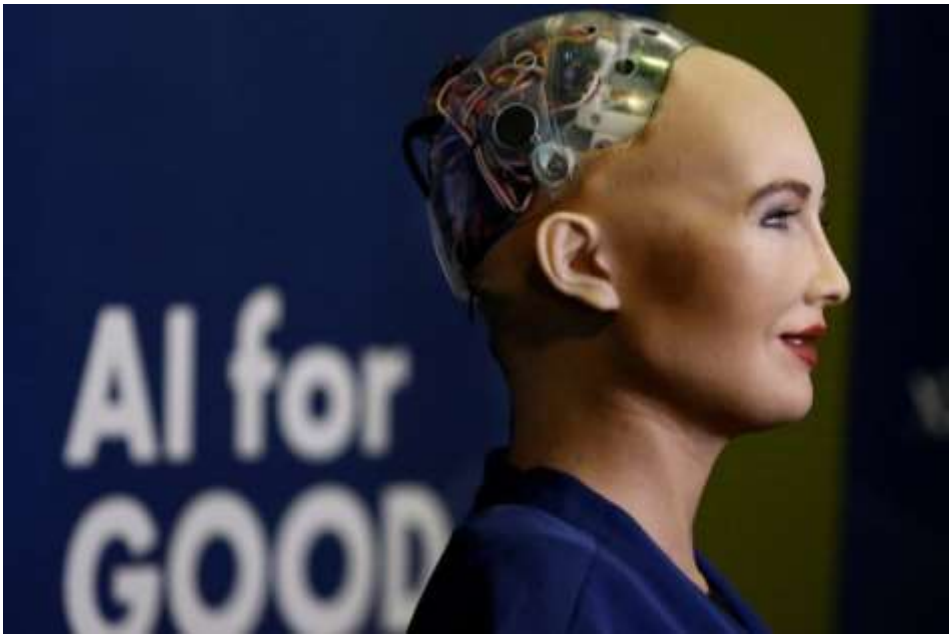

Figure 6. *Robot Sofia (Business Insider, 2018)*

In order to make this possible, SinglarityNET is creating a decentralized AI marketplace. In this marketplace, AI companies can trade data, algorithms, and solutions in a secure and transparent manner. When developing an Artificial Intelligence, instead of manually aligning algorithms, SingularityNET will be able to communicate and exchange data between them as the system develops. For example, a robot that needs to learn to dance can decide which algorithms should work in order, rather than the Artificial Intelligence algorithms (SingularityNET, 2019).

When the process is completed, the developer who sends the process is paying the system again with crypto money. In the development phase of Artificial Intelligence system, which developers' algorithms are used, the process gives them the share of the demander's payment. In this way, the system aims to create a gain platform for artificial intelligence developers besides miners. Blockchain based distributed networks will allow AGIs to be treated as an organism without the need for an administrator.

Because of the marketplace's decentralized approach, SingularityNET aims to shave off many of the current costs of AI development, seriously reducing the barrier of entry for AI start-ups. In addition, the project creates APIs that allow

third parties to access AI solutions without the high level of expertise normally required.

2.4.2.DeepBrain Chain

Its main objective is creating a distributed AI computing platform with a strong focus on peer-to-peer decentralized marketplace action. More specifically, the marketplace aspect would let users from all over the world share excess computing power for AI computations and resources.

DeepBrain Chain specifically targets the cloud market for AI, but plans to build applications for trade of AI algorithms and solutions over time. The plan is to connect all idle AI computing power to parties that could use a little extra GPU, leading to a serious boost in cost efficiency. The team projects a 70% cut to the current cost of AI computations, which would make the otherwise too costly process of training AI accessible to small businesses and startups. The DBC token is used as the native token for the DeepBrain Chain network, and to reward suppliers of computational power. Other services that the platform will provide are applications for AI data storage, data annotation, data analysis, and the trading of completed AI algorithms (DeepBrain Chain, 2019).

Nodes of the DeepBrain Chain ecosystem will conduct various activities. Potential uses include mining the native token, cloud computing, and running corporate-level applications. Since everyone in the world can contribute excess computing power to the project, its long-term success will heavily hinge on user participation.

Figure 7. *DeepBrain Chain (Se, 2018)*

2.4.3.Effect.AI

Effect.AI is a project based in Amsterdam that combines Blockchain technology with Artificial Intelligence. The Effect.AI Company focuses on

creating decentralized applications for AI purposes. However, their scope is much bigger, as they are also creating the "Effect Network Protocol" on the background. This protocol will allow for all kinds of dapps to be built on top of it, which is exactly what Effect.AI is doing.

The project has been making impressive progress and it is now almost ready to launch the "Effect.Force" dapp. Effect.AI has been assembling a global, on-demand workforce that can be hired for training AI algorithms, which still need a lot human input for training purposes. Through the Effect.Force dapp, any business can access this workforce.

The Effect.Force is the first step for Effect.AI, after which the team plans to launch a smart market for AI products and services. Ultimately, the team wants to establish a decentralized, distributed computational platform for AI purposes. The frameworks that Effect.AI is building for these applications will be launched on their Effect Network Protocol, after which they will become open source and can be used for all kinds of purposes. For example, the Effect.AI labour force can also be put to work for other tasks such as surveys, product-market fit analysis, testing marketing strategies and much more (Effect.AI, 2019).

3. Conclusion

Blockchain and AI are the two revolutionary technologies: AI that promotes centralized intelligence on close data platforms, Blockchain that promotes decentralized applications in an open-data environment. Both emerging technologies currently trending in the industry. The emergence of these two technologies offers greater advantages in the coming future. Blockchain helps make AI more accountable while Blockchain development, application and process automation are enhanced by software and hardware intelligence. With the combination of these two technologies, many advantages such as energy consumption, privacy and ability of understanding artificial intelligence decisions can be obtained. Although combination of them can have some challenges, both serve to improve the capabilities of another. As connectivity and algorithms infuse every aspect of business, there is an increasing need for security, trust, data access and accountability and convergence of two offers opportunities for better surveillance and accountability. Although both technologies have different aspects and practices and did not combined widely; future actions are encouraging, motivated by the substantial the expected benefits. Researchers create and explore their own combinations and work together very well.

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ARCHITECTURE

PLACE ATTACHMENT AND THE RESHAPED RESIDENCE; WITHIN THE SCOPE OF GLOBALIZATION

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1. Introduction

With the effect of globalization, the world has rapidly changed and has become much more complex than before, but it still aims to create the same type of societies. The phenomenon of globalization --which is being experienced all over the world-- has a profound impact on third world countries, as well as on developing ones. Globalization has brought about many changes in social, cultural, social, economical and technological fields. This phenomenon is generally defined by concepts such as universalization, internationalization and westernization, but it is in fact a policy of the dominant capital and the culture to make developing countries dependent. In other words, it is an effort to transform the Earth into a global village, by standardizing it and making it dependent on the strong. This deliberate system is affecting different parts of the world every single day, and thus globalization is shaping its own structure. Organized international capital aims to transform the society into an object of consumption; by imposing forms of rapid transition on the unconscious and unorganized public, and by triggering FOMO (Fear Of Missing Out). "This situation creates, at least, an identity-confusion in the societies of less developed countries" (Tunalı 2013: 37).

The powerful capital is shaping the society by indirectly influencing and manipulating it. This method is creating sociological changes in the social structure and thus influencing/shaping all consumption habits. In other words, the capital is objectivizing everything in the daily life cycle and it is directing the individuals by way of hidden instruments of domination. For example; how to dress, what to eat, what type of a house to live in, which car to buy, where to shop, which mass media to use (visual and printed media, Internet, billboards, etc) is all *hiddenly* decided by the capital. Naturally, our country is also directly affected by this new system in the world.

Especially since the 2000s, the globalization phenomenon has accelerated even further and in this process it has created major changes in architectural structures that are mostly in our bigger cities. The fact that our country is in a earthquake zone and that our structures will not resist in a possible earthquake; technological developments; increased mass media; increased importance of speed; imposing a life-style that is disconnected from nature, espeacially in major metropolises... All of these facts have led to major changes in the housing culture, as well as in many other areas. This process of change and transformation is related to many disciplines such as sociology, economics and politics, but it is *directly* related to architecture and its different fields. For example, although

many of our cities such as Istanbul, Ankara, Izmir, Adana and Bursa retain the certain traces of their past, they also have undergone some radical changes. On the one hand, in and around the city, we have themed gigantic shopping malls, multi-storey closed luxury living-complexes, and integrated residence/shopping-mall/office structures; and on the other hand, we have slums created by the migration movement, and old neighborhoods that are completely transformed by the urban renewal; and as a result, the diverse housing culture is being shaped in itself.

At this point, the purpose of this article is to examine the need for housing -- which is the most important requirement in human life-- with its spatial structure in socio-economical and socio-cultural transitions. In this study; the concepts of place and place attachment --based on the process of change and transformation-- were discussed in a conceptual framework; newly formed social classes/neighborhoods, and the gradual disappearance of homogeneous neighborhood culture were analyzed; life forms and spatial structures shaped by closed living complexes were examined in detail.

2. The Concept of Place, and the Place Attachment

In order to define the human being and his living environment, it is necessary to correctly understand the emotion that is imposed on space/place concepts. It is also necessary to observe where that emotion points at. Typically, when people attribute an emotional meaning and a quality to their environment, the space evolves into a place. In other words, "adopting the space" and identifying with it, transforms that space into a place. Phrases like "my city", "my neighborhood", "my work place", "my street", "my house" mean that the person wants to place a physical/sensory attachment to his environment. "The concept of place attachment defines the ways in which people connect to various places, and it describes the effects of these connections on identity development, space creation, perception and implementation" *(Giuliani, 2003).* The concepts of place identity and place attachment help us to understand where and why people feel at home, and why is it so shocking for people and groups to relocate mandatorily or voluntarily *(Altman ve Low, 1992).* According to *Saunders and Williams (1988*); "A home is a socio-spatial formation; it forms when the physical unit of the residence merges with the social unit of the inhabitant." The most important element for individuals in perceiving a space as a place is "home".

The space/place transformation should be examined in the framework of social perception, human-environment interaction, and time-individual communication. In other words, a person's sensory and subjective relationship with a space defines that space as a place. According to Cresswell (2004), "The 'place' is where people connect and get in touch with each other in one way or another; it is a meaningful location." Here Cresswell does not seem to have fully separated the space and the place concepts; yet he has defined space as a more abstract concept compared to the place. When people attribute a certain meaning to a space, and when they can relate to it, that space becomes a “place." "A place is not dead like a location, it has an experiential quality; it represents a form of

radication for human existence and experience" (Relph, E., Place and Placelessness, 1976). But due to today's rapid changes and transformations; the relationship with place attachment and place identity has become extremely fragile. Especially within the last 30-40 years, various changes and transformations in our big cities have created sharp changes in the structural environment as well. The new world order which is in the process of globalization; migration from villages to the cities; need for shelter; diversification of consumption patterns; technological developments; new urban transformation policies; increased importance of speed... All of these facts have caused the transformation of concepts such as place/space and attachment/identity. This structure, which forms the basis of cultural, economical, social, transformations, has also affected the structures which are the products of architecture.

Newly developed housing types, especially in our big cities; neighbourhood relationships; social/cultural balances; interclass communication and harmony; neighborhood culture; meaning and sensory connection attached to spaces... All of these factors have gone through radical changes. "If a human does not belong anywhere, he cannot be a citizen of the world, and he can not gain his identity by living independently of the environment" (Schulz, 2000). And according to Keyder; "We have been living in a new world since 1980. In this world, the management of the economy is gradually taken into the hands of the capital" (Keyder 2004). Therefore, the new world order is very effective in the change and transformation of cities as well. In the rapidly expanding world of communication/telecommunications; various banks (and their credit cards), media companies, market research and advertising companies have a tendency to operate in alignment with the current market's consumption strategy and thus they offer all kinds of intermediaries to the society in an organized way. This perplexed and multifaceted network of power relations is mostly focused in major metropolises, and it is reproducing itself and ever deepening and spreading. The most obvious indication of this is the glass skyscrapers which are rising all throughout the world by breaking up the urban fabric (Pioneer & Weyland 2005).

