Geliş Tarihi:
01.02.2022
Kabul Tarihi:
05.11.2022
Yayımlanma Tarihi:
31.12.2022

Kaynakça Gösterimi: Ahmad S. M., Nebati E. E., Koç N., & Acar M. F. (2022). Analytic network process approach for evaluating sustainable supply chain management. *İstanbul Ticaret Üniversitesi Sosyal Bilimler Dergisi,* *21*(45), 1032-1054. doi: 10.46928/iticusbe.1066741

ANALYTIC NETWORK PROCESS APPROACH FOR EVALUATING SUSTAINABLE SUPPLY CHAIN MANAGEMENT

Araştırma

Sani Muhammad Ahmad
saniahmady50@gmail.com
Emine Elif Nebati
İstanbul Sabahattin Zaim Üniversitesi
emine.nebati@izu.edu.tr
Sorumlu Yazar (Correspondence)
Nur Koç
İzmir Katip Çelebi Üniversitesi
nur.koc@ikcu.edu.tr
Mehmet Fatih Acar
İzmir Katip Çelebi Üniversitesi
mehmet.fatih.acar@ikcu.edu.tr,

Sani Muhammad AHMAD, bağımsız araştırmacıdır. Endüstri Mühendisliği alanında yüksek lisans derecesine sahiptir.

Emine Elif NEBATİ, İstanbul Sabahattin Zaim Üniversitesi Üniversitesi Endüstri mühendisliği öğretim üyesidir. Endüstri mühendisliği alanında dersler vermekte ve bu alanlarda araştırmalar yayınlamaktadır.

Nur KOÇ, İzmir Katip Çelebi Üniversitesi, İİBF, Uluslararası Ticaret ve İşletmecilik bölümünde Araştırma Görevlisi'dir. Uluslararası ekonomi alanında araştırmalar yapmaktadır.

Mehmet Fatih Acar, İzmir Katip Çelebi Üniversitesi Uluslararası Ticaret ve İşletmecilik Bölümü Doçent Dr. Öğretim Üyesidir. Üretim Yönetimi alanında dersler vermektedir.

ANALYTIC NETWORK PROCESS APPROACH FOR EVALUATING SUSTAINABLE SUPPLY CHAIN MANAGEMENT

Sani Muhammad Ahmad
saniahmady50@gmail.com
Emine Elif Nebati
emine.nebati@izu.edu.tr
Nur Koç
nur.koc@ikcu.edu.tr
Mehmet Fatih Acar
mehmet.fatih.acar@ikcu.edu.tr,

Abstract

Purpose – The aim of this study is to list the effective factors for improving sustainable supply chain management (SSCM) performance and to determine the most appropriate alternative activity.

Methodology/approach – The data used in the study were obtained through face-to-face interviews with business managers working in various manufacturing industries and a literature review. With the Analytic Network Process (ANP) method, the factors that affect supply chain management are prioritized and alternatives are evaluated. Fifteen sub-criteria and five alternatives are identified in the study.

Findings – Proposal of decision support model is presented for a SSCM with ANP. The result of the study shows the main driving powers for achieving sustainable supply chains for environmental, economic and social perspective.

Originality – With the increasing negative effects of industrialization, multinational companies have become more important for SSCM. In today’s competitive environment, companies should develop an efficient and integrated supply chain management to meet customer satisfaction. The model in this study includes sustainable supply chain management criteria related with economic, social and environmental regulations. This model contributes to operations management literature with showing the how organizations can evaluate their operations in terms of sustainability.

Keywords: Analytic Network Process, Sustainable Supply Chain Management, Manufacturing Industry

JEL Classification: C50, M11, C23

SÜRDÜRÜLEBİLİR TEDARİK ZİNCİRİ YÖNETİMİNİN DEĞERLENDİRİLMESİ İÇİN ANALİTİK AĞ SÜRECİ YAKLAŞIMI

Özet

Amaç– Bu çalışmanın amacı, sürdürülebilir tedarik zinciri yönetimi performansını iyileştirmede etkili faktörleri listelemek ve en uygun alternatif faaliyeti belirlemektir.

