2nd International Sustainability Congress

Village Park, Polonezköy, Istanbul Turkey
October 26-28, 2017

MARMARA ÜNİVERSİTESİ 1883

ICS
INTERNATIONAL CENTER OF SUSTAINABILITY

EXTENDED ABSTRACTS PROCEEDINGS

2nd International Sustainability Congress*

2017

International Center of Sustainability (ICS) is a research and academic center for sustainability founded in 2015 and housed within the Marmara University in Istanbul. ICS is dedicated to build resilience of communities and ecosystems to environmental and socio-economic risks. ICS has an integrated approach and defines sustainability not only in terms of environment but also in terms of socio-economic process. The ICS supports efforts to create an active culture of sustainability and it is committed to developing and maintaining healthy living environments and communities while fully integrating sustainable practices at home and abroad.

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by Refika Bakoglu, Marmara University, Turkey (Music: Hosein Mahmudi)

11:15-12:15 **Keynote Speaker**
CSR & Sustainable Development: Do Goverments Listen?
by Yahia Zoubir, Kedge Business School, France

12:15-13:15 **Lunch**

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12:30-13:15 **Keynote Speaker**
Does Atypical Leadership Promote Diversity?
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Facilitators: Mustafa Ozbilgin and Refika Bakoglu

16:30-18:00 **Closing Session**
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CONGRESS PROGRAM*

Friday, October 27th

08:30 - 09:30 Registration

09:30 - 11:00 Opening Session

Community Art: Finding our Rhythm in Sustainability
Refika Bakoglu
Marmara University, Turkey (Music: Hosein Mahmudi)

11:00-11:15
Coffee Break

11:15 - 12:15

Keynote Speaker

CSR and Sustainable Development: Do Governments Listen?
Yahia Zoubir
Kedge Business School, France

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Meltem Sarıbeyoğlu Skalar

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Ayşem Şener Uzunhekim

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Emre Alpman

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Saturday, October 28th

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Energy Transition, Climate Change Mitigation and Sustainability

Tanay Sıtkı Uyar
Marmara University, Turkey

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12.30-13:15

Keynote Speaker
Does Atypical Leadership Promote Diversity?

Mustafa Özbilgin
Brunel University, United Kingdom

13:15-14:15
Break for Lunch

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Creative Sustainability Ideas Workshop
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16:30-18:00

Closing Session
Conflict Transformation through Expressive Arts

Aylin Vartanyan Dilaver
Boğaziçi University, Turkey

EXTENDED ABSTRACTS PROCEEDINGS

Alliances of World Cities and Their Role in Achieving Sustainable Development

Meltem Sarıbeyoğlu Skalar

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Abstract

Non-governmental organizations that are established by city administrations have been becoming a new kind of actor on international plane. World cities have been pursuing to strengthen their position on international stage and making their voices be heard through the international NGOs. The purpose of the paper is to examine the extent of the role of the NGOs, which function in the name of cities, in the field of sustainable development law to achieve sustainable city development.

Keywords: Citta Slow, Slow City, Sustainability, Sustainable City, Ula, Seferihisar, Branding of a Town, Brand Evaluation of Ula.

1. Introduction

Non-governmental organizations (NGOs) have been increasingly on the world stage in recent decades. Although they are not subjects within the framework of international law and do not have opportunity to claim their rights or oblige the other international actors to fulfil their obligations, they are not completely stripped of any power or influence (Willets, 2011; Vedder, 2007). In this regard, alliances of world cities as large communities of individuals started to play a role in the sphere of international law and, particularly, in the field of sustainable development law (Porras, 2009).

2. Literature Review

City governments or municipalities play an indispensable role in achieving sustainable development of their cities facilitating the channels of co-operation with the inter-governmental organizations, i.e. World Bank and private sector – particularly foreign direct investments – that were a result of newly gained international status through their NGOs memberships (Porras, 2009). Heins criticizes heavily the lack of legitimacy in the acts and activities of NGOs (Heins, 2008). Porras believes legitimacy is not a question for the NGOs that are established by elect city governments or municipalities (Porras, 2009).

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World cities have been pursuing to strengthen their position on international stage and make their voices be heard through the international NGOs such as United Cities and Local Governments (UCLG), The World Association of Major Metropolises, Commonwealth Local Government Forum (CLGF) and Local Governments for Sustainability (Kanuri et al., 2016). Significant legal instruments of sustainable development, such as Agenda 21, Rio+20 Outcome Document and Sustainable Development Goals, referred sustainable development objectives of the large, poor, and growing cities of the developing world as well as of developed world cities (Respectively, Agenda 21: Programme of Action for Sustainable Development - UN Doc A/Conf.151/26, 1992, 14 June 1992; Outcome Document: The Future We Want, GA Res 66/288, UN GAOR, 66. sess, Agenda Item 19, UN Doc A/RES/66/288, 11 September 2012; Transforming our world: the 2030 Agenda for Sustainable Development UN Doc A/RES/70/1, 25 September 2015).

3. Methodology

The research is a doctrinal legal research. All relevant legal texts and materials are studied and a descriptive method is applied. The main question is "The factor of indeterminacy of the applied law is taken into account prevailing over the other methods such as analogy and deductive reasoning.

Limitations of the study*:* Primary legal texts are soft-law materials and the relevant law is, in many aspects, indeterminate.

Sample and Data Collection: The data were accessed on websites of international NGOs as well as in various institutional documents issued by the United Nations and doctrinal research.

Validity of the Research: Validity of this research can be measured in relation to other legal research in the area and applying a test of coherence of the legal reasoning and findings within this research.

3.1. Findings and Evaluations

Legitimacy is not a question for the NGOs that are established by elect city governments or municipalities. City administrations represent the community who live in the cities, therefore they provide legitimacy.

City governments or municipalities seek more autonomous position from the States while conducting their relations on international platform. This leads them to pursue funds from inter-governmental bodies such as World Bank or through foreign direct investments to improve the inadequate or outdated infrastructure in their cities.

The city administrations try to access the funds on international stage for some of the following major problems and needs that are all required for a sustainable city development, such as a healthy living environment; inclusive housing and social services; healthy air; protection and restoration of safe and green urban areas; affordable and sustainable transport and energy; creation of decent jobs; urban planning and improvement of slum areas; sustainable waste management; clean drinking water; sanitation; risk reduction in disasters and climate risks. The local achievement in these areas will have a positive impact on attaining the Sustainable Development Goals globally.

The funds provided by private sector leads to the privatization of the public services, which slowly but steadily leads to the privatization of local governments. However, this is not necessarily a negative outcome. Local authorities can still contribute to sustainable development in global scale through improving life quality in their cities in local level.

4. Conclusion

In this research it is observed that city governments or local authorities have a very significant role to play to achieve sustainable development in their cities. They are directly addressed in international instruments and required to promote sustainable urban development, which does not trade-off between economic, environmental and social aspects of development. The international NGOs, consist of cities, constitute an efficient and legitimate platform where they become visible on international stage in their endeavours to achieve sustainable development.

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Consideration of Ula (A Town in Muğla) As a Città Slow Within a Sustainability Concept

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Abstract

As a reflection of today's modern and fast lifestyle, immigration has increased to metropoles thus bringing along several problems like urbanization, air pollution and traffic with it. As a consequence of rapid population growth in big cities, rapid construction is causing environmental pollution and green areas are rapidly disappearing. For instance, a metropolis like Istanbul is forced to deal with fast and stressful living conditions. However, although the construction sector is nowadays popular, people living in big metropoles will gradually need to move to calmer towns and villages in the countryside, and thanks to technological advances in mobility this will happen more easily than ever. In other words, 'reverse immigration' from cities will begin. This is a process where a developing country, region or city producing migration begins to take immigration (İslamoğlu, Yıldırımalp and Benli, 2014:76: Chacko, 2007:131). According to İslamoğlu, Yıldırımalp and Benli (2014:76), reverse immigration is the result of developments in technology, the creation of new employment and growth opportunities in developing locations, and sustainable agricultural growth due to increases in rural employment and production.

In this research, geographical and cultural characteristics of the town of Ula will be examined and the opportunity of this town to gain a città slow (slow city) status will be evaluated. This town qualifying to become a città slow would also boost employment opportunities in its region. In this research, one or more of qualitative research methods will be deployed.

Keywords: Citta Slow, Slow City, Sustainability, Sustainable City, Ula, Seferihisar, Branding of a Town, Brand Evaluation of Ula.

1. Introduction

The purpose of this study is to offer an alternative model to the fast and stressful lifestyle of big metropoles, and to help brand unknown regions by giving them citta slow status, thus contributing to the preservation of historical and cultural values of our country at large. Based on this idea, Ula is selected as a pilot location to be examined for the suitability of the citta slow concept.

15 km away from the city centre of Muğla, Ula has unique geographical and cultural characteristics. This town is famous for its organic products like garlic, honey and *tarhana*, a dried food

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stuff made of curds and wheat flour. People of Ula are relatively old and provide for their transportation in the town with their bicycles. Ula's population also has a high literacy rate. Locals prepare their organic foods in summer for winter and socialize during the preparation process. Cookie tarhana is a locality specific to this town and is an important part of the preparation process. Locals have their unique customs and dialect too, and houses are built in an indigenous architectural style having even won international awards. The town is set on a large plain between two wooded hills.

Following the local elections in 2015 Muğla became a metropolitan city, rendering Ula a county and officially connecting it to the metropole. So Ula now has its borders extended to Gökova, including the città slow Akyaka, and qualifies as a county with seaside.

Equipped with all these natural, environmental, architectural and cultural values, the town of Ula appears eligible to become a città slow. Such a qualification would allow the town's natural, environmental, architectural and cultural values to be better preserved and its high quality of life to be sustained.

2. What is a Città Slow?

Terminologically, 'città' means 'city' in Italian and is derived from 'civitāte' in Latin, meaning 'a centre of social life, remarkable both for the number of inhabitants and for the ability to fulfil various economic, political, cultural, religious and other similar functions, expanded territorially, regulated in road and building development and provided by public services. (Zingarelli 1992:378) In this context, 'città slow' means 'slow city'.

As a natural extension of the slow food movement, città slow emerged in 1999 in Chianti-Greve, Italy as a reaction to the belief that while globalization facilitates communication, integration and evolution among people, it also drives uniformity leading to the creation of a single type of person and ultimately to banality. (Günerhan, Erdem & Günerhan, 2010:34)

The goal of this movement is to foster the development of places that enjoy a robust vitality based on good food, healthy environments, sustainable economies and the seasonality and traditional rhythms of community life (Knox, 2005:6). According to Kazançoğlu and Dirsehan, (2016, pp.142) slow urbanism promotes the provincial culture and a calmer life instead of the stress, mayhem, fast-paced life and quick consumption habits associated with fast food. Unal, (2016, pp.15) also argues that the città slow philosophy defends the experiencing of life at a pace where one can actually enjoy it.

Based in Orvieto Italy, the Città Slow Association is active around the world working to preserve and sustain the historic, cultural, social and environmental aspects of cities everywhere. Candidate cities are required to have a population of less than 50.000 for membership and have to comply with the 70 criteria specified by the association. These criteria are essentially grouped into 7 principles: infrastructure and environmental policies, increasing the quality of cities' urban texture, protection and support of local production, hospitality, awareness and support of slow food activities and projects (Keskin, 2012:91). In line with the criteria set by this organization, there are currently 236 cities in 30 countries around the world, of which 14 are in Turkey. The città slow members of Turkey are Akyaka, Eğirdir, Gerze, Gökçeada,

Göynük, Halfeti, Perşembe, Şavşat, Seferihisar, Vize, Taraklı, Uzundere, Yalvaç and Yenipazar (www.cittaslow.org).

3. Methodology

The research is an exploratory qualitative research in its nature since the research objectives are not investigated much in the literature, sustain due to their business capacity. During this research the town of Seferihisar in Izmir, Turkey's first qualified città slow, is referenced in order to examine the applicability of similar methods to Ula. Our main question is can one clearly observe that the firms surviving through the ages stress sustainability on a verbal level by content analyzing their web sites.

3.1. The Case of Seferihisar as Turkey's first citta slow

15 km away from the city centre of Izmir, Seferihisar represents a distinctive landscape with its natural features and its historical and archaeological sites. It is also a popular tourist destination that attracts many nearby visitors from Izmir. The town and its vicinity present a good blend of tangerine and olive farming, artichoke production, goat husbandry, and cheese making. The historical district of Seferihisar, Sığacık offers a weekly traditional farmer's market where the locals sell their handcrafts and agricultural products. (Çoskun Hepcan, Eser & Hepcan, 334-335).

Equipped with these natural, environmental, historical and cultural assets, Seferihisar became the first qualified città slow in Turkey in 2009. Evaluated according to 52 criteria under headings like infrastructure, environment, urban aesthetics, hospitality and slow food, the city achieved a 73% success rate against the required minimum of 50% and acquired the 'snail' logo of The Città Slow Association. (Şahinkaya, 2010:14)

Under this città slow status, as Şahinkaya, (2010, pp.15) also stated, numerous activities have since been carried out such as encouragement of local production, establishment of a village market, creation of gardens for children to learn organic agriculture, removal of TV antennae, planting of geraniums on the windows and balconies of houses, provision of solar lighting systems in city illumination, promotion of eco-tourism instead of mass and all inclusive tourism, and construction of boutique hotels in harmony with the natural and historical fabric of the city's architecture.

Having joined the Città slow network, Seferihisar became a centre of interest and was considered a fine example of implementing some alternative development strategies in order to create a more livable and sustainable environment in the country. (Çoskun Hepcan, Eser & Hepcan, 334)

3.2. Relationship between Città Slow and Sustainability

Sustainability is defined as the retention of the human negative impact on the ecosystem at the level which should not exceed carrying capacity of the system, in order to transmit the non-renewable resource to future generations. (Keskin, 2012:83: Ercoşkun, 2007:9)

The concept of sustainability is based on 3 dimensions: economic, social and environmental. The environmental dimension of sustainability is closely related to environmental policies aimed at protecting the natural environment and is at the top of the città slow criteria. With the use of renewable energy

sources, the widespread use of recycled waste, the support of local production and the conservation of natural resources, it is possible to create sustainable slow cities with a high quality of life, by adhering to these criteria.

3.3. Different Aspects of Città Slow and Sustainability

Sustainability is not a one-dimensional concept. It should be examined together with multi-dimensional concepts such as social, economic and environmental. The environmental and social dimensions of sustainability seem to be more prominent in the exploratory survey we are going to make on Ula, within the framework of the città slow criteria protecting the architectural and cultural urban fabric and supporting local production.

4. Conclusion

The città slow movement is helping immensely to protect the natural, historical and cultural authenticity of cities and to transfer it to future generations in a globalized and industrialized world. Thus, it is possible for more cities in our country to earn this qualification and leave sustainable cities with a high quality of life to future generations.

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Recent Recycling Studies of Textile Fibers

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Abstract

There are three most important necessities to be alive for people: feeding, clothing, and sheltering. Therefore textiles which are basic materials to meet clothing, to cover some places and they have a great importance beside great consumption in the world. 7 Billion people live in the world, if every person is thought to give an average of 1 kg of textile waste per year, 7 billions kg of textile fiber waste / year is a very serious environmental problem in this world. Assessment of textile wastes has come to the agenda after 1980's, with increasing importance to environment, ecology, toxicology and public health issues.

Textile wastes occur at various stages and these textile wastes are evaluated in different ways.cotton, wool, linen, etc. natural fibers are produced naturally and they are biodegraded when they are thrown into nature at the end of their life cycle, they do not harm nature, they can sustain in nature when they are cultivated and bred.

Polyester, nylon and so on synthetic fibers are not biologically degraded easily, it takes for a long time about 300-400 years, when they are thrown into nature at the end of their life cycle, biodegraded products can be harmful to environment. If synthetic waste are recycled by extruding into fibers, they do not harm nature, thus sustainability of nature can be protected.

Key words: Textile fibers, textile waste, recycling of fibers, reuse of fibers, PET bottle recycling.

1. Introduction

The use of fossil fuels and the development of chemical industry since the industrial revolution of the 19th century, deteriorated environment and the ecological balance. Interest in the environment has increased considerably due to the ozone layer thinning, the melting of the glaciers, global warming, pollution of natural resources, deterioration of ecological balance. A wide environmental movement occurred since the 1980s, it has been initiated by scientific organizations, non- governmental organizations, and social media. Therefore, state governments, local governments have taken up this issue

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and started to issue laws and regulations related to environmental protection. Therefore, after the 1980s, the environmental factor began to take its place in all industrial production, textile as well. Western countries are ahead in this respect of environmental protection, while Eastern countries are far behind. Three aspects of environmental protection are considered during industrial production:

1-Prohibition of the use of toxic chemicals that damage the environment,

2-The preference of chemicals which can eliminate toxic effects after production,

3-Recycling of production wastes (Uygur, 1997).

There are three most important necessities to be alive for people: feeding, clothing, and sheltering. Therefore textiles which are basic materials to meet clothing, to cover some places and they have a great importance in the world together with great consumption in the world. 7.5billions people live in the world, if every person gives an average of 1 kg of textile wastes after usage per year, 7.5 billion kg of textile wastes per year occur which is a very serious environmental problem in the world. In the clothing industry, green textiles that do not harm nature have been encouraged for a while, biodegradable natural fibers have been preferred in garments, fiber types that do not harm the environment have been encouraged. Assessment of textile wastes has come to the agenda after 1980's, with increasing importance to environment, ecology, toxicology, public health, social and economical life issues (Watson, 1991).

Nowadays, natural resources are limited and recycling studies are becoming more and more widespread that the recovery of every substance consumed is important in protecting the environment. Textile wastes occurred at various stages of textile production, so some recycling studies on these materials will help the environmental protection beside the sustainability.

2. Textile Fiber Wastes

Wastes occurred as fibers or fabrics; as chemicals used in textile finishing: for example, sizing chemicals, indigo dyes, etc.; as waste waters; as used textile products in life cycle of textiles in textile area. Textile waste fibers and fabrics occurred in various stages of textile production:

1 –Staple fiber dusts are poured under the machines during the production stages of yarn, woven-knitted fabrics from fibers. At the same time, fiber dusts are spread into the air and are sucked by aspirators and these fibers are also waste fibers. These fiber dusts are sent either to the recycling system according to the quality or the regenerated fiber production system or destroyed by burning or removed as landfill.

Filament fibers do not leave fiber wastes during the production stages of yarn, woven-knitted fabrics.

2-During the finishing treatments, some of the loose staple fibers are leaving the yarns, fabrics and pass to the wastewater. These waste fibers have been filtered out, and then they are sent either to the recycling system or the regenerated fiber production system or destroyed by burning or removed as landfill. In addition, erroneously dyed or printed textile products, printing lining etc. are considered as waste and can be sent to recycling treatments.

3- During the production of garments, approximately 10 % fabric remained as waste after cutting process. They are used as baby clothes of toys, buckles, applique materials, patchworks etc. The wastes from here are also converted into recycling systems. Cotton fiber wastes during cotton fabric production to produce a bathrobe made of cotton is given in the Table 1 (Güngör et all, 2009).

Table 1. *Cotton fiber wastes during the production of a bathrobe made of cotton*

Picked cotton	After gin	After yarn	After weaving	After finishing	Confection
6000 g	2453 g	2096 g	1972 g	1764 g	1500 g
Cotton waste	3547 g (cotton seed)	357g	124 g	208 g	264 g
Cotton waste %	% 59	% 6	% 2	% 3,5	% 4,4

It is suggested that the large amount of waste occurs after gin process since the existence of seeds; and the high amount of waste is obtained during yarn process, confection process, finishing process, weaving process successively. 4. After the textiles are used by consumers for a while, body becoming smaller, fading, tearing, old fashioned etc. , they convert to waste. Textile consumption per capita per year in the European Union is 15 kg / year, leading to textile waste generation of more than 5 millions in EU countries per year. The textile products used in these countries are processed as follows.

a) Used textile products that can be worn are either sold as second hand in lower income people or sent to The 3rd World countries.

b) Used textile products are either transformed into new models, etc. or converted into another textile product e.g. from old blouse, skirt, etc. to bags, short skirt and so on.

c) Disposed textile products are used for different purposes such as wipers, cleaning cloths, covers, isolation materials etc.

d)Used textile products that are lost wearable property are either burned or disposed of as landfill

e) Used textile products are recycled into fibers by tearing machines.

1-Recycled fibers can be used in the textile industry for the production of low quality blankets, cleaning, wiping cloths, paper (non-woven surface) or insulation materials.

2-Automotive, construction, entertainment etc. sectors as filling or insulation materials (Annex 1997; Groot, 1997).

The world and US textile waste in 2015 and the prediction in 2030 are given in Table 4 (Textile Exchange 2017).

Table 3. *The world and US textile waste in 2015 and the prediction in 2030*

Waste	2015	2030
World textile waste (Million tons) MT	92	148
US textile waste (Million tons) MT	12	40

It is suggested that 20% of textile waste is collected for reuse or recycle in US in 2015. Most of textile wastes are incinerated or landfilled. Textile waste between 2000-2014 in US is given in Table 4 (Textile Exchange 2017).

Table 4. *US Textile waste in2000 and in 2014*

Waste	2000	2014
Textile waste (Million tons) MT	9.5	16.2
Per capita generation lbs/pp/yr	67	102

It is suggested that average 16 % of textile waste/ year is collected for reuse or recycle in 2000 and in 2014. 84% Textile waste is incinerated or landfilled, 19 % of it is incinerated one.

f) Recovering polymers such as PET bottles etc. by re-melting and extruding them into fibers. Synthetic fibers such as polyamide, polyester, polyethylene, polyurethane, etc. are thermoplastic materials and fibers. Thermoplastic materials are melted at their own melting points, and these melted polymers can be extruded into textile fibers. Natural fibers such as cotton, linen, wool, etc. and regenerated fibers such as viscose rayon, casein etc. cannot be melted since they have no thermoplastic properties therefore they cannot be extruded into fibers.

Polyester, nylon and so on synthetic fibers are not biologically degraded easily, it takes for a long time about 300-400 years, when they are thrown into nature at the end of their life cycle, and biodegraded products can be harmful to environment. If synthetic fibers waste are recycled by extruding into fibers, they do not harm nature, thus sustainability of nature can be protected. Cotton, wool, linen, etc. natural fibers are produced naturally and they are biodegraded when they are thrown into nature at the end of their life cycle, they do not harm nature, they can sustain in nature when they are cultivated and bred.

Legislation is being drafted in the EU to increase the collection of used textile products in some countries. In Germany, for example, the law introduced on 7th of October 1996 has given a considerable prevention of the wastes. Waste that cannot be formally prevented is recycled. The law also provides for the replacement of recycled materials by preserving the quality standards of the first raw materials used in production (Maetschke et all, 1997).

3. Recycle Methods of Textile Wastes

Recycling of textile fibers has been known for about 150 years and textile fibers have been recovered from used products for economic reasons that were initially turned around. Nowadays, recycled fibers gain importance with environmental awareness. In countries such as England, Italy, India, Turkey, there are recovery franchises of textile products. Recycled fibers are used in the production of lower quality products (Watson, 1991).European Union waste clothes in 1997 given in Table 2 (Groot, 1997).

Table 2. *European Union waste clothes, textiles in 1997*

EU	Waste clothes	Recycled	Converted to various products	Exported to 3rd world countries	Burnt or landfilled

Million tons (MT)	5.8 MT	1.5 MT	0.5 MT	1 MT	4.3 MT

It is suggested that 75% of collected clothes are burnt; only 25% of collected clothes are recycled in 1997. There are mechanical and thermal energy recycles processes of textile wastes.

3.1. Mechanical Recycle

After the used textiles such as garments, covers, carpets etc. are passed through the appropriate processes; they are given to the tearing machines and broken up to their fibers. Uniform mechanical fragmentation unit for all products may not provide the same efficiency of recycle capability. With the flexible process scale and various adaptations, mechanical disintegration devices are being developed which give successful results in different textile products. Mechanical recycle of used textile products takes place in the following stages.

a) Collection of used textile products in a center: Collecting waste from the consumers requires a serious work. The environmental conditions such as storage conditions, for example rain play an important role on decaying textiles. It has been reported that around 35 % of used textiles in Europe are collected (Maetschke et all, 1997).

b) Classification of collected textile products: Collected textile products are classified on fiber type, color, texture type, fabric weight and so on. Due to the complex structure and characteristics of used textile products, it is difficult to classify them. This stage requires manual labor which affects cost considerably, but in recent years, automatic classification studies are also performed. Previous classification is important since it is furthermore important to correctly classify the recycled textile fibers to be used in the various field of textiles.

c) Cleaning, washing of classified textile products: It is necessary to clean or disinfect the impurities of used textile waste. This can be applied before or after classifying operations. Brushing or washing treatments can also be commonly applied for this stage.

d) Disintegration of cleaned textile products in the mechanical tearing device: Various fabric and garment products in different structures require different mechanical shredding levels in order to obtain recycled fibers. Each raw used textile product can be opened and broken up into single fibers. This means very high machine use, energy consumption, and fiber damage. Some adaptations in the tearing machines are exploring the possibility of successful disintegration of different products. The disintegration process involves cutting, separating, and tearing steps, so that the textile product is transformed into fabric pieces, yarn pieces, and fibers, respectively.

The cutting process results in an incomplete pre-disintegration of the textile waste and this process prepares the waste for the tearing (opening) process. Cutting process shortens the length of the fibers in the used textile products, which reduces the quality of the recycled fiber material. The first fiber shortening in the recycling process occurs during cutting process.