"Themed gigantic shopping malls, multi-storey closed luxury living-complexes, integrated residence/shopping-mall/office structures, and buildings equipped with smart protection systems... All of these supports the consumption culture in multiple dimensions and in various areas" (Tunalı 2019: 77-80). Individuals are involuntarily influenced by structures that are the main object of consumption. The individual is pushed into a cleverly designed and boundless system in which he desires to belong to a certain class, gain a new identity and move up the social ladder and begins to satisfy all of his spatial needs according to these motives. As in Baudrillard's statement, "the necessities of living are placed in the background, while the identity gained by product is brought to the foreground." So, in this process, it is inevitable that this new space concept will necessitate new lifestyles. Yırtıcı, defines the new form of organization of advanced capitalism as follows: "The most important fact that separates capitalism from its early stages is that, in globalized capitalism, the emphasis has

shifted from production to consumption and all social and economic relations are now based on a discourse that is focused on consumption" (Yırtıcı, 2002). For example; shopping malls which are in almost every region of the mega-cities are declared as free spaces of convenience, but in reality they are nothing more than public spaces that restrict human movement; in these structures --their boundaries of are drawn by various methods-- the security systems allow only a certain degree of movement. This process has tranformed the place attachment expressions such as “my home”, "my neighborhood" --which allow us to define ourselves-- and it has objectivized the concept of “home“, so the new dwellings --especially in the metropolises-- are transformed into mere consumption areas; whereas, "home" is where the place attachment is felt the strongest. It has become inevitable that, in the process of globalization, the capital indirectly commodifies everything and turns it into a fast moving consumer good. In the already complex urban structure, the capital is pushing the individuals into loneliness by confining their lives to certain limits and by directing them to a consumption-based lifestyle.

The neo-liberal policies --especially after 1980-- widened the gap between the upper and lower income levels, and so nowadays, the fragmented structure of our society is even more apparent. This fragmentation in society has caused a fragmentation in the spatial structure as well. Therefore, the society has been forced to adopt this new consumption culture and it has been directed to express itself with certain symbols and indicators. The housing designed for the use of people from various classes, and the new architectural forms, are transforming and changing our cities, and so sense of place attahment is rapidly disappearing. In a very short time, our environment is bound to become unrecognizable, and this process will create new types of housing with new spatial organizations. The transformed society will reinforce its position of class with indicators acquired through "spending power."

In this context, today's residential areas and their immediate surroundings have also become an indicator. There are two important factors about residential areas: first; the consumption demands are immediately met in the market, and the housing areas also benefit from that. Second; due to decreased quality of life in the cities and the disappearance of neighborhood element or neighborhood character, our society has become completely consumption-oriented and is pushed for new searches. Therefore; "alternative" housing areas should be created and marketed for this segment who have limited spending capacity within the supply and demand equilibrium (Firidin Özgür 2006:79). In the consumption culture, housing is not limited to physical needs only; it is also a decisive element of an individual's social status. That is to say, consumption culture not only shapes products for the individual; it intervenes in order to shape the individual's self and lifestyle in order to maintain the continuity of the system (Featherstone, 1996: 46; Ritzer, 2000: 51; Thorns, 2004: 125). This intervention is reflected in all segments of the society; it deeply influences the culture of housing and it shapes the organizations of spaces.

Especially in the last 10-20 years, the closed and vertical buildings have created irreversible changes in the appearance of our mega cities. This structural transformation --which is the essence of this article-- depicts the fragmented structure and social segregation created by socio-cultural and socio-economic changes in the society. Closed living-complexes and integrated residence/shopping-mall/office structures are the evidences of new lifestyles in urban environments. Although this new trend of construction is seen in many of our big cities, it is mostly in Istanbul in terms of density and diversity. So, in this context, the aim of this study is to create a conceptual framework and present a socio-spatial analysis of the current urban transformation process, while remaining faithful to the literature.

3. New Housing Trends in the Globalization Process

The housing structure in our country varies depending on the current policies, and in the last 10-20 years, numerous vertical structures have appeared in many districts of Istanbul. Crowding the city skyline, these buildings --with different lifestyles they offer, and as selected products of the real estate market-- only appeal to certain segments of the society. These structures have become the symbol of living a different lifestyle and being an upper-class. With both their architectural features and the new lifestyles they offer, they are presented as objects that are produced for individuals with high income levels. These vertical structures rising in many regions such as Beşiktaş, Kadıköy, Pendik /Kurtköy, Kağıthane, Beyoğlu, Ataşehir are often described as *rezidans**. Furthermore, the definition of the *rezidans* product described as *Gated towers* or *Vertical gated development* in the English literature remains somewhat vague. Likewise, some naming can be very misleading. For example, in recent years, many mediocre living complexes with the name "Rezidans" have been developed in Pendik/Kurtköy region. In terms of their location, living standards and architectural features, it is not appropriate to describe such living complexes as "Residans". Therefore, first of all, we have to adopt a set of descriptive criteria to avoid this vague definition (Pérouse 2012:84-95). These buildings, whether they are called *rezidans* or living complexes, are all symbols of the socio-cultural and socio-economical change in Istanbul with their common characteristics. In some areas, they almost represent post-modernism and neoliberal policies rising through the slums and the apartments. Many regions in the city have become capital areas for a housing-production-based economy. Another aspect of the problem is that; these areas, where multi-functional living complexes are built, are not suitable for the lifestyles of the people living in those areas. Again, let's take Küçükbakkalköy region and Atatürk neighborhoods in Ataşehir as an example; Twenty years ago, these regions were occupied by low-income groups and gypsy citizens, however, today they are dotted with multi-functional luxury living complexes, and the real owners of these areas had to move to other shanty towns such as Dudullu and Kayışdağı, due to their social, economical and cultural structures and habits. In this process; a fully commodified market has emerged where the right to change prevailed over the right to use, and the large-scale contractors, real estate investment trusts and some brokerage houses that have an

interest in the establishment of this market have emerged as the new powerful actors (Göktürk, Soysal, Türeli, 2011).

There are too many multifunctional buildings being constructed in our cities and the compatibility of these buildings with our social and cultural structure is another aspect of the problem. These mega buildings --such as Akasya (Acıbadem, Konut/Avm), Brandium (Küçükbakkalköy)-- host a combination of many functions like shopping, hotel, housing, sports areas, entertainment, parking and so on... and as a result, some elements that make up the texture of our society --such as consumption habits, entertainment, eating & drinking, social interactions-- are also being changed and transformed. For example, the sales points of fast-food restaurants like Mc Donalds, Burger King, and international coffee shops like Starbucks and Tchibo have become a normal part of everyday urban life. But at the same time, the social communication and interaction in the residential areas of these multi-storey structures --which almost an entire town could inhabit-- are destroyed and people are isolated. Whereas in our culture, most residences and shopping areas are separate. Shopping is usually organized around a street. Most residences are in gardens and they are independent and private low-rise living spaces.

These structures --which affect many factors such as housing culture and social interaction-- have many common features despite their diversity. They are all high-rise buildings and many of them combine many functions. Some are connected to a shopping mall, and security is essential, and it is monitored by many camera systems. There is a 24-hour special service for all residents; sports, childcare, pool, café, market, guest rooms, art rooms, entertainment areas and health services are all available. All these amenities express an isolated lifestyle that is in a city but separated from the city by high walls. This process, in the context of the re-introducing the capital to the scene of the big cities, is also a striking sign of a symbolic rivalry between capitalists. Along with that, the Istanbul skyline has entered into a *Dubaization* process in terms of shape. Moreover, within the framework of brand search, these structures are also used as landmarks to highlight the power and the difference of certain brands. As often mentioned nowadays, this could very well be the expression of the luxury economy --which is constantly seeking a glorious privilege-- in the real estate market (Pérouse 2012:84-95). Therefore, in this process, cities were divided into separate parts; privileged housing is distinguished from the ordinary housing. The consumption-oriented globalization across the world is marketing new building typologies and various architectural products by objectivizing the housing culture and by applying different manipulations. So at this point, it has become inevitable to question the current situation in realities such as place attachment, belonging, loyalty, ownership, neighborhood culture and human/environment relations. In the supply-demand balance that has emerged with the globalization phenomenon, the quest for identity and consumption-object on the part of the society of the spectacle, has made multi-functional building types quite attractive.

4. Conclusion

In the process of turning the space into place; the sense of place attachment --which is conceptualized with indicators such as residency period, social relations, meaning attribution, trust, sense of ownership-- has been subjected to various interferences through consumption, transformation and global changes, and as a result, our mega-cities are now facing many problems. In almost every area, "speed" has become the most important factor, and mobility has prevailed over sedentation, and so in this proccess, the validity of concepts such as "place", "place attachment", "loyalty" and "social communication" has become debatable. So, in the future, are we going to have complex/multiple forms of place attachment that is free of spatial boundaries? The consumption culture that accompanies the global change in our age; in addition to creating socio-cultural changes, it is inevitably changing the environmental and the physical forms as well, and it is pushing people to live individual lives and changing many other aspects of life very quickly. Concepts such as place attachment, collective memory, and identities that describe a place are now becoming obselete. For example; let's define the residence as a property, and define the home as a place where the individual establishes emotional connection, attributes meaning and accumulates memories in time; in that case, we can say that the home is replaced by the residence. The above-mentioned "new" housing is the result of urban population growth, technological developments, industrialization and environmental changes on a global scale, and they are now becoming mere luxurious shelters. There are now many image-oriented structures rising in cities, public areas and green spaces are shrinking, the traffic is even more intense now, there is not enough space for the pedestrian traffic, and many artificial-mechanical housing is being produced away from the nature, and so as a result of all these facts, sensory identity and collective memory are damaged, and the imposition of an individual and an individualistic social life is destroying the sense of place attachment and loyalty. Perhaps in the future, residences will become properties and small rooms will be an expression of the individual identity.

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A COMPARISON OF GENERAL CONDITIONS' APPROACH TO SUBCONTRACTING IN THE U.S. AND TURKEY

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1. Introduction

Construction projects are relatively big and complex and take a long period of time to perform. The budget required for a construction project is relatively big. Since construction projects are designed and performed to meet a certain need, and placed on a piece of land, every construction project is unique, with its requirements, conditions, and limitations. Because of the size of the project a considerable workforce and equipment is required, whereas complexity requires specialty production. The time limitations require simultaneous operation, and because of budget requirements, management efficiency is key for the success of a project.

Since construction projects are designed to meet a certain need, the scope of the projects may vary significantly. As a result, contractors cannot perform every project or all parts of a project. Specialty contracting is inevitable for certain projects or certain parts of a project. Additionally, size and complexity increase the level of risk for a project. Thus, the contractors seek to share the organizational problems and risks of the projects in return of the loss of profit. General contractors prefer to use subcontractors in different sections and/or phases of the project to provide these specialty services, supply equipment and labor with fewer management problems, and distribute the risks. A subcontractor is an entity that works for the general contractor within the predefined limitations, is bound by a contract, and performs a portion of the project (Can and Arikan, 2014) (Figure 1). However, despite decreasing risks in exchange for less profit, subcontracting introduces a number of problems such as difficulties in general management, scheduling, communication, as well as divided authority, loss of efficiency, and causing legal disputes.

General conditions document is a part of the tender documents, that becomes an addendum to the main contract once it is signed and regulates the relationship between the owner and the contractor. This document is one of the most important documents of the tender package since it defines the roles and liabilities of the parties (Komurlu, 2019), as well as states the administrative procedures to be

followed regarding the relationship of the parties during the performance of the project (Chui and Bai, 2010).