Yöntem– Çalışmada kullanılan veriler değişik imalat sektörlerinde çalışan işletme yöneticileri ile yüz yüze görüşmeler ve literatür taraması yoluyla elde edilmiştir. Çok kriterli karar verme yöntemlerinden biri olan Analitik Ağ Süreci (AAS) yöntemi ile tedarik zinciri yönetimini etkileyen faktörlere öncelik verilmiş ve alternatifler değerlendirilmiştir. On beş alt kriter ve beş alternatif belirlenmiştir.

Bulgular – AAS ile sürdürülebilir bir tedarik zinciri yönetimi için karar destek modeli önerisi sunulmuştur. Çalışmanın sonucu, çevresel, ekonomik ve sosyal açıdan sürdürülebilir tedarik zincirlerine ulaşmak için ana itici güçleri göstermektir.

Özgünlük– Sanayileşmenin artan olumsuz etkileri ile birlikte çok uluslu şirketler sürdürülebilir tedarik zinciri için daha önemli hale gelmiştir. Günümüz rekabet ortamında şirketler, müşteri memnuniyetini karşılamak için verimli ve entegre bir tedarik zinciri yönetimi geliştirmelidir. Bu çalışmadaki model; ekonomik, sosyal ve çevresel düzenlemelerle ile ilgili sürdürülebilir tedarik zinciri yönetimi kriterlerini içermektedir. Bu model, kuruluşların faaliyetlerini sürdürülebilirlik açısından nasıl değerlendirebileceklerini göstererek operasyon yönetimi literatürüne katkıda bulunmaktadır.

Anahtar Kelimeler: Analitik Ağ Süreci, Sürdürülebilir Tedarik Zinciri Yönetimi, İmalat Sanayi

JEL Sınıflandırması: C50, M11, C23

INTRODUCTION

Sustainability has become a popular topic of recent years and is increasingly gaining more and more attention in academia, industry, governmental institutions as well as non-governmental organisations (NGOs). The negative impact of industrialization affects human life and society in different ways such as toxic air, global warming and greenhouse emissions, forest deforestation, acid rain, radioactive emission and etc. Meanwhile, most of the developed countries are busy competing to be industrialized, while the negativities are still deteriorating human life despite all the measures that are taken. Still, the rate remains increasing dramatically, so efforts need to be doubled (Büyüközkan and Çiftçi, 2012).

In recent years, the world has been looking for different strategies to improve its environmental, social and economic activities to fight against the negative impact of industrialization, and one among the strategies is by implementing a sustainable supply chain management approach (SSCM). Sustainable supply chain management is one of the best strategies that help any organization to win against their competitors by cutting up risk, improving a quality standard, eco-friendly, quality of life, labour equity, employee health care etc.

Furthermore, based on research we have made so far in this area, we decided to use an integrated framework for evaluating sustainable supply chain management using multi-criteria decision-making tool Analytic Network Process (ANP). It is hoped that it will guide strategic decisions in sustainable supply chain management by ranking the encountered factors and alternative options according to their importance. Moreover, the method helps decision-makers to find an appropriate method for achieving sustainable supply chain management. To simplify and facilitate this method, we suggest a multi-level procedure for constructing ANP model which can be of significant help for companies seeking to gain more insight and understanding of the models under proposal. ANP, is a method that takes into account the relationships and ties between the factors and provides feedback. we decided to use an integrated framework for evaluating sustainable supply chain management using multi-criteria decision-making tool Analytic Network Process (ANP). The reason for using this method is that the criteria take into account the interaction between them as internal and external dependency. Also, it is the evaluation of feedback. It is hoped that it will guide strategic decisions in sustainable supply chain management by ranking the encountered factors and alternative options according to their importance. However, the method helps decision-maker to find an appropriate method for achieving sustainable supply chain management. To simplify and facilitate this method, we suggest a various levelled procedure for constructing ANP model which can be of significant help for companies seeking to gain more insight and understanding of the models under proposal. ANP, is a method that takes into account the relationships and ties between the factors and provides feedback. In the development of sustainable supply chain management performance, alternatives need to be evaluated. In this process, researchers often prefer multi-criteria decision making techniques.