Separation process separates garment accessories such as buttons, zippers etc. which can be used on used textile products. These accessories create problems in tearing operation, reducing the quality of the recycled fibers and making the applications difficult, so they need to be separated after the cutting process. The buttons are usually made of metal or plastic, so they can be separated manually or automatically by means of a collector. The centrifugal and wind principle is used in automatic separators.

Opening process: During the tearing process, the cut fabric pieces are torn and converted into fibers by a specially prepared mechanism. During the tearing process, critical fiber shortening occurs, and this shortening is also related to the strength of the fibers and the structure of the used textile product. For example, strongly twisted yarns tearing and opening is more difficult than that of loose twisted yarns. For different textile products, it is possible to make changes in the number of rollers, at the speed of the rollers, in the process which gives the materials to the machine. Even though the cut fabric pieces in all of today's tearing machines are separated from the fibers in the first rollers, the entire process takes over from the trunks, resulting in an unnecessarily shortening the length of the fibers. In the future, adaptation of the development tearing machines to the material to be recycled, and the formation of fully opened fibers after each cylinder, must be developed.

e) Classification of recycled textile fibers: The properties of the recycled textile fibers for further processing have great importance; they are classified according to their general characteristics such as fiber type, color, length, fineness etc. Each classification includes a wide variety of subclasses that make it difficult for the specific use of the recycled fibers (Maetschke, 1997; Balkan, 2017). Textile wastes and tearing machine are given in Figure 1, 2 (Marlasca, 2017).

Figure 1. Textile waste Figure 2. Tearing machine

3.2. Recycle by melting

It is suitable only for the evaluation of synthetic fibers, synthetic materials which have thermoplastic property and which do not contain much impurity, but not suitable for natural fibers which have no thermoplastic property. For example, recycled polyester fibers from polyester bottles is performed by melting process. Significantly, the selective collection of plastics in Europe continues to increase. In 2011, a total of 6.3 million tons of plastics was collected selectively, of which 5.2 million tons was packaging (Recycling plastic, 2017). Plastics are sorted into their polymer type such as PET, PE, PVC, PP, PA, PS etc.

Then they are cut and paper labels are removed, adhesives, and other dirtiness materials, washed, dried, and shredded into small pellet. Pellet form of plastic can be recycled or can be mixed virgin polymer and then it is extruded into fibers, sheets, etc. after melting process. This process reduces PET waste, environmental pollution, and quite easy. Energy, time, place, cost is saved, it is suggested that recycling PET requires up 60% less energy than producing new PET (Plastic recycling, (2017), (Preventing pack,

2017) . Plastic bottles and recycling by melting process (extrusion process) are shown in Figures 3,4. (Plastic bottles, 2017; Xinrongpm, 2017).

Figure 3. Plastic bottles to be recycled

Figure 4. Recycling by melting process

4. The Usage of Recycled Fibers

Recycled fibers are used in textile and non-textile areas. The usage in textile areas is

The Production of non-woven fabric: Recycled fibers are commonly used nowadays in the production of glued nonwoven fabrics. In spite of some deficiencies, the glued nonwoven fabrics are well suited for the use of different sized fibers produced from tearing machine in loose pieces, yarn fragments, short fibers etc. Further research into the production of nonwoven fabrics should be on reinforced fabrics. It is possible to expand the product range through the complementary thermal process for fabrics made from recycled-glued fibers containing adhesive chemicals.

Yarn and fabric production: Recycled fibers are converted to yarns, to woven, knitted fabrics, and other structures by processing these yarns. It is important the mixing ratio, homogenity, fiber structure, tearing / opening degree, fiber length, dirtiness etc. of recycled fibers in the spinning, bending process. It has been reported that the most suitable technique for yarn production from recycled fibers is OE (open end) rotor spinning (Maetschke et al., 2977). The most important problem in this stage is the non-textile impurity materials which can cause problems in the spinning machines, if necessary further processing, and further investigations should be done in this regard. Recycled fabrics can be used in the technical textiles (filters, etc.), in the home textiles (blankets, upholstery, carpet, carpet lining, etc.), in the clothing textiles (cardigans, sweaters, jackets, etc.), in health care textiles (towel, cleaning and wiper materials, etc.). The new untreated fibers are mixed with recycled fibers at specific ratios to produce more durable, lower cost textile products. It is also used into produce flock dust for flock printing.

The use in non-textile areas

Recycled fibers are also used in the field of non-textile areas. These sectors are mainly the paper industry, automotive industry (insulating felts, filling materials, etc.), the construction industry (insulation felts, construction filling materials, etc.), the machinery industry (ropes, conveyor belts, etc.), the agro-industry (artificial soil, various binding yarns, etc.) (Watson 1991; Groot H. 1997).

5. Conclusion

The use of recycled fibers has both economic and ecological importance. When considered from an economical point view: a) Waste costs are reduced by re-use of production wastes in textile or non-textile areas. b) Recycled fibers are cheaper than new fibers, resulting in lower cost of new products.

When considered from an ecological point of view: a) The natural ecological balance will be preserved since a large amount of textile waste will be reduced to discharge to large waste areas. b) During the production of new textile fibers, environmental pollution occurs more or less from waste dyes, wastewater, used energy. The use of recycled fibers will also protect the environment as environmental pollution that occurs during fiber production. Water saving is also provided.

The major disadvantages of the recycled fibers are that their fiber lengths and fiber strength are impaired and that the fiber mixtures are not always at a certain rate, fineness, standard type of fiber. They are also generally in various colors since they are obtained from colored textile products and do not have a specific color standard.

Recycling textile products will help sustainability of natural sources in the world since textiles are among three leading requirements of people in the world that are used in a large amount. Collaborations must be increased between governments, NGO's, social media, textile producers, consumers on environmental issues by considering their responsibilities in environmental protection, reuse, recycling which help sustainability.

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Performance Evaluation of Refrigerants Used in a Flash-System Refrigeration with Regarding to Environmental Aspects

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Abstract

In the present study, the mathematical model described a flash-system is implemented in EES in order to evaluate the different operating parameters on the coefficient of performance (COP). In addition, in order to realize an environmentally friendly refrigeration flash-system, NH_3, R290, R134a and R404A of refrigerants are examined. The operating conditions are chosen to represent low and medium cooling temperature applications. The evaporation temperatures (T_E) of low temperature cycle are considered to be -40°C, -35°C, -30°C, -25°C, -20°, -15°C and -10°C. The condensing temperature of high temperature cycle (T_C) is varied evenly between 30°C and 50°C in order to investigate effect of the ambient conditions. At a given low and high temperature values, the corresponding low and high pressure values are calculated for various refrigerants. In addition, the optimum intermediate pressure values (P_{int}) which maximize the COPs are determined for each studied refrigerants such as NH3, R290, R134a and R404a. Furthermore, mass flow rate requirements of system for different evaporation capacity of the evaporators, Q_{evap}, are computed and compared for various refrigerants.

Keywords: Flash System, Global Warming Potential, Ozone Depletion Potential, Natural Refrigerants, Performance Coefficient

1. Introduction

Chlorofluorocarbons (CFC) and hydro-chlorofluorocarbons (HCFC) are being replaced by natural refrigerants due to the environmental considerations. Applications with natural refrigerants such as ammonia, propane, carbon dioxide etc. are increasingly preferred in low temperature refrigeration

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applications. Mainly, In order to decide the environmentally friendly and efficient refrigerant in the application, along with the design conditions, other important characteristics such as toxicity, flammability, ODP, GWP etc. should be also taken into account.

2. Thermodynamic Analysis of a Flash-System

The schematic diagram of a two stage flash-system cycle is shown in Figure 1a. The main components of this cycle are the first stage compressor (low temperature cycle), evaporator, expansion valve 1, the second stage compressor (high temperature cycle), condenser, expansion valve 2. A flash tank is located between the high and low temperature cycles. The use of flash tank provides reducing the mass flow rate of steam coming to the evaporator. Consequently, optimizing of the evaporator size can be possible in refrigeration applications. In addition, the flash tank between these cycles can supply either saturated vapor or saturated liquid-vapor to the mixing point between the compression stages; this provides more flexibility to control operating conditions of the cycle.

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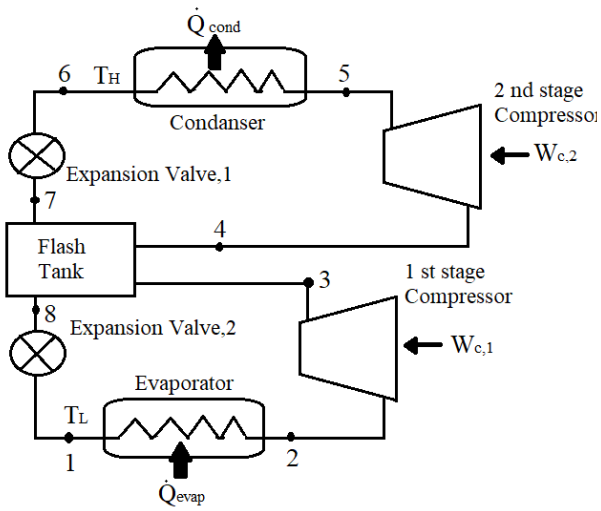

Figure 1(a): Schematic view of the two-stage flash refrigeration system

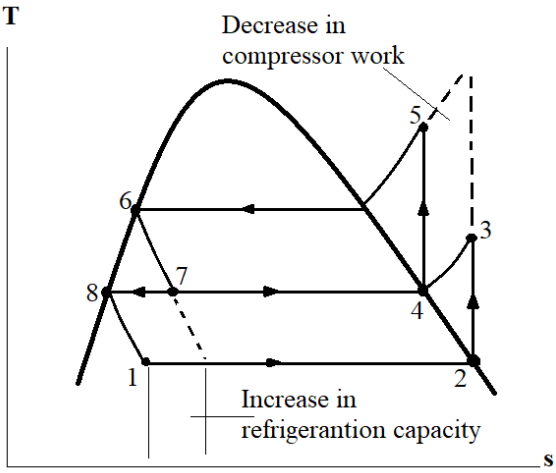

Figure 1(b): T-s diagram of the system

The thermodynamic model of the two stage flash-system is developed using first law of thermodynamics. Mass and energy equations are derived for both low and high temperature cycles. In this study, considering the schematic and the state points of Figure 1a and 1b, the following equations are developed for the analysis.

3. Environmental Analysis

Two major parameters GWP and ODP are used in evaluating the trace of refrigerants on the environment. One kg of R404A has a GWP of 3800, one kg of R134A has a GWP of 1370, one kg of NH3 has a GWP of 1 and one kg of R290 has a GWP of 20. In addition, ODP value is zero for R404A, R134a, NH_3 and R290 (Lemmon et al.). These values showed that true selection of environmentally friendly refrigerant is crucial to reduce the harmful effects of them on the environment and to decrease contribution to the global warming. The properties of refrigerants considered in this study can be seen in Table 1.

Table 1: *Thermo-physical and environmental properties of refrigerants (UNEP and Lemmon et al., 2007)*

	NH_3 (R717)	R134a	R404A	R290
Classification of refrigerants	Natural	HFC	HFC	HC
Critical Temperature (^oC)	132.3	101.1	72	96.7
Critical Pressure (MPa)	11.33	4.05	3.731	4.25
ODP	0	0	0	0
GWP	1	1370	3700	∼20

4. Results and Discussion

Influence of several parameters on the flash system performance is investigated using the developed mathematical method. Initially, the effect of intermediate pressure on the system performance has been examined. Secondly, an influence of different operating conditions in terms of evaporation (T_L) ad condensation (T_H) temperatures is considered. The evaporator capacity also has been varied for scaling up the system. Finally, the evaluation of selected refrigerants with regard to environmental protection is presented.

Table 2: *Optimum intermediate pressure values (P_{int}) which maximize the COP.*

		T_L (°C)						
		-40	**-35**	**-30**	**-25**	**-20**	**-15**	**-10**
NH_3	**P_L (kPa)**	-	-	-	**119.4**	**151.5**	**190.1**	**236.2**
	P_{int} (kPa)	-	-	-	**618.9**	**682.7**	**750.1**	**821.2**
	COP	-	-	-	**1.66**	**1.83**	**2.03**	**2.25**
	P_H (kPa)	**2253**						
R134a	**P_L (kPa)**	-	-	-	-	**106.5**	**132.8**	**164.1**
	P_{int} (kPa)	-	-	-	-	**526.2**	**564.2**	**604.3**
	COP	-	-	-	-	**1.75**	**1.93**	**2.14**
	P_H (kPa)	**1318**						
R404a	**P_L (kPa)**	**105.1**	**132.7**	**165.6**	**204.5**	**250.1**	**303.0**	**364.1**
	P_{int} (kPa)	**864.0**	**915.2**	**968.8**	**1025**	**1084**	**1146**	**1211**
	COP	**1.04**	**1.14**	**1.25**	**1.38**	**1.52**	**1.69**	**1.88**
	P_H (kPa)	**2295**						
R290	**P_L (kPa)**	-	**111.0**	**137.2**	**167.8**	**203.4**	**244.5**	**291.6**
	P_{int} (kPa)	-	**663.1**	**703.7**	**746.3**	**790.9**	**837.8**	**886.8**
	COP	-	**1.30**	**1.42**	**1.56**	**1.71**	**1.89**	**2.1**
	P_H (kPa)	**1867**						

Effect of the refrigerants to the environment

In this part of the study, the effect of using different refrigerants on the system performance and the environment has been investigated. The calculated COP values of the flash-system, GWPs of the studied refrigerants and refrigerant charge requirements are given in Table 4. In addition, GWPs of refrigerants have been examined for the leakage of the refrigerant to the atmosphere. The charge amount of NH3 is assumed to be a reference value, 1 kg, for evaporation capacity (Q_{Evap}) of 5250 W. Accordingly, mass flow rates with other refrigerants; R290, R134a and R404a are calculated to compute the charged refrigerant amount of the flash system.

Table 4: *Charge requirements, GWPs of the used refrigerants and COPs of the flash-system*

Refrigerants	NH_3	R290	R134a	R404a
Refrigerant charge (kg)	m_{NH3}=1	m_{R290}=1.086	m_{R134a}=1.195	m_{R404a}=1.308
GWP	GWP_{NH3}=0	GWP_{R290}=3	GWP_{R134a}=1300	GWP_{R404a}=3780
Total GWP	GWP=0	GWP=3,27	GWP=1559	GWP=4944
COP	1.83	1.71	1.75	1.52

5. Conclusion

In this study, the performance of the selected refrigerants, NH_3, R290, R134a and R404A, are evaluated in a flash-refrigeration system with respect to energy efficiency and environmental considerations. For the studied system, the natural refrigerant NH_3 results in the highest COP value and the best environmentally friendly performance as compared to other refrigerants. It is also found that the COP of R404A is lowest. While COP values of R290 and R134a are similar, the GWP values of them are highly different. The difference between the R134a and the R290 is calculated to be 1297.

Consequently, it is observed that there is not an ideal refrigerant which works in a wide range of evaporation temperatures and satisfies all efficiency and environmental requirements. However, natural refrigerants can be utilized with high efficiencies at moderate evaporation temperature applications.

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Role of Hydrogen as a Fuel for Sustainable Transportation

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Abstract

Hydrogen is seen as the major component of future sustainable energy systems. Transportation sector is one of the largest consumers of the global energy market. Hydrogen can become a promising fuel for sustainable transportation by providing clean, reliable, safe, convenient, customer friendly, and affordable energy. In this study, the possibility of hydrogen as the major fuel of future transportation systems has been investigated comprehensively based on the recent studies published in the literature. Due to its several characteristic advantages such as energy density, abundance, ease of transportation, a wide variety of production methods from clean and renewable fuels with zero or minimal emissions; hydrogen is a great chemical fuel which can potentially replace fossil fuel use in internal combustion engines. In order to take advantage of hydrogen as an internal combustion engine fuel, existing engines should be redesigned to avoid abnormal combustion. Hydrogen use in internal combustion engines could enhance system efficiencies, offer higher power outputs per vehicle, and emit lower amounts of greenhouse gases. Even though hydrogen powered fuel cells have lower emissions than internal combustion engines, they require additional space and weight and they are generally more expensive. Therefore, the scope of this study is hydrogen fuelled internal combustion engines. It is also highlighted that in order to become a truly sustainable and clean fuel, hydrogen should be produced from renewable energy and material resources with zero or minimal emissions at high efficiencies.

Keywords: Hydrogen, Fuel, Sustainability, Internal Combustion Engine, Transportation, Energy

1. Introduction

Continuous increase in worldwide population and rise in living standards are the two major reasons behind escalating global energy demand (Acar et al., 2016). Currently, this energy demand is heavily met by fossil fuels which are known to have some significant disadvantages (Cammack et al., 2015). These disadvantages can be listed as their limited reserves and nonhomogeneous distribution of these reserves, increase in prices with political uncertainties or with rapid consumption of easily accessible reserves, and greenhouse gas emissions which are known to be the primary contributor of global climate crisis (Acar and Dincer, 2017a; Dutta, 2014).

Hydrogen is seen as a potential candidate to replace fossil fuel use in future energy systems to provide enhanced energy security and better price control by taking advantage of renewable and abundant energy and material resources (Dincer and Acar, 2016). In addition, hydrogen can help solve some of the significant environmental and societal problems caused by extensive fossil fuel use, such as climate change and local air pollution (Cipriani et al., 2014). These problems strongly stimulate the research, development and demonstrations of clean and sustainable energy systems from energy and

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material resources to energy conversion and distribution systems including energy carriers (Dincer and Acar, 2017). As one of the heavy consumers of global energy supply, transportation industry requires transition from traditional to smart energy systems and hydrogen is a very good candidate for the sustainable future of the transportation industry (Sherif et al., 2014; Acar and Dincer, 2013).

Recent studies have shown that hydrogen is one of the most promising energy carriers to replace fossil fuels, however, further research is needed to expose its advantages and disadvantages of hydrogen as an alternative fuel before it could fully be commercialized (Salvi and Subramanian, 2015). Hydrogen is the cleanest fuel having a heating value three times higher than petroleum (Acar and Dincer, 2017b). However, hydrogen is not a natural source of energy, therefore, it requires to be processed by using a variety of energy and material resources (Ehret and Bonhoff, 2015). As a result, production costs of hydrogen is quite high, which is almost three times more expensive compared to fossil fuels (Acar et al., 2015; AlRafea et al., 2016).

There are still problems in the realization of the renewed hydrogen from water, but the market supply and the cost of hydrogen do not constitute the bottleneck of hydrogen vehicles today although the hydrogen used presently may not be renewed (Acar and Dincer, 2014). But, hydrogen's excellent characters, studying the availability of H_2 in internal combustion engines (ICE), and investigating the performance of hydrogen fueled engines, become one of the utmost important research directions in the recent literature (Larsson et al., 2015; Amoo et al., 2014).

For all the reasons mentioned above, the primary aim of this study is to review and investigate most recent hydrogen fueled ICE analyses and comparatively assess some novel alternatives in order to propose hydrogen as a potential major fuel of the sustainable future. In this study, hydrogen is investigated in internal combustion engines and in fuel cell vehicles. The aim of this study is to review hydrogen as a fuel for internal combustion engines for the vehicle propulsion in terms of advantages, disadvantages and fundamentals of hydrogen engines. Whereas for vehicle fuel cells the study focuses on performances, cost, infrastructure, type of storage and type of productions in hydrogen.

2. Literature Review

In this section, several aspects that are related to the use of hydrogen as a fuel in internal combustion engines is discussed in detail. This discussion includes properties of combustive hydrogen, abnormal combustion in hydrogen engines, engine components, thermal efficiency, emissions, power output, and system costs.

Hydrogen can be used in spark ignition (SI) engines via the following three methods:

i. *Manifold induction*: Cold hydrogen is introduced through a valve controlled passage into the manifold.

ii. *Direct introduction of hydrogen into the cylinder*: Hydrogen is stored in the liquid form, in a cryogenic cylinder. A pump sends this liquid through a small heat exchanger where it is converted into cold hydrogen gas. Hydrogen flow is monitored and controlled in this unit. The reason of using cold hydrogen is to prevent pre-ignition and reduce NO_x formation.

iii. *Gasoline supplement*: Hydrogen can also be used as an add-on fuel to gasoline in SI engines. In this system, hydrogen is inducted along with gasoline, compressed and ignited by a spark.

In this section, a brief summary of the most recent available literature data are reviewed and discussed in order to understand the fundamentals of hydrogen combustion, flammability, ignition energy and octane number. Details of these characteristics to hydrogen engines based on recent studies as well as on-going efforts in the development of hydrogen fueled internal combustion engines (H_2ICEs) are also discussed in this section. Some characteristic properties of hydrogen are listed in Table 1 in comparison with iso-octane and methane, which are representing as the natural gas and gasoline, respectively.

Flammability limit gives the proportion of combustible gases in a mixture; between these limits, this mixture is flammable. From Table 1, it can be seen that the flammability of hydrogen in air (mixture) is at 4–75% which gives hydrogen wide range of flammability as compared to other fuels (Diéguez et al., 2014). It is clear that 4% of hydrogen in air is still flammable but non-coherently and burns incompletely. The 4% value relates to configuration of one particular experiment. Therefore, the limit may vary being below 4% or above, (depending on condition), in real-world situations. For safety considerations this limit is important where it is less important for engine combustion (Noor et al., 2014). Wide ranges of mixture of hydrogen permit extremely lean or rich mixture that combust with air. This makes the hydrogen engine operate at lean mixture resulting in greater fuel economy and more complete combustion reaction (Talibi et al., 2017).

Table 1. Comparison of main characteristic properties of hydrogen, methane, and iso-octane at 27°C and 1 atm.

Property	*Hydrogen*	*Methane*	*Iso-octane*
Molecular weight (g/mol)	*2.016*	*16.043*	*114.236*
Density (kg/m^3)	*0.08*	*0.65*	*692*
Mass diffusivity in air (cm^2/s)	*0.61*	*0.16*	*0.07*
Minimum ignition energy (mJ)	*0.02*	*0.28*	*0.28*
Minimum quenching distance (mm)	*0.64*	*2.03*	*3.5*
Flammability limits in air (vol. %)	*4-75*	*5-15*	*1.1-6*
Lower heating value (MJ/kg)	*120*	*50*	*44.3*
Auto ignition temperature in air (°C)	*585*	*450*	*277*
Flame velocity (m/s)	*1.85*	*0.38*	*0.37-0.43*
Higher heating value (MJ/kg)	*142*	*55.5*	*47.8*
Stoichiometric air to fuel ratio (kg/kg)	*34.2*	*17.1*	*15*
Stoichiometric air to fuel ratio (kmol/kmol)	*2.387*	*9.547*	*59.666*

Source: Das (2016)

3. Comparative Assessment of Selected Vehicles

In this section, environmental, economic, and thermodynamic performance of conventional, hybrid, electric, and hydrogen fueled vehicles are presented.

3.1. Environmental Impact Comparison

Because of their negative impact on the environment, CO_2 emissions are considered to be the primary GHGs. Reducing CO_2 emissions is one of the issues that needs to be addressed by the future energy carrier. Managing CO_2 either as a waste or as commodity for another purpose and Carbon Capture and Sequestration (CCS) are some of the methods to avoid the CO_2 emissions. In 2001, The Center of Environmental Science of Leiden University published the "operational guide to the ISO standards" to describe the LCA procedures according to ISO standards. The environmental impact categories are selected based on this operational guide. In this study, global warming potential (GWP) and acidification potential (AP) are used to evaluate the environmental impact of selected vehicles. GWP (kg CO_2 eq. per 100 km of travel) is a measure of CO_2 emissions and AP (kg SO_2 eq. per 100 km of travel) indicates SO_2 discharge on soil and into water. The environmental impact results of selected vehicles, in terms of GWP and AP, are presented in Figure 1. Conventional (i.e., fossil fuel powered ICE) vehicles are seen to be most environmentally harmful vehicle types. From Figure 1, it can be seen that electric vehicles are the most environmentally benign of the selected vehicles, in terms of CO_2 emissions and acidification potential. Hydrogen fueled internal combustion engines (H2ICE) are more environmentally benign in terms of CO_2 emissions, while fuel cells have better performance in terms of acidification potential.

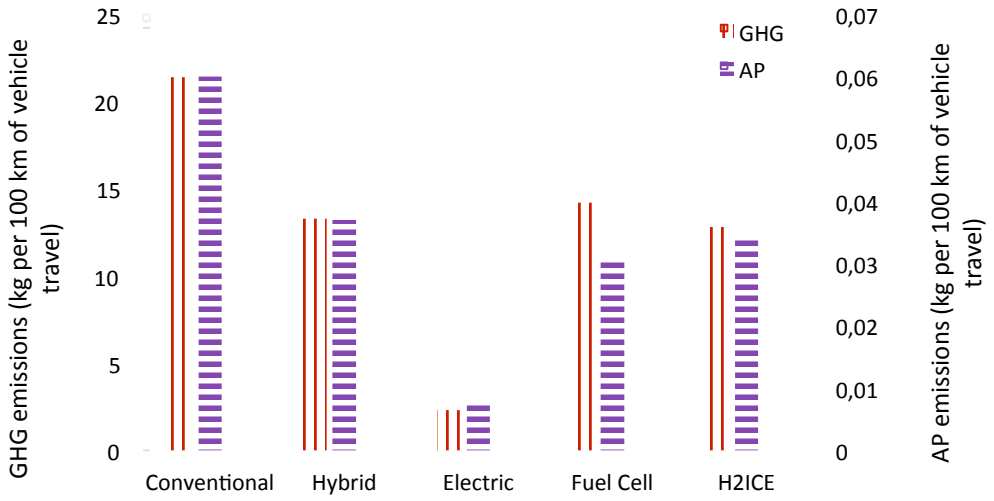

Figure 1. *GWP and AP of selected vahicles (Data from Nanaki and Koroneos,.2013).*

3.2. Social Cost of Carbon Comparison

The social cost of carbon (SCC) is a measure of the marginal external cost of a unit of CO_2 emissions, due to the environmental damages caused by that emission. An integrated assessment modeling (IAM) framework is used to estimate the value of SCC. This framework uses a baseline socio-economic scenario,

a model that identifies the relationship between emissions and temperature change, and a function to relate this temperature change to economic damages. In this study, an average of 160 USD per tonne of CO_2 emissions is used as the base of SCC calculations. The results presented in Figure 2 shows that electric vehicles are the most advantageous processes and conventional (i.e., fossil fuel powered ICE) vehicles are seen to be the most harmful.