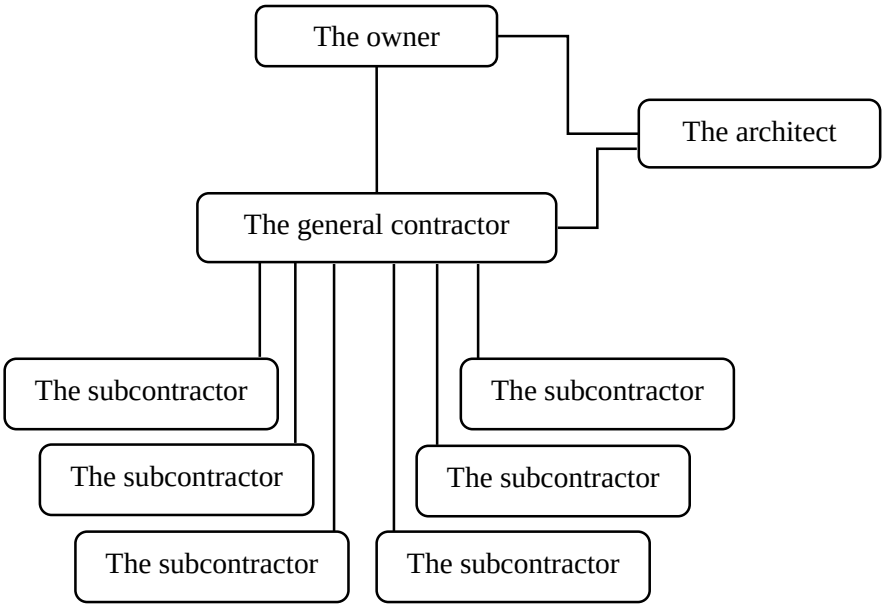
There are a number of standard general conditions documents published by governmental entities, professional institutions, councils etc. Standardization of this document has various advantages such as saving preparation time, avoiding misinterpretation, achieving consistency in courts of law (Komurlu and Arditi, 2017). Founded in 1857, the American Institute of Architects (AIA) has a strong influence on the construction industry. A201-2007 General Conditions of the Contract for Construction published by AIA, the first version of which was introduced in 1911 as a part of A-Series family of documents (AIA, 2007), is the most widely used general conditions document in the U.S. (El-adaway et al., 2014).

In Turkey, the government is the most important investor for construction projects, with more than 40% of the investments (Komurlu and Arditi, 2017). Public Procurement Authority of the Ministry of Environment and Urbanization is the entity that regulates public projects. Because of its mandatory use in public projects, the General Conditions for Construction (MEU, 2014) introduced by the Public Procurement Authority is the most widely used general conditions document in Turkey.

This study aims to compare and review the approach of AIA's "A201-2007 General Conditions of the Contract for Construction" and the "Turkish General Conditions for Construction" documents to subcontracting via comparing the clauses related to subcontracting in the two documents in order to point certain differences in construction industries in the U.S. and Turkey. Literature review has been preferred as the primary method for obtaining information about subcontracting, subcontractor selection methods, relationship between parties, and comparing different approaches to the general conditions documents.

2.Subcontracting

Regarding the size, complexity, budget limitations and special requirements of projects, subcontracting is unavoidable for contractors. Furthermore, contractors prefer subcontracting for sharing risks. Contractors use subcontractors as a buffer (Celebi and Kuruoglu, 2014) and prefer to keep a managing position subcontracting 80-90% of the work to be performed (Aydin et al., 2016). The results of a survey conducted with 500 general contractors in the U.S. state that relationship with subcontractors directly affects a contractor's performance for completing a project (Kale and Arditi, 2001). Thus, the success of a contractor heavily depends on choosing the right subcontractor and manages the subcontractors effectively (Aydin et al., 2016).



Project Delivery Method

Figure 1. Contractual Relationship Between Parties According to Traditional

There are a number of subcontractor selection methods that general contractors prefer. According to Dulung and Pheng (2005) economic target, technical and administrative target are the selection criteria. Ko et al. (2007) have developed an evolutionary fuzzy neural network model to evaluate subcontractor performance. Koseokur (2007) has introduced multilayer artificial neural networks to select subcontractors for a major contractor, using financial status, resource status, quote and experience as selection criteria. Kocak and Sey (2008) claim that capacity, specialty, quote, quality, payment terms, reliability, timely delivery are the main criteria for subcontractor selection. Arslan et al. (2008) have introduced a web-based subcontractor evaluation system which uses cost, time, quality and capability as selection criteria. Radziszewska (2010) has introduced an interface for subcontractor selection which uses cost allocation, compatibility to market variations, relationship with other entities, communication management, know-how sharing, solution conflicts, standard behavior rules, communication frequency, reliability and quality control. Cheng et al. (2011) have used evolutionary fuzzy hybrid neural networks for subcontractor selection. Polat et al. (2012) have developed a multi-purpose optimization model and used a genetic algorithm method for solving the subcontractor selection problem. Goals for the model are project duration, cost minimization and quality maximization. Ciftcioglu (2013), Rencber and Kazan (2014), and Can and Arikan

(2014) has used the analytic hierarchy process (AHP) for evaluating subcontractors. Finally, Aydın et al. (2016) have produced a subcontractor evaluation method based on documentation, references, technical staff capability, delivery durations, cost, and financial status. Regarding the technical as well as financial status and capabilities of a subcontractor, and their effect on the performance of the subcontractor, the selection method is the primary step for the general contractor to reach project goals.

Subcontracting causes a number of problems, which can be minimized with the collaboration of two parties for a long period of time, and forming a work environment for operation. It is statistically proven that the contractors and subcontractors that have a long-term relationship have minimum coordination and supervision issues (Celebi and Kuruoglu, 2014). According to a study conducted by Polat et al. (2012) 42% of the contractors frequently choose subcontractors based on their capacity to supply materials, 56% always based on reliability, 56% always based on the discount offered, 48% always based on the timely delivery of the materials, 47% always based on the quality of the materials, and 40% frequently based on payment terms. Besides, 42% of the contractors stated that they keep a record of the subcontractors' performance.

One of the major causes of disputes in subcontracting is the scope of the subcontract. The owner publishes the contract documents. Then the owner and the contractor negotiate on the terms, both technical and administrative, and finally the main contract is signed. Once the contract is signed, the scope of the project is set. Following, the contractor asks subcontractor candidates for quotes. Finally, a subcontract is signed between the contractor and the subcontractor. However, even if the contractor copies the related clauses and details from the main contract to the subcontract, since the subcontractor's technical ability to perform, financial status, risk perception is different from the contractor's, the work delivered by the subcontractor may not meet the requirements of the owner. Thus, the subcontract should include all of the technical details that are included in the main contract (Caudle, 2011), reflect the administrative perception of the subcontractor, and ensure the understanding of terms for both parties. Besides, since one of the major causes for contractors to subcontract is transferring risks, subcontracts may include indemnity provisions more comprehensive than the contract, which exceed the risk perception of the subcontractor (Milligan and Rubinstein, 2002). Another point causing disputes is the payment approach. Pay when paid is a common practice where the contractor pays the subcontractor once the payment is received from the owner. However, in addition to exposing the owner to the risk of a mechanic's lien, reflecting the risk of getting unpaid directly to the subcontractor threatens the performance. Thus, if this approach is to be followed, both the owner and the subcontractor should be informed (Hollander, 2002), and all parties should negotiate on the terms.

3. General Conditions of the Contracts

3.1. A201-2007 General Conditions of the Contract for Construction

AIA's "A201-2007 General Conditions of the Contract for Construction" document has an article dedicated to subcontracting. This article, i.e. Article 5. Subcontractors consists of 4 sections. In the definitions section, the concept of subcontractor and sub-subcontractor is defined, and their contractual relationship with the contractor is stated. According to that, a subcontractor or a sub-subcontractor is an entity which has a contract with the contractor to perform a portion of the work. Besides, it is stated that suppliers that don't perform on-site are not subcontractors.

In the second section, the awarding of the subcontractors is defined. It is stated that the contractor should propose the subcontractors to the owner through the architect in a timely manner. Unless the owner or the architect asks for additional time for evaluation, or makes a reasonable and timely objection, the contractor has the right to sign a contract with the proposed subcontractor. The owner or the architect may reject the proposed subcontractor if they believe the subcontractor is not capable. However, in case of a disagreement between the owner and the contractor about the capability of the proposed subcontractor, the contractor has the right to file a claim for the time and cost between the rejected and accepted subcontractor.

According to the third section, the contractor should set a contract that bounds the subcontractor with the same terms of the main contract. So that the subcontractor should undertake the contractual obligations and responsibilities such as access, safety, insurance etc., and benefit the rights, remedies and redress that the contractor has against the owner. Additionally, the contractor should request the subcontractor to set contracts with sub-subcontractors with similar conditions. However, section 3.3.2 declares that the contractor is responsible for the acts and omissions of any of its subcontractor's agents and employees. Additionally, section 10.2.5 refers to the section numbers according to which the contractor is responsible for the subcontractor's agents' and employees' acts and omissions about safety. Besides, section 11.1.1 states that the contractor should purchase insurance that also covers subcontractor's operations.

In the fourth and final section, it is stated that in the case of the contractor default, the owner, after consulting the contractor's surety, has the right to proceed with the work with the original price of the subcontractor's contract. However, preferring this option, the owner has to make the payments to the subcontractor that are due past. Additionally, the owner has the right to assign the subcontract to a successor contractor, taking the legal responsibility of the contractor's obligations under the subcontract.

In addition to Article 5. Subcontractors, some various sections regulate affairs with the subcontractors. Such that section 9.6.2 defines the contractor's time limit for transferring payments to subcontractor once received from the owner, and section 9.6.3 states the architect's liability to inform the subcontractor about the progress, and the related payment. Section 9.6.4 states the proving liability of the contractor of the payment made to the subcontractor. Finally, section 2.1.2 states

that the owner should provide information upon the contractor's request required for enforcing mechanic's lien rights.

3.2. The Turkish General Conditions for Construction

"Turkish General Conditions for Building Construction" document manages the subcontracting issue under clause 20 which has 10 provisions. It is initially stated that those companies that are forbidden from public tenders cannot be contracted as subcontractors. Following, the contractor is strictly forbidden to subcontract the whole of the project. If the contractor wishes to subcontract a portion of the work, the subcontractor needs to be approved by the owner before the signing of the contract. The contractor has to submit the owner for approval before changing a subcontractor. It may be requested that the contractor should submit a list of contractors within the bid documents. However, the contractor may request for approval of a subcontractor even if it was not presented with the bid documents.

The following provisions state that the contractor has total liability for the work performed by the subcontractor, and concluding that if the work performed by the subcontractor does not meet the contractual requirements, the owner may request the change of the subcontractor from the contractor. Finally, the contractor and the subcontractor have the full liability of their portions of the work during the substantial completion phase, final completion phase and warranty phase.

3.3. A Comparison of the "A201-2007 General Conditions of the Contract for Construction" and the "Turkish General Conditions for Construction"

AIA's "A201-2007 General Conditions of the Contract for Construction" document has evolved via a number of revisions since 1911, through which it has followed the needs and directed the construction industry. Besides, in the traditional contract delivery method, namely design-bid-build, which is the most widely preferred delivery method, the designer performs as the project manager through the bidding and building processes. Thus, the general conditions document published by the AIA is the most commonly used one. Wide use of the document has a number of advantages. First, it saves preparation time. Second, it is widely accepted by the industry and it is comprehended by the majority of the industry. Additionally, courts of law are familiar with the document.

As a result of the wide range of use and comprehension by the majority of the industry "A201-2007 General Conditions of the Contract for Construction" document has been changed to regard the needs of suppliers and subcontractors, as well as the general contractors and the owners. Since the success of a project depends on the effective operation of all parties including the subcontractors, and the general contractors are financially stronger, the document guarantees the

rights and remedies of the contractor, forcing the general contractor to cover the subcontractors' work via an insurance and the owner to provide the necessary information for a mechanic's lien.

However, the document requires the general contractor to sign a contract reflecting the conditions of the main contract. Subcontractors are not financially strong enough to meet the requirements of such a contract, which may lead to a subcontractor claim. On the other hand, in case of an underperformance by the subcontractor, disputes may arise between the contractor and the subcontractor, which threaten not only the portion the subcontractor is responsible for, but the whole of the project, because of delays in the project schedule, loss of quality, additional costs, consequential damages etc. Choosing the subcontractor based on the discount, the contractor has to work with the least competitive of the subcontractors, which inevitably leads to claims and disputes.