Govindan et al. (2020) proved that sustainability will lead to improvement of business performance. He also emphasized that it should be noted that investment in environmentally sustainable practices in developing countries yields better results than in developed economies (Govindan et al., 2020; Wang and Dai, 2018; Aljoghaiman et al., 2020). Contributions of this study are;

- Improve sustainable supply chain management performance
- Identify the importance of main and sub-criteria concerning sustainable supply chain management and investigate the inter-relationship among sustainablity enablers
- Conserve natural resources and make a better world for human lives
- Identify the alternatives, criteria and dimensions scores while ranking, to evaluate alternatives based on proposed enablers via analytic network process approach

Sustainable supply chain management help any organization to win against their competitors by cutting up risk, improving a quality standard, eco-friendly, quality of life, labour equity, employee, health care etc. Natural resources can be protected by preventing inefficient waste treatment, changes in consumer preferences, and improper discharge of solid wastes (Moktadir et al., 2021). The application has been carried out comprehensively with real data. Thus, it is hoped that it will contribute to the company's ability to catch up with sustainable supply chain management developments, to gain sustainable competitive advantage and to improve its current situation.

LITERATURE REVIEW

Today, a lot of companies, governmental institutions and non-governmental organisations (NGOs), are working tightly to overcome the negative impact of industrialization. Sustainable supply chain management can be defined as a process of minimizing, reducing or cutting up risks in the supply chain. These risks can be classified into social, economic and environmental such as pollution, waste management, depletion of the resource, inflation of energy cost and products liability (Campos-Guzmán et al., 2019). The idea of sustainable supply chain management was brought up the 1980s (Cooper et al., 1997) that comprised three main dimensions social, economic and environmental, these dimensions have to be met by any organizations before achieving sustainable supply chain management (Seuring and Müller, 2008). However, a lot of companies find it difficult to reach sustainable supply chains, despite all efforts they put because of the absence of balancing natural environment and society to companies' duties (Carter and Rogers, 2008). The worst case is, most of the companies neglect social dimension as one of the main criteria for achieving sustainability since it does not have a direct contribution to companies' financial benefit (Walley and Whitehead, 1994). Seuring and Müller (2008) reviewed 191 papers on sustainable supply chain management issued from 1994 to 2007 and most of them focus on two dimensions: environmental and economic, only a few discussed on the social dimension.

Since the beginning of world, a lot of scholars and researchers are busy writing theories on how people are going to make decisions. However, different concepts have been used but the popular one is using multi-criteria decision making (MCDM) (Triantaphyllou, 2000). MCDM is classifies in two categories which is: multi-objective decision making (MODM) and multi attribute decision making (MADM) that can be used based on data types (Tzeng and Huang, 2011). MCDM deals with optimizing objection function with some constraints as well as decision variables using mathematical modelling, while MADM focus on attribute comparison and selection between different alternatives. However, in order to solve real-life problems, it consists of fuzzy logic, utility system and preference modelling (Figueira and Ehrgott, 2005). Besides, MADM can be classified into three classes; fuzzy integral, outranking methods and Multi-Attribute Utility Theories, MADM methods includes Analytic Network Hierarchy (ANP) and Analytic Hierarchy Process (AHP) are the most popular approach (Saaty and Vargas, 2006). Kainuma et al. (2006) published a multi-attribute theory based on green supply chain where supply chain performance can be evaluated from an environmental viewpoint apart from a managerial perspective. Another approach was presented by Büyüközkan and Çifçi (2012) for evaluating green supply chain management using the fuzzy analytic network process (FANP). In the study, all alternatives (for example, carbon taxing, employees training program and incentives for cooperation) were evaluated with different clusters: green logistics (reverse logistics, distribution and production), organizational performance (delivery flexibility, quality and cost) and green organizational activities (recycling, remanufacture and reuse. Rostamzadeh et al. (2018) developed an approach for evaluating supply chain risk management using fuzzy Topsis in which they figured out seven main criteria and forty-four sub-criteria at their final evaluation. Some of the sub-criteria they considered include government policy risks, improper sewage disposal, and economic issues. Kumar et al. (2020) raised a study that contributes to the aviation industry, looking at how the environmental issues are gaining more attention especially in modern societies. With the concerned of environmental sustainability and its degradation of Bangladesh industries, Suhi et al. (2019) addressed this issue based on Best Worst Method approach, in which they weighted and assessed several industrial activities and at the end, they revealed that waste management contribute more for achieving a sustainable environment. However, Sarkis et al. (2019) reveals that customers awareness and environmental information of the company has a significant influence on sustainable performance for achieving sustainability. In addition, their analysis suggests that it has an impact on stakeholder's commitment. Furthermore, a Fuzzy Multi-Criteria Decision Making methods was used by Padhi et al. (2018) to reveal top processes of supply chain management such as efficient technology, strategic sourcing, sustainable design and development.