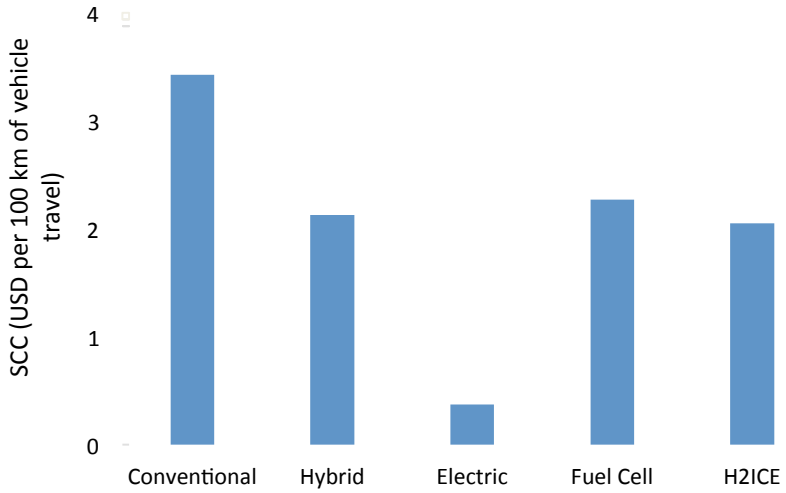

Figure 2. *SCC of selected vahicles.*

3.3. Energy and Exergy Efficiency Comparison

The literature reviews performed by Onat et al. (2015) and Reichmuth et al. (2013) are used as a basis to present the energy and exergy efficiencies of selected vehicles. Here, efficiency is defined as desired product output per unit of consumed input. Both the output and inputs are expressed in terms of energy in energy efficiency, while for exergy efficiency they are expressed in terms of exergy. Figure 3 presents the energy and exergy efficiency data of selected vehicles from which it can be seen that in terms of energy and exergy efficiencies, biomass gasification has an advantage compared to other methods. On the other hand, solar based electrolysis shows the poorest performance compared to the selected production methods.

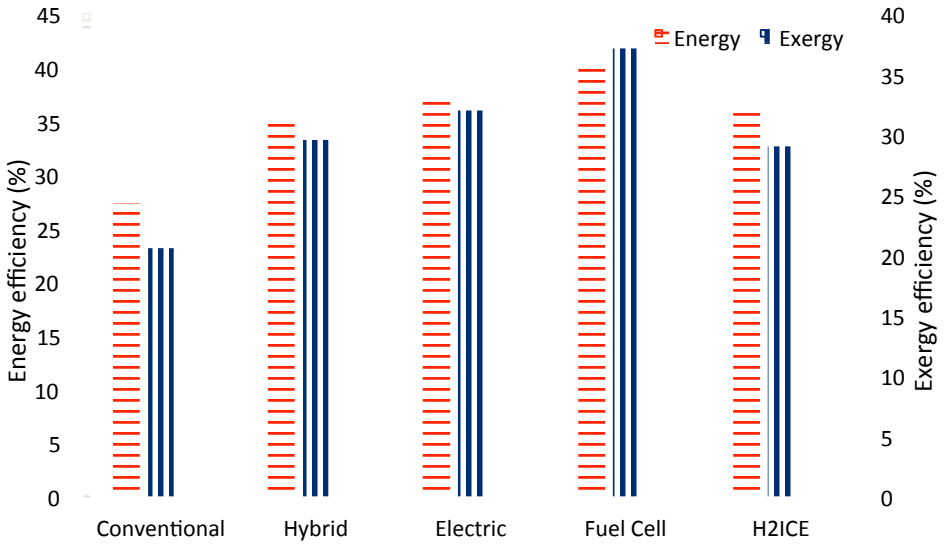

Figure 3. *Energy and exergy efficiencies of selected vahicles.*

4. Conclusions

The crucial outcomes of this study are summarized below:

• Hydrogen in internal combustion engines has many advantages in terms of combustive properties but it needs detailed consideration of engine design to avoid abnormal combustion, which is the major problem in hydrogen engine. This, as a result can improve engine efficiency, power output and reduce NO_x emissions.

• In fuel cell vehicles, the hydrogen purity can affect the performance of the fuel cell vehicles. This impurity comes from the poisoning of the Sulphur during production process. From the environmental aspects, the emission of fuel cell is low as compared to conventional vehicles but as penalty, fuel cell vehicles need additional space and weight to install the battery and storage tank, thus increases it production cost.

• The cost and also the efficiency of the hydrogen plant depend on the electricity tariff and the sources for producing hydrogen. If the location is near with its natural resources, it will help in reducing its cost, so for the development of hydrogen plant, location with its sources should be considered.

• There are many ways to generate hydrogen as an energy carrier and the sources are in abundance. Mainly it is produced from fossil fuels and as by-product hydrogen in chemical processes. Different types of hydrogen productions have their own source and it varies in terms of system applications as well.

• The best method to produce hydrogen is the one which has simplest process, easily to get the main sources, low cost and environmentally safe.

• The study in the production methods, vehicle performance, plant performance, infrastructure availability, emissions and air pollution is needed, before the hydrogen fuel and vehicles can be commercialized and compete with other type of fuels.

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Aerodynamic Optimization of Small Scale Vertical Axis Wind Turbines for Maximum Exergy Efficiency

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Abstract

This study included unsteady exergy efficiency predictions for three different vertical axis wind turbines. The mean and the standard deviation of the computed efficiency values showed no direct correlation between them. Therefore, in order to optimize the rotor geometry to maximize the mean exergy efficiency without increasing the deviations from this mean, one has to perform a multiobjective optimization.

***Keywords**:* Energy efficiency, wind turbine, nonlinear lifting line theory, multiobjective optimization.

1. Introduction

Small scale wind turbines located in urban areas allow renewable energy be produced where it is needed. Since the wind turbines placed in urban environments may be subjected to winds with varying directions (Kalidelis et al., 2012; Cace et al., 2007) vertical axis wind turbines provide an advantage over horizontal axis ones thanks to their ability to accept wind from any direction. However, the blades of a VAWT are subject to unsteady angle of attack even when they operate in steady wind conditions (Paraschivoiou, 2002). Therefore, huge variations in the torque and consequently the power produced may be experienced (Paraschivoiou, 1983; Usanmaz and Alpman, 2017). Since the rate of energy extracted is nothing but the rate of useful work obtained (Pope et al., 2010; Şahin et al. 2006), the variations in it will lead to variations in the exergy efficiency of the turbine. Usanmaz and Alpman (2017) addressed this problem of vertical axis wind turbines and performed a multiobjective aerodynamic optimization study which aimed to maximize the average power produced while keeping the variations of rotor torque at minimum. In a similar way an aerodynamic optimization study is going to be performed in this paper which will seek to maximize the average exergy efficiency while minimizing the variations in this quantity. Here the corresponding multiobjective optimization studies are going to be performed using the NSGA-II algorithm (Deb et al., 2002) while the energy efficiency values will be calculated via the nonlinear lifting

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line method (Marten et al., 2015) available in the open source wind turbine design and analysis software QBlade (http://q-blade.org/). Since the NSGA-II algorithm will require the exergy efficiency calculations performed many times during the optimizations an extreme learning machine (Huang et al., 2006) will be developed for fast predictions. This metamodel will be trained using a database constructed using the Latin Hypercube design of experiment methodology (Cavazutti, 2013). The final paper will include the specification of suitable optimization parameters, the database construction, optimization studies and the obtained results. Since exergy efficiency is one of the key indicators of sustainability (Rosen et al., 2008) optimizing wind turbines for maximum exergy efficiency, which is the aim of this paper, is important to ensure sustainable wind energy.

2. Methodology

The energy balance for a control volume with one inlet and one exit can be written as (Pope et al. 2010):

$$\dot{Ex}_{in} - \dot{Ex}_{out} - \dot{W} - \dot{Ex}_{dest} = 0 \quad (1)$$

Here, $\dot{Ex}_{in}$ and $\dot{Ex}_{\rho ut}$ are rates of exergy entering and leaving the control volume, $\dot{W}$ is the rate of work extracted and $\dot{Ex}_{dest}$ is the rate of exergy destruction inside the control volume due to irreversibilities (Pope et al. 2010; Şahin et al. 2006). In the case of a control volume around a wind turbine the term $\dot{W}$ corresponds to the power produced by the turbine. The corresponding exergy efficiency is then calculated by

$$\eta_{ex} = \dot{W}/\left(\dot{Ex}_{in} - \dot{Ex}_{out}\right) \quad (2)$$

Typically the rate of exergy contains physical and the kinetic energy components (Pope et al. 2010). However, in this study the physical component is assumed to remain constant therefore, only the exergy of the kinetic energy is considered. Here, the power produced by the turbine and the velocity in the wake are predicted using a nonlinear lifting line theory (Marten et al. 2015) of the QBlade software. Since this method could yield the velocity distribution on any plane selected by the user, a square prism shaped control volume is defined around the turbine. The side of the cross-section of this volume is 2.5 times the diameter of the rotor and it extends one rotor diameter upstream and downstream of the rotor cylinder. The rates of energy entering or leaving the control volume are calculated using the following integral:

$$\int \rho \, {u^3}/{2} \, dA \quad (3)$$

Where is the velocity component normal to the area element *dA* on the inlet or exit plane. Numerical solutions performed to yield an unsteady energy efficiency variation. Here, the mean of these variations is taken as the first objective. The second objective, which is the amount of variation in the energy efficiency, is quantified by taking the standard deviation of these variations. During the study the optimization aims to maximize the first objective while minimizing the second one. The turbine performances presented here are obtained at a steady wind speed of 5 m/s and a rotor tip speed ratio of 3.

3. Results and Discussion

The vertical axis wind turbine analyzed here composed of three blades with a constant CLARK Y 11.7% smoothed airfoil section (https://mselig.ae.illinois.edu/ads/coord_database.html). Three different rotor geometries taken from (Usanmaz and Alpman, 2017) are considered in this extended abstract. The details of the geometries are given in Table 1.

Table1 : *Rotor geometries studied (Usanmaz and Alpman, 2017**)***

Rotor Height (m)	Rotor Radius (m)	Blade Sweep Angle (°)
3.841	2.014	45.58
3.581	1.769	38.59
4.500	2.290	23.01

Figure 1 displays the mean value and the amount of standard deviation in the exergy efficiencies calculated for the rotors presented in Table 1. It is clear that when the mean value increases the amount of deviation might also increase depending on the geometry of the rotor. Therefore, a multiobjective optimization procedure should be applied when optimizing the rotor geometry for better energy efficiencies.

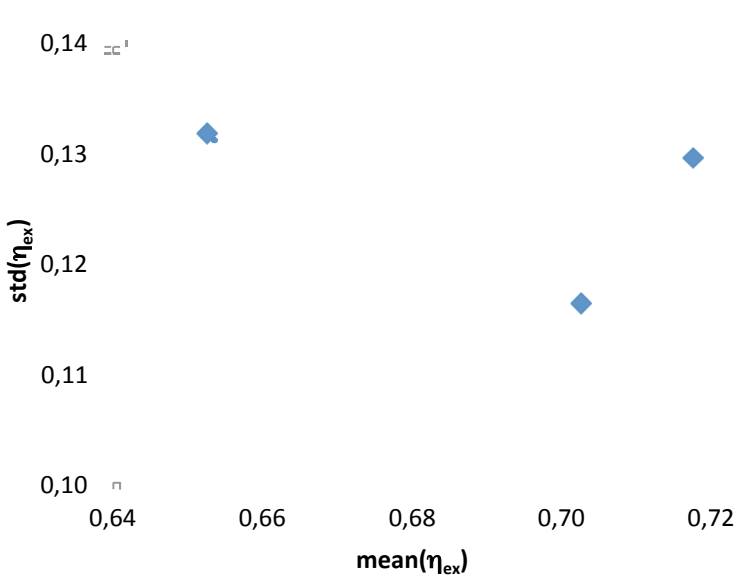

Figure 1: *The mean value and the amount of standard deviation in the exergy efficiencies calculated for the rotors presented in Table 1.*

4. Conclusion

In this study unsteady exergy efficiency computations for three turbine geometries selected from (Usanmaz and Alpman, 2017) are performed using the nonlinear lifting line method of the QBlade software. Mean and standard deviation of the predicted energy efficiency values are calculated and presented. The results showed that if one aims to optimize the geometry for maximum energy efficiency, its variations might also increase hence a multiobjective optimization approach should be used. The final paper will include the details and the results of this approach.

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The New Solution to Waste Tires Recycling and Its Contribution to Sustainable Environment

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Abstract

The world has problems with the waste that the human being generates. Every year human being generates and dumps nearly 2 billion tons of waste. For all kind of products product we use a different kind of waste comes out of the consumption pipeline. Environmental sustainability will be achieved if we focus on zero waste philosophy. Waste tires are also part of the big picture. There are more than 1.2 billion vehicles running on earth. This means that we are disposing 20 million tones of waste tire each year. The purpose of this study is to find ways to improve the environmental sustainability while focusing on waste tires. Waste tires are major problematic issue since they are not easily dissolves in nature compared to other wastes the human life produces.

Keywords: Waste Tires, Waste, Pyrolysis, Sustainability, Waste to Energy, Waste to Products, Environmental Sustainability, Carbon Black, Pyrolytic Oil, Scrap Tire

1. Introduction

The paper will focus and show the environmental problems that are causing because of waste tires in Turkey and in global. Each year world is facing huge amounts of this black and ugly waste. The used tires are not like the other nylon and plastic products since the nature needs more time to dissolve them. Actually the tire is very important for vehicles since all the vehicles cannot run without tires. With the help of industrial development now the tires are made of petroleum derived synthetic rubber. Therefore the effect of the waste tires is more harmful compared to the natural rubber products. Additional to its contamination effect since the tires needs huge dumping ground; it is hard to keep those places environmentally safe. The fires caused from the waste tires are also another problem. Since the derived from the petroleum, in case of fire, the pollution that the tires produced while they are burning is very harmful for both human and other living creatures. Although there ways of tire recycling none of them is very effective, the new approach to recycling the waste tires can be summarized as pyrolysis technique. With the use of this technique the waste tires can be recycled totally living nothing behind. The method is a good example of waste to energy or waste to value products.

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The tire recycling business has a lot of different methods. A basic method is illegal dumping and land filling. Although we can't call as recycling, burning the waste tires is another dangerous way of removal. Grinding is the most common way for waste tire recycling. However this method is not producing high economic value. The method were utilised between the two World Wars when there was shortage of fossil fuels. Modern era of Pyrolysis was started with the Research studies of Bell Laboratories of United States. The researchers started working on the subject during 1950s. In ten years of time a wide range of study group started working on the usefulness of the technique.

2. Sustainability in Long Term Environmental Issues

We are creating huge amounts of waste that is disproportional to the our footprints. These waste also affects the other living beings and the total earth we are living on it. Therefore it is important to decrease our waste level proportional of our body footprint space. Conversely it is not possible to change the behaviours in a sudden. For this reason recycling of wastes is the key to sustainable environment. The increase in population, consumption, production is consuming the resources of the world in an accelerating speed. Thus by products, energy and the other useful outcomes of the recycling are more important. On the other hand recycling methods should focus on zero residual.

3. Methodology

Our methodology actually started with an entrepreneurial step. A personal intention of mine brought me here. The research started to find the methods of recycling of waste tires. After deciding a method in order to produce most valuable outcomes from the process of recycling, we find the ways to improve it. Now the author finalized the establishment of two factories in Turkey. The methodology can be summarized as trial and error on top of literature and one to one interviews. The driving force of the methodology based on profit making. Thus I eliminated any method that has no economic value. The investment structure and the methodology forced our system to find the optimum solution.

3.1. Limitations of the study

Four limitations are present and need to be considered when interpreting the results of the work done until now. These limitations are as follows: Time, finance, regulations and lack of information (know how, study, literature, expert, academician, etc).

3.2. Sample and Data Collection

The data collection mostly based on factory and manufacturer visits all around the world. In addition of these sight visits, the academic research applied at the same time. We also established our own laboratory in order to test the products especially the pyrolytic oil and derived carbon black. The laboratory findings led us to develop additional products and also led us to amend some of the machinery and the processes. Basically the data / finding / result population of this study is composed of factories that the author initiated and established until now.

3.3. Validity of the Work Done

It is the market place that ensured the validity. Testing the products marketability defined the validity of the work done. The demand level to carbon black, scrap steel and the oil showed the quality of the products thus the process and the method. The validity of the pre research based on the experience that faced and the market forced us.

3.4. Findings and Evaluations

During the 7 years of period we've found that Turkey needs additional regulations on recycling incentives. Turkey is one of the parties of Kyoto Protocol. The protocol has definitely a positive effect on the Turkish recycling policy, regulations, business and market. Specifically the regular by products of pyrolysis methods has some difficulties to market. It has been evaluated that it needs some chemical process and additional treatments to the material outcomes.

4. Conclusion

The pyrolysis method is absolutely the one method to recycle waste tires in a most valuable way. The process still has potential for development.

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World Health Organization Statistics

Effect of Non-Uniform Wake on the Exergy Efficiency Calculations for Wind Turbines

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Abstract

This study investigates the effect of the non-uniform wake on the exergy efficiency calculations for small scale wind turbines. Performance predictions are made for a model small scale vertical axis wind turbine using a steady and an unsteady method. Numerical calculations showed that including the unsteady wake effects in to the exergy efficiency calculations clearly affects the predictions of this quantity.

Keywords: Exergy efficiency, wind turbine, nonlinear lifting line theory, double multiple stream tube method, unsteady wake.

1. Introduction

Wind energy, being one of the renewable energy sources, has an important place in sustainable development. However growing energy demands made people question the reliability of wind energy [Ozgener and Ozgener, 2007]. Exergy efficiency which defines the ratio of work extracted to the maximum possible useful work is one of the important indicators of sustainability [Rosen et al. 2008]. Using the exergy balance equation [Çengel and Boles, 2002] exergy efficiency of horizontal and/or vertical axis wind turbines have been calculated in the literature [Rosen et al. 2008; Pope et al. 2010; Saravanan et al. 2011; Şahin et al. 2006]. In these studies the downstream velocity at the wake of the rotor, which corresponds to the exit velocity of the control volume, was assumed to be uniform. However, this may not be the case in practice [Burton et al. 2011]. Pope et al. [2010] showed the importance of defining a suitable downstream velocity by using four different definitions for this quantity.

This study will include effect of the non-uniform wake of small scale horizontal and vertical axis wind turbines on the exergy efficiency calculations. Here, an integral form of the exergy balance equation will be used for this purpose. For horizontal axis turbines downstream velocity predictions will be initially performed using methodologies blade element momentum theory (BEMT) [Burton et al. 2011]. Among the wind turbine performance prediction [Burton et al. 2011] is a popular method for its speed and reasonable accuracy. Therefore, it is frequently employed for the aerodynamic design and optimization of horizontal axis wind turbines [Alpman et al. 2014]. The results obtained using this method will be compared to the results obtained using a nonlinear lifting line theory [Marten et al. 2015]. Being a vortex method, nonlinear lifting line theory could include unsteady effects and could yield better predictions than the BEMT. For the vertical axis wind turbines the corresponding predictions will be first obtained using double multiple stream tube model [Paraschivoiu, 2002] and again they will be compared with nonlinear lifting line predictions. The necessary numerical predictions will be performed using the open source wind turbine design and analysis software QBlade [http://q-blade.org/] which contains all of the methods described above.

The final paper will include exergy efficiency calculations performed for three bladed horizontal and vertical axis wind turbines. The blades of the horizontal turbines studied will be obtained using the design methodology described in chapter 3 of [Burton et al. 2011]. The vertical axis turbines will have untwisted and untapered blades.

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Geometric properties of these turbines will be selected such that they will have the same swept area and rotor solidity with the horizontal axis ones. Since exergy efficiency is one of the key indicators of sustainability [Rosen et al., 2008] its accurate calculation is very important. The study in this paper aims to improve the calculation of this quantity for wind turbines.

2. Methodology

The exergy balance for a control volume with one inlet and one exit can be written as [Pope et al. 2010]:

$$\dot{Ex}_{in} - \dot{Ex}_{out} - \dot{W} - \dot{Ex}_{dest} = 0 \quad (1)$$

Here, $\dot{Ex}_{in}$ and $\dot{Ex}_{out}$ are rates of exergy entering and leaving the control volume, $\dot{W}$ is the rate of work extracted and $\dot{Ex}_{dest}$ is the rate of exergy destruction inside the control volume due to irreversibilities [Pope et al. 2010; Şahin et al. 2006]. In the case of a control volume around a wind turbine the term $\dot{W}$ corresponds to the power produced by the turbine. The corresponding exergy efficiency is then calculated by

$$\eta_{ex} = \dot{W}/\left(\dot{Ex}_{in} - \dot{Ex}_{out}\right) \quad (2)$$

Typically the rate of exergy contains physical and the kinetic energy components [Pope et al. 2010]. However, in this study the physical component is assumed to remain constant therefore, only the exergy of the kinetic energy is considered. Here, the power produced by the turbine and the velocity in the wake are predicted using the QBlade software. For the vertical axis wind turbine analyzed in this extended abstract, this procedure is done in two ways. First the performance of the turbine is obtained using the double multiple stream tube model [Paraschivoiu, 2002]. The mass flow rate through the turbine was calculated by multiplying the average turbine inlet velocity with the swept area of the rotor. The exit kinetic energy is then calculated by multiplying this mass flow rate with the average of the square of the wake velocity. In the second approach turbine performance is obtained using a nonlinear lifting line theory [Marten et al. 2015]. Since this method could yield the velocity distribution on any plane selected by the user, a square prism shaped control volume is defined around the turbine. The side of the cross-section of this volume is 2.5 times the diameter of the rotor and it extends one rotor diameter upstream and downstream of the rotor cylinder. The rates of exergy entering or leaving the control volume are calculated using the following integral:

$$\int \rho \, {u^3}/{2} \, dA \quad (3)$$

Where u is the velocity component normal to the area element dA on the inlet or exit plane. The turbine performance presented here is obtained at a steady wind speed of 5 m/s and a rotor tip speed ratio of 3.

3. Results and Discussion

The vertical axis wind turbine analysed here composed of three blades with a constant CLARK Y 11.7% smoothed airfoil section [https://mselig.ae.illinois.edu/ads/coord_database.html]. The rotor has a height of 4.5m, radius of 2.29m and blades are swept by 23.01 degrees. This turbine was the one which yielded maximum power production after the optimizations presented in [Usanmaz and Alpman, 2017]. Figure 1 displays the turbine power and wake speed for the turbine predicted using double multiple stream tube method. Using these predictions and following the procedure described in the Methodology section the exergy efficiency was calculated to be 0.822.

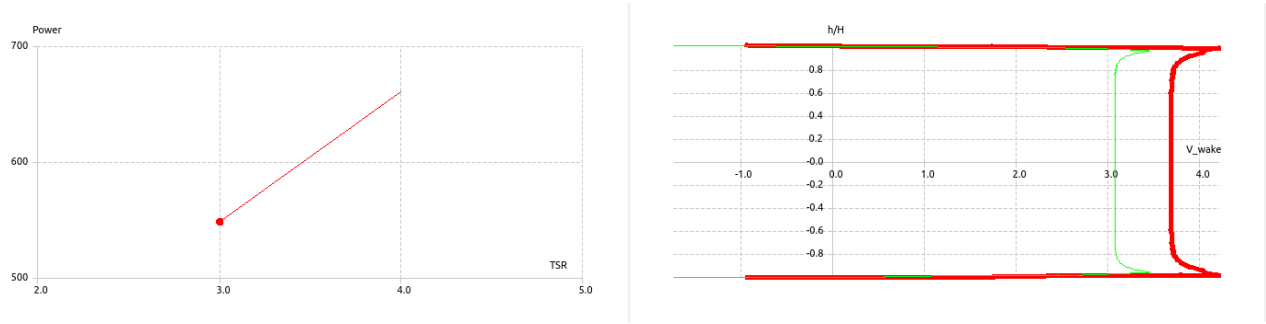

Figure 1. Power and wake velocity predictions by double multiple stream tube method.

In order to compute the exergy efficiency via the nonlinear lifting line theory, unsteady performance predictions are performed for 10 rotor revolutions and velocity field is saved at each time step which corresponds to five degrees of blade movement. The velocity distribution on the exit plane at the final time step is displayed in Figure 2. The exergy efficiency is then computed using the integral given above after the quasi-steady conditions are reached, which is achieved after the 450th time step. Figure 3 shows the exergy efficiency values computed at every 10th time step after the 450th along with their mean value which was obtained to be 0.677. It is clear that once the unsteady wake effects are introduced to the computations, the predicted exergy efficiency values may show huge variations and even the mean value of these values is not in agreement with the one calculated using the double multiple stream tube method.