The "Turkish General Conditions for Construction", being introduced by the government for civil engineering works, is being used for all governmental projects for decades. It generally is a one-sided document and the owner i.e. the government has a strong rule on the contract. The subcontractor is not addressed as a separate party but rather an entity that the general contractor is liable for actions and performance. Besides, the disputes between the general contractor and subcontractor are not addressed in the document, and the owner is not interested or does not intervene in such disputes. As a result of these, the risks introduced by subcontracting are solely on the general contractor, and the threat to the success of the project cannot be minimized, let alone eliminated.

Table 1. Clauses about subcontracting in "AIA A201-2007 General Conditions of the Contract for Construction" in the U.S. and "General Conditions for Construction" in Turkey

A201-2007 General Conditions of the Contract for Construction		The Turkish General Conditions for Building Construction	
Article 5	Subcontractors	Article 20	Working with subcontractors and their liabilities
5.1	Definitions		
5.2	Award of subcontracts and other contracts for portions of the work		
5.3	Subcontractual relations		
5.4	Contingent assignment of subcontracts		

4. Conclusion

Subcontracting is a common practice used by general contractors for supplying specialty services, reducing risks and minimizing management problems for supplying labor, materials and equipment. Subcontracting, besides the advantages it provides such as concurrent operation with minimal personnel requirement, supply and better control of specialty services and distributing risks from one entity to multiple, has a number of drawbacks, namely reflecting main contract clauses and requirements to the subcontractor, risk assignments not regarding the financial and/or technical properties of the subcontractor, coordination of both document and production processes.

Subcontracting and its effect on the performance of the project depend on the factors listed below:

- Subcontractors are selected generally based on their capability, experience, references, financial status, technical staff etc.
- In addition to the analytic hierarchy process, various artificial neural network systems are being developed and used for evaluating data for subcontractor selection.
- Since general contractor subcontracts the majority of the projects, the general contractors' performance heavily depends on the performance of the subcontractors.
- Properties of the subcontract, as well as the relationship between the general contractor and the subcontractor, have a direct effect on the success of the project.
- The collaboration of the general contractor and the subcontractor for a long period of time minimizes the problems and disputes and helps form an effective work environment.

General conditions document is one of the most important documents in the contract set of documents regulating the roles and responsibilities of the owner and the contractor. AIA's A201-2007 General Conditions of the Contract for Construction is one of the most commonly used general conditions document in the U.S., and The Turkish General Conditions for Construction is the most referred general conditions document in Turkey.

Reviewing the quality of performance based on the qualities of contractor's and subcontractor's personnel, it is found that sustaining an adequate number of personnel for both the contractor and the subcontractor, focusing and fussy staff, the high level of technical know-how, and the high education level has importance for success (Celebi and Kuruoglu, 2014).

Subcontracts should include provisions for additional work stating the extent, and the procedure to be followed, as well as the main contract (Milligan and Rubinstein, 2002). Besides, subcontractors should set proper risk management

policies for the risks transferred by the contractor, evaluate the difference between the owner-directed changes in the work and contractor-directed changes, know whether there are liquidated damages clauses in the contract or not, and avoid no-damages-for-delay clauses (Mervin et al., 2014). Both the main contract and the subcontract should be clear, detailed and comprehensive, and include clauses for resolving disputes.

AIA's A201-2007 General Conditions of the Contract for Construction has a more comprehensive approach, allocating informing and performance liabilities to all of the parties. On the other hand, despite the obligation of requesting the owner's approval for the subcontractor, the Turkish General Conditions for Construction document regards the contractor as the sole responsible for all of the acts and omissions conducted on jobsite. Thus, the owner does not intervene with the relationship between the general contractor and the subcontractor, and its effect on the project performance. These two general conditions documents reflect the approach to the relationship between the parties in the respective countries.

The author aims to provide know-how about subcontracting and general conditions documents' approach to subcontractual relationships for the general contractors and subcontractors seeking opportunities in different markets.

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THE ROLE OF LEAGILITY IN HUMAN RESOURCES MANAGEMENT OF CONSTRUCTION INDUSTRY

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1. Introduction

Today's world is being shaped around a highly nimble and quick-responding business environment. Agility is becoming the number one priority for the organisations. So, this process affects the ways of doing business, as well as Human Resources Management (HRM) practices. Instead of "person fits the job" notion, "job fits the person" concept rises. In this transformation, a new management concept, named leagility (combination of lean and agile), step forward. Therefore, HRM, one of the fundamental components of an organisation, needs to reshape itself acoording to this new business environment and adapt new methods. Also the leaders, who are in charge of this reshaping process, should adopt new, contemporary methods in this process to be able to build up successful organisations.

In this paper, basic concepts about HRM and leagile (lean+agile) will firstly be reviewed in a nutshell. Then, it will be discussed that how the future HRM should be and what to do in process of reshaping it. After that, all the related concept, especially leagility, will be linked to construction industry bearing in mind the HRM climate of the construction industry. Finally, recommendations about the future HRM of construction industry will be investigated.

2. Basic Concepts

2.1. HRM in a Nutshell

Human Resource Management (HRM), has the goal of the best possible use of human resources to make organizations effective, successful, and sustainable (Cleveland, Byrne & Cavanagh, 2015). The modern HRM dates back to early 1900s, the time of Taylor's methods of productivity increasing that changed industrial and labor relations. Beginning from the 1980s, HRs began to transform from being an administrative maintenance function to being a core business function that could contribute to organizational effectiveness (Ulrich & Dulebohn, 2015). HR manager's role in a company varies from administrative actions to managing employees.

HRM is basically based on two models: Hard Model and Soft Model (Table 1). In practice, many organisations apply some elements of both models. The key distinction lies in whether the emphasis is placed on the human, or the resource. (Green, 2000).

Table 1. HRM models.

HRM	
Hard Model	**Soft Model**
. Utilitarian instrumentalism	. Developmental humanism
. Sees humans as a resource to be provided and deployed as necessary to achieve organisational objectives	. Treats human resources as valued assets who offer a source of competitive advantage
. Command and control	. Empowerment and commitment

Modern HRM thinks employees as a critically important asset to the organization. Nevertheless, HRM does not exist to serve employees, but help to develop and sustain them as an asset that is critically important to the organization. Benefit to the organization represents the ultimate criterion for evaluating the success or failure of HRM (Cleveland, Byrne & Cavanagh, 2015). But in a humane perspective, besides the benefits of organisation, satisfaction of workers should be considered as well.

2.2. Lean in a Nutshell

Lean production concept was formed on foundations of Toyota Manufacturing System and the ideas of lean are based on its functional process. Lean thinking subsequently became the generic term to describe their universal application beyond manufacturing (Womack & Jones, 2003).

The ideas of lean consist of continuous improvement, flattened organisation structures, teamwork, the elimination of waste, efficient use of resources and cooperative supply chain management (Green, 2000). Lean understanding can be summarised as: 1) Understand and maximize value, 2) Optimize the value stream, 3) Pull production, 4) Single-pieceflow and 5) Continuous improvement (Medinilla, 2012).

There are 14 basic principles of the Toyota Production System (Toyota Way) which are organized in four broad categories: the first one is long-term philosophy, the second one is the right process will produce the right results, the third one is add value to the organization by developing your people and the last one is continuously solving root problems drives organisational learning (Liker, 2004).

It's not wrong to say that lean and HRM share same expectation, which is creating and delivering value. Lean creates and delivers value for the customers of an organization (Womack & Jones, 2003). Similarly, normative theories of HRM posit that HRM systems can also be a source of value creation and delivery for employees of an organisation (Ulrich & Dulebohn, 2015). The link between Lean and HRM in literature is apparent and can be found in Liker (2004)'s before-mentioned fourteen Toyota Way principles also. Principle 9 (Grow leaders who thoroughly understand the work, live the philosophy, and teach it to others),

principle 10 (Develop exceptional people and teams who follow your company's philosophy) and principle 11 (Respect your extended network of partners and suppliers by challenging them and helping them improve) consist elements that is parallel with HRM understanding.

As well as HRM is a pre-requisite to lean adoption, lean is an opportunity for HRM to design more powerful management system (Zirar, Radnor & Charlwood, 2015). HRM shares same expectations with lean in mainly three areas, which are: (1) Integration of business strategy with quality (Guest, 1987), (2) Committed workforce and increased flexibility in terms of organisation and job design (Wilkinson et al., 2001), (3) Positive employee attitudes (Guest, 1987).

In lean, eastern-like manager type exists. This type of managers makes the system work as a whole and support their sub-ordinates while teaching them how to better perform their job, and making them reach their full potential. But in creative-industry companies (companies that works in similar understanding with design and construction companies) there is a problem that is rarely seen at manufacturing plants: workers often know more about their craft than their managers. So, if the teaching part is taken out from Lean, what is left behind for the management is "Servant Leadership" (Medinilla, 2012). Servant leader is not responsible to fix the problems but providing the appropriate environment for everyone to take part in problem solving process

2.3. Agile in a Nutshell

Agility is the ability of company to anticipate, sense and respond to volatile environment to create competitive advantage. In short, Agility is equal to sum of adaptability, speed and execution. In a survey, its reported that; becoming agile is number-three priority for the business following managing change and attracting/developing/retaining talented workers (Silverstone, Tambe & Cantrell, 2015). In fact, those three results points the same objectives that are agility and adaptability to changes.

Agile is partly an evolution of lean thinking into the field of software/product development (Medinilla, 2012). Agile is based on iterative development of self-organising and multi-functional teams. It needs disciplined project management process. The foundation of the Agile is based on The Agile Manifesto that constitutes the ideas of what to do and what not to do in the process of software development. There are twelve principles of Agile, which can be summarised as: (1) Satisfying the customer through continuous delivery, (2) Changing requirements are competitive advantage, (3) Delivering working software frequently, (4) Customer and developers must work together, (5) Motivated individuals are needed, (6) Face-to-face conversation is the most effective way of delivering information, (7) Primary measure is the working software, (8) Constant development is important, (9) Technical excellence and good design, (10) Simplicity is essential, (11) Self-organizing teams are the key, (12) Regular intervals are important (URL-1). Agile has some variable subsets/tools in practice. Scrum is the most widely used one for agile development because of its lightweighted process framework and success of implementation.

Agile and organisational culture has a strong relationship because agile needs some certain environmental requirements to live on (Siakas & Siakas, 2007). There are basically four organisational cultures which are shown in Figure 1. Clan culture means flexible organisational structure with co-operation and mentoring leaders. Hierarchical culture means vertical organisational structure with strict authority and strong leadership. Democratic culture means horizontal organisational structure with flexible aproaches and coordinating leaders. Disciplined culture means formal structure and distant power of control. Agile culture needs cooperation, active team players and empowering leaders with a horizontal hierarchy and flexibility. Thus, democratic organisation type is the most suitable on for agile organisations.

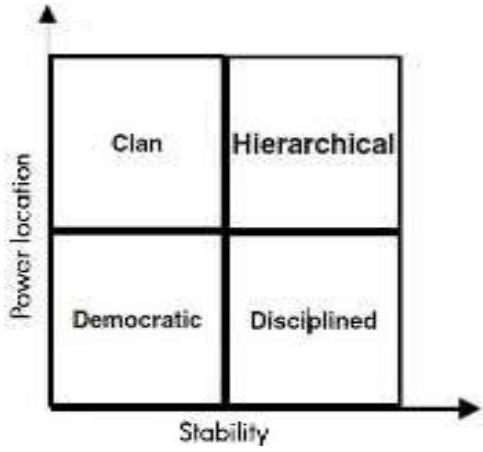

Figure 1. Typology of organisational cultures.

As the business environment changes and becomes more volatile and unpredictable; organizations that are able to adapt to changing business conditions will take advantage from their competitors. To compete in a quickly changing and adapting business environment, HR departments of the organisations should reshape themselves. Therefore, agility becomes the fundamental driver and HRMs should create a new type of organization that is nimble and highly responsive (Silverstone, Tambe & Cantrell, 2015).

To sum up, leagile is the combination of lean and agile with a decoupling point. In leagile, lean part aims to reduce all kind of wasted to minimize cost while agile part aims to quickly respond to nimble demands. Leagility contains flexibility and responsiveness while targeting minimised cost and reduced wastes.