METHODOLOGY

Some of the real problems are too complex and difficult to model and solve using Analytic Hierarchy Process (AHP) approach due to some interdependent relationships and connection from different stages. However, as a result of goals, criteria and sub-criteria cannot be modelled using a simple approach, Analytic Network Process approach might be the perfect approach in this case rather than AHP approach. The ANP method, developed by Thomas L. Saaty, is one of the most frequently used decision-making methods (Saaty and Vargas, 2006). In the ANP method, relationships between all main criteria, sub-criteria and alternatives are defined.

ANP is a tool for solving different decision-making cases based on requisite and vision relations, in which the criteria, sub-criteria and alternatives are treated equally during nodes assessment. Each node should be compared to other nodes as long as there is a relation in between and then grouped into clusters. The relationship arc is directly connected to each cluster based on the connectivity network, where an eigenvalue and pairwise comparisons will follow by between node and node in the clusters, then between clusters. Unlike other decision making methods, these relationships are modeled to form a network structure. With the network structure created, the relations of the factors with each other are taken into account. ANP allows for more complex interrelationships among the decision levels and attributes. ANP does not require this strictly hierarchical structure. Interdependencies may be represented by two way arrows (or arcs) among levels or if within the same level of analysis, a looped arc. The directions of the arcs signify dependence, arcs emanate from an attribute to other attributes that may influence it (Jayant, 2016).

The function of ANP is to determine and consider the relationship of a network structure with a high degree of interdependence."Most complex real-world decision-making problems have numerous interdependent elements that can be captured and processed utilizing the feedback and interaction capabilities of an ANP model" (Saaty and Ozdemir, 2021; Tjader et al., 2014). Thus, this method is more appropriate for the economic valuation of natural areas.

In this study we used pairwise comparisons where the scale ranges from one to nine, in which scale one has similar important while scale nine shows that an alternative is more important than a given node, then converted into super matrix in Table 1. Finally, an alternative with highest scores is chosen. Steps of method are given below. (Dağdeviren et al., 2013).

Step 1: Defining the Decision Making Problem and Creating the Network Model

Step 2: Determining the relationships between the criteria

Step 3: Pair-wise comparison between criteria and calculating priority values

Step 4: Calculating Consistency

Step 4: Creating Supermatrıces

Step 5: Determining the Most Appropriate Alternative

Table 1. Pair-Wise Comparison Scale

Value	Definition	Explanation
1	Equal	Two indicators contribute equally to the objective
3	Marginally strong	Experience and judgement slightly in favor of one indicator over
5	Strong	Experience and judgement strongly in favor of one indicator over another
7	Very strong	An indicator is favored very strongly over another; its dominance demonstrated in practice.
9	Extremely strong	Evidence favoring one indicator over another is of the highest possible order of affirmation.
2,4,6,8	Intermediate values to reflect fuzzy inputs	Compromises/between

Reference: (Saaty and Vargas, 2006)

The second type of analysis to be used is sensitivity analysis. Sensitivity analysis is one of the most important steps that support a decision in which a decision-maker is attentive to know what might affect his/her decision when some changes happen to key factors. The main aim of sensitivity analysis is to validate and stabilize the changes in key factors or parameters so as to get a perfect final decision. Therefore, we conducted three experiments by weighing environmental, economic and social criteria as (0.33, 0.33, 0.33) for Exp1, (0.5, 0.3, 0.2) for Exp2 and (0.8, 0.1, 0.1) for Exp3 respectively.

ANALYSIS

Problem Definition

The proposed approach with ANP which can provide new structural models for evaluating sustainable supply chain alternatives. However, the main principle of this study is to explore two problems. The first one is to identify and model the main enablers for sustainable supply chains. Sustainable supply chains enablers can be any elements or components that induce a supply chain to become sustainable, like environmental quality management, governmental regulations, adoption to green practices and so on. The second one is dealing with sustainable supply chains alternatives, which we used ANP to select the best alternatives by considering the highest scores.

Data Collection

All the data used in this study were collected from three different sources. Firstly; we collected data from SMEs and the businesses have less than 250 employees. The manufacturing companies such as; food, beverage, furniture industry etc. Secondly; we examined comprehensive relevant literature reviews, Finally, we met with qualified supply chain management experts. The following are the process of the steps for evaluating sustainable supply chains.