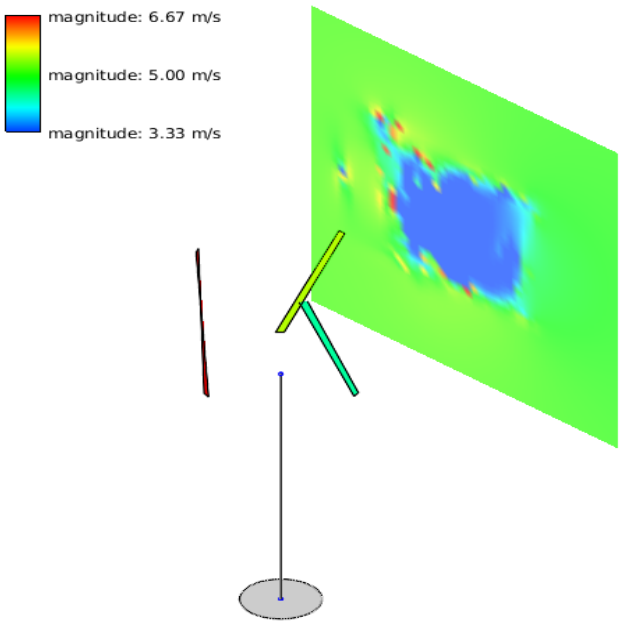

Figure 2. Velocity distribution on the exit plane at the final time step

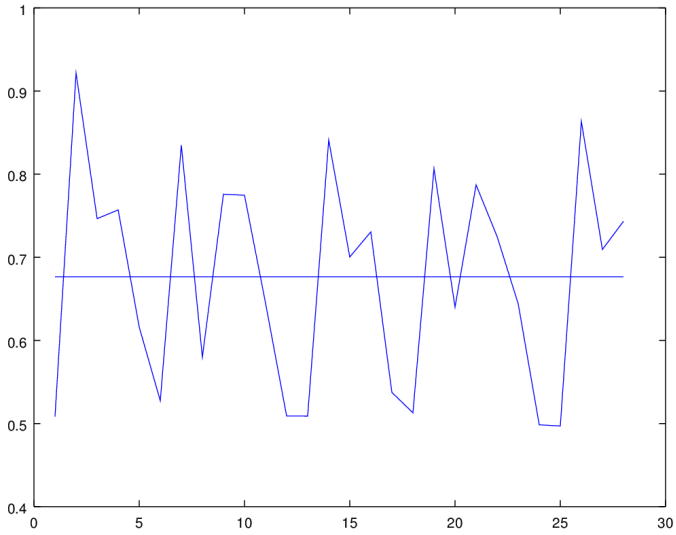

Figure 3. Exergy efficiency values (vertical axis) at different time steps.

4. Conclusion

In this study the effect of unsteady wake on the exergy efficiency computations of a small scale vertical axis wind turbine was investigated using double multiple stream tube and nonlinear lifting line methods. The latter method may simulate the unsteady wake effects while the former assumes a steady wake. The computations clearly showed that when the unsteady wake effects are introduced to the predictions, the results showed huge variations and even the mean value of those variations did not agree with the steady state predictions.

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The Sustainability of Loose Monetary Policy and Its Effect on Economic Fluctuations

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Abstract

In this study, we firstly analyzed the stance of monetary policies of USA, Euro Area, and the United Kingdom according with Taylor Rule level of interest rate and the natural rate of interest. Secondly, we analyzed the domestic and international effects of monetary policies. We found that loose monetary policies in 2002-2005 are the main reason of economic crisis in 2008. Another finding is that the low interest rate policies after the 2008 crisis disrupt the economic structure in domestic and international levels.

***Keywords**:* Building integrated renewable technology, Energy efficiency, Renewable integration of HVAC system, Optimisation of the renewable systems.

1. Introduction

The relationship between monetary policy and economic fluctuations has deep roots in the history of economic thought. Since Currency School, many economists and schools of economics analyzed how related the monetary policy and cycles in the economy. After the 2008 crisis, the number of studies investigating monetary policy and economic activity increased. Taylor (2008 and 2009) emphasizes that lower interest rate policy of the Fed than Taylor rule level is the main factor of the housing bubble in the 2002-2008 period. However, loose monetary policy has also impacts on international markets and foreign countries. Saxena and Wong (2002) analyzed the international effects of 1997 Asian crisis and warn of the effects of international economic cycles on countries even with strong fundamentals.

In this study, firstly we analyzed the monetary policy of USA, Euro Area, and the UK in the period 2002-2016 and cycles in the domestic economy. Secondly, we analyzed international effects of global central bank policies.

2. Methodology

We need a criterion to analyze the stance of monetary policy. We have two different criteria: Taylor Rule interest rate and the natural rate of interest. While using these two criteria, it is possible to

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compare how monetary policy tight or loose and show the relationship between monetary policy stance and boom-bust cycle. For investigating international impacts, we use growth rates and foreign resources use of Turkish economy.

3. Effects of Monetary Policy

According to Taylor (2008 and 2009), the main reason for the boom in housing price in the 2002-2008 period was the keeping interest rate below the Taylor rule level by the Fed. There also other studies concluded similar result with Taylor.

The other criterion, the natural rate of interest, was first used by Wicksell (1962). Wicksell (1962) considers the economy is in equilibrium when the market rate of interest and the natural rate of interest are equal. This perspective has been continued by Austrian economists. Mises (1953) is the first economist building a bridge between the Wicksellian natural rate of interest and business cycles. Hayek (1967), a follower of Mises, contributed Austrian tradition of the business cycle theory by developing the Austrian capital theory.

One of the main differences between Taylor Rule and Austrian view is while Taylor Rule considers the rising in general level of prices is the signal to central banks to increase the policy rate, Austrians think the general level of prices is a false indicator. For Austrians, relative price changes are important to see how monetary policy affects the economic structure. In addition, Austrian perspective helps to understand why we had a boom in housing sector rather than other sectors.

The central bank printing international reserve money can also impact the international economic activity by affecting international liquidity and interest rate level besides the domestic economy. A country suffering the lack of saving needs the foreign resource to finance its economic activity. However, when there is a money glut rather than a savings glut in the world economy, the country will face an unsustainable economic boom which eventually turns into a crisis.

4. Conclusion

Interest rates in the USA, EA, and the UK and in international markets were lower than Taylor Rule level and the natural rate of interest level between 2002-2005. These loose monetary policies facilitate to finance economic growth by using foreign resources and caused a faster growth period in the World economy. In the end of the loose monetary policies, bust cycle inevitably occurred.

The positive impacts of the loose monetary policy conducted by central banks after 2008 crisis on economic performance are not as strong as predicted by many economists and politicians. It is highly possible that this loose monetary policy period disrupts both domestic and international economic structure.

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Reviewing Sustainability Awareness Studies by Content Analysis

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Abstract

The main purpose of this study is; reviewing sustainability awareness studies in the world's few databases (Ebsco, Springer, Science Direct, Taylor & Francis, Google Scholar) with open access to content analysis. In this way, it will be possible to have an idea of the direction of the development of the articles/proceedings on this concept in the international literature. It will also be possible to identify gaps in issues of sustainability awareness that are less relevant in the literature.

Keywords: Sustainability, Sustainability Awareness, Content Analysis, Awareness, Globalization

1. Introduction

The concept of sustainability awareness; can be defined as all of the activities carried out in order to gain awareness and sensitivity towards the environment, to provide motivation in increasing values toward environment, to improve individuals' perspective on global environmental problems, and make them to understand that they are part of the natural environment (Erdoğan and Tuncer, 2009). Sustainability awareness aims to raise awareness of individuals in climate change and global warming issues and to change their attitudes and behaviors in order to ensure that the natural environment is sustainable (Hamid et. al, 2016).

2. Research Problematique

The research questions discussed in the study are as follows

- What are areas of sustainability awareness studies most commonly associated with?
- How is the distribution of studies on sustainability awareness according to countries?
- In what period are the studies on sustainability awareness concentrated?
- What are data collection tools used in studies on sustainability awareness?
- What are data analysis techniques used in studies on sustainability awareness?
- Generally in which magazines sustainability awareness studies have been published?

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3. Methodology

In this study, content analysis was used as data analysis technique. Content analysis is a research technique in which valid findings from the relevant text are presented as a series of procedures. The most important feature of it is that it should be systematic and impartial (Koçak and Arun, 2006).

Firstly, the concept of sustainability awareness has been defined as a scanning and selection criterion. Then, an article/proceeding pool was prepared using the related databases. Finally, the relevant concept was examined in terms of field, country distribution, period, data collection tool and analysis technique, journal criteria.

The most important limitation of the study is the examination of only open access articles and proceedings in the relevant databases. In accordance with the research aim, 15 articles / proceedings on sustainability awareness with open access have been reached.

4. Conclusion

In the distribution of the article/proceedings according to the related field, the fields of environment and educational sciences come to the fore with 6 studies. Subsequent studies show that there is a multidisciplinary structure. It has been determined that there are 1 of each study in arts, industrial design and construction-IT and 1 study in economics. As to distribution according to the countries, 3 studies in Malaysia and 2 studies in the USA are in the foreground. In 9 studies, the survey was used as a data collection tool. In data analysis, 3 studies were performed content analysis by descriptive statistical analyses (mean, std. deviation and frequency). The studies were mostly published in the Procedia Social and Behavioral Sciences (3 articles).

This research can be extended by including the studies in the Web of Science. In the future study, a meta-analysis can be carried out to perform a detailed analysis. In the future studies, by examining the thesis abroad toward human resource practices, cross-country comparative analyses will be possible.

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Management Practices towards the Incorporation of Sustainability in African Universities.

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Abstract

Africa is one of the wealthiest continents in the world which is so rich in natural resources such as oil, natural gas, coal, gold, silver, diamond, timber, bauxite, uranium, chromium, mountains, forests, coastal lands, deserts, woodlands, freshwater ecosystems and etc. Despite being endowed with all these natural resources, Africa is still the poorest continent in the world. This calls for sustainable management, development and protection of the environment. This is why there is a high demand for African universities to help their societies respond to all these environmental, economic and societal challenges. This study observed and evaluated the incorporation of sustainability practices in African universities. The main research question of the study is: How are Universities incorporating sustainability-oriented practices in African sustainability focused universities as far as CORE system (Curriculum, Operations, Research, and Engagement) is considered? The employed research methodology mainly relies on content analysis of UI Green Metric ranking and universities' websites of selected universities in Africa from the UI Green Metric Sustainable University assessment and ranking index to observe the universities integration of sustainability practices. The sample of the study is selected from four hundred and seven (407) top sustainable universities ranked by UI Green Metric. The total population observed and evaluated in this study is the only eleven (11) Sustainability focused Universities in Africa according to UI Green Metric sustainable ranking. It is obvious that from observations made in this study, that the studied universities have sustainability as part of their goal and have plans, policies, strategies and have gone ahead to incorporate some of their sustainability goals. From the findings, the eleven universities need to increase their commitment in the Operational Eco--efficiency (setting and infrastructure, Energy and Climate Change, Waste reduction/ recycling, Water conservation and Transportation) aspect of the CORE system. Also, in the area of Education which consist of (Curriculum, Research and Engagement) in the CORE System all the studied universities performed below average and need to really be more committed in this aspect of sustainability which is very important in the education of students and the society about sustainability. Africa Univrsities should strive for the attainment of the sustainable development goals in order to achieve sustainable management, development and protection of the environment.

Keywords: Management and Sustainability Practices, Content Anaylsis, CORE System, UI Green Metric, African Universities.

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1. Introduction

According to World Health Organization African region (WHO, 2015), Climate change is hitting African people so hard. By the year 2100, the temperature will rise by 4^{o}C. There will be 40% less rainfall. Some area will get drier and much drier. There will be more droughts. There will be more high winds. There will be more floods, and other extreme weather events. This presents African governments with many challenges. GDPs will drop. Social relations will suffer. Crop lands will shrink by up to 90%. Security and defense will be stretched and people's health will be affected. Certain diseases are deeply affected by (a) socioeconomic issues, (b) the public health context (c) weather related changes. The weather changes will affect food and waterborne diseases, such as cholera, vector-borne diseases, such as dengue and malaria, and airborne diseases such as meningococcal meningitis. The weather changes will also directly affect nutrition and there, health. Soil will be salinized, sometimes to toxic levels. Food spoiling will increase due to mycotoxins. Food security will decrease. Flooding, droughts, famine and other events affect health through injury, malnutrition and diseases. In addition, heavy rain, heat and drought increase exposure to chemicals, pollution and waste.

The need for the incorporation of sustainability practices in both government and non-governmental educational institutions have become increasingly apparent during the last decades. Universities being the essential part of the global economy and since they prepare most of the professionals that develop, manage and teach in public, private and non-profit institutions, they are uniquely positioned to influence the direction of a sustainable society. Consequently, as major contributors to the values, health and well-being of society, universities have a fundamental responsibility to teach and research for sustainability. This is essential because future professionals will be working globally with companies that increasingly have sustainability on their agenda. This puts high demands on universities to incorporate sustainability in their institutions so that this mentality interpenetrates all activities as a university identity. The importance of the present research links to current discussions regarding sustainability approaches in universities. Universities have begun to recognize the need to reflect the reality that humanity is affecting the environment in ways which are historically unprecedented and which are potentially devastating for both natural ecosystems and us. (Cavas *et al.*, 2014).

This is a great concern among universities, for example, to increase their students' awareness and commitment to sustainable practices. As a result, student organizations and special events have emerged to focus on sustainable practices regarding transportation, construction, energy, waste, food, water, and landscaping (Emanuel, 2010) By seeking to incorporate sustainability in the system, many higher education institutions are adopting specific sustainable management systems (Clarke & Kouri, 2009). A management system is usually based on management by objectives (Lundberg *et al.*, 2009), in which the principal aim refers to the process of directing and controlling employees and work units, and motivating them towards performances regarding specific set of objectives. Although, higher education institutions are interested in performing under a variety of objectives in their management system, this research focuses on those related to sustainability. To significantly address these problems, university management practices have the potential to contribute to the integration of sustainability (Vecchio, 2012). Hence, an approach as the one presented here can contribute to research regarding sustainability-oriented practices in universities (Emanuel & Adams, 2011). It is the above problems that set the stage of this study in observing management practices towards the incorporation of sustainability in the top sustainability focused African universities.

2. Literature Review

Africa is the second-most- populous and largest continent after Asia in the world. It is made up of 54 countries with 1,216 billion people. Africa is so endowed with natural resources and ecosystem. It is also considered as a strategic continent for global development opportunities. There are five main regions in Africa. Figure 1 shows the five regions with countries under each region. They are namely:

1. **North Africa** (6 countries): Egypt, Libya, Tunisia, Algeria, Morocco and Western Sahara
2. **West Africa** (18 countries): Benin, Burkina Faso, Cameroon, Cape Verde, Chad, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, and Togo.
3. **Central Africa** (6 countries): Central African Republic, Congo, Democratic Republic of Congo, Equatorial Guinea, Gabon, and São Tomé and Príncipe.
4. **East Africa** (14 countries): made up by the countries in the Horn (Eritrea, Ethiopia, Somalia, Djibouti), plus Sudan, Uganda, Kenya, Tanzania, Rwanda, Burundi and plus the islands (The Comoros, Mauritius, the Seychelles and Madagascar).
5. **Southern Africa** (10 countries): Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia and Zimbabwe.

Figure 1. *The Five Regions in Africa and Mapping Africa's Natural Resources*

According to Mainstreaming Environment and Sustainability in African Universities Partnership (MESA:2004-2008), despite the rich ecosystem and natural resources, Africa today holds a marginal place in the world economy. Some countries are still affected by war and violence. Too many people across the continent are constantly plagued by persistent poverty and food insecurity. HIV/AIDS has left a devastating impact which is not over yet, and malaria still impacts on too many families each year. Ecological resources are being degraded and valuable ecosystem services are being lost. Many countries in Africa are struggling to meet the Millennium Development Goals now Sustainable Development Goals. Important sustainable development opportunities are constrained by lack of infrastructure, poor governance, inadequate quality and access to education and health services. Climate change is predicted to have substantive impacts on Africa's environment and the livelihoods of people. It will affect food production, health and security, and some of Africa's major coastal cities such as Lagos, Cape Town and Alexandria are threatened by sea-level rise. Contemporary sustainable development challenges include establishing and sustaining a reasonably high economic growth rate that can alleviate poverty, benefit all people in equitable ways and sustain a growing population, while ensuring that the

environmental and natural resource integrity of the continent is maintained. Establishing strong future oriented governance systems that take account of history and context is part of this challenge, as is strengthening of social cohesion. These challenges require added impetus and 'fast tracked' responses, in the light of the new challenges posed by Africa's current relatively low capacity for adapting to the consequences of global climate change. Effective strategies that reach current professionals, governors, communities and young people across the continent are needed. Soon Africa will be the continent with the youngest population on Earth, and in this youthfulness lies enormous creativity and change potential. Today, Africa can also be singled out for having the lowest carbon footprint as it produces only four percent of global carbon emissions that are now impacting on the climate and the future of the planet and its people. Africa has the potential to circumvent harmful development patterns if the creativity, ethics and knowledge of its youth and professionals can be harnessed in time.

2.1. Climate Change and its Effect in Africa.

According to Young Africa Leaders Intivatives' discovery (YALI, 2015), agriculture is extremely important to Africa's economy. Seventy percent of the population lives by farming and a third of the income in Africa is generated by agriculture. Over 95 percent crops in Africa, are primarily watered by rainfall. This makes food crops on our continent vulnerable to health stress from our warming planet and extreme weather events linked to climate change. These include changes to seasonal rainfall, droughts and floods. In fact, rain-fed agriculture in Africa could drop by half in 2020. Climate change is already affecting many fisheries around the world. The warming brought about by climate change increases ocean temperatures, which causes some fish to move to cooler waters beyond their normal range. These changes in the marine environment have devastating consequences for people dependent on fishing for food and their income. Climate change will also have a huge impact on health. Changes in rainfall associated with climate change can increase the population of disease-carrying mosquitoes. This can result in more malaria, the biggest killer in Africa. Scientists have noted that malaria is already spreading to higher elevations in Africa due to climate change. Predictions are for a 5 to 7 percent increase in malaria distribution by the end of the century. A warmer environment with more rainfall can also increase the cases of other deadly diseases, such as yellow fever and dengue fever. In addition to these diseases, the poor air quality that often accompanies a heat wave can lead to breathing problems and worsen respiratory conditions. The most vulnerable ones like urban poor, older adults, young children, traditional societies, and subsistence farmers are most harmed by these threats. Extreme weather events linked to our changing climate can cause huge migrations of people. Flooding, drought, and other competition for resources like fresh water can ignite conflict. It can impel people to leave their homes and migrate.

According to AMCEN 12 decision (2008), Africa has contributed the least to the increasing concentration of greenhouse gases in the atmosphere, it is the most vulnerable continent to the impacts of climate change and has the least capacity to adapt. Africa's priorities are to implement climate change programs in such a way as to achieve sustainable development, in particular, to alleviate poverty and realize the Millennium Development Goals now called Sustainable Development Goals with emphasis on the most vulnerable groups such as women and children. Given that Africa is the most vulnerable region with the least adaptive capacity, adaptation is the most immediate priority. Capacity building is needed to enable human resource development through, among other measures, focused training, mentoring and learning-by-doing approaches; and to empower relevant institutions at different levels; to enhance observation, research and knowledge management; and to strengthen communication, education and awareness-raising, at all levels, especially at local and community levels.

2.2. Education for Sustainable Development

The Brundtland Report *Our Common Future* defined sustainability as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987), foregrounds the interconnections of the economic, social, and environmental aspects of corporate actions (the 'triple bottom line'). Recently, several definitions of sustainable higher education institutions have emerged (Madeira *et al*., 2011*)*. Alshuwaikh and Abubakar (2008) argued that a sustainable campus should be environmentally healthy, with a prosperous economy through energy and resource conservation, waste reduction and with efficient environmental management; it should promote equity and social justice and export these values to the community. According to Milutinovic and Nikoli (2014), the vision of sustainable development in higher education is a world where everyone has the opportunity to benefit from a quality education and learn the values, behaviors and lifestyles required for a sustainable future and for positive societal transformation (Jorge *et al.,* 2013)

In the last two decades, an increasing number of higher education institutions have been engaged in integrating sustainability into their systems (Ceulemans *et al*., 2011; Lozano *et al*., 2013; Shephard & Furnari, 2013). This is arguably due to the increased level of consciousness in society of sustainability issues and the significant impacts of campus activities on both the environment and communities (Alshuwaikhat & Abubakar, 2008; Lozano, R, 2006). This contribution can occur within the context of education, research, outreach/engagement and the administrative management of the university itself (Alshuwaikhat & Abubakar, 2008; Jabbour, 2010). Therefore, it is necessary to evaluate how universities have been contributing towards the integration of Sustainability (Leal Filho, 1997, de Castro, *et al.*, 2012). Sustainable development rests on three pillars - economic, environmental and social - as mentioned above. These three dimensions are often used in various development programs and can be seen as the triple bottom line. It is important that each dimension gives equal consideration to ensure a sustainable outcome (Rogers *et al.*, 2008).

Figure 2: *Pillars of Sustainability*

Figure 2 shows that to get sustainable results in a fine balance must be reached between the three components. If one component overpowers the others, the outcome will be unsustainable. Scholars have stressed the basic types of activities given in higher education institutions assessing the main elements in this transformative process towards sustainability (Hills *et al*., 2011, Christensen, *et al*., 2009, Ferrer-Balas, D., 2008). For instance, Christensen *et al*., identified that the main activities are related to the fields of operation and maintenance, teaching, research, and outreach which is engagement and cooperation with local communities, companies, the media, *etc.* (Christensen *et al*., 2009). Similarly, different definitions focus on the activities as a C.O.R.E. System (Hills *et al*., 2011). The

abbreviation stands for curriculum, operations, research and engagement. The CORE model is presented as a "campus-wide guide for holistic implementation of campus sustainability initiatives" (Hills *et al*., 2011). Models like these are based on assessments as the one of Lukman and Glavic. (Lukman & Glavic, 2007) argued that desirable outcomes of sustainability-oriented practices are those fostering "research, technical development and innovations within a knowledge-based society". Lukman and Glavic also argued that incorporating sustainability-oriented practices into everyday activities involves a further identification of variables such as "management performance (vision, mission, statement, strategy, and sustainability council/ coordinator), education and research (programs, curriculum, teaching methods), operations, forming networks and reporting to stakeholders (assessment tools, sustainability indicators)". The construction of a framework of sustainability assessment in universities is enriched by the C.O.R.E system/model in approaches to management practices.

2.3. Sustainability in African Universities

According to the Mainstreaming of Environment and Sustainability in African's Universities (MESA:2004-2008), in 2006, African Ministers of Education signed a statement of commitment to implement the United Nations Decade of Education for Sustainable Development (2005-2014) in the context of the Second Decade of Education in Africa. In particular, they made a commitment to support the development of strategies for implementing the United Nations Decade of Education for Sustainable Development in their respective countries and to ensure that the principles of sustainable development are included in educational development frameworks, programs and activities at all levels. The Ministers also emphasized the need to ensure that African cultures, knowledge systems, languages and ways of life are integrated into frameworks, programs and activities developed within the Decade.

A number of key ESD outcomes are already visible in Africa, notably the commitment that many African education ministries are making to integrate environment and sustainable development issues such as health, poverty alleviation, and indigenous knowledge in national curricula. A draft sub-Saharan Strategy for Education for Sustainable Development has been developed by UNESCO that provides guidance for African Ministries of Education and Training and practitioners seeking guidance on the UNDESD in Africa. Core principles of the strategy include stimulating an endogenous process for a paradigm shift in education, taking a holistic approach, ensuring an interdisciplinary and integrated approach to Education for Sustainable Development. It also emphasizes participation and decentralization, ensuring harmonization and coherence, mainstreaming gender and highlighting the crosscutting nature of Information Communication Technologies (ICT) through Education for Sustainable Development.

Under this framework, an innovative university focussed partnership initiative for Education for Sustainable Development has been established across the African continent. Led by UNEP's Environmental Education and Training Unit, this partnership involves UNEP, UNESCO and the African Association of Universities (AAU), as well as a range of other partners such as the Southern African Development Community (SADC), the Nile Basin Initiative (NBI), the Global Virtual University (GVU), Leadership for Environment and Development (LEAD), the United Nations University (UNU), the International Centre for Research in Agroforestry (ICRAF) and its network, the African Network for Agriculture And Agroforestry Education (ANAFE), the Horn of Africa Regional Environment Centre and Network (HOA-REC/N) amongst others. This partnership supports the mainstreaming of environment and sustainability in Africa's universities (MESA), creating a mechanism and supportive environment for universities to respond to the environment, sustainable development and climate change challenges in Africa.

The core issues of esD (as defined by UNESCO in the International Implementation Scheme for the UNDESD, 2005)Environmental issues: conservation of biodiversity and natural resources, transforming rural societies and environments, sustainable urbanization and disaster prevention and mitigationeconomic issues: poverty reduction, greater corporate responsibility and accountability, a 'benign' market economy socio-cultural issues: fulfilment of human rights, promotion of peace and security, gender equality, good health, good governance, reinforcement of intercultural understanding, preservation of cultural diversity crosscutting complex issues:climate change, urbanization, sustainable consumption and production. The vision of the UN Decade of Education for Sustainable Development is a world where everyone has the opportunity to benefit from quality education and learn the values, behavior and lifestyles required for a sustainable future and for positive societal transformation (UNESCO, 2015).