3. Methodology

A brainstorming process on the related subject was held by a group of 17 professionals of construction project managers as part of a management workshop lectured in Istanbul Technical University at May, 2018. Firstly, main topics and general knowledge on the related literature (focused on leagility and HRM) was presented to the professionals. Then, relationship of leagility, HRM and contruction industry was discovered together. After that, offers about the

related topic was discussed among this group of professionals. Finally, the ideas emerged from this brainstorming process was collected together and presented.

4. Discussion

As it's mentioned before, HRM is mainly divided into two models: hard and soft. Various studies have showed that the dominant culture in the construction industry based on hard model of HRM. This deduction is not only limited to construction labour force, but also proper to say for the construction professionals and managerial staff.

In the construction sector, the primary source of competitive advantage is equal to cost efficiency, there is not a valid view that recognize HR as a competitive advantage (Green, 2000). As well as many fundamental vital inputs, HR is seen as a cost also. Therefore, while other industries try to offer better salaries, job satisfaction, job security and softer HR practices; construction industry is having difficulty to attract smart and creative people or enforce the existing human capital because of this understanding. It's not wrong to say that employees in the construction industry are used as cogwheels in a remorseless machine. The first thing is to do is to change this view and adopt contemporary management trends in the construction industry.

As agility becomes a driving force of business environment, HRM should reshape itself amd the ones who fail to do that transformation put their organizations at risk of vanishing (Silverstone, Tambe & Cantrell, 2015). As it is stated by Williamson (2006), today's younger employees are working to live rather than living to work. This process will eventually end up HRs to reconfigure itself in terms of its structure, talent management and delivery of services which it creates. The most important and urgent issue should be to create a workforce that suit the needs of the new age. Therefore, HRs should make changes on the following fronts according to Silverstone, Tambe and Cantrell (2015): (1) need to focus on to improve performance of the people and provide adaptability by pull demanded human resource, (2) should define loose job definitions, self-determined roles and provide continuously adapting and reshaping workforce, (3) not rely on static job; fit the individual, not the job, (4) should not dictate workers what to do and treat them as a passive consumer, reshape itself between workers as co-creators of the processes, should be more colloborative and network-oriented, (5) should build an adaptive, ethical and empowered culture, (6) foster internal and external mobility, (7) develop a learning organisation.

In short, "Employees matter" is the key principle in leagile. Therefore, HRM should support employees as a coach or mentor, answer the needs of the employees and facilitate an environment that keeps them motivated and productive. According to Moreira (2017), the next generation HR should: experiment with motivation, explore self-management, hire for agile, move to team-based performance, get closer to customer, incorporate gamification, move to continuous feedback, support agile roles, facilitate open space, promote discovery mindset, foster servant leadership and promote agile mindset.

Before-mentioned ideas overlap with study done by Cleveland, Byrne and Cavanagh (2015) describes how the future HR systems should: (1) identify malleable and changeable targets, knowledge, skills and abilities, (2) expand performance measurement to contain employee-centred criteria in addition to profitability and economic suffiency, (3) know that the most important asset of a company is creative and independently thinking human, (4) mind the needs of people and redesign the job according to that, instead of fitting people to static job descriptions (5) evaluate every person as an unique; so train, educate, develop and foster them.

Changes in business environment also impact the leadership types that are valued in organisations. The leaders who: (1) motivating and developing teams, (2) managing self-organizing teams and aligning their efforts with goals of the company, (3) managing workload and capacity, (4) building corporate culture and driving change, (5) continuously improving the whole system is gaining importance in the new business environment (Silverstone, Tambe & Cantrell, 2015). In other words; servant leadership is the key. Servant leaders focus on to service employees first. Instead of being in front and giving directives, he leads from behind and shares ownership. True leadership is about giving control instead of taking control (Silverstone, Tambe & Cantrell, 2015). Spears (2010) identifies ten attributes of servant leadership as listening, empathy, healing, awareness, persuasion, conceptualization, foresight, stewardship, commitment to grow people and building community. HR should attempt to identify servant leaders in the company since those that exhibit servant leadership often go unrecognized and choose to give credit to others.

5. Conclusion

As the business environment changes, agility and rapid response to emerging problems becomes the most important asset of an organization. Agile management, also its combination with lean, or in a broader term leagile management has the potential to meet up the requirements of the new business environment. As it's firstly arised in software industry, its basic principles are applicable to construction industry, too. The environment of the construction industry consists volatile, uncertain, complex and ambiguous elements. Adaptability, speed and quick execution (which are sub-elements of leagile) are the best possible solution to this environment. Construction organisations need to shape everything from head to toe to become more responsive and competitive; including their business strategies, organizational structures, workforce behaviours, operations, leadership types and human resource management efforts.

As it's known that the conventional business methods will change and reshape themselves, to be able to adapt to this environment HRs have to reshape themselves either. Conventional HR practices of construction industry is based on hard models. First thing to do is HRs have to reshape themselves in consideration of "employees matter" motto and transform into a soft model approach. By doing that, organisations should adopt methods including self-

management, gamification, servant leadership, agile and discovery mindsets, continuous improvement and experimenting new motivational methods.

It's possible to say that, construction companies which incorporate HRs that are able to facilitate: (1) customised job definitions, (2) constant learning and development, (3) loosely defined career paths, (4) mobile workforce, (5) flexible performance objectives, (6) frequent feedbacks, (7) collaboration across whole organisation, (8) extended workforce networks, (9) give credit to improvisation, (10) value adaptible, creative and independent thinking workers, (11) encourage intrinsic motivation, (12) decentralise the power and empowers the front-line people to make important decisions will stand out amongst others in the industry.

Also, it should be noted that, the future lies down outside the physical boundaries of corporations. In the future, workers of the organisations will not be ones that are bounded to physical walls of it, they will be the ones that meet-up the specific requirements of the specific unique tasks. Workforce will be free-flowing, transient, temporal and uniquely tied to projects, not to organisations. So, HRs should build up systems that make it possible to work in a harmony with free-flowing working environment.

Finally, to implement the leagile thinking in construction sector, firstly emphasis should be placed on the human and employer-centred thinking should be adopted. In this transformation, the key cornerstones will be motivation, leadership, competence, trust and of course people.

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INVESTIGATION OF ANKARA KUĞULU PARK AND TUNALI HİLMİ AVENUE IN THE SPACE AND IDENTITY DIALECTIC

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1. Introduction

Understanding the city habitant's daily life practices and interactions with spaces is important for the cultural and identity analyses of individuals and societies. Urban spaces are both spatial and sociological entities as sharing and transmitting points of daily life practices and social experiences. Therefore, every study which focuses on deciphering the urban space and urban culture puts forward the necessity of evaluating social and sociological processes.

Urban culture which is fading away and cultural values and urban identity which are sustained become the subjects of urban studies. This study is one of which focuses on Kuğulu Park and Tunalı Hilmi Avenue which are used actively in the capital city Ankara and which became important symbols of it. Today, Kuğulu Park is an important public green area for Ankara as it was years ago. Also Tunalı Hilmi Avenue which is still alive with its density and public space quality have been selected for the analysis of urban culture and identity values. This couple symbolizes an inseparable integrity in the urban memory with their spatial qualities and social values which complete and support each other. Tunalı Hilmi Avenue and Kuğulu Park are urban spaces which reflect the modern culture of Ankara besides containing Ankara's commercial, entertainment, sightseeing etc. facilities.

Its location and proximity to the region of embassies and foreign bureaucrats and individuals with academic and political backgrounds and families using it as a residence area has established the socio-cultural infrastructure of the area. (Resuloğlu, 2011) This cultural infrastructure which is still protected today makes itself to be felt dominantly in the social life. In this study, the park and avenue which is used by the habitants actively who are from every age and gender group has been examined with its physical environment and social structure and spatial use and user interactions have been explained within the framework of daily life practices.

2. Space, Place and People

Architecture is a form of communication and reflection of cultures, values and emotions with their interactions. The basis of architecture is based on the concept of space. While time is a view of the changing reflections of space, changes are results of experiences.

The relationship of time and space is a dynamic structure which completes each other and provides possibility for transitions and tendencies between relationships. This relationship also creates perception and integrity supporting

transformation and change. (Aydınlı, 2008) What renders this system as critical is the 'instance' when experiences are realized. The important element at this point is the existence of humans. Space is not only a passive object but it is a field of interaction that is experienced with human existence. When it is taken in this frame, it is important the necessity to perceive the concept of space as a whole in transition from people concept to the city scale and to interpret it in a social frame.

The concepts of 'space' and 'place that we use in daily life can't be discerned from each other too much. In the frames of different disciplines, the difference between these concepts carries importance. The concept of 'place' is in relation with concept of 'space' and besides it covers it. While the concept of 'space' is a general expression, the concept of 'place' expresses the 'private' with experiences which are realized in the frame of daily life practices. In a different expression, place contains many sources with the point it is located and its physical features it contains and besides this with respect to the sub meanings of these. And again with a different expression, this could be expressed as 'the spirit of space' or 'space lived in'. (Schulz, 1980)

It makes the concept of space special its structure in the integrity of social, economic and political relationships and its interactions between these relationships. It makes the concept of space an area of interest in the view of every discipline as the analyses of social systems can be examined over spaces and spatial practices. An action and/or concept to happen in a space and to be expressed in the frame of qualities peculiar to the space is a different perspective that reflects the important of space. When it is examined in the view of social relationships, there is an order of the relationships and relationship networks under consideration which appear by identifying experiences in time and obtained information sources with the references of spatial features. In this interaction, space is in a structure which may change/transform with the people and social structure and it is also a sociological concept.

3. City, Identity, Culture and Interaction

Urban spaces are compositions in which human relationships developed within daily life in this frame and necessary elements which maintain these relations to be formed take place and establish. They gain different identities in the frame of the meanings that users load to the space. When it is examined in this view, urban spaces are cultural and identity reflections of societies.

The concept of culture is one of the most important sub components of the city. Culture is a value system in general which provides material and spiritual value judgements shaped with social life form integrity in the historical process and maintain social shaping in the frame of these value judgments and which is transmitted from one generation to another. The concept of city culture finds its way with the effects of the city and society and political, social and economic etc. factors and with the experiences and interactions of city habitants, families and

city groups. (Taşçı, 2014) When it is examined in this frame, the concept of city culture is experienced and shaped in the triangle of urbanization, being city habitant and urban life.

The original of identity concept is based on the attachment concept. Although the concept of attendance has been examined by many disciplines, the basis of the concept is science of psychology. The attachment concept in the mixture of psychology and sociology is the condition which is born from the interaction of the individual with concepts like place, space, object, people, society and community. And the feeling of attachment makes the first step of the transition to the 'identity' concept. In short, identity is a unity of individual and social relationships in the framework of socio-cultural structure.

Urban spaces contain many social, economic, political, cultural, symbolic etc. elements. In the frame of these elements, city spaces which are shaped by experiences affecting and conducting city memory are spaces which transmit value judgements of individuals and/or groups they have by communication. At this point, instead of individual memory, collective memory leads forward. Memory spaces which integrate in the frame of symbols and/or discourses influence communities' and/or societies remembering processes and create 'the soul of place' concept with the attachment feelings of individuals. (Schulz, 1980) Of course, this concept isn't only related to symbols and discourses. And economic, political and sub cultural etc. unities give direction to the interaction of memory spaces. The common element in this interaction is directing towards the future by establishing a bond with the past in the frame of sustainability of societies. Spaces where this unity can't be established are fated to be forgotten.

4. Method

In this study where urban space analyses are made, evaluations related to physical, sociological and cultural structures of spaces are made. The first of these evaluations consists of the data related towards the analysis of seven design principles which are mentioned in Bentley et. Al's (2005) work 'Responsive Environments'. Tunalı Hilmi Avenue and Kuğulu Park are urban spaces where change and transformation are experienced not planned but by itself. It presents the density and liveliness it has since the past till today in the frame of a quality and it is aimed to explain how they protect these By Bentley et. al.'s principle features which have to be thought in the design stage of spaces that have potential of attracting users. In this frame, positive/negative results in the transforming and changing structure between the past and today have also been examined. These principles at the same time are supported with Gestalt Theorem, 'genius loci' concept and Lynch's (2017) symbol and components approaches. And the second analysis consists of interviews made with the people who use the avenue and park especially since the 80's period and/or the people who reside in the area or around. The interviews are deep interviews and they were made with 12

persons, including 8 men and 4 women. In the interviews, it was given place to oral history definitions and also interviewer interpretations related to Bentley et. al.'s (2005) design dynamics.