Identify the Best Alternatives for Sustainable Supply Chains

The sustainable supply chain alternatives were selected based on literature reviews and interview with qualified supply chain management professors. in Table 2. The alternatives details are as follows:

Tax on carbon emission (A1): The rate of environmental problem is continuously growing as a result of a high increase in burning fuels like natural gas, petrol and coal. Tax on carbon emission is one of the best ways of achieving a sustainable supply chain by taxing burning fossil fuels based on carbon content.

Collaboration incentives on sustainability (A2): Collaboration incentives is the fastest way of creating awareness to supply chain partners for achieving a sustainable supply chain management, sometimes people tend to be reluctant when it comes to sharing information, and this cause a big drawback for achieving sustainability, but with collaboration, it will reduce some negativity and increase satisfaction.

Employee training programs on sustainability (A3): Training and skills contribute immensely toward employees' lifestyle for achieving social sustainability, quality of life, equity, health care, low risk, efficient and effectiveness.

Management commitment (A4): The first stage of achieving sustainability for any company is the adaption by the top management. Management training plays a vital role in achieving sustainability by educating and showing them the advantages of it to their companies' benefits as well as the failure of implementing.

Public campaigns (A5): Public campaigns and enlightenments is another strategy that contributes toward achieving sustainability by conducting training camps, incentives rewards for green practices and green certificate award.

Table 2. Alternatives (Practices) for Sustainable Supply Chains

Practices	**References**
Tax on carbon emission (A1)	(Babagolzadeh et al., 2020: 102245), (Huang et al., 2020: 106207.), (Yu et al., 2019:218)
Collaboration incentives (A2)	(Todeschini et al., 2020:1), (Chen et al., 2017: 73)
Training programs for employees (A3)	(Jerónimo et al., 2019: 413), (Kay et al., 2018:909)
Management commitment (A4)	(Abbas, 2020: 118806), (Gianni et al., 2017:1297)
Public campaigns (A5)	(Luthra et al., 2015:339), (Walker et al., 2008: 69)

Identify the Main Criteria for Sustainable Supply Chains

The main criteria and pillars of a sustainable supply chain depend on three factors namely: social, economic and environmental, and these criteria can be divided into sub-criteria-based methodology and assessment objectives. However, among the main criteria, environmental sustainability is considered as the main pillar that has a direct or indirect effect on social and economic enablers.

Environmental Sustainability Sub-Criteria

Environmental Sustainability is considered as a word biggest problem and named as the main pillar among other sustainable supply chain criteria. In Table 3, based on literature review and citations we selected five sub-criteria under environmental sustainability as follows: adoption of environmental standards (EV1), environmental quality management (EV2), governmental regulations (EV3), government rewards and incentives (EV4) and adoption of green practices (EV5).

Adoption of environmental standards (EV1): Adoption of environmental standards is an important element of environmental sustainability. It means that minimizing negative effects of companies' activities to ecosystem via replacing of fossil energy, energy saving, usage of renewable materials, decrease of solid waste, water savings etc.

Environmental quality management (EV2): It is another criterion under the sustainability of the environment. A general term, "environmental quality" can relate to a variety of factors. These factos are humans, animals, plants, clean water and air, among other things. Environment quality management term is used to define the management of entire system.

Governmantal regulations (EV3): Other criteria that aids in achieving sustainability is governmental regulations. All actions in industries are shaped by government policies and legislations.

Government rewards and incentives (EV4): Governments and other organizations' incentives and awards of businesses are key sub-criteria in environmental sustainability. As an illustration, the United Nations Global Compact helps businesses in establishing more socially, ecologically, and economically sustainable processes.

Adoption of green practices (EV5): Another sub-criteria that contributes to environmental sustainability is the actions taken by businesses to reduce the harm they do to the environment, from procurement to production and distribution. Applications like green production, distribution, and supply chain reversal are examples.