2.4. Sustainability Assessment Tools

According to the sustainability model (Fig. 3). Sustainability refers to the holistic and interconnected phenomena of economic, environmental, and social aspects (Lozano, 2006). Sustainability oriented practices are always multidimensional and are organized within the economic, environmental and social dimensions. Strictly one-dimensional activity (*e.g.* Environmental) hardly exists, since it is always related to economic and social effects. University's performance aspects (research, education, and environmental protection) are interconnected, multidimensional, too. They should all be evaluated when the sustainability of the University is under consideration. Research, development, investment and matriculation are aspects, which are closely linked with an economic dimension of the development of universities.

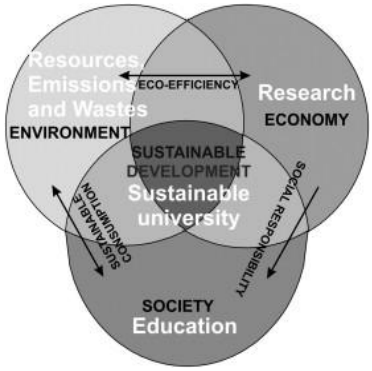


Figure 3. *A Sustainable Development model (Lukman, 2007)*

The assessment of sustainability in universities has been examined with a number of critical reviews and meta-analyses on the use of various assessment tools. UI GreenMetric a global sustainability assessing and ranking tool for university addresses this lack. The mission for the assessment and ranking of UI GreenMetric was that it is of interest and accessible to universities in developing countries as well as to those in developed countries. It provides an entry-level tool for assessing campus sustainability efforts. The assessment and ranking emerged out of a number of disparate concerns and realizations regarding the challenge of introducing sustainable concepts in a Sustainability Environmental Assessment (SEA) context. The other aspects of the mission for the assessment and ranking were that it be global in scope, raise awareness in sustainability and be a driver of change (Lauder, 2015).

Table1: The UI GreenMetric Categories used in the assessing, ranking and their weighting

Sustainability in Universities.

Category	Percentage of Total Points (%)
1 Setting and Infrastructure (SI)	15
2 Energy and Climate Change (EC)	21
3 Waste (WS)	18
4 Water (WR)	10
5 Transportation (TR)	18
6 Education (ED)	18
TOTAL	**100**

Looking at the above assertions in Table 1, in order to achieve a quantitative study in this research, these cardinal dimensions of sustainability interwoven with the C.O.R.E System/Model (Curriculum, Operation, Research and Engagements) would be used in observing the sustainability oriented-practices of the eleven top African Sustainability focused universities according to UI GreenMetric. In the next section, the methodology applied in this study will be briefly illustrated.

3. Methodology

This study is an exploratory qualitative research that is based on content analysis. This study observed and evaluated the management practices towards the incorporation of sustainability in African universities. It is intended by this research using content analysis of UI GreenMetric and universities' websites to observe universities' incorporation and management practices related to sustainability to answer the main question of the study, which is: How are Africa universities' managements incorporating sustainability in sustainability focused Universities as far as CORE system (curriculum, operations, research, and engagement) is considered? The UI GreenMetric Sustainable University assessment and ranking index was selected since it considers the Operations, Curriculum, Research and Engagements (CORE system) of universities with indicators such as Setting and Infrastructure, Energy and Climate Change, Waste, Water, Transportation and Education. This covers the triple bottom line of sustainability (Environment, Economy and Society) which other indexes like GASU, GEENSHIP, AASHE: STAR, ESM and others, focused mostly on operational Eco-efficiency.

3.1. Limitations of the study

This research observed Management practices towards the incorporation of sustainability practices based on the assessment of UI GreenMetric sustainable ranking index, the website contents and sustainability annual reports of universities using the CORE system in interpreting the results of the research.

3.2. Procedure for Data Collections and Analysis

The sample of the study was selected from four hundred and seven (407) top sustainable universities in the world ranked by UI GreenMetric 2015 and 2016. The total populations of the study observed and evaluated in this study are the only eleven (11) Sustainability focused Universities in Africa according to UI GreenMetric sustainable ranking index. The study sample includes Kafrelsheikh University, American University in Cario, Covenant University, Ota, University of Kwazulu Natal, South Valley University, Minia University, University of Education Winneba, Universitie Cadi Ayyad, Polytechnic of Namibia, University of South Africa, University of Tlemcen. Table 3 shows the sustainability website links of the selected universities in their various regions.

***Table 3**. Selected Top African's Sustainability Focused Universities and their Sustainability Website Links or Sustainability Annual Report Links.*

Regions	No	University	Sustainability Websites
Southern Africa	1	University of Kwazulu Natal (South Africa)	http://conservancy.ukzn.ac.za/Homepage.aspx
	2	University of South Africa (South Africa)	http://www.unisa.ac.za/sites/corporate/default
	3	Polytechnic of Namibia (Namibia)	http://nust.na
West Africa	4	Covenant University, Ota (Nigeria)	http://covenantuniversity.edu.ng/News/Covenant-University-Flags-off-Waste-to-Wealth-Initiative#.Wbg-qcZx2M9
	5	University of Education , Winneba (Ghana)	http://www.uew.edu.gh/
North Africa	6	Kafrelsheikh University (Egypt)	http://www.kfs.edu.eg/sustainability
	7	American University in Cario (Egypt)	http://www.aucegypt.edu/about/sustainable-auc
	8	South Valley University (Egypt)	http://www.svu.edu.eg/arabic/
	9	Minia University (Egypt)	http://www.minia.edu.eg/new/
	10	Universitie Cadi Ayyad (Morocco)	https://www.uca.ma/
	11	University of Tlemcen (Algeria)	https://www.univ-tlemcen.dz/

The data collection was carried out between January to Setpmeber, 2017. In order to qualify and quantify the data, the researcher used descriptive data analysis to determine the authenticity of the situation at stake. Descriptive data analysis involves the calculation of percentage distribution. This method of data analysis was used because percentage explains precisely the state of things without the complexities of other statistical methods. The data analysis used in this study involves tables, charts and diagrams which describes the common sustainability practices in the selected universities.The formula used in calculating percentages in this study is:

$$\frac{\text{University Total Score in each Category}}{\text{UI GreenMetric Total Score in each Category}} \times \frac{100}{1} = \%$$

3.3. Validity of the Research.

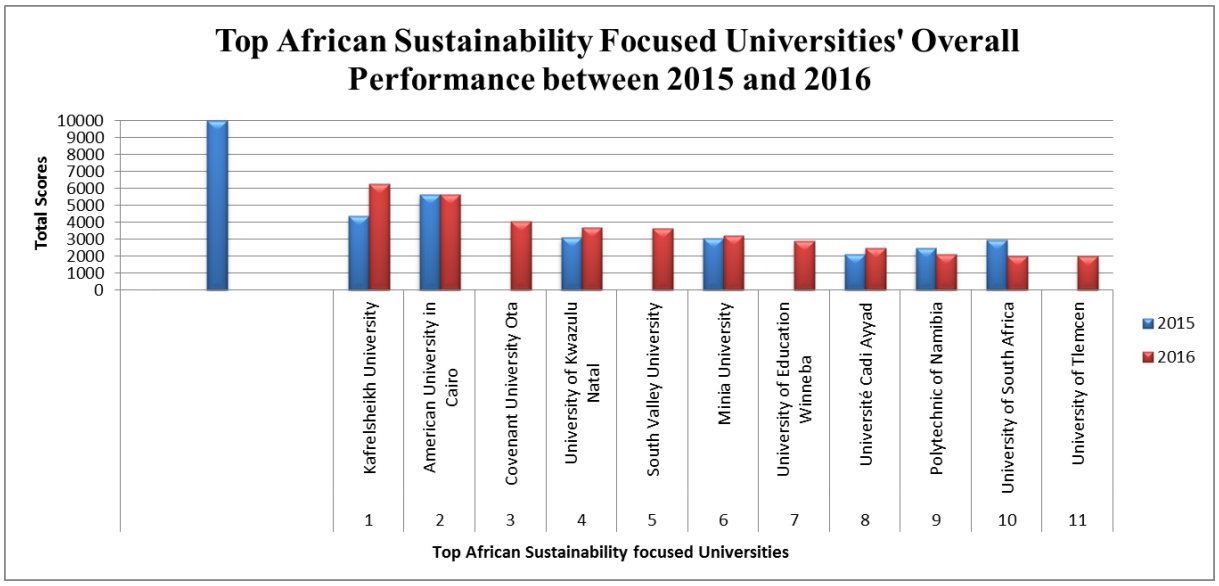
According to Jupp (2006) and Onwuegbuzie et al (2012), one of the most suitable instruments to analyze the contents of a website is content analysis, applied by many researchers. Content analysis is a rigorous method for document analysis, mainly known as a systematic way to reduce the sources and quantitatively analyze the documents' characteristics. The central issue of concern in this research places special attention to the degree in which the data used here inter-connects with the theoretical arguments generated in order to answer the proposed research question, "How are University's managements incorporating sustainability-oriented practices in sustainability focused African universities as far as CORE system (Curriculum, Operations, Research, and Engagement) is considered?" which lies in the quality of the assessment tools elaborated to assess the embeddedness of sustainability practices in European universities. This study presents secondary research (quantitative research) based on content analysis methodology using the published data on UI GreenMetric and universities' websites

which are related to sustainability to analyze the sustainability-oriented practices of the eleven selected top sustainability focused African universities according to the ranking of UI GreenMetric 2015 and 2016.

3.4. Findings and Evaluations

From our observations, the result shows that though to different extent, the only eleven African Sustainability focused universities in the UI Green Metric assessment and ranking index have taken sustainability seriously and are making efforts to incorporate sustainability practices in their universities. Table 2 shows the result of the UI GreenMetric assessment and ranking 2015 and 2016 for the selected universities in Africa and their scores on each indicator.

Table 4: *UI GreenMetric 2015/2016 Sustainability Assessment and Ranking of top African's Sustainability focused Universities.*



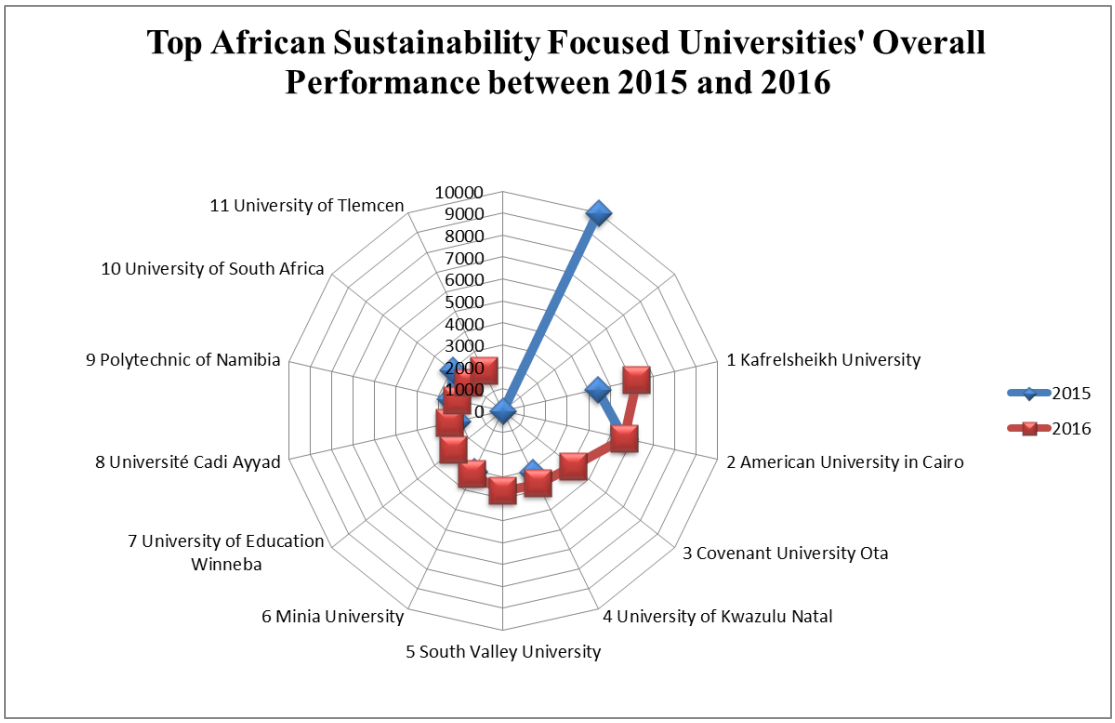


Figure 4. *Analysis of Top African Sustainability focused Universities' Overall Performance between 2015 and 2016 with Bar and Radar Chart.*

According to the analysis of Figure 4, it is clear that the eleven top African sustainability focused universities performed below average in the general incorporation of sustainability practices in 2015 and 2016. There was an increase in the overall commitment to the incorporation of sustainability practices in Kafrelsheikh University and American University in Cario while there was a low commitment to the incorporation of sustainability practices in Covenant University Ota, South Valley University, Minia University, University of Education Winneba, Universitie Cadi Ayyad, University of Tlemcen, University of Kwazulu Natal, University of South Africa and Polytechnic of Namibia in 2016.

4. Conclusion

Considering that Africa has contributed the least to the increasing concentration of greenhouse gases in the atmosphere, it is the most vulnerable continent to the impacts of climate change and has the least capacity to adapt. Africa's priorities are to implement climate change programs in such a way as to achieve sustainable development, in particular, to alleviate poverty and realize the Sustainable Development Goals with emphasis on the most vulnerable groups such as women and children. Given that Africa is the most vulnerable region with the least adaptive capacity, adaptation is the most immediate priority. The purpose of this research was on answering the question: *How are Universities incorporating sustainability-oriented practices in African sustainability focused universities as far as CORE system (Curriculum, Operations, Research, and Engagement) is considered?* The eleven African universities have sustainability as part of their goal and have plans, policies, strategies and have gone ahead to incorporate some of their sustainability goals. Universities in North African seen to be more committed in incorporating sustainable practices in their various universities more than others. Universities in the East and Central Africa region need to put more effort in the incorporation of

sustainable practices in their universities and societies. From the findings, the eleven African universities and others universities in Africa need to increase their commitment in the Operational Eco-efficiency (Setting and infrastructure, Energy and Climate Change, Waste reduction/ recycling, Water conservation and Transportation) aspect of the CORE system. Also, in the area of Education which consists of (Curriculum, Research and Engagement) in the CORE System, the studied African universities need to really become more committed in this aspect of sustainability, which is very important in the education of the students and the society about sustainability considering Africa is the most vulnerable region with the least adaptive capacity.

African universities need to increase their commitment towards the incorporation of sustainability practices in the Setting and Infrastructure, Energy and Climate Change, Waste reduction/ recycling, Water conservation and Transportation system of the university and in the curriculum, research and engagement activities. This is because sustainability as the triple bottom line of economic profitability, respect for the environment, and social responsibility will be unsustainable if one dimension overwhelms the others, the outcome will be unbalanced and unsustainable. Considering the fact that adaptation is the most immediate priority to Africa's needs in response to the vulnerability of the effects of climate change. Capacity building is needed to enable human resource development and the attainment of sustainable development goals at local and community levels. Africa Universities should raise up and encourage the society at large on the need to strive for the attainment of sustainable development goals which will help to achieve sustainable management, development and protection of the environment in order to face all these environmental, economic and societal challenges.

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Investigating the Certifications of Sustainability Offered by Different Organizations

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Abstract

Modern world which is highly globalized that most of companies turned their faces to use their resources efficiently through sustainable solutions. Since not only consumer needs are enough also stakeholder needs and expectations are a considerable subject in businesses. Sustainability and sustainable development issues are important tools for companies in the long-run. Recently people are mostly looking for highest benefit both for them and the society itself and also for their environment. If a company's services and products are socially responsible and sustainable it became more preferable by customers that's why sustainability is popular for marketing and selling as a social responsibility subject. Nowadays most of the companies have environmentally friendly suspects and there are some organizations which are looking for some certain sustainability criteria to have effective sustainability movements and to have better trust relationship among society and producers about how sustainable companies are. In this paper, the most faced major international and national organizations in the recent studies will be explained, which are have their own sustainability criteria and certification programs.

Keywords: Sustainability, Certification, Sustainable Development, Trust

1. Introduction

People are more sensitive to use environmental friendly products to be have better future that's why sustainability is an advantage for the companies in the current situation because consumers more tend to choose natural, ecological or environmentally products. As a result of this situation to have competitive advantage producers look for sustainable solutions for their services and products.

In addition to these consumer wants to see some proves which is given by independent organizations. There are some organizations in the market place that try to provide society goodness through creating transparency and trust, in terms of sustainability, these organizations give certificates and effective solutions by setting some criteria.

Peer-review under responsibility of the International Sustainability Congress.

2. Literature Review on Organizations and Sustainability

In this study, selected organizations examined which has sustainability criteria and certification through company actions, by considering previous literature and surveys this work evaluated the following certifications.

ISO – Green Tick

ISO is an international organization for standardization that has criteria about different kind of subjects, Green Tick has its own sustainability standards with the light of concerned ISO standards. Having Green Tick on products gives consumers confidence about their choice due to transparency and integrity of certification. The Green Tick sustainability certification system was designed to provide the lay consumer with an instantly identifiable eco-label that would signal that the product had been independently certified as sustainable. (Harris, S. 2007)

GRI –The Global Sustainability Standards Board GSSB

Global Reporting Initiative, is an international independent organization which offers sustainable solutions and criteria in marketplace to make clear the reflection of producers on sustainability issues.

UN - National Global Compact

The United Nations Global Compact initiative is presented for businesses as a universally accepted set of principles that aim to encourage businesses to align their operations and strategies with committed values. (Özsözgün-Çalişkan, A. 2015) With the direction of their criteria they want to build sustainable solutions for a better world.

BIST - Sustainability Index

Borsa Istanbul (BIST) and Ethical Investment Research Services Limited (EIRIS) made an agreement to evaluate Sustainability Index in international criteria for BIST companies in Turkey.

Sustainable Academy – Greening Hotels

Sustainable Academy (https://surdurulebilirlikakademisi.com) is an organization which in association with BIST and National Global Compact about sustainability and it has a Greening Hotels Certificate with some criteria for hotels in Turkey.

Above mentioned certifications can be summarized according to their criteria as indicated in Table 1.

Table 1: *Summary of Selected Certifications Based on Their Criteria.*

Certificates	Criteria
ISO – Green Tick	Green Tick has two major topics safety and environment. Under them, there are twenty detailed criteria.
GRI –The Global Sustainability Standards Board GSSB	GSSB has universal and specific criteria. There are three universal; Foundation, General Disclosures and Management Approach, three specific; Economic, Environmental and Social under specific topics thirty-three detailed criteria is evaluated.
UN - National Global Compact	There are four main subject about; Environment, Human Rights, Labor and Anti-Corruption as total ten principles concerned as criteria.
BIST - Sustainability Index	Sustainability Index has seven detailed criteria about these three main topics; Environment, Governance and Social.
Sustainable Academy – Greening Hotels	Greening Hotels has four subject as criteria; Energy Management, Water Management, Improving Indoor Air Quality, Waste Reduction and Recycling

Source: Prepared by the author based on relevant literature.

3. Conclusion

Certification of sustainability eliminates gap of trust for consumer and it helps companies to make sustainable developments and to have environment friendly products and services. In addition to these thanks to certifications since products are proved by independent organizations with their certain and published criteria that creates strong brand image as sustainable and products are becoming more trustable and marketable.

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The Visual Perception of Corporate Sustainability and Its Dimensions

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Abstract

Many researches in recent years have focused on the concept of corporate sustainability. Companies, society and a growing number of consumers, are now more aware of what corporate sustainability is about (Sukitsch, Engert and Baumgartner, 2015). Particularly corporations have become a key focus of attention in the sustainability debate, since they are perceived to be responsible for many negative impacts on the environment and on societies. Increasingly corporations and their leaders are recognizing the relations and inter-dependences of economic, environmental and social dimension (Lozano, 2013). Corporate sustainability is advancing from greenwashing and branding to a business imperative as high-profile global companies employ sustainability development in creating opportunities for business growth, innovating new products and services, and generating revenue (Rezaee, 2017). In order to achieve the vision described by the concept of sustainable development, the contribution of the real sector is defined as corporate sustainability (Bansal, 2005).

This study has been conducted to determine the visual perception of corporate sustainability, and its three dimensions; social sustainability, environmental sustainability and economic sustainability. The images have been gathered from images.google.com on September 2017. Both Turkish and English phrases have been searched and first 50 images on every phrase has been saved a total of 400 images. Then the images are analyzed according to their content. A list has been made for every image to determine the objects that are used. After that, the objects are categorized according to GRI (Global Reporting Initiative) report criteria. A spread sheet program has been used to calculate the frequencies. The results are presented with tables for each category. According to the results the most common objects are biodiversity related objects which are shown as plants or animals. The next most frequent object category is human/people which shows itself as human figures or human hands. The figures that symbolize economic dimension are the least common ones. Other details can be inspected on results section.

Keywords**:** corporate sustainability, social sustainability, environmental sustainability, economic sustainability, cultural differences, visual perception, visual content analysis.

1. Introduction

Corporate sustainability can be viewed as a new and evolving corporate management paradigm. The term 'paradigm' is used deliberately, in that corporate sustainability is an alternative to the traditional growth and profit-maximization model. While corporate sustainability recognizes that corporate growth and profitability are important, it also requires the corporation to pursue societal goals, specifically those relating to sustainable development, environmental protection, social justice and equity, and economic development (Wilson, 2003). Most notable definitions and

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approaches of sustainability, in corporate contexts, refer to the Brundtland Report (1987) and/or are based on the triple bottom line concept with its economic, environmental and social dimensions (Elkington, 1997). Dyllick and Hockerts (2002) framed the three dimensions in the company context as the business case (economic), the natural case (environmental), and the societal case (social) (Engert, Rauter and Baumgartner, 2016).

Corporate Sustainability is the discipline by which companies align decision-making about the allocation of capital, product development, brand and sourcing with the principles of sustainable development, in a resource-constrained world (GACSO, 2011)

In a globalised and networked world economy, it could be expected that managers address sustainability challenges similarly, regardless of country-specific characteristics. Alternatively, it could be argued that the degree of engagement for sustainable development varies according to country-specific historical and cultural backgrounds as well as in the resulting environmental, social and economic conditions (Schaltegger et al., 2014). This argument may also be true on the different visual perceptions about "corporate sustainability" of cultures with different languages. Moving from this reality, this paper is aimed at answering the question: what is the visual perception of corporate sustainability and its dimensions? To find the answer to this question the visual objects are categorized according to GRI (Global Reporting Initiative) report criteria. The roof concept is corporate sustainability and economic sustainability, environmental sustainability, and social sustainability are the three dimensions of corporate sustainability. Besides graphs, texts, charts, logos, etc. which could not be categorized under corporate sustainability or its three dimensions are categorized under "Institutional" category.

GRI report helps organizations to set goals, measure performance, and manage change in order to make their operations more sustainable. A sustainability report conveys disclosures on an organization's impacts – be they positive or negative – on the environment, society and the economy. In doing so, sustainability reporting makes abstract issues tangible and concrete, thereby assisting in understanding and managing the effects of sustainability developments on the organization's activities and strategy (GRI, 2013). The Global Reporting Initiative (GRI) provides a framework for the reporting of the sustainability performances of businesses and organizations (GRI, 2013). There are three dimensions: economic, environmental, social. As can be seen on Table 1 Economic and Environmental categories do not have sub categories but Social category has four sub categories as Labor Practices and Decent Work, Human Rights (focusing on workers and suppliers/contractors), Society (focusing on communities), and Product Responsibility (focusing on customers).

Table 1: *Categories and Aspects in the Guidelines (GRI, 2013)*

Category	**Economic**	**Environmental**
Aspects	· Economic Performance · Market Presence · Indirect Economic Impacts · Procurement Practices	· Materials · Energy · Water · Biodiversity · Emissions · Effluents and Waste · Products and Services · Compliance · Transport · Overall · Supplier Environmental Assessment · Environmental Grievance Mechanism
Category	**Social**	

Sub- Categories	Labor Practices and Decent Work	Human Rights	Society	Product Responsibility
Aspects	· Employment · Labor/Management Relations · Occupational Health and Safety · Training and Education · Diversity and Equal Opportunity · Equal Remuneration for Women and Men · Supplier Assessment for Labor Practices · Labor Practices Grievance Mechanisms	· Investment · Non-discrimination · Freedom of Association and Collective Bargaining · Child Labor · Forced or Compulsory Labor · Security Practices · Indigenous Rights · Assessment · Supplier Human Rights Assessment · Human Rights Grievance Mechanisms	· Local Communities · Anti-corruption · Public Policy · Anti-competitive Behavior · Compliance · Supplier Assessment for Impacts on Society · Grievance Mechanisms for Impacts on Society ·	· Customer Health and Safety · Product and Service Labeling · Marketing Communications · Customer Privacy · Compliance

It is remarkable that environmental and economical sustainability dimensions are mostly from companies' perspective, the images from social dimension searches reflect not only companies' perspective but also urban development (housing, health and well-being etc.) perspective. Table 2 presents a summary of common aspects that characterize the debate in the urban context. The table was compiled based on a review of selected academic and policy literature, with the ambition of highlighting key aspects, rather than being an all-embracing list (Weingaertner and Moberg, 2014). On 2015 similar results are obtained by an n-gram analysis of the corporate sustainability by the researchers (Ural, Tuna 2015). This research showed that environmental aspects are highly valued by both academicians and field workers.