5. Findings and Evaluations

Tunalı Hilmi Avenue and Kuğulu Park are urban spaces which reflect the modern culture of Ankara besides containing Ankara's commercial, entertainment, sightseeing etc. factors. When it is examined in this frame, besides its integral structure with the vehicle traffic, with the action of walking, the park and the avenue have different perceptions, meanings and interactions for the habitants of the area, city users and owners of enterprises.

The urban identity of Tunalı Hilmi Avenue and Kuğulu Park are related to physical and social infrastructures/concepts and processes. They continue their sustainability with their characteristics which are shaped in the frame of these processes and collected under the titles of shopping and leisure. Against the heavy effect of the globalization concept in every period of our life, this couple are attendance and value points for the city with the activity of walking.

6. Evaluation Of "Tunali and Kugulu Park" Urban Space Dynamics

Variety

Variety is different options to be at the same place. Areas which have variety attract different users to them and they put forward different experiencing processes.

The work area is like a sub centre with the variety it contains in it in the city scale with the other commercial, entertainment, resting and residence structures around it. Therefore, it has a potential that attracts every age group and educational and cultural groups and that meets all these different demands. This condition establishes the most effective point of the variety concept. Besides, supply and demand being performed with waking activity makes this couple a stronger attraction area in view of its users.

In opposite, the commercial activities in Tunalı Hilmi Avenue to change due to the increase in the variety of the user profile not to conform to the life standards of the users of the area appears as a different condition of denial. While the high number of shops and stores is reflected as a variety, the low quality of products is not attractive for the users. Different product designs and quality concept in the previous periods have been as low as spot and outlet products nowadays. In spite of that there are still spaces like cafés, restaurants and bars etc. which serve for the social life since past periods, decrease in experience times and qualities of these is still questioned. Nowadays, the decrease in quality of spaces used in night and social areas has influenced negatively the liveliness of night use and the user profile which began in the 80's and continued in the 90's. Besides, closing of

movie theatres and theatre halls in the avenue and around and decreasing of this type of cultural activities appears as another cultural deficiency for the area.

And Kuğulu Park also experienced its most active periods in the 80's and 90's just like Tunalı Hilmi Avenue. The variety of Kuğulu Park doesn't only appear with its human profile but the plant and animal types it contains. In spite of this, it is also possible to observe that the green texture and natural life variety that the park contains has been decreased which lost area since the past till today. The influence of the avenue which lost its night life liveliness has also weakened the night use of the park that is integrated to it. In spite of this, as it protects its feature as a densely used park in the night time creates fractions in this influence.

The park attracts different users to it with different physical features it has and with activity possibilities occurring related to this. Nevertheless, different users profiles bringing different neighbourhood cultures causes negative opinions. This condition is observed as disturbing attitudes arise during the use of the park (such as throwing garbage to the ground, not being shrewd etc.).

Permeability

With the environments to present accessing options to people to the degree it gives possibility and permits, the set-up and operation of the accesses between areas are named as permeability. In the permeability concept, especially pedestrian and vehicle roads and the condition of them carry importance.

Tunalı Hilmi Avenue is one which is important with its dense pedestrian use. While the straight axe of the avenue experienced with walking determines the route, side street and avenue connections are dynamic and mobile points for users. This condition is also an element which provides interregional passages and commerce to overflow to side streets/avenues. In the passages on the avenue, there are multiple entry-exit arrangements. These entry/exits provide connections to both Tunalı Hilmi Avenue and other streets and avenues. Even though main passages and tiny gates maintaining different courses for pedestrians is an element that supports the activities in the streets remain alive, the insufficiency of activities in side street and avenue connections to attract users has weakened the use of these areas. Besides this, shops, stores and passages being without doors seem attractive to the users. Traffic flow to be slow in the pedestrian passes in the avenue and along the avenue gives possibility to pedestrians to pass to both sides of the road and it supports both sides to have the same liveliness.

When the avenue is examined in the view of pedesterian road widths, this is insufficient for today's use potential. The damages and want of care in pavements cause problems for the pedesterian and the ones who are mostly influenced by this are families with baby cars and middle aged and above disabled individuals. Meanwhile, in the vehicle road, both the disorder of the infrastructure caps and vehicles parking in the second line narrowing the road cause problems for the

vehicle users. When it is examined from this perspective, accessibility which is the first step of permeability is cut down due to use problems.

The roads inside Kuğulu Park are 'traces' and continuous. They have the quality and characteristics to support users direct themselves inside the area. The park has continuous roads and besides this, it provides the user to enter the park from six different points. The most important of these is the main entrance from Tunalı Hilmi Avenue. This entrance to have the feature of a square in its own scale makes this entrance special. This entrance is also the reference of the main pedestrian axe where Tunalı Hilmi Avenue and Atatürk Boulevard passes are maintained. Besides this, entries at Polonya Avenue and Atatürk Boulevard aren't frequently selected as there is dense vehicle traffic around them. And the other entry at Tunalı Hilmi Avenue direction can't be noticed too much due to that it has a feature of an intermediate road and the buffets around it to make perception difficult. And at points where slope increases in the park, problems are seen especially in the access of above middle aged users.

Visual Appropriateness

Visual appropriateness principle is related to mind codes in the frame of users' perceptions. The formation of visual image is a result of the interaction between the visible and unseen. (Aydınlı, 2008) Formation of image is related to the qualities of the object besides the looking time of the subject's stimulants and their subjective conditions (psychology etc.).

Tunalı Hilmi Avenue shows continuity at the eye level with the proportional appropriateness of either the shops or shop façades. The green texture which takes place on the avenue creates the sense on the user that structural effects decreased and natural city landscape increased. And the plate use in commercial parts is the most disturbing visual pollution for the users.

Kuğulu Park presents a harmony in the integrity of green, water and hard floor. Against the dense structuring effect of the city, the park which appears with its green area produces a visual focus point but the cafeteria inside the park disrupts this harmony. And the fence surrounding the pool provides security for the swans and users and it appears as a strong bordering element in the user's perspective. Besides this, the disorder of place and structures such as the buffets in the park entrance, municipal police point and taxi stand destroys the expression of the park entry and creates chaos in directions.

Personalisation

Personalisation is a result of attachment concept. The element active in personalisation is the purpose of use of that place. In this frame, areas personalised according to purpose of use present different reflections to their environment.

Tunalı Hilmi Avenue which gives service both to the neighbourhood and the city supports different personal area uses of the users. Commerce to overflow to the street presents different perspectives to the customers and pedestrians using the avenue. Peculiar implications of shops and shop stands support the visual richness of users. Besides this, the concept of personalisation and daily mandatory shopping have only been squeezed between the use of certain shops and stores and walking activities that became habit as the avenue's commercial activities went far from the ability to appeal the area users.

And Kuğulu Park gives service both as a neighbourhood and city park. The park has a structure to be personalised differently by every user and to be able to serve for different uses. Although it is sufficient for individual or group activities, it is faced with insufficient space in collective uses (concerts etc.). During in-depth interviews, users of the area express 'feeling the existence' of the park as personalisation.

Legibility

The concept of legibility is an element which presents the user defined points keeping him away from the feeling of being lost and invites them.

Doubtlessly, the most defined point of Tunalı Hilmi Avenue is Kuğulu Park. Other than this, the junction points at the beginning and end of the avenue and Tunus Avenue are the most distinct points and the structures are also included in this reference point concept. The change of reference points in structures shows variety according to the users profile and selections.

Kuğulu Park which is a reference point only by itself has a huge number of reference points in the park according to its own scale such as the pools, swans, statues etc. This condition strengthens the 'place' expression of the park used for gathering.

Robustness

Spaces are places limited with fixed use. In public areas and spaces used in the frame of daily life, strength should be a concept that should present variety and be continuous.

In Tunalı Hilmi Avenue, both the continuity and variety of shops and the street musicians and sellers along the avenue support the use variety and create different activity points and they include the users to this flow. Although this condition shows itself during in-depth interviews, this perception of continuity ends in the Bülten Street intersection at many of these interviews. As a ramp begins following Bülten Street, the quality of commercial activities changes and as there exists no point to excite the user, this causes the perception of continuity of the users to be lost.

And Kuğulu Park provides users to direct them to the parts that they want to exist and use in the frame of integrity with its child playing area, café area, free walking areas and sitting areas. The park presents possible areas for various activities and actions and different styles of use support activity mobility. The continuity of activities are separating from each other with respect to their locations and visual continuity shows integrity.

Richness

The principle of richness is related to sensory experiences. The activity and variety of different sensory experiences support the richness of the space.

The perception of visuality in Tunalı Hilmi Avenue maintains readability of both ground and basement floors and the first floors. This condition not only makes activities in the ground floors to be sensed but also activities in different elevations to be perceived. For the pedestrians, this is both a visual and physical richness. Together with this, the odours spreading from the shops and eating-dining places enjoy and attract the user and they support them to be directed to different spaces. But the density of vehicle traffic and the exhaust gas smell and noise due to this is the most disturbing condition.

Kuğulu Park is a central space which is separated from the dense urbanization effect of the city and where you can meet with green and trees. The users of the park mostly use the sense of seeing as a passive recreation. And another important sense of us in using the park is sounds. Although in crowded time periods in the park we are disturbed by this, the sounds of the nature and people makes a combination. And the musicians are added to these sounds and support the establishment of a different ambiance. Although the sound of the dense traffic around is also felt by us, the visual and acoustic sense dominance of the park comes forward and it curtains this effect.

7. Discussion

Tunalı Hilmi Avenue and Kuğulu Park which are among the actively used public areas of Ankara are symbols of the social life with their commercial activity variety and social life areas and they are important in the view of sustainability of city culture. The use of public areas in the frame of daily life practices maintains spaces to be examined over experience processes. Daily life practices and social life changes experienced in work areas influence individuals' space experiences and they gave directions to relationships and affected the change and transformation process of areas. This interaction has established the identity of work areas. Foreign individuals and/or groups to exist at limits of life areas with respect to the locations of work areas has been an element supporting the variety and especially difference of avenue activities and besides this, bureaucrats and academic origin families to prefer this area has established the socio-cultural infrastructure of this area.

Tunalı Hilmi Avenue has gained a commercial identity following the end of 70's and especially the construction of passages supported the mixed use of avenue activities. The avenue to be shaped in the frame of commercial activities influenced the attendance to the avenue and established a public area use value. This condition establishes the bases of the avenue's urban sub central structure. With globalization activities to speed up in commercial activities in the 90's, the change of cultural life practices influenced cultural spaces negatively and caused cultural spaces which establish a special face of the avenue to be closed in this process and damaged the cultural identity of the avenue. Besides this, the pace of commercial activities also influenced the use of residences in the area and caused it to decrease.

Tunalı Hilmi Avenue and Kuğulu Park are active points of the city with their density, liveliness and quality of public area. In opposite to this, we should also take into account the negative effects of deficiency of cultural spaces reflecting to social life. Besides, the avenue and park also have physical deficiencies. With the insufficient area in the park limiting variety of activities, the problems experienced in pedesterian and vehicle traffics in the avenue are biggest indicators of this. This condition causes users to direct themselves to areas and functions that they need. With the use of the avenue and park to be squeezed inside time slices under the titles mandatory and need, the feeling of attachment is damaged.

8. Conclusion

Tunalı Hilmi Avenue and Kuğulu Park are very significant for the city either with their dense use or with various activities and experiences they present. They especially became important places with the richness of public and cultural life they present in Ankara. If we evaluate from the perspective of urban quality and sustainability of the cultural life this district has a great social value.