Table 3. Environmental Sustainable Supply Chain Management

Sub-criteria	References
Adoption of environmental standards (EV1)	(Cruz and Wakolbinger, 2008:61), (Gunasekaran and Spalanzani, 2012:35)
Environmental quality management (EV2	(Gunasekaran and Spalanzani, 2012:35), (Mani et al., 2016:42)
Governmental regulations (EV3)	(Porter and Scully, 1995:17), (Ellegood et al., 2020: 102056)
Government rewards and incentives (EV4)	(Todeschini et al., 2020:106), (Abbas, 2020: 118806)
Adoption of green practices (EV5)	(Jerónimo et al., 2019), (Cruz and Wakolbinger, 2008:61), (Gunasekaran and Spalanzani, 2012:35)

Economic Sustainability Sub-Criteria

The economic sustainability is named as the biggest apparent problem, In Table 4, we identified five sub-criteria under it based on previous studies namely: collaborative partnerships (EC1), management of risk (EC2), strategic management (EC3), sharing information (EC4) and technology efficiency (EC5).

Collaborative partnerships (EC1): Supply chain collaboration is a vital issue for organizations looking for achieving their economic sustainability goals. Companies can work more effectively with their collaborative partners so that economic sustainability can be achieved through cooperation.

Management of risk (EC2): Risks are part of life and cannot be completely eliminated. But it is possible to minimize the risks. Managing the process by identifying and considering long-term risks is important for economic sustainability.

Strategic management (EC3): Stategic management is another sub – criteria of economic sustainable. It means that processing of determining purposes and procedures to make an organization or corporation more vying.

Sharing information (EC4): Information sharing is a way to generate a more effective dialogue between all partners. In this way, the possible negative effects that may arise due to asymmetric information are minimized and create positive effects in the context of economic sustainability.

Technology efficiency (EC5): The share of technological developments in sustainability is undeniable. The term sustainable technology, which is frequently mentioned today; are modern technologies that address and promote sustainability with its environmental, economic and social dimensions. Sustainable buildings, which minimize energy consumption, biofuels, solar energy systems contribute to the sustainability of technology.

Table 4 . Economic Sustainable Supply Chain Management

Sub-criteria	References
Collaborative partnerships (EC1)	(Todeschini et al., 2020: 1), (Chen et al., 2017: 73)
Management of risk (EC2)	(Cruz, 2008: 1005), (Panda, 2014:92)
Strategic management (EC3)	(Yadavalli et al., 2019), (Dai et al., 2021)
Sharing information(EC4)	(Faisal, 2010:508), (Vachon, 2007:4357)
Technology efficiency (EC5)	(Chen et al., 2017: 73), (Dai et al., 2021: 598)

Social Sustainability Sub-Criteria

In Table 5, Five sub-criteria are selected based on reviews under social sustainability are quality of life, (SO1), labour equity (SO2), strategic planning (SO3), employee healthcare (SO4) and voice of customer (SO5).

Quality of life (SO1): Numerous factors that influence living standards are included by the quality of life criterion. The topics that determine life quality include, for instance, the ability to meet basic requirements, access to opportunities for education, and access to healthcare.

Labour equity (SO2): Another important sub-criterion of social sustainability is workers' rights. Ensuring employee rights, fair working conditions, unionization opportunities are part of social sustainability.

Strategic planning (SO3): Other sub – criteria that contributes in achieving social sustainability is strategic planning. Strategic plans aid in defining the course that a business should take, setting attainable goals that are consistent with the related vision and mission.

Employee healthcare (SO4): Employee healthcare is an important factor in the context of social sustainability. Issues such as health, cleanliness and safety in workplaces affect the social sustainability.

Voice of customer (SO5): One of the most crucial stakeholders for businesses is their customers. Another strategy to achieve social sustainability is to consider the demands of the consumers, their experiences, their thoughts and suggestions, and their comments and expectations.

Table 5. Social Sustainable Supply Chain Management

Sub-criteria	**References**
Quality of life (SO1)	(Carter and Jennings, 2002: 37), (Mani et al., 2016:42)
Labour equity (SO2)	(Carter and Jennings, 2002: 37), (Mani et al., 2016:42)
Strategic management (SO3)	(Lechler et al., 2019:64), (Melkonyan et al., 2019:144)
Employee healthcare (SO4)	(Mani et al., 2016:42) , (Melkonyan et al., 2019:144)
Voice of customer (SO5)	(Yadavalli et al., 2019: 100113), (Dai et al., 2021: 598)

The figure presents the proposed ANP model for evaluating sustainable supply chain management using Super Decision Software.