Table 2: *Social Sustainability: Aspects in the Urban Context (Weingaertner and Moberg, 2014)*

Category	Social
Aspects	· Accessibility (e.g. access to employment, open spaces, local services, resources) · Social capital and networks · Health and well-being · Social cohesion and inclusion (between and among different groups) · Safety and security (real and perceived) · Fair distribution of income, employment · Local democracy, participation and empowerment (community consultation) · Cultural heritage (e.g. local heritage and listed buildings) · Education and training · Equal opportunities and equity · Housing and community stability · Connectivity and movement (e.g. pedestrian friendly, good transport links) · Social justice (inter-generational and intra-generational) · Sense of place and belonging · Mixed use and tenure · Attractive public realm · Local environmental quality and amenity

2. Methods

This study has been conducted by two researchers to determine the visual perception of corporate sustainability, and its three dimensions; social sustainability, environmental sustainability and economic sustainability. Özlem Tuna has a Ph.D. degree with her work on corporate sustainability and is a field expert. She has many papers which are published on the area. The

scientific frame work, image analysis and categorization are some of her contributions to this study. The study is designed by Nuri Ural and he is an expert on research methods. He also helped on gathering the images, analyzing and representing the quantitative data, and reporting the results.

The images have been gathered from images.google.com on September 2017. Both English and Turkish phrases with the same meaning are googled. There are four English and four Turkish total of eight search phrases. The translations of the Turkish and English phrases are as follow.

Table 3: *The Phrases in English and their Turkish Translations*

English	Turkish
Corporate Sustainability	Kurumsal Sürdürülebilirlik
Environmental Sustainability	Çevresel Sürdürülebilirlik
Social Sustainability	Sosyal Sürdürülebilirlik
Economic Sustainability	Ekonomik Sürdürülebilirlik

These eight phrases have been searched and first 50 images on every phrase has been saved total of 400 images. The images are numbered to establish a consensus between researchers. Then the images are analyzed according to their content. A list has been made for every image to determine the visual objects that are used on these images. A sample search result can be seen on Figure 1.

Figure 1 - Sample Image Results From "Corporate Sustainability"

After that, the visual objects are categorized according to GRI (Global Reporting Initiative) report criteria. The roof concept is corporate sustainability and economic sustainability, environmental sustainability, and social sustainability are the three dimensions of corporate sustainability. Besides,

some visual objects are categorized under institutional category. Environment related objects like sky, plants and green grass, animals etc. are categorized under "Environment" group. Hands, human figures, accommodation figures and buildings and workplace related visual objects are categorized under "Social" group according to GRI. And for "Economic" group visual objects like currency symbols like dollar or euro, money box or coins etc. are categorized. As a last category, graphs, texts, charts, logos, etc. are categorized under "Institutional" group.

After this categorization a spread sheet program has been used to calculate the frequencies. The results are presented with tables for each category. On the tables there are two different presentation style, the bold ones and the regular ones. Bold data should be evaluated among themselves and the regular ones represent the details of the bold typed category and should be evaluated separately. The tables can be seen on results category of this paper.

3. Results

The 400 images from 8 different search phrases contain 1241 different visual objects which are categorized in four different groups. The results have been analyzed using spread sheet programs. The data has been represented with frequencies and percentages.

Table 4: *Corporate Sustainability*

	English		Turkish	
	Freq.	Percentage	Freq.	Percentage
ENVIRONMENTAL				
Bio Diversity	62	69,66%	44	62,86%
Energy	20	22,47%	8	11,43%
Water	1	1,12%	1	1,43%
Emissions and waste	2	2,25%	1	1,43%
Transportation	3	3,37%	8	11,43%
Materials	1	1,12%	8	11,43%
	89	**58,17%**	**70**	**51,09%**
SOCIAL				
Housing	8	33,33%	3	15,00%
Health	1	4,17%		
Society	15	62,50%	15	75,00%
Employment			1	5,00%
Education			1	5,00%
	24	**15,69%**	**20**	**14,60%**
ECONOMICAL	**2**	**1,31%**	**0**	**0,00%**
INSTITUTIONAL	**38**	**24,84%**	**47**	**34,31%**
TOTAL	**153**	**100%**	**137**	**100%**

The results about the search phrase "corporate sustainability" both in Turkish and English can be seen on Table 4. The most common visual object on images are categorized in environmental category. For both languages more than half of the objects are environmental related. Among environmental objects most of them (%70 English -%63 Turkish) are symbolizing bio diversity. Another important result is that a big part (%63 English-%75 Turkish) of social visual objects are Society related. Economy related visual objects are negligible. Other results can be seen on Table 4.

Figure 2: *Corporate Sustainability in English*

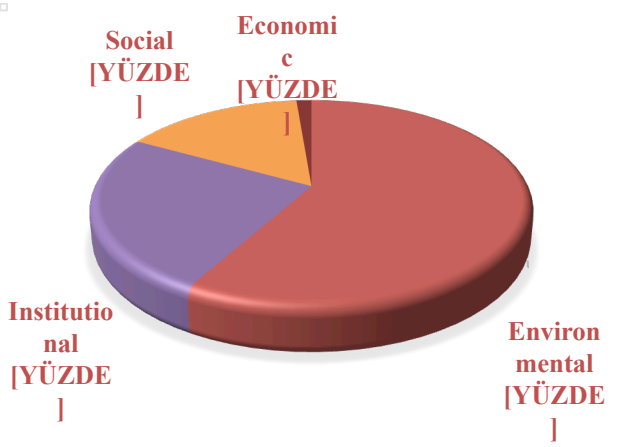


Figure 3: *Corporate Sustainability in Turkish*

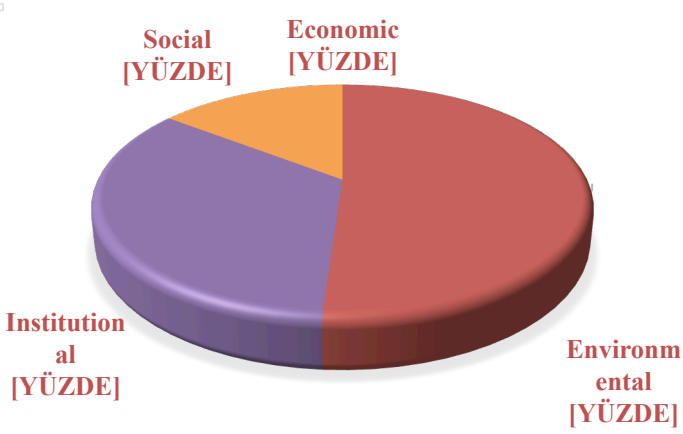


Figure 2 and 3 are showing the graphs for search phrase "corporate sustainability". It's worth paying attention to how the graphs are similar. The most common visual objects are Environmental related.

Table 5: *Environmental sustainability*

	English		Turkish	
	Freq.	Percentage	Freq.	Percentage
ENVIRONMENTAL				
Bio Diversity	114	74,03%	95	74,22%
Energy	13	8,44%	14	10,94%
Transportation	4	2,60%	11	8,59%
Materials	11	7,14%	0	0%
Emissions and waste	6	3,90%	1	0,78%
Water	6	3,90%	7	5,47%
	154	**69,06%**	**128**	**65,31%**
SOCIAL				
Society	19	55,88%	15	42,86%
Education	1	2,94%	2	5,71%
Employment	3	8,82%	4	11,43%
Housing	11	32,35%	8	22,86%
Health			6	17,14%
	34	**15,25%**	**35**	**17,86%**
ECONOMICAL	**0**	**0,00%**	**0**	**0,00%**
INSTITUTIONAL	**35**	**15,70%**	**33**	**16,84%**
TOTAL	**223**	**100%**	**196**	**100%**

Table 5 shows the results for the search phrase "Environmental sustainability" both in English and Turkish. Again environmental visual objects are most common (%69-%65), even higher than the other search results because this search is especially related to environment, and among them

biodiversity related objects are observed most often (%74-%74). Other results can be seen on Table 5.

Figure 4: *Environmental Sustainability in English*

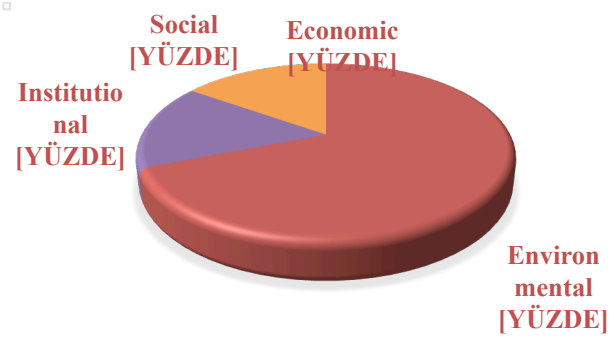
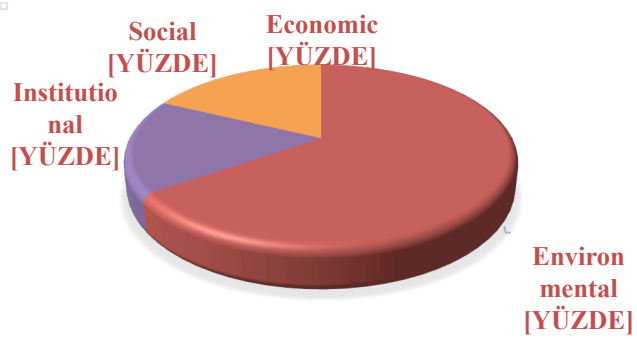


Figure5. *Environmental Sustainability in Turkish*



The graphs for the search phrase "Environmental sustainability" can be seen on figure 4 and on Figure 5. The distributions are very close on both languages. Because the search phrase is directly related to environment the environment group is even higher than the other phrases.

Table 6: *Economic sustainability*

		English		Turkish	
		Freq.	Percentage	Freq.	Percentage
ENVIRONMENTAL					
Bio Diversity		47	46	45	70,31%
Transportation		3	5,00%	10	15,63%
Energy		7	11,67%	1	1,56%
Materials		4	4	4	6,25%
Water				4	6,25%
		60	**44,12%**	**64**	**43,54%**
SOCIAL					
Society		14	82,35%	14	53,85%
Housing		3	17,65%	4	15,38%
Employment				2	7,69%
Education				3	11,54%
				3	11,54%
		17	**12,50%**	**26**	**17,69%**
ECONOMICAL		**14**	**10,29%**	**6**	**4,08%**
INSTITUTIONAL		**45**	**33,09%**	**51**	**34,69%**
TOTAL		**136**	**100%**	**147**	**100%**

The results for the search phrase "Economic sustainability" for both English and Turkish can be seen on Table 6. Because this search is directly related to economics it has the highest amount of

economical related visual objects among all other searches. It is surprising that, it is still very low comparing other visual object groups. The most common groups are Environmental and Institutional ones as usual.

Figure 6: *Economical Sustainability in English*

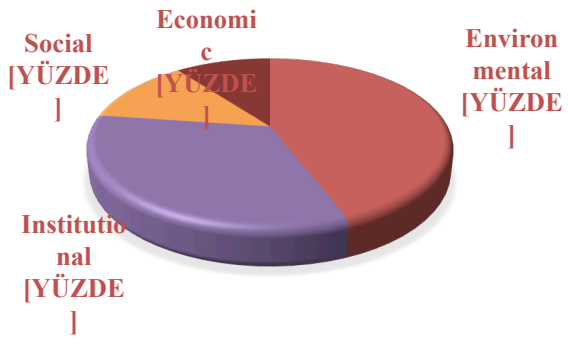


Figure 7: *Economic Sustainability in Turkish*

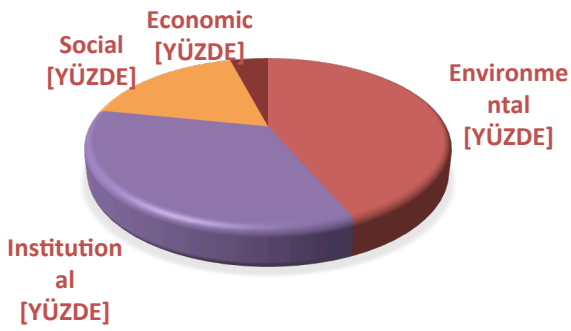


Figure 6 and Figure 7 show graphical results for the phrase "Economical sustainability". Both languages are very similar. This time economical visual images are beyond negligible but still very low compared to other groups.

Table 7: *Social sustainability*

	English		Turkish	
	Freq	Percentage	Freq	Percentage
ENVIRONMENTAL				
Bio Diversity	25	58,14%	49	76,56%
Energy	7	16,28%	4	6,25%
Emissions and waste	3	6,98%		
Transportation	3	6,98%	5	7,81%
Materials	5	11,63%	6	9,38%
	43	**37,39%**	**64**	**46,04%**
SOCIAL				
Education	1	4,17%		
Society	15	62,50%	25	78,13%
Health	4	16,67%	4	12,50%
Housing	4	16,67%	3	9,38%
	24	**20,87%**	**32**	**23,02%**
ECONOMICAL	**1**	**0,87%**	**1**	**0,72%**
INSTITUTIONAL	**47**	**40,87%**	**42**	**30,22%**
Total	**115**	**100%**	**139**	**100%**

Not surprisingly on Table 7 Social visual objects are more frequent than the other search phrases in "Social sustainability", but still environmental and institutional visual objects are more than social visual objects. Economical visual objects are negligible as usual.

Figure 8: *Social Sustainability in English*

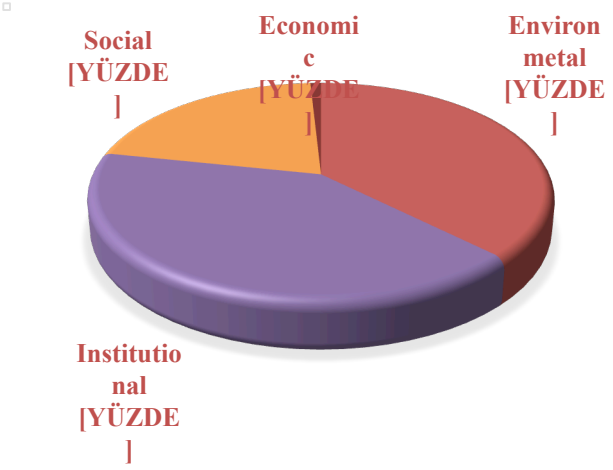
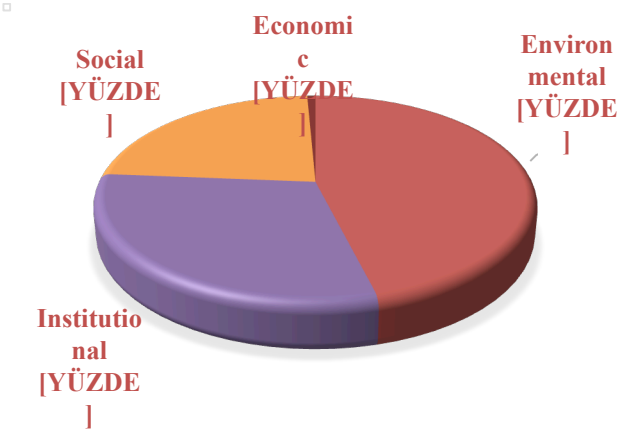


Figure 9: *Social Sustainability in Turkish*



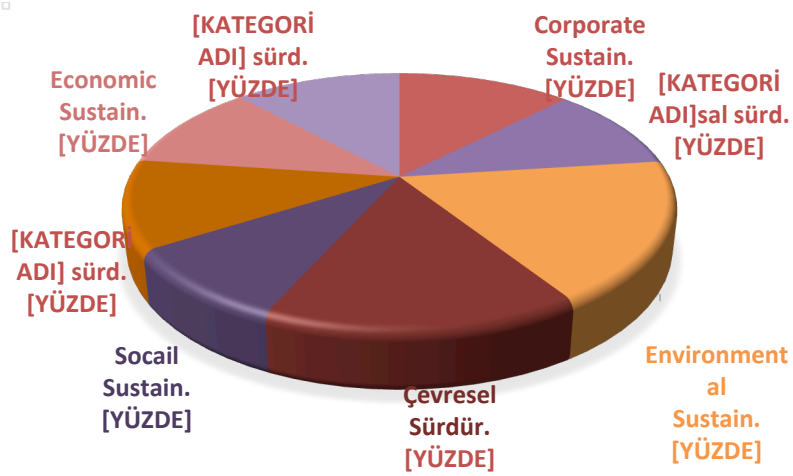
The graphs for "Social Sustainability" both in English and Turkish can be seen on Figure 8 and Figure 9. Although they are very similar on English search results Institutional visual objects are more than

Table 8: *Total Frequency by Dimensions*

		Image Categories				
		Environmental	Social	Economic	Institutional	Total
Search Phrases	Corporate sustainability	89	24	2	38	153
	Kurumsal sürdürülebilirlik	70	20	0	42	132
	Environmental sustainability	154	34	0	35	223
	Çevresel Sürdürülebilirlik	128	35	0	33	196
	Social sustainability	43	24	1	47	115
	Sosyal sürdürülebilirlik	64	32	1	42	139
	Economic sustainability	60	17	14	45	136
	Ekonomik sürdürülebilirlik	64	26	6	51	147
	Total	672 (%54)	212 (%17)	24 (<%1)	333(%27)	1241

Table 8 shows a short abstract of all phrases and their main groups. There are eight phrases, four Turkish and four English that are shown as rows. The images are categorized on four groups which are represented as rows. There are total 1241 visual objects on 400 images. The distributions are quite similar on every category and it fits the total distribution. The details can be found on earlier parts of this paper in result category.

Figure 10: *Total by Dimensions*



Eight search phrases contain similar quantities of visual objects. Only Çevresel sürdürülebilirlik and Environmental sustainability, which are actually the same phrase one in English and the other one in Turkish, have slightly higher visual objects in images. The distributions can be seen on figure 10.

Figure 11: *Total by Categories*

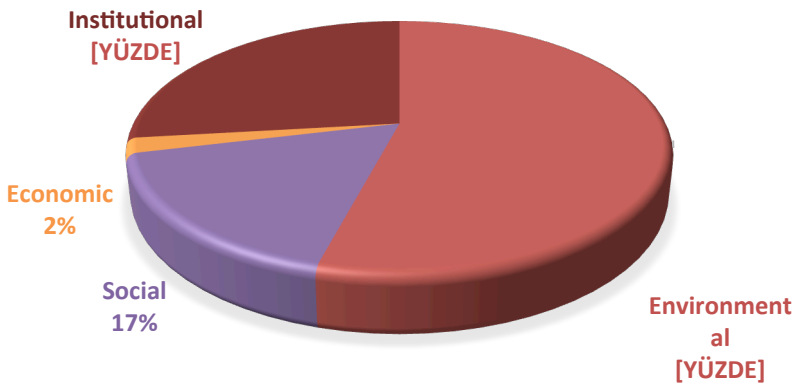


Figure 11 shows a visual presentation for visual object categories on 400 images. These 400 images contain 1241 visual objects and only a small part of them are economical. More than half of them are environmental and the rest are divided into Institutional and Social categories. The details are on figure 11.

4. Conclusion

The concept of corporate sustainability is increasingly being analyzed and considered both by academics and practitioners. Despite this a study for the visual perception of corporate sustainability and its dimensions could not be encountered. This study is hoped to contribute to the field with data about the visual perception of corporate sustainability and its dimensions in Turkish and English. The searches have been resulted mostly with images that corporates use to represent themselves. These images contribute on the point of view of corporates and their partners about sustainability.

Since Organization for Economic Cooperation and Development (OECD) has been established on 1960 its politic (International Union for Conservation of Nature and Natural Resources – IUCN, 1980;

Brundtland Report, 1987) and academic (Shrivastava, 1995; Starik ve Rands, 1995; Elkington, 1997) studies approach the subject from an environmental perspective. Besides the corporate sustainability is related in literature with socio-productivity and eco-productivity (Dyllick ve Hockerts, 2002). It is mentioned that this may only be possible with effective use of natural resources and making it an important part of corporate strategies. The results of our study seem parallel with that. The visual perception of corporate sustainability and its dimensions seem to handle the subject from perspective point of view on both languages, and when compared with other aspects the biodiversity aspect of environment group seem to be more important. Other than this the economic perspective seems to be really low on each eight phrases. Apart from this there is an important similarity on all phrases and groups between Turkish and English. This similarity is really worth attention. As last both languages contain an substantial amount of logos, graphs, schemes etc.

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Investigating the User Acceptance of Autonomous Vehicles to Contribute to Sustainability

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Abstract

Technology develops rapidly and presents new innovations every day. Some of them become lost or even acquire bad reputations, as the people or the environment may not be ready to accept it. Maybe the hoverboard in the movie Back to the Future movie cannot be seen on the streets yet, but the latest developments regarding autonomous vehicles have drawn the attention of tech-savvy individuals and marketers. Although there are discussions about this technology's potential problems, technology also provides many benefits that makes this change inevitable. Therefore, this study aims to investigate how people would react to autonomous vehicle technology.

Keywords: Technology Acceptance, Autonomous Vehicles, Individual Innovativeness, Trust in Technology, Sustainability of Autonomous Vehicles

1. Introduction

"We must develop a comprehensive and globally shared view of how technology is affecting our lives and reshaping our economic, social, cultural, and human environments. There has never been a time of greater promise, or greater peril." Klaus Schwab, Founder and Executive Chairman, World Economic Forum

Technology changes our lives everyday by providing us with new inventions; in 2011, Hannover Fair labeled this new era: Industry 4.0. This collective term encompasses many innovations such as automation systems, data exchanges, internet of things, cyber-physical systems, production technologies etc. Among these technologies, autonomous vehicles are discussed widely due to the latest test drive news surrounding Google's self-driving car tests (The Guardian, 2014) or Tesla's self-driving car crash

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(USA Today, 2017). The technology is clearly still in the development process, but the social and environmental aspects of this technology should be investigated as well.

According to SAE (Society of Automotive Engineers), autonomous vehicle technology is examined in five levels from no automation to full automation. Even though there are vehicles with partial automation are on the streets, it is still unknown how people would accept fully autonomous vehicles.

This study intends to understand the factors that affect the acceptance of fully autonomous vehicles in accordance with earlier studies and design an extended model by considering trust level, past experience and personality traits of the public.

The sustainability of the autonomous vehicles is an essential subject, as it affects our lives environmentally and socially; thus, this factor should be discussed when investigating the acceptance by people. AVL Turkey Director Umut Genc commented in an interview that the most important benefits of the autonomous vehicles regarding sustainability will be their increased fuel efficiency and reduced pollution, thanks to the effective use of resources. The autonomous vehicles will provide efficient parking and increase road capacity. The drivers will be free of traffic stress, and non-drivers will be able to own vehicles as well. However, while people will be saving time and energy, it is also possible costs of transportation will increase due to the additional travel. Kaenel (2016) reports that autonomous vehicles will reduce fuel consumption and are also expected to ease traffic congestion.

One new risk that autonomous vehicles may bring is the possibility of system failure. However, after being tested for many years under many different conditions, the probability is very low. Although there are some concerns about privacy and security, the engineers can develop new technologies for both physical and software security. Newman (2016) states that autonomous vehicle technology may save 300,000 lives per decade in addition to increasing our mobility.

Another autonomous vehicle scenario involves shared vehicles and reduced employment. Since this technology does not require a driver, new ownership patterns could arise, which could change transportation methods. Taxi or truck drivers may not be needed to drive but instead be present for emergency or safety purposes. Litman (2014) reports that incremental costs are still uncertain, but are estimated to be high since the existing technologies cost hundreds of dollars. However, the additional cost could be covered by reduced energy consumption and insurance savings.

2. Literature Survey and Conceptual Evaluation

In order to develop a deeper understanding about technology acceptance and autonomous vehicles, the previous literature was surveyed and a conceptual model suggested.

2.1. Technology Acceptance Model

First designed by Davis in 1989 and based on Ajzen and Fishbein's Theory of Reasoned Action (TRA), the Technology Acceptance Model is the most acknowledged model that explains individuals' attitudes toward technology. The model designed by Venkatesh and Davis has two core constructs: perceived ease of use and perceived usefulness.

Davis defines perceived usefulness (PU) as "the degree to which a person believes that using a particular system would enhance his or her job performance," and perceived ease of use (PEU) as is defined as "the degree to which a person believes that using a particular system would be free of effort." An interesting point about the models is that PEU affects PU as well; easy to use systems are perceived as more useful by people.

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2.2. Individual Innovativeness

The Oslo Manual of OECD (2005) defines innovation as "the implementation of a new or significantly improved product (good or service), process, a new marketing method, or a new organizational method in business practices, workplace organisation or external relations."

Innovativeness is the difference between people and organizations based on their acceptance of change. Rogers (2003) explains how levels of innovation change based on the personality traits, and accordingly defines five categories for innovativeness: innovators, early adopters, early majority, late majority and laggards.

2.3. Trust

Trust is a major determinant of a relationship between people or a person and a system. Lee & Moray (1994) stated that trust is an important factor that effects the interactions with an automatic systems. Similarly, Ghazizadeh et al. (2012) reported after their study with truck drivers that "trust was also a major determinant of intention to use, suggesting that the acceptance model can be usefully augmented by this construct."

2.4. External Locus of Control

Locus of control defines a person's perception about being in control of the events that affect his/her life. According to Rotter (1966), people with an external locus of control believe that they cannot control events and are less resistant to receiving control from the outside. Choi & Ji (2015) adopted that construct in their study by saying "people with an external locus of control tend to believe that humans will always cause accidents and hence that an automated driving system would be far better than human drivers."

2.5. Suggestion for the Conceptualization

Based on the relevant literature review, a conceptual model is illustrated in Figure 1.