Tunalı Hilmi Avenue sidewalks are suitable for the pedestrians. And the slow traffic makes the avenue more pedestrian friendly. This relationship supports the integration of the avenue with the Kuğulu Park and encourages the pedestrians to walk towards the avenue sidewalks. When it is examined within this concept, we can propose to evaluate Tunalı Hilmi Avenue within the scope of pedestrianization project. In the scope of the proposal, it is required to perform façade maintenances of current buildings and standardize advertising boards. Besides, the arrangements to be added the current landscape of the avenue (green-water, median applications etc.) and use of urban furniture will increase the liveliness and quality of the avenue. Together with this, enriching the quality of social spaces from the perspective of cultural activities will support the cultural sustainability of the avenue. Existence of cultural activities enhance the urban quality. So development of new activities on the avenue and around might create a potential to sustain the urban quality for the future of the district. The revisions

that will be performed in the scope of the proposal will expand Kuğulu Park's physical borders and activity areas to be established. Another significant approach for Kuğulu Park might be minimizing the existing cafeteria and leaving that space as a natural landscape. With these arrangements that could be performed in the avenue and park, the Karum Shopping Center which is close to the business district and which is not visited much will also be a very lively public space. This change will provide another liveliness to the avenue. Also this will support the public quality of Arjantin Avenue and Seğmenler Park within this area

Tunalı Hilmi Avenue and Kuğulu Park as a district has a potential of establishing a rich urban life although it is under the dynamics of urban change within time. This district which has a significant place in the collective memory of the city, has to sustain its socio-cultural potential and socio-spatial quality. Besides this, the proposed arrangements that will be realized in the commercial areas will help to sustain the pedestrian friendly characteristics as a 'street' and enhance the urban quality.

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AN ASSESSMENT ABOUT BARRIER FREE DESIGN IN URBAN GREEN AREAS

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Introduction

Public spaces in cities are social, economic and cultural functions and a scene of daily life. It is a necessity of urbanization that public space is arranged for ça fair 'use of all individuals of society and as habitable spaces (Kaplan & Öztürk, 2004). Some individuals in the community may be congenital or subsequently disabled. World Health Organization (WHO) describes disability as lack of or limitation in the performance of normal activities, expressed as behaviors, abilities and tasks expected of the person or the body as a whole (WHO, 1980). Disability is the state of limiting mental-physical disruptions, limiting the individual's life activities, and limiting the individual's abilities and strength (Coleman, 2000). However, the physical characteristics of an individual do not actually prevent him / her from being a part of the society in which he / she lives, but the meanings attributed to his / her disability cause him / her to be prevented by being labeled (Burcu, 2011).

In the design approach of urban spaces, barrier-free design and universal design (universal design) appear as a design for physical integration and social integration that can be used by all citizens (Kaplan and Öztürk, 2004). The design required for the survival of all disabled people in urban space is different according to the type of disability of the individual. For example, a disabled person who has a vision problem in traffic needs a design such as an acoustic traffic light, while a disabled person using a wheelchair needs a specially designed public transport (Atıcı, 2007). For this reason, urban designs and accessories to be made within the scope of disability regulations should be made considering all kinds of disability. Providing services to as many individuals as possible in urban green spaces is one of the main discussion topics in planning, design and management (Hussein, 2006). In this context, the green areas, which are part of the urban public space, were evaluated within the framework of different definitions of disabilities.

Study Material

The material of the study is located in Kastamonu, West Black Sea Region of Kastamonu Province, and its altitude is 775m with a surface area of 13.108.1 km2 (İbret and Aydınözü, 2009). The province is mostly composed of rugged lands.

There are Küre Mountains lying parallel to the Black Sea coast in the north of the province, and Ilgaz mountains with east-west extension in the south (Öztürk and Özdemir, 2013). 74.6% of Kastamonu is mountainous and forested, 21.6% is plateau and 3.8% is plain (Yıldız, 2013).

In this study, the open and green areas in the city have been examined, and the parks located at the important strategic points for the disabled have been taken into consideration by considering the population size of the neighborhood. The parks that are selected as research areas are located in the central district of Kastamonu. The city currently has a total of 46 parking spaces. The total area of these parks is 152,183 m2. İstiklal Yolu Park, Cevizli Park, Kışla Park and Ekrem Esen Parks are considered as the study area.

Figure 1. Çalışma alanının konumu

İstiklal Yolu Park

İstiklal Yolu Park is located on Kastamonu Merkez Saraçlar Mahallesi İstanbul Street. To the east of the park is the Kastamonu Municipality Fire Department, to the west is Bağlarbaşı street, to the south is Yüce street and to the north is İstanbul Street (also D675 Highway) which is the widest front of the park with a length of 121 meters. The area around the park is 400 meters and 8740 m^2**.**

Figure 2. Environmental relationship analysis of İstiklal Yolu Park

Cevizli Park

Cevizli Park Kastamonu is located on Islabey District Kisla Street. The façade of the park (east façade) faces the Kisla Street, the main highway of the city, the west façade faces the historical Ismailbey Mosque and Complex, the north façade faces Estargon Street and the south façade faces Tascesme Street. The park has a 40 meter long façade to Kışla Street and this façade constitutes the main entrance of the park. The park is 180 m long and its area is 2400 m^2.

Figure 3. Environmental relationship analysis of Cevizli Park

Kışla Park

Park, Kastamonu Central Ismailbey District is located on Kisla Street. The park has three open façades (east façade) overlooking the barracks street (the city's main road), the northern façade facing Mustafa Kaya Street and the western façade facing İnebolu Street. There is a new city park under construction on the border of the southern façade of the park. The park has an 80 meter façade to Kışla Street and this façade constitutes the main entrance of the park. Access to the parking area, which is located inside the park, is also possible by car. The area around the park is 420 meters and the area is 10270 m^2.

Figure 4. Environmental relationship analysis of Kışla Park

Dr. Ekrem Esen Park

The park is located on the 57th Alay Boulevard in the North District of Kastamonu. The park has three open façades overlooking the street. Its front façade (South façade) is copper to 57th Regiment Boulevard, side façade (East façade) to Akarsu Street and rear façade (North façade) to Aybala Street. There is a residential area on the west side of the park. The main entrance of the park is made by 57th Alay Boulevard. The area around the park is 362 m and 8120m^2.

Figure 5. Environmental relationship analysis of Dr. Ekrem Esen Park

Methods

A structured questionnaire was used as a method of collecting information. For this, Kastamonu Turkey Disabled Association Branch located in the city center has been reached with various physical disabilities associations and schools. Turkey Disabled Association Kastamonu Branch There are 10,714 people with disabilities detected in Kastamonu centers, according to data from the Association. When determining the number of questionnaires to be conducted, 10,714 disabled individuals in the center were considered. Cross-sectional method calculation and $n= (Z^2NPQ)/(ND^2+Z^2PQ)$ formula were used to find the number of disabled people to be surveyed (Özdamar, 2001).

In the formula n: Sample size, Z: Confidence coefficient (this coefficient is taken as 1.96 for 95% confidence), N: Main mass size, P: Probability of the property we want to measure in the main mass (taken as 50%), Q = 1 – P, D: Refers to the accepted sampling error (a sampling error of 10%). Accordingly, the number of surveys to be reached was calculated as 62.

The survey was conducted in urban areas. In this study, in order to see the wishes and expectations of the users, questions about the open and green spaces where individuals with disabilities can spend their spare time were asked. The questionnaires were prepared as a result of face-to-face interviews. In this way, problems, needs and expectations were perceived and analyzed better.

In this study, the approach of disabled people to accessible physical environment and compliance with the standards (TSE 12576, TSE 9111) on 4 selected sample areas were examined. For this purpose, 62 disabled people can be reached within the city and their approach to the physical environment and their problems are tried to be determined. In addition, observation forms were created for each selected park area and field analyzes were processed on this form.

Findings

Demographic characteristics of the survey participants are given in Table 1. It is seen that the ratio of males to females among participants is higher (60%) and orthopedically disabled people (40%) are more likely than disabled people. The findings show that the rate of non-work (66%) is higher. This factor, which affects both the conditions of health conditions and social life, is between 3000-4000 with 39% and 2000-3000 with close value. It is observed that they mostly live in Kuzeykent neighborhood.

DEMOGRAPHIC FEATURES		unable to see	unable to hear	unable to hear and orthopedic disability	Mentally Handicapped	Autistic	Mental Retardation	Nanism	Chronic Disease	Total	Percent
Gender	Woman	0	4	4	12	1	1	2	1	0	25	40
	Man	7	6	3	18	2	0	0	0	1	37	60
	Total	7	10	7	30	3	1	2	1	1	62	100
Education	Not literate	1	0	0	0	0	0	0	0	0	1	2
	Literate	0	4	3	2	0	0	2	0	0	11	18
	Primary school	0	0	1	6	1	0	0	1	0	9	15
	Middle School	1	3	1	10	0	0	0	0	0	15	24
	High school	2	3	1	7	2	1	0	0	1	17	27
	College	3	0	0	4	0	0	0	0	0	7	11
	Faculty Undergraduate	0	0	1	0	0	0	0	0	0	1	2
	Graduate	0	0	0	1	0	0	0	0	0	1	2
	Total	7	10	7	30	3	1	2	1	1	62	100
Working Situation	Working	4	3	0	14	0	0	0	0	0	21	34
	Not working	3	7	7	16	3	1	2	1	1	41	66
	Total	7	10	7	30	3	1	2	1	1	62	100
Income status	Less than 1000 TL	3	0	0	0	0	0	0	0	0	3	5
	1001-2000 TL	3	5	0	0	0	0	0	0	1	9	15
	2001-3000 TL	1	2	6	11	1	1	1	0	0	23	37
	3001-4000 TL	0	3	0	18	2	0	0	1	0	24	39
	4001 TL and more	0	0	1	1	0	0	1	0	0	3	5
	Total	7	10	7	30	3	1	2	1	1	62	100
Job	Worker	2	1	0	4	0	0	2	0	0	9	15
	Officer	2	0	2	2	0	0	0	0	0	6	10
	Freelance Business Owner	0	2	1	3	0	0	0	0	0	6	10
	Student	1	3	3	9	1	0	0	1	1	19	31
	Unemployed	0	1	0	0	0	1	0	0	0	2	3
	Never Worked	2	3	1	12	2	0	0	0	0	20	32
	Total	7	10	7	30	3	1	2	1	1	62	100
Distribution by Neighborhood	Akmescit	0	1	1	1	0	0	0	0	0	3	5
	Aktekke	0	1	0	0	0	0	0	0	0	1	2
	Atabeygazi	0	0	0	1	0	0	0	0	0	1	2
	Beyçelebi	0	0	0	1	0	0	0	0	0	1	2
	Candaroğulları	0	2	0	1	1	0	0	0	0	4	6
	Cebrail	0	0	0	1	0	1	0	0	0	2	3
	Esentepe	1	0	1	2	0	0	1	0	0	4	6

	Hepkebirler	0	1	0	0	0	0	0	0	0	1	2
	Honsalar	1	1	1	0	2	0	0	0	0	5	8
	İnönü	2	2	0	2	0	0	0	0	0	7	11
	İsfendiyar	0	0	1	0	0	0	0	0	1	2	3
	İsmailbey	0	1	1	2	0	0	0	0	0	4	6
	Kırkçeşme	1	0	1	2	0	0	0	0	0	4	6
	Kuzeykent	0	1	0	12	0	0	0	0	0	13	21
	M. Akif Ersoy	1	0	1	1	0	0	0	0	0	3	5
	Saraçlar	1	0	0	4	0	0	1	0	0	6	10
	Yavuz Selim	0	0	0	0	0	0	0	1	0	1	2
	Total	7	10	7	30	3	1	2	1	1	62	100

Table 1. Demographic structure of the participants

When questioned the degree of the relationship between the disabled and the other persons in the social life outside the family, it is seen that 34% of them have the highest value. When the adequacy of physical arrangements for the disabled in open and green spaces is questioned, it is not very pleasant. 53% was very poorly preferred. The comparison of the obstacle status of the participants and their suitability in terms of anthropometric measurements (body measurements) and ergonomic aspects of urban furniture in the green area and the comparison of the obstacle statuses and the suitability of stairs and ramps in the green area are given in Table 2.