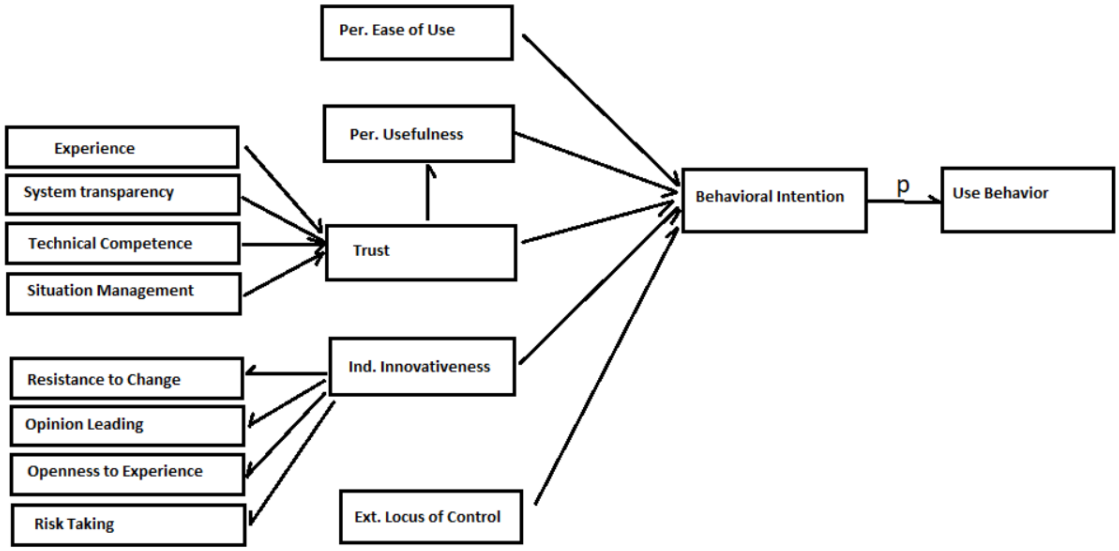

Figure 1: *Suggested Conceptual Technology Acceptance Model for the Autonomous Vehicles*

Source: Developed by the Authors Based on the Relevant Literature Review

PEU and PU are two main constructs of behavioral intention, according to the technology acceptance model. In this suggested model, the effect of PEU on PU is removed, as suggested by previous studies on autonomous vehicles. In the model, the use behavior is shown proportionally, because as Ajzen (1991) said, "intentions can only be expected to predict a person's attempt to perform a behavior, not necessarily its actual performance."

Trust is suggested to be a construct for behavioral intention and also has an effect on PU. System transparency, technical competence and situation management are described as factors in the literature. Experience is suggested by the author as a factor of trust, since past experiences may change a person's tendency to trust. The individual innovativeness scale is predicted to be a new construct for the author's technology acceptance, as it defines the personality traits that push against an innovation. External locus of control is also included in the model, because it has been found effective in previous studies.

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User Motivation for a Sharing Economy: A Chaperone of Sustainable Consumption

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Abstract

In the last two centuries, the world has seen growth in science and technology in a way it has not seen before. This growth led to the Industrial Revolution and capitalistic economies where mass production and globalization opened the market to everyone. Rich economies became richer, and new demands have been created. Moreover, the development of medical science and nutrition has increased the global population to a proportion that the world has never seen since its inception. When this overpopulated generation gained strong purchasing power and massive consumption options, they built up a lifestyle of overconsumption (Giljum et al., 2009). Buying products and services again and again became the lifestyle rather than consuming only what is required. As a result, overconsumption has affected everyone socially and economically, but most importantly it has affected the planet environmentally. So, sustainable consumption became the crying need for this generation; meanwhile, a new concept called the sharing economy has emerged as one of the fastest growing ideas in the last decade. Sharing economy refers to a platform where consumers and providers share objects, skills or services. Sustainable consumption and the sharing economy both have been the talk of the world in recent days and this study shows the relationship between them. The study shows how sustainable consumption is achievable through a sharing economy based on statistics and other literature. Moreover, it identifies consumers' motivational factors to participate in a sharing economy and develops a conceptual model to explain the relationships between motivational factors, a sharing economy and sustainable consumption.

Keywords: Sustainable consumption, Sharing economy, Consumer motivation

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1. Introduction

It's been 3.7 million years since planet Earth first saw the human species and its evolution, according to the anthropologists Boyd and Silk (1997). Currently, one of the major problems the world is facing is environmental pollution, and one of the major reasons behind this is the rapid increase in the world's population, which is busy consuming resources and producing massive amounts of waste from these resources (Dovers & Butler, 2015). As of 2015, Earth is home to 7.3 billion people, which means there are 7.3 billion people to feed, nurture, educate and keep warm. According to predictions, it will reach 9.2 billion by 2050 (Dovers & Butler, 2015).

In 1800 AC the world hadn't seen even 1 billion people; it took 123 years to reach 2 billion, then 33 years to reach 3 billion. Since then every 12–14 years 1 billion people have been added to the world's population (Dovers & Butler, 2015). Population growth was very slow until the 18th century, but from the 19th century on it increased dramatically due to the Industrial Revolution, huge agricultural production, improved nutrition, development of medical science and technology and so forth (Dovers & Butler, 2015). The scenario of consumption is worse due to overconsumption by developed countries, where they consume almost 10 times more than the underdeveloped countries (Giljum et al., 2009). For instance, the average middle-class US citizen consumes 3.3 times the subsistence level of food and 250 times the subsistence level of water, which means if the rest of the world starts consuming like an average middle-class American, the world can only carry 2 billion people at the current rate of resource extraction (Dovers & Butler, 2015). This problem is currently getting worse and worse, and there are many consequences of significant overconsumption by developed countries. Moreover, as developing countries are also trying to develop, which is a fundamental right of any country, the level of consumption will increase and create severe pressure on the environment and society. Sustainable consumption is one of the most effective solutions to this problem, and the sharing economy has evolved as an innovative and modern method to involve consumers in sustainable consumption.

The aspiration of a research is to come across the information which is hidden and which is undiscovered yet through applying scientific procedure (Kothari, 2004). This research very elaborately discusses about the emergence of sustainable lifestyle from individual perspective and how sharing economy can play a key role to follow a sustainable lifestyle. The research aims to identify the motivation of Turkish citizen to participate in sharing economy with an exploratory research, involves an intense data storming through multiple in-depth interviews, and to prove the positive correlation between sharing economy and sustainability with data and statistics from other researches. The research also identifies the world view about sharing economy ensuring sustainability; also it's been considered as a part of alternative lifestyle by many cities which are striving for sustainable development. Sharing economy brings the platform to the individuals to participate in the sustainable development through a sustainable lifestyle for the greater benefit of the environment and society.

2. Literature Review and a Conceptual Framework

In order to develop a model for consumer motivation to participate in a sharing economy, the emergence and a brief explanation of the sharing economy with sustainable consumption are discussed in the literature review section.

2.1. The Consequences of Overconsumption

What loads are we putting on the world or on the next generation by this consumption madness? Unsustainable consumption brings many long-term economic, social and especially environmental consequences (Pedersen, 2013). As we have seen, the world's population has increased significantly since the 19th century and shows no sign of slowing down in the near future, and this massive unsustainable consumption by a large population stresses the environmental ecosystem beyond the planet's capacity (Arunachalam, 2015). Yet, the pollution in the environment is as disproportionate as we have seen before between population and consumption. The theory that a higher population leads to more pollution doesn't fit according to the statistics of countries' contributions to greenhouse gas emissions that lead to climate change.

It's clear that developed countries are the major producers of greenhouse gas emissions as per capita CO2e gas is 5–10 times higher in North America, Europe and Oceania compared to Asia and Africa; although the populations in the former are smaller than in the latter, due to overconsumption, their contributions to pollution are much higher (Scott, 2009). This signifies that cleaner production will not be enough to ensure sustainable development as long as consumption is not sustainable.

2.2. The Inevitable Need for Sustainable Consumption

Sustainable consumption has emerged as a vital topic as many scholars have come to the realization that environmentally friendly and greener consumption alone will not be enough to achieve sustainable development (Marchand, Walker & Cooper, 2010). Over the past few years, it's been evident that consuming green products must go along with reduced per capita consumption to ensure sustainable development of society (Marchand, Walker, & Cooper, 2010). Sustainable development is not a new concept. Global awareness regarding sustainable production, greener consumption, waste management and reduced emissions are the most spoken about topics in sustainable development; however, it's also been apparent that the participation of consumers to consume less can have an enormous impact on sustainable development. Although scholars, policy makers and academicians have tried to define sustainable consumption differently with their own justifications and validity, still the official definition is that of the Norwegian Ministry of Environment (1994) "sustainable consumption is the use of goods and related products which respond to basic needs and bring a better quality of life, while minimizing the use of natural resources and toxic materials as well as the emissions of waste and pollutants over the life cycle, so as not to jeopardize the needs of future generations" (Black & Cherrier, 2010).

2.3. Sustainable Consumption as a Form of Sharing Economy

Sharing economy is a broad and complex concept that does not have one universal definition. It has been described differently, but the generally accepted characteristics include renting, bartering, loaning, gifting and swapping of assets that are typically underutilized, either because they are lying

unused or because they have not yet been monetized (Felländer, Ingram & Teigland, 2015). It's been mentioned and regarded alongside many other similar ideas and concepts such as peer-to-peer economy, mesh economy, collaborative consumption and collaborative economy. All over the world the old phenomenon of the sharing economy is reemerging. It seems to play a major role in global business as approximately 19% of US citizens have been either a consumer or a provider and 44% have heard of sharing economy services (PWC, 2015). The numbers of sharing economy consumers and service providers are increasing significantly around the world, which has caused large businesses, policy makers and governments to take this growing concept more seriously.

The major predicament of unsustainable consumption, discussed above, can be innovatively and strategically tackled with a sharing economy (Stratmann, Ferreiro & Narayan, 2013). One major characteristic of unsustainable consumption is unused, underused or unrealized wasted materials, and sharing economy is mainly based on sharing those materials with others to make maximum use of them. For example, one doesn't need a drill machine often, maybe twice or thrice in a year, so if he/she buys one, in the entire life cycle of the product it will be used 15 times in 5 years. What a sharing economy promises is a platform where consumers can look for a drill machine owned by someone who lives nearby, rent it only when required and not spend a huge amount of money for the depreciation of the product. Thus, the machine could be used by multiple users hundreds of times in a win-win situation, where everyone is economically benefited while enabling social and environmental challenges.

3. Model Development for Consumer Motives to Participate in a Sharing Economy

Based on the literature and qualitative research, this conceptual study intends to identify the relationships between sustainable consumption, a sharing economy and consumers' willingness to participate in a sharing economy. A conceptual model has been drawn based on the entire discussion. This model could be used for further analysis and causal research and also to develop hypotheses. Perhaps this research should be done in other cities and different parts of the world to ensure the validity and reliability of the theoretical development; a set of hypotheses and propositions has been suggested that can be tested to develop a more reliable theory on this study.

Table 1: *Hypotheses Developed from the Literature Review*

L	**Hypothesis**	**Sources**	**Variables Involved**
	Extrinsic motives have more influence on users to participate in a sharing economy than intrinsic motives.	Glind, 2013	Financial, environmental, social, practical
	Financial motives influence users to participate in a sharing economy.	Botsman and Rogers, 2011; Glind, 2013; Zipcar, 2013	Financial
	Practical motives influence users to participate in a sharing economy.		Practical
	Social motives influence users to participate in a sharing economy.		Social
	Environmental motives influence users to participate in a sharing economy.		Environmental
	Users' intentions influence motivation to participate in a sharing economy.	Own	Intention
	Users' previous experience in a sharing economy influences their motivation to take part in a sharing economy.	Botsman and Rogers, 2011; Glind, 2013	Experience in sharing economy
	Users' personal values influence their motivation to participate in a sharing economy.	Own	Personal values
	Users' preferences on product or service attributes influence their motivation to participate in a sharing economy.	Own	Product attribute preference
0	Demographics influence motivation to participate in a sharing economy.	Botsman and Rogers, 2011; Glind, 2013; OuiShare, 2013;	Gender, age, education, occupation, residence, income, Internet use

		Makkonen, 2013	

Table 2: *Proposition Developed from the Literature Review*

L	Proposition	Sources
	A sharing economy leads to sustainable consumption.	Florin & Bâlgăr, 2016; PCW, 2015;

In the following model, the relation between different factors, described in the literature, has been shown. The process starts from both intrinsic motivation and extrinsic motivation to participation in a sharing economy. The model uses four motivational factors, which are divided between intrinsic and extrinsic motivation based on the previous research. The second part of the model proposes the evidence that a sharing economy leads to sustainable consumption.

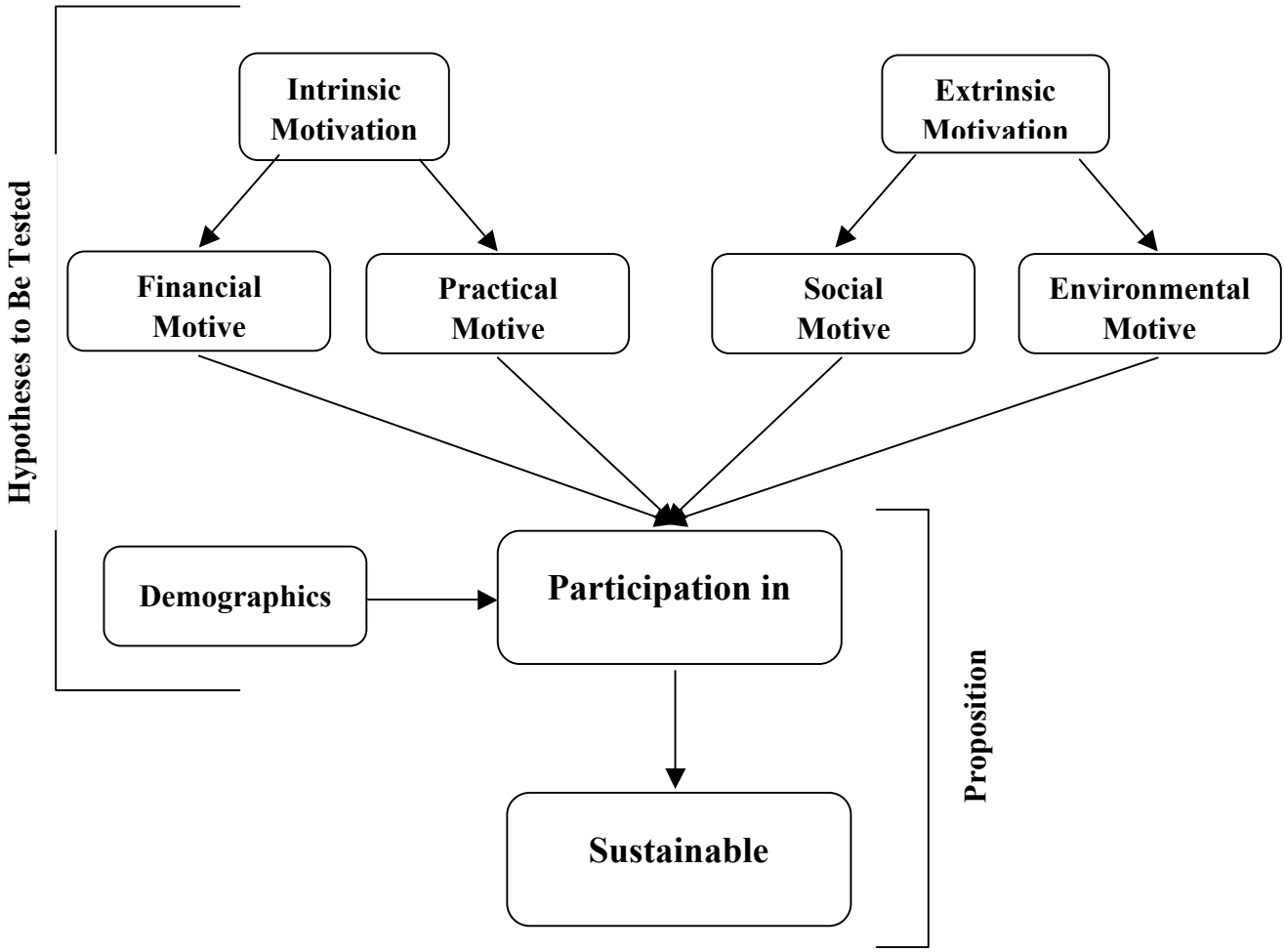

Figure 1: *Conceptual Model, Prospect of Sustainable Consumption through a Sharing Economy.*

Source: Developed by the authors based on the relevant literature review.

The Conceptual Research model in figure 1 shows the graphical presentation and relationships between different variables of the research. The research model in this research has been developed based on the literature review and the exploratory research to conduct further quantitative researches. The variables of the models are from the literature review, where the previous researchers have found out significance regarding these variables. The model includes two major parts. The first division is for testing hypothesizes mentioned in table 1, which includes three sub divisions – 1. Independent Variables, which are Financial Motivation, Practical Motivation, Social Motivation and Environmental Motivation. 2. Dependent Variable, which is Users' participation in sharing economy and 3. Demographics. The second division includes a proposition showing the relationship between Sharing Economy and Sustainable Consumption.

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A Methodology for Assessment of Green Manufacturing

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Abstract

The consciousness and awareness on the importance of the environment have increased in the last decade. The effects of this realization can be seen both in regulations about the laws, standards and in practical applications of the companies. “Charter of The Global Greens” or regulation, like Eco-Management and Audit Scheme (EMAS) of The European Union are some of the regulatory examples. Moreover, there are practical applications of environmental requirements in the companies. Such applications are also called as green applications and seen in various fields starting from the design of the product to the final delivery of it. As a result of these applications, a popular term, green supply chain, has emerged and widely been used in the recent studies. It is difficult and tedious to provide the greenness of a supply chain unless an analytical approach is utilized. The first step of this process is the greenness assessment of the existing chain. However, it will be better to determine the components of a supply chain and focus on each in more detail. It is inferred from the existing literature that the green supply chain can be considered under four main parts such as in-bound logistics, in-plant logistics, out-bound logistics and reverse logistics. The scope of this study is limited with green manufacturing including in-plant logistics activities. Hence, firstly, the important key performance indicators (KPIs) in in-plant logistics with main and sub indicators are determined and afterwards, a scoring structure is provided by using fuzzy ANP.

Keywords: Green Supply Chain Management, Green Manufacturing Assessment, Fuzzy ANP.

1. Introduction

Depending on the realization of the environment’s importance, “Environmental Friendly” concept has become so popular. There have been so many declarations and regulations announced like “Charter of The Global Greens” (Greens, 2001), “Eco-Management and Audit Scheme (EMAS)” from The European Union, "ISO 14000 Series" from International Organization for Standardization (ISO), "The Green Dragon Environmental Management Standard" from Green Dragon EMS in Wales and "BS 8555", British Standard in UK and Ireland. In order to provide the environmental requirements and reduce harm, business world takes action in all processes within a supply chain.

As stated by Sarkis (1992), GSCM can be analyzed under four main topics such as in-bound logistics, in-plant logistics, out-bound logistics and reverse logistics. The first field that was focused on was reverse logistics. The studies of Barnes (1982) and Pohlen (1992) are two of the first studies in that area. Afterwards, Bloom et al. (1991) and Welford et al. (1993) started to talk about environmental

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manufacturing strategies. Then, in 1994, Drumwright (1994) focused on in-bound logistics. Finally, Sarkis (1995) combined these parts into together and published his study in the academic world. Subsequently, whole Green Supply Chain Management (GSCM) model including the green design was defined by Wilkerson (2005).

Different type of GSCM models including conceptual and technical approaches have been proposed by various authors. While some of them focus on the specific part of a supply chain, the others consider the whole chain. As indicated by Sarkis (2002) and shown in Figure 1. There are four stages in a supply chain including procurement, production, distribution and reverse logistics.

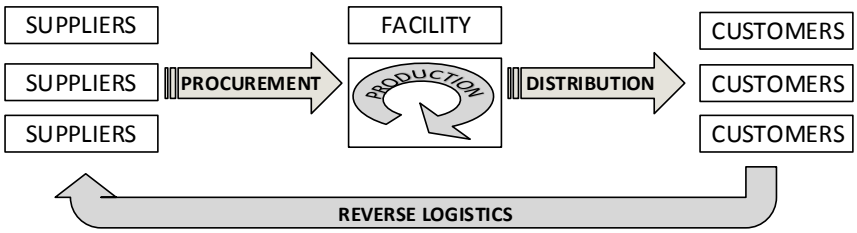

Figure 1: *The four main components of supply chain*

It is not easy to provide a green supply chain. Lots of adjustments should be performed in various fields. However, before performing the required adjustments, the first stage should be to assess the existing greenness level. Then, depending on the greenness level, the required actions can be taken. Regarding the importance of this stage, it is focused on the greenness assessment in this study. But, depending on the comprehensive structure of the supply chains, the scope is limited with green manufacturing and hence, the studies related with green manufacturing are focused on. Firstly, it is aimed to obtain the greenness indicators in the manufacturing environment, then, it is focused on the techniques that are used to evaluate the indicators. Different from the existing literature, an indicator structure to evaluate the green manufacturing is proposed. Moreover, fuzzy ANP is used to determine the importance level of determined indicators and a greenness scoring system is provided and shown with a numerical example.

The remainder of the paper is organized as follows: The literature review about the green manufacturing is provided in Section 2. There is the proposed methodology and the numerical example in section 3 and the conclusions are provided in Section 4 and the references are provided finally.

2. Literature Review

It is difficult to manage the systems without measuring them. A robust assessment system including proper indicators and techniques will enable to determine the existing situation and enlighten the roadmap. There are various assessment methodologies applied in different fields. Regarding the scope of this study, it is focused on the studies considering green manufacturing.

Green manufacturing is not just directly related with the production, it also contains all inputs and outputs in the process; starting from the machines to tools, from used energy to waste, from in-transit methodology to re-usage of the outputs. There are various studies about green manufacturing. One of the first studies including hazardous waste management was presented by Bloom et al. (1991). Following Bloom et al. (1991), Welford et al. (1993) focused on environmental performance, waste minimization and many other environmental related subjects. Afterwards, various studies have been performed by Azzone in different years including risk reduction with preventive, proactive or creative mode, classification of green operating policies and cleaner technologies (Azzone et al., 1994, 1997, 1998). Pollution concept was also studied by Porter et al. (1995). After 2000, this trendy subject was studied by Zhang et al. (2005), Dornfeld et al. (2007), Sawhney et al. (2007), Johansson et al. (2009), Bergmiller et al. (2009), Diaz et al. (2010), Deif et al. (2011), Sivapirakasam et al. (2011), Chuang et al. (2014), and Govindan et al. (2015).

Assessment of systems is one of the complex elements of the business management. Managers utilize various assessment systems to achieve their aims in the competitive business world. Hence, depending on its importance, academicians and the companies have become eager to check, assess and evaluate the greenness. Theyel (2006) states the importance of environmental performance as "*environmental performance is a concern of managers due to reasons ranging from regulatory and contractual compliance, to public perception and competitive advantage*". With similar point of view, assessment of the green manufacturing is also another key important process for the business as well. This assessment and evaluation process became critical for the companies for different purposes either to have competitive advantage and improve customer satisfaction or regulatory reasons. Moreover, checking the KPIs continuously, is an additional important factor when if environmental labels or certificates, like British Standard "BS 8555" in UK and Ireland, are taken.

Assessment is also important for different decision levels including operational, tactical and strategic business decisions. Sarkis (1999) focused on the importance of KPIs which are used for critical and important decisions by many managers and organizations. Moreover, an illustrated example was provided with the developed model in that study. Besides that, in another research, performance measures for green manufacturing practices in India were determined by Digalwar et al. (2013). Nevertheless, there are so few studies that are similar to the studies of Sarkis (1999) and Digalwar et al. (2013) that are directly related with green manufacturing. Instead, the studies indirectly include green manufacturing under Green Supply Chain Management (GSCM) and Sustainable Supply Chain Management (SSCM). Some of the such studies can be listed as Sarkis et al. (2001) for waste management, Lakhal et al. (2004) for a lumber industry and Zhu et al. (2004) and Zhu et al. (2005) for Chinese manufacturing industry.

Regarding the review of the literature, it can be concluded that there are limited number of studies that are directly related with the assessment of green manufacturing. Therefore, this study will fill this gap by considering this topic under a fuzzy logic based methodology. With the proposed fuzzy based assessment methodology, it is aimed to provide contribution both to the literature and practitioners.

3. Proposed Methodology and Numerical Example

In this study, following a detailed survey on the greenness literature, four dimension s determined for in manufacturing environments' greenness assessment (Table 1). Considering the interactions among them, Analytic Network Process (ANP) approach is found proper to analyze the importance degrees of them. After finding the criteria importance degrees, an integrated score is calculated to measure a manufacturing environment's greenness.