Comparison of the disability status of the participants and the level of social relations other than non-family members	Very inadequate	4	0	0	4	1	0	0	0	0	9	15
	Insufficient	0	1	2	0	1	0	1	0	0	5	8
	Partially adequate	0	0	3	7	1	0	0	0	1	12	19
	Enough	0	3	2	14	0	1	1	0	0	21	34
	Very adequate	3	6	0	5	0	0	0	1	0	15	24
	Total	7	10	7	30	3	1	2	1	1	62	100
Comparison of the obstacle situations of participants and the adequacy of the physical arrangements of the parking area in the green spaces	Very inadequate	4	4	1	21	2	0	1	0	0	33	53
	Insufficient	2	1	2	7	0	1	0	1	0	14	23
	Partially adequate	1	2	2	1	1	0	1	0	1	9	15
	Enough	0	3	1	1	0	0	0	0	0	5	8
	Very adequate	0	0	1	0	0	0	0	0	0	1	2
	Toplam	7	10	7	30	3	1	2	1	1	62	100
The comparison of the participants' disability and their suitability in terms of anthropometric measurements (body measurements) and ergonomic aspects of urban furniture in the green area	Very inadequate	3	3	1	18	2	0	1	0	0	28	45
	Insufficient	3	2	2	7	0	1	0	1	0	16	26
	Partially adequate	1	2	2	4	1	0	1	0	1	12	19
	Enough	0	3	1	1	0	0	0	0	0	5	8
	Very adequate	0	0	1	0	0	0	0	0	0	1	2
	Total	7	10	7	30	3	1	2	1	1	62	100
Comparison of the obstacle status of the participants and the status of the stairs and ramps in accordance with the standards in the green area	Very inadequate	2	2	2	17	1	0	1	0	0	25	40
	Insufficient	4	1	1	6	1	0	0	1	0	14	23
	Partially adequate	1	3	2	5	1	1	1	0	1	15	24
	Enough	0	3	1	2	0	0	0	0	0	6	10
	Very adequate	0	1	1	0	0	0	0	0	0	2	3
	Total	7	10	7	30	3	1	2	1	1	62	100

Table 2. Qualification findings depending on the disability of the participants

The relationship of the participants to go out in line with their obstacle situations and needs, and comparison of the assistance they receive for mobility in the urban space has been revealed. According to this, it was found that the participants preferred closed spaces, encountered accidents and had difficulty in going to the parking areas.

Comparison of participants' disability status and going out according to needs	Required	1	3	1	13	1	1	1	0	0	21	34
	Work-School	1	2	1	4	0	0	0	0	0	8	13
	Social Activity	4	3	3	8	0	0	1	0	1	20	32
	Going to Parking Areas	1	2	1	4	1	0	0	0	0	9	15
	Going to Disabled Institutions	0	0	1	1	1	0	0	1	0	4	6
	Total	7	10	7	30	3	1	2	1	1	62	100
Comparison of participants' disability status and assistance for mobility in urban areas	Alone	4	8	4	16	2	1	1	0	1	37	60
	Family	1	1	1	11	1	0	1	0	0	16	26
	Relative	0	1	1	2	0	0	0	1	0	5	8
	Friend	2	0	1	1	0	0	0	0	0	4	6
	Total	7	10	7	30	3	1	2	1	1	62	100
Comparison of participants' disability and leisure time	Open area	6	6	1	6	0	1	0	1	1	22	35
	Closed area	1	4	6	24	3	0	2	0	0	40	65
	Total	7	10	7	30	3	1	2	1	1	62	100
Comparison of the obstacle conditions of the participants and the ease of walking on the sidewalk and pedestrian roads	Yes	4	6	1	19	2	0	1	0	1	34	55
	Pavement widths not suitable	1	0	2	3	0	0	0	1	0	7	11
	There are obstacles on the sidewalk	2	2	0	1	0	0	0	0	0	5	8
	Bump pit on the roads	0	1	1	3	0	0	0	0	0	5	8
	There are tools on the sidewalk	0	0	0	2	0	0	0	0	0	2	3
	Ramps insufficient	0	1	3	2	1	1	1	0	0	9	15
	Total	7	10	7	30	3	1	2	1	1	62	100
Comparison of the obstacle conditions of the participants and the ease of walking on the sidewalk and pedestrian roads	Yes	3	1	2	19	2	1	1	0	1	20	32
	Upper and lower pedestrian crossings not suitable for disabled use	4	2	1	3	1	0	0	0	0	9	15
	Suitable level crossings for disabled people are less likely than lower and upper pedestrian crossings.	0	3	3	1	0	0	1	1	0	16	26
	Vehicle drivers do not show respect	0	2	1	3	0	0	0	0	0	7	11
	Light times too short	0	2	0	4	0	0	0	0	0	10	16
	Total	7	10	7	30	3	1	2	1	1	62	100
Comparison of obstacle situations of participants and difficulty of using high pavement	Very little	1	1	1	19	1	0	0	1	0	24	39
	Moderate	2	2	2	4	0	1	1	0	1	13	21
	Highly	0	2	1	6	1	0	1	0	0	11	18
	Too much	4	5	3	1	1	0	0	0	0	14	23
	Total	7	10	7	30	3	1	2	1	1	62	100
Comparison of accident situation due to the obstacle status of the participants and urban space design	Yes	4	4	2	16	2	0	2	1	1	32	52
	No	3	6	5	14	1	1	0	0	0	30	48
	Total	7	10	7	30	3	1	2	1	1	62	100
A comparison of participants' abandonment status	Yes	4	4	3	12	2	0	1	1	1	28	45
	No	3	6	4	18	1	1	1	0	0	34	55
	Total	7	10	7	30	3	1	2	1	1	62	100

due to disability and urban space design												
Comparison of obstacle status of participants and easy access to green area	Yes	4	7	2	18	2	1	2	1	1	32	52
	No	3	3	5	12	1	0	0	0	0	30	48
	Total	7	10	7	30	3	1	2	1	1	62	100
Comparison of obstacle status of participants and reliability of green area	Yes	3	5	4	24	2	0	1	0	1	40	65
	No	4	5	3	6	1	1	1	1	0	22	35
	Total	7	10	7	30	3	1	2	1	1	62	100
Comparison of the obstacle status of the participants and the frequency of going to the parking area	I can not go	4	4	2	11	2	0	1	0	0	24	39
	Several times a year	1	1	2	17	0	1	0	1	0	23	37
	Several times a month	1	2	2	1	1	0	1	0	1	9	15
	Several times a week	1	2	0	1	0	0	0	0	0	4	6
	Everyday	0	1	1	0	0	0	0	0	0	2	3
	Total	7	10	7	30	3	1	2	1	1	62	100

Table 3. Evaluation findings depending on the disability status of the participants

After the surveys, spatial observations were made. The main problems and approaches related to the selected parks as a result of the observation forms are given below.

İstiklal Yolu Park

5 of the 6 entrances on 3 fronts of the park are accessible for disabled people. In this way, it is possible for people with disabilities to enter and exit the park from all sides. The park is suitable in terms of pedestrian paths, but the lack of guide track pavements makes it difficult for visually impaired individuals to use the park and pass between the compartments. The parking area consists of two sections, upper and lower. These areas have an almost flat slope. The ramp that connects the two sections is a problem with the standards since the slope is between 6-8%. The second ramp in the park is not accessible with a slope of 17% and no warning surface. Seating areas are located in suitable places. However, it is not suitable for bench dimensions and area measurements. In addition, it is not accessible because there is no warning surface in front of the bench. There is no fountain in any part of the park. The garbage cans in the park are accessible by standards.

Cevizli Park

Only one of the 4 entrances in the park is accessible for disabled people. Therefore, entrance and exit of the park from all directions is not possible for disabled people. The pedestrian paths in the parking area are suitable in terms of size, but the lack of guide track pavements makes it difficult for visually impaired individuals to use the park. The parking area is flat and has a close slope. Although ramps are needed at the entrance and surrounding pavements of the park, no ramp analysis has been performed. Seating areas are located in suitable places and are suitable for bench dimensions and area dimensions. However,

since there is no warning surface in front of the bench, the seating areas are not accessible. There is a fountain at the back of the park. The fountain is accessible as a measure for the disabled. The garbage cans in the park are accessible by standards. There is no parking.

Kışla Park

The entrance with two staircases located on two different fronts in the park is not accessible for disabled people. There is no ramp analysis in these areas. The park is also accessible with a flat entrance and the largest entrance is accessible for disabled people. The park is suitable for pedestrian walkways, but the lack of guide track pavements makes it difficult for visually impaired individuals to use the park. The parking area consists of 3 separate sections at separate elevations. Between these sections, ladder and ramp solutions are designed. The ramp designs applied in the entrances and between the sections of the park are not taken into consideration. Seating areas are located in suitable places and are suitable for bench dimensions and area dimensions. However, since there is no warning surface in front of the bench, the seating areas are not accessible. There is a fountain in the middle section of the park. The fountain is accessible as a measure for the disabled. The garbage cans in the park are accessible by standards. The café-restaurant in the park area increases the number of visitors to this area. For this reason, there are insufficient parking spaces for 16 cars in total, 10 cars inside and 6 cars outside. In addition, there are no disabled parking spaces, warning signs and signs reserved for disabled people in the existing car parks.

Dr. Ekrem Esen Park

Including the ramp size of the park, which has 3 stair entrances and 1 ramp entrance on two different fronts of the park, not all are accessible for disabled people. The pedestrian area in the parking area is suitable in terms of size, but the lack of guide track pavements makes it difficult for visually impaired individuals to use the park. The parking area consists of 4 separate sections at separate elevations. Between these sections, ladder and ramp solutions are designed. The ramp designs applied in the entrances and between the sections of the park do not comply with the standards. The seating areas are not accessible in terms of their size and the absence of a stimulating surface in front of the seating area. There is a car park for 50 cars at the south entrance of the park. This parking lot is sufficient for the number of vehicles, but there is no disabled car park and warning signs and signs reserved for disabled people in the parking area.

Conclusion

A significant amount of the world's population is composed of individuals with disabilities. However, the difference between people with disabilities and non-disabled individuals is not due to the fact that people with disabilities have

disrupted bodies or minds, but because they represent an oppressed minority within a society that renders them disabled (Shakespeare 1994; Burcu, 2011). The profile formed when the needs of the disabled are mentioned in the society, the fact that the wheelchair and visually impaired individuals come to mind, leads to the fact that the profile is not taken into consideration. However, the requirements that may vary according to the type of chair used by a wheelchair individual may be insufficient for another disabled person. For example, the ramp that an individual using a wheelchair may exceed may not meet the needs of an individual using a manual chair or having difficulty walking (Şavlı, 2016).

In the light of the evaluations, the suggestions for the selected sampling areas are given below;

The priority design principle in open and green spaces should be the realization of designs that enable healthy people and disabled individuals to use all areas together. In line with the results obtained with the field observation and evaluation form made within the scope of this research, the suggestions for problematic areas in the study area are as follows;

• Guide tracks should be laid at all entrances of the selected parking areas and information signs should be brought. All sections with stairs should be analyzed according to the standards and existing and inaccessible ramps should be rearranged according to the standards. Handrails should also be made at the appropriate points of all ramps.

• Guide pavements should be made on all pedestrian roads in order to ensure that visually impaired people can reach and easily reach the area.

• Stairs that do not meet the standards in terms of width, step depth and height should be redesigned. In addition, non-slip guide slabs should be made to the appropriate dimensions at the beginning, end and end of the steps of the stairs. Ramp design should also be applied in the parts where stairs are made. For safety, handrails on both sides of stairs and ramps should be made in appropriate dimensions.

• Parking lot solutions for disabled people should be made in the parking lot in the park and the number of disabled parking spaces should be reserved in accordance with standards. Disabled parking signs and signs should be placed in these car parks.

• Seating areas should be created in accordance with the standards in which the wheelchairs can easily enter and dock alongside the seating elements. In addition, the warning surface should be made in front of the bench.

• There is no fountain in the park. Due to the need, fountain suggestions can be brought to the use of all individuals with disabilities in terms of their use.

• Information and guidance signs should be provided to warn all disabled groups in areas where vehicle and pedestrian entrances are together.

Open and green spaces, which are part of the urban public space, play a major role in enabling disabled people to participate in the social environment. In these areas, the problems faced by the disabled cause them to move away from the society and lose their self-confidence. In order to avoid these problems, practitioners need to address the unhindered design approaches of local governments.

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