Table 1: *Green Manufacturing Environmental Assessment Criteria and Scoring Scale*

Main-criteria	Sub-criteria	Scoring scale
1. Green material handling	1.1. Emission level	1-5
	1.2. Greenness of accessories	1-5
	1.3. Energy consumption	1-5
2. Green product design	2.1. Material recyclability	1-5
	2.2. Sub-product reusability	1-5
	2.3. Design for disassembly	1-5

	2.4.	Design for end-product energy consumption	1-5
3. Green production	3.1.	Waste reduction	1-5
	3.2.	Usage of recycled resources	1-5
	3.3.	Greenness of production equipment	1-5
	3.4.	Environmental safety	1-5
4. Managerial approach for green manufacturing	4.1.	Certification	1-5
	4.2.	Existence of structured processes for environment	1-5
	4.3.	Financial support	1-5
	4.4.	Support to green energy production	1-5
	4.5.	Waste treatment activities	1-5

3.1. ANP/Fuzzy ANP

Analytic Network Process (ANP) approach is a decision making technique which allows the consideration of interactions among criteria. Analytic Hierarchy Process (AHP) can be seen as a starting point of ANP (Jharkharia and Shankar, 2007). Different from AHP, ANP uses a network and provides a methodology to take into account the influence of each criterion on the others. Details of the ANP can be seen in Saaty (1999). Uncertainty in the problems can also be considering by applying fuzzy logic techniques on the decision process. In the literature, Tuzkaya and Onut (2008), Tuzkaya et al. (2010), Büyükozkan et al. (2004) are some the examples of the many studies which uses Fuzzy ANP approach.

In this study, to evaluate the decision makers' preferences by appliying Fuzzy ANP, pair-wise comparisons are realized with triangular fuzzy numbers $\left(a^{l},a^{m},a^{u}\right)$. The *mxn* fuzzy matrix can be seen in Eq. 1. In this matrix, a_{mn} represents the comparison of the component *m* with component *n*. If $\widetilde{A}$ is a triangular pairwise comparison matrix, it is assumed that the reciprocal, and the reciprocal value, i.e. $1/a_{mn}$, is assigned to the element a_{mn} (Tuzkaya and Onut, 2008):

$$\widetilde{A}=\begin{pmatrix} (1,1,1) & \left(a_{12}^{l},a_{12}^{m},a_{12}^{u}\right) & \cdots & \left(a_{1n}^{l},a_{1n}^{m},a_{1n}^{u}\right) \\ \left(\frac{1}{a_{11}^{u}},\frac{1}{a_{11}^{m}},\frac{1}{a_{11}^{l}}\right) & (1,1,1) & \cdots & \left(a_{2n}^{l},a_{2n}^{m},a_{2n}^{u}\right) \\ \vdots & \vdots & \vdots & \\ \left(\frac{1}{a_{1n}^{u}},\frac{1}{a_{1n}^{m}},\frac{1}{a_{1n}^{l}}\right) & \left(\frac{1}{a_{2n}^{u}},\frac{1}{a_{2n}^{m}},\frac{1}{a_{2n}^{l}}\right) & \cdots & (1,1,1) \end{pmatrix} \quad (1)$$

In the literature, there are a number of methods exist to calculate the fuzzy priorities, $\widetilde{w}_i$, where $\widetilde{w}_i = (w_i^l, w_i^m, w_i^u)$, and i=1,2,…,n, using the judgment matrix, $\widetilde{A}$, which approximates the fuzzy ratios $\widetilde{a}_{ij}$, so that $\widetilde{a}_{ij} \approx \widetilde{w}_i / \widetilde{w}_j$. In this study, the logarithmic least-squares method is used. The relative importance and the interdependencies among criteria with the form of triangular fuzzy weights are calculated by applying this technique. The logarithmic least-squares method can be seen in Eq. 2 (Tuzkaya and Onut, 2008):

$$\widetilde{w}_i = (w_i^l, w_i^m, w_i^u), \quad k=1, 2, \ldots,n. \tag{2}$$

where

$$w_i^s = \frac{\left(\prod_{j=1}^{n} a_{ij}^s\right)^{1/n}}{\sum_{k=1}^{n}\left(\prod_{j=1}^{n} a_{kj}^m\right)^{1/n}}, \quad s \in \{l, m, u\}.$$

Following this step, for converting the weights to crisp numbers, Yager Index (Yager, 1981) is used and it is simply calculated by using Eq. 3.

$$\widetilde{F} = (n-a, n, n+b) = (3n-a+b)/3 \tag{3}$$

Finally, unweighted supermatrix for criteria and sub-criteria influences is constructed. Then, the supermatrix is weighted by criteria weights and a limiting supermatrix is generated.

3.2. SCORING System

Following criteria weight determination phase, greenness level of manufacturing environment is obtained by using simple scoring system. To assess the greenness level of the systems, a scale is determined for each of the sub-criterion and focused environment score is determined considering the situation of the system. After determining the scores for each sub-criterion weighted sum is taken to obtain the integrated score.

3.3. Numerical Example

Proposed methodology is applied to a numerical example. For the evaluation process, the scale shown in Table 2 is used.

Table 2: *Linguistic scale for importance (Kahraman et al., 2006)*

Linguistic scale for importance	Triangular fuzzy scale	Triangular fuzzy reciprocal scale

Just equal	(1,1,1)	(1, 1, 1)
Equally important (EI)	(1/2, 1, 3/2)	(2/3, 1, 2)
Weakly more important (WMI)	(1, 3/2, 2)	(1/2, 2/3, 1)
Strongly more important (SMI)	(3/2, 2, 5/2)	(2/5, 1/2, 2/3)
Very strongly more important (VSMI)	(2, 5/2, 3)	(1/3, 2/5, 1/2)
Absolutely more important (AMI)	(5/2, 3, 7/2)	(2/7, 1/3, 2/5)

First of all, main criteria are evaluated using the scale given in Table 2 and normalized weights are obtained as shown in Table 3.

Table 3. Main criteria evaluations and normalized weights

MC	C1	C2	C3	C4	N. Weights
C1	JE	SLI	SLI	SLI	0,1435
C2	SMI	JE	JE	SLI	0,2340
C3	SMI	JE	JE	SLI	0,2340
C4	SMI	SMI	SMI	JE	0,3885

An example for the sub-criteria evaluations are given in Table 4.

Table 4. An example for sub-criteria evaluations and interdependencies

C21	C11	C12	C13	N. Weights
C11	JE	ALI	JE	0,201
C12	AMI	JE	AMI	0,599
C13	JE	ALI	JE	0,201

According to the evaluation of the decision makers, unweighted supermatrix is obtained and its' weighted by using main criteria evaluations. Then limiting supermatrix is generated and sub-criteria weights are obtained as shown in Table 5. Also, hypothetical score values are assigned for the numerical example and sub-criteria weights are used to obtain a weighted score for the example company's manufacturing environment. Weighted score is obtained as 2.6 and it shows that the greenness level of this company is not a good one considering the best practice could be at the level of 5.

Table 5: *Final normalized weights for the sub-criteria and performance assessments*

Main-criteria	Sub-criteria	Normalized Weights	Score values
1. Green material handling	1.1. Emission level	0,042	1
	1.2. Greenness of accessories	0,045	3
	1.3. Energy consumption	0,055	2
2. Green product design	2.1. Material recyclability	0,068	5
	2.2. Sub-product reusability	0,054	1
	2.3. Design for disassembly	0,059	2
	2.4. Design for end-product energy consumption	0,052	2
3. Green production	3.1. Waste reduction	0,083	3
	3.2. Usage of recycled resources	0,069	2
	3.3. Greenness of production equipment	0,043	1
	3.4. Environmental safety	0,038	5
4. Managerial approach for green manufacturing	4.1. Certification	0,122	1
	4.2. Existence of structured processes for environment	0,099	3
	4.3. Financial support	0,079	3
	4.4. Support to green energy production	0,039	4
	4.5. Waste treatment activities	0,048	5

4. Conclusion

Many regulations and standards were defined in the recent years after the increase importance level of environmental consciousness. These regulations and standards mostly includes in whole areas of the product from the design to the delivery to customer. Companies are willing to implement these regulations, standards and other environmental benign applications due to various motives such as economical, customer oriented, etc. As Theyel (2006) stated "*environmental performance*

is a concern of managers due to reasons ranging from regulatory and contractual compliance, to public perception and competitive advantage". Considering its' importance for the companies, this study aims to propose a methodology for assessment of the greenness of manufacturing environment. Significant key performance indicators (KPIs) in GMnfg. are determined with main and sub indicators and a fuzzy logic based methodology, fuzzy ANP is used for the criteria weight determination and a weighted sum scoring formula is applied to find the integrated scores for the companies.

Defined KPIs and the proposed methodology may be helpful for the companies to measure greenness level of their manufacturing environments and may be a starting point to be a more environmentally benign company.

As future researches, determined KPIs may be used for real-life applications. Also, comparison of different techniques and different form of fuzzy numbers may be a good step to improve the methodology. Furthermore, developing a Decision Support System (DSS) facilitates user-friendly applications for the companies.

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Sustainability Performance Analysis of East Black Sea Project (DOKAP) Cities by Using TOPSIS Method

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Abstract

This study is designed to examine the sustainability performances of the East Black Sea Project (DOKAP) cities and to compare the sustainability performances of these cities in terms of economic, environmental and social sub-dimensions. In this study, nine provinces' within the scope of East Black Sea Project - Artvin, Giresun, Gümüşhane, Ordu, Rize, Samsun, Tokat, Trabzon and Bayburt- sustainability performances have been examined in social, economic and environmental dimensions. Nine provinces were analyzed with a total of 52 indicators in three dimensions. The TOPSIS method which is the one of best multi-criteria decision making methods has been used for the analysis. Equal weights are given to every dimension. Moreover, sustainability analysis for each dimension was also conducted. As a result of the study, the performance ranking of DOKAP cities was made. It has been determined that Rize has the best performance with the current indicators and weights. In addition, the results of analysis for each dimension were compared with overall results obtained. It was seen that Samsun in the social dimension, Rize in the economic dimension and Tokat in the environmental dimension has the best performances. Besides, it has been determined that weighting in the order of sustainability and economic indicators have a high impact on the results.

Keywords: Sustainability, Urban Sustainability, Multiple Criteria Decision Making Methods, TOPSIS, DOKAP

1. Introduction

The concept of urban sustainability is becoming increasingly important in determining the extent to which countries' development goals are achieved. This study aims to examine the sustainability performances of the East Black Sea Project (DOKAP) cities and to compare the sustainability performances of these cities within the scope of the Eastern Black Sea Project through the indicators of urban sustainability. Due to the purpose of the study and the suitability of the dataset, the TOPSIS method was used as a multi-criteria decision-making method. In conclusion, the performance order of the cities was made and the results were compared with the social, economic and environmental sub-dimensions.

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2. Literature Review

Sustainability means that the community, the ecosystem, or any ongoing system is functioning till uncertain future without consuming the main resources (Gilman, 1992).

Urban sustainability or the sustainable city has begun to be used to refer to a unit that takes specific balances at the economic, social and environmental dimensions, and is compatible with the regional and global sustainable development goal and contributes effectively to this goal (Sahin, 2010).

All the cases in Turkey have been analyzed with TOPSIS (Ideal Multidimensional Weighting Method) which is one of the "Multi Criteria Decision Making" methods in terms of economic, social and environmental aspects of sustainability (Gazibey et al.,2014). Various indices and indicators used for measuring sustainability were compared and indicators of sustainability to be used in the implementation section were established. In the survey, 52 sustainability indicators for sub-dimensions of social, economic and environmental dimensions were used in order to assess the sustainability of 81 provinces.

3. Methodology

In this study, the indicators that constitute the social, economic and environmental dimensions were examined separately in order to compare the sustainability performances of DOKAP cities and the differences between sustainability dimensions. The indices were determined according to the literature survey results. Previous conducted studies in the world and in Turkey have been taken into account and adaptable indicators have been chosen for the DOKAP cities where the implementation will be done. In the first part of the application, the sustainability performance order of the cities was made with a holistic view, and in the second part, each dimension was sorted separately. In the third and last section, the grades are calculated for each indicator belonging to the cities.

Limitations and Data Collection

Some of the data at the city level in our country is not kept, is not accessible or has not been published has caused some of the representatives not to be included in the analysis. Since urban sustainability analysis has not been carried out regularly over the years, the results of the study were not compared with the past years and a performance analysis was not performed on a yearly basis.

In the analysis, 52 sustainability indicators for economic, social and environmental dimensions were used to assess the sustainability of the nine cities that are DOKAP cities. Social dimension was used with 7 sub-dimensions and 21 indicators, economic dimension with 7 sub-dimensions and 21 indicators and environmental dimension with 4 sub-dimensions and 10 indicators. Decision matrix used in the study, Turkish Statistical Institute, Ministry of Finance, Ministry of Justice, Ministry of National Education, Social Security Institution, and the official data of the State Planning Organization. Data were obtained from the internet sites of the specified institutions and from the reports they published using Level-3 (city level).

Table 1. *DOKAP Cities Sustainability Performance Sequence Table*

SIRA	İL	C DEĞERİ
1	RİZE	0,9981
2	TRABZON	0,7883
3	SAMSUN	0,5543
4	ORDU	0,2867
5	GİRESUN	0,2049
6	TOKAT	0,1075
7	BAYBURT	0,0843
8	ARTVİN	0,0281
9	GÜMÜŞHANE	0,0004

4. Findings and Evaluations

When the relative distance values of the cities are examined in terms of sustainability dimensions, it is seen that the relative distance values (0,9981, 0,7882 and 0,5543) of the first three cities (Rize, Trabzon and Samsun) are higher.

In the social dimension, Samsun and Trabzon were at the forefront of other cities. On the economic dimension, Rize is very far ahead of all cities. Tokat is in the first place in the environmental dimension.

Table 2: *Dimension Sustainability Performance Table*

SOCIAL DIMENSION	
CITY	C*
SAMSUN	0,9983
TRABZON	0,9845
BAYBURT	0,7335
TOKAT	0,6259
RİZE	0,4710
ARTVİN	0,3283
ORDU	0,2228
GÜMÜŞHANE	0,1759
GİRESUN	0,0010

ECONOMIC DIMENSION	
CITY	C*
RİZE	0,9985
TRABZON	0,7883
SAMSUN	0,5543
ORDU	0,2867
GİRESUN	0,2049
TOKAT	0,1075
BAYBURT	0,0843
ARTVİN	0,0281
GÜMÜŞHANE	0,0001

ENVIROMENTAL DIMENSION	
CITY	C*
TOKAT	0,9203
TRABZON	0,9037
BAYBURT	0,8930
ARTVİN	0,8806
RİZE	0,8788
GÜMÜŞHANE	0,8377
GİRESUN	0,7873
ORDU	0,1182
SAMSUN	0,0063

5. Conclusion

When we look at the order of sustainability performances of DOKAP cities in three dimensions, it is seen that there is no dominance in all dimensions or there is not a balanced distribution in three dimensions. First three provinces are Rize, Trabzon and Samsun in overall evaluation, Samsun in social dimension, Rize in economic dimension, Tokat in environmental dimension is the higher performance cities.

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A Balanced Scorecard Approach and a Model Proposal for Institutional Sustainability Measurement

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Abstract

Today, Norton and Kaplan's balanced scorecard (BSC) model is used to improve enterprise performance. The BSC creates key performance indicators for companies. Companies identify their current status in performance reports and set performance targets for the future with the BSC. These targets have been both a strategy and a sustainability tool for companies. For this reason, there is a need for its performance balanced scorecard in measuring the sustainability performance of companies. BSC will play an active role in determining the sustainability and its strategy. The aim of this study is to determine the sustainability performance of the scorecard pattern for companies. Its performance reports have been examined. It has been found that there are no key performance indicators in the studies and it is more superficial. The model in the study is a detailed model that includes key performance indicators. In this context, the economic, environmental, social and institutional profile dimensions of the GRI G4 (Global Reporting Initiative) sustainability reports and the financial, customer, internal processes, learning and development dimensions of the performance scorecard are intertwined. The company's sustainability was analyzed with the BSC model.

Keywords: Sustainability, Sustainability Scorecard, Sustainability Report, Balanced Scorecard, Key Performance Indicators

1. Introduction

The concept of sustainability has become the most popular topic today. "Our Common Future" of the Brundtland Commission published in 1987 with the report, sustainability has been influential in almost every field of our lives. [1] Different definitions have been made by everyone about the concept of sustainability. Sustainability is used in many areas. There are terminological uses such as sustainable development, sustainable agriculture, sustainable cities, sustainable economy, sustainable architecture

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and sustainable growth. [2] These terms are also an indication that sustainability is a common expression among sectors.

For companies; especially the "corporate sustainability" concept is important. Corporate sustainability refers not only to economic sustainability, but also to social and environmental sustainability. Sustainability reports have become widespread with the inclusion of social and environmental issues. Companies share their sustainability activities in public with these reports. Published sustainability reports are generally in the GRI (Global Reporting Initiative) format. Performance indicators set by the GRI in the formation of reports play a key role. These indicators have brought an international perspective to measurement and evaluation.

Kaplan and Norton's balanced scorecard to company's performance strategy is to maintain its position and importance in terms of sustainability. There are four dimensions in the balanced scorecard performance. These are financial, customer, internal processes, learning and development dimensions. [3] In this study, BSC and sustainability dimensions were intersected.

2. Literature Review

There are differences in the definitions of sustainability. According to Azapagic and et al, it is to take measures for the future [4]. According to Yelkikalan and Aydın, it is the fulfillment of today's needs and the effective use of all resources for the future. [5] According to Çamlıca and Akar, it can preserve and sustain its existence [6]. According to Bıçakçı; it is defined as existence. [7] According to Çakar, Filiz and Hacıhasanoğlu, Chaplin and others, a common definition has been sought in sustainability. It has been reported that the correct use of available resources should prevent future generations from being exposed to resource deprivation. [8], [9], [10] Hicks notes that by examining the relationship between income and consumption, sustainability cannot be possible if consumption is high. [11]

Sustainability reports have come to the forefront with the addition of economic and economic factors as well as environmental and social factors. There are four outstanding reporting frameworks on sustainability around the world. These reports G4 presented by the Global Reporting Initiative (GRI), Communication on Progress (COP) prepared in accordance with UNGC, Integrated Reporting (IR) prepared by the International Integrated Reporting Council (IIRC) and the Carbon Disclosure Project (CDP). [12] Companies mostly use the G4 standard, which is presented by the Global Reporting Initiative from these reporting frameworks.

According to Norton and Kaplan, the most widespread work that created sustainability as a model with "Balanced Performance Carnets" was introduced by White in 2005. In White's work, economic, environmental and social sustainability factors and the four dimensions of BSC, financial, customer, internal processes, learning and development approaches, have been intertwined. The current GRI sustainability report form in 2005 is the G3 report. White reviewed the economic, environmental and social dimensions of the GRI G3 report format and the four dimensions of the BSC and general proceedings. [13]

The work of White and others is interpreted by Özçelik in 2013. In Özçelik's study, sustainability has examined the formation process of performance cares. [14] Sustainability performance scorecard is divided into 3 basic steps by Figge et al. The first of these steps; the selection of strategic business units,

SOCIAL IMPACT MEASUREMENT FOR ENSURING SUSTAINABILITY IN SOCIAL INITIATIVES

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Abstract

The study begins with the concepts of social value and social impact as performance indicators in social initiatives and then focuses on performance management in the third sector by examining social impact measurement. It discusses measuring impact as the crucial process in social investment and argues how to choose the measurement method. It then introduces the classification of methods in various forms and continues by explaining the most commonly used social impact measurement models to gain sustainability in the third sector. Related models include cost effectiveness and cost benefit analyses, social accounting and auditing, SROI, balanced scorecard, SIMPLE, benefit-cost ratio, BACO ratio, expected return metric, cost per impact and blended value. Finally the conclusion focuses on the overall perspective of the subject, critical areas to pay attention to and limitations.

Keywords: Social value, social impact, social impact measurement

1. Introduction

The increasing importance of sustainability has led to the expansion of the social dimension of the subject and its application. The private sector managers have begun to need to audit and manage the performance of their companies' social performance. Along with this situation, there has been a major increase in the third sector enterprises - nonprofit social initiatives. They originated a new business area to create social value by focusing on market-oriented businesses. Social initiatives have become a pioneer in creating social value in a wide range of areas with so many different activities.

With these developments, the most significant concept to be addressed is become the social impact, in other words how the value is created and measured. The need to identify the social performances of both profit based businesses and nonprofit social initiatives caused the development of several methodologies and tools to measure social impact. This paper examines how to choose the appropriate measurement model and the most frequently used impact measurement tools.

2. Social Value and Social Impact As Performance Indicators In Social Initiatives

It is necessary to mention the concept of social value before examining social impact to figure out the value proposition that social initiatives generally focus on. We can categorize three types of values that support the actions of social initiatives as; fundamental values, operational values and political values. Fundamental values are consist of; common good that means having a purpose which benefits humanity and/or the planet, cooperation refers to work together for mutual benefit,

decentralization relates ensuring that policies and practices are for people at the lowest, or most local possible level, democracy means having democratic structures such that each person involved in the governance shares equal rights to participate in decision-making, inclusivity ensures that every person in society has an equal right and opportunity to participate in or to benefit from the social initiatives without discrimination, good work refers to undertake work which is socially or environmentally useful and which therefore enhances the quality of life while, people-centred addresses that the needs and wishes of people is the primary task of social initiatives rather than serving the interests of capital, and accountability refers being able to explain the actions to stakeholders and to the wider community (Birkhölzer, 1997). In addition to these fundamental values, there are also operational values which social initiatives relate to in their day-to-day operations such as; partnership, quality, professionalism, innovation, accessibility, trust and caring. And lastly political values vary substantially depending on the initiative including; favouring the most vulnerable in society, distribution of wealth and equity or social justice. As a result, the mission of creating economic value should not be the sovereign mission of social entrepreneurs, and it is not (Dees, 1998; Peredo and McLean, 2006; Perrini 2006). The performance to create these kinds of social values will therefore be measured in terms of social impact on people and on society. Social impact is related to identifying and evaluating the value of activities.

Social impact can be defined as "the change that occurs as a result of an activity" or "the consequences of an action/activity/project/program result on different people". It is used for the impact of a corporation on society on the economic, environmental and social dimensions. The term is often replaced by terms such as social value creation (Emerson et al. 2000) and social return (Clark et al. 2004). Social impact is any of the great variety of changes in physiological states and subjective feelings, motives and emotions, cognitions and beliefs, values and behaviour that occur in an individual, human, or animal, as a result of the real, implied, or imagined presence or actions of other individuals (Latané, 1981). It can be defined as the total impact that a non-profit organization has on all of its stakeholders (Dillenburg et al. 2003). It refers to impacts (or effects, or consequences) that are likely to be experienced by an equally broad range of social groups as a result of some course of action (Freudenburg, 1986). They are the wider societal concerns that reflect and respect the complex interdependency between business practice and society (Gentile, 2002). As seen, social impact refers to the change that the initiative has created on all stakeholders, especially society. Therefore, measuring the size of this change arises as a very important issue. Measuring social impact is the process of ensuring evidence that the initiatives' actions provide a real and concrete benefit to community or the stakeholders.

3. Social Impact Measurement for Sustainability

Social initiatives should use social impact evaluating and measurement to achieve sustainability. Social impact analysis is based on the desire to uncover the value that cannot be calculated by traditional cost benefit analysis techniques. Different approaches emerged in the form of new measurement models and indicators, and standardization of the processes to understand the value created. Measuring performance has become so crucial because of the growing difficulty to raise funds from investors and donors and the increasing competition in this area. The volunteers and people working in social initiatives can clearly be able to see the value and benefits created by their organizations' work. But there are benefits to measure the social impact in more detail. Performance measurement will provide a way for social initiatives to compare their performance with other organizations and a way to measure economic and social performance against desired objectives (Zahra et al. 2009). The feedback will help the organization to learn and improve. They have to cope with increased funding pressures. (Kotler and Andreasen, 1996). It will also help investors and donors to assess the performance of social initiatives and decide their investments. Social initiatives are obliged to prove that the money they have obtained has been spent effectively and that the necessary benefits have been achieved. (Bouckaert and Vandenhove, 1998). It will bring accountability to social entrepreneurship, allowing for a way to show the community or environmental benefits. It seeks to identify and quantify this impact (Young, 2003). As a result, social impact measurement helps the

development of social initiative in general, improves investors' confidence, provides social satisfaction and beyond these benefits it ensures sustainability in social initiatives.

4. Social Impact Measurement Models

Before heading to the measurement models it is useful to mention the various classifications took part in literature. There are about thirty different social impact measurement models in different sources. In these sources, various classifications are made such as; qualitative and quantitative, classical and non-classical, internal and external. A summary of the most frequent classifications is explained in this section such as Schaltegger et al. (2000) five dimensions, Clark et al. (2004) five dimensions, Maas and Liket's (2011) distinguished six dimensions and finally Rinaldo's (2010) four variables.

The literature aiming the social impact measurement in social initiatives is in its early stages and therefore there are numerous methodologies, approaches and tools about the issue. This section will cover the most commonly used social impact measurement models in social initiatives such as; Cost-effectiveness analysis (CEA), Cost-benefit analysis (CBA), Social accounting and auditing, Social return on investment (SROI), Balanced Scorecard (BSC), Social IMPact measurement for Local Economies (SIMPLE), Robin Hood Foundation benefit-cost ratio, Acumen Fund's BACO ratio, The Hewlett Foundation's expected return metric, Cost per impact, and Blended value.

5. Conclusion

The methods mentioned are mainly based on both economic and social performance of social initiatives. It should be emphasized that there is no method to be called the most correct or most successful. Each method has its own strengths and weaknesses. For this reason, it is not possible to mention a valid way to meet the needs of all social initiatives since the literature on measuring the social impact of social initiatives is still developing. Considering all the approaches, it can be realized that each of them has basic principles as meeting the needs and expectations of stakeholders, requiring transparency in every activity, assimilating change and improvement and being sustainable. The important point here for social initiatives is to anticipate and understand what the social impact means for the various stakeholders. In order to obtain accurate and valid results, it is absolutely necessary to use quality data in the measuring process. By the help of this perspective social initiatives are able to reveal their own successes, meet stakeholder expectations and ensure sustainability.

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