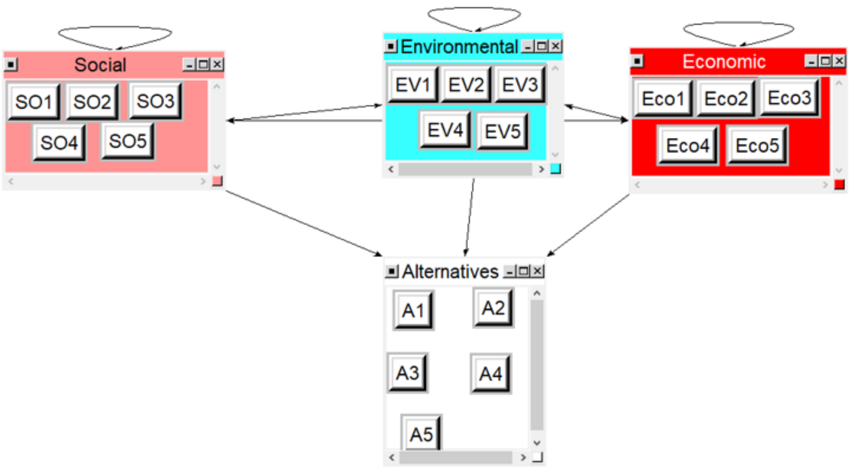

Figure 1. Proposed ANP model

Table 6 shows the list of main and sub-criteria of sustainable supply chain management and shows the percentage weights of overall, within the cluster, and the importance cluster weights.

Table 6. Scores of ANP analysis

	Sub-criteria	**Overall (%)**	**Within cluster (%)**	**Cluster weight (%)**
Alternatives Criteria	A1: Tax on carbon emission	4.71	20.39	
	A2: Collaboration incentives on sustainability	3.06	13.24	
	A3: Training programs for employees	4.48	19.39	**23.08**
	A4: Management commitment	5.79	25.09	
	A5: Public campaigns	5.05	21.89	
Environment Criteria	ENV1: Adoption of environmental standards	11.92	34.90	
	ENV2: Environmental quality management	10.30	30.14	
	ENV3: Governmental regulations	4.11	12.04	**34.17**
	ENV4: Government rewards and incentives	2.26	6.63	
	ENV5: Adoption of green practices	5.57	16.30	
Economic Criteria	EC1: Collaborative partnerships	5.51	15.37	
	EC2: Management of risk	5.01	13.98	
	EC3: Strategic management	5.83	16.25	**35.87**
	EC4: Sharing information	12.05	33.59	
	EC5: Technology efficiency	7.47	20.82	
Socia l	SO1: Quality of life	3.73	54.28	**6.88**

	SO2: Labour equity	0.33	4.76	
	SO3: Strategic management	1.06	15.46	
	SO4: Employee healthcare	0.56	8.18	
	SO5: Voice of customer	1.19	17.33	

Table 7 presents the result obtained from ANP, where the total column shows the alternative score obtained from the limit matrix table while the normal column shows the normalized alternative scores. The Ideal column shows the final result of alternatives by dividing the alternative scores with the highest alternative scoring and the last column shows alternative rankings.

Table 7. Alternative Rankings From ANP

Alternatives	**Total**	**Normal**	**Ideal**	**Ranking**
Tax on carbon emission (A1)	0.0471	0.2039	0.8124	3
Collaboration incentives (A2)	0.0306	0.1324	0.5278	5
Training programs for employees (A3)	0.0448	0.1939	0.7728	4
Management commitment (A4)	0.0579	0.2509	1.0000	1
Public campaigns (A5)	0.0505	0.2189	0.8722	2

Table 8 shows the sensitivity analysis experiments where the ranking of the alternatives stayed unaltered when the criteria load or weights varied. Therefore, showing that this model is indifferent to criteria weights variations.

Table 8. Different Criteria Weights of Sensitivity Analysis

Alternatives	**Weights (Evn, Ec, So)**		
	Exp1	Exp2	Exp3
	(0.33, 0.33, 0.33)	(0.5, 0.3, 0.2)	(0.8, 0.1, 0.1)
Tax on carbon emission (A1)	0.35089	0.24716	0.13931
Collaboration incentives (A2)	0.22795	0.16056	0.0905
Training programs for employees (A3)	0.33381	0.23513	0.1325
Management commitment (A4)	0.43192	0.30424	0.1714
Public campaigns (A5)	0.37673	0.26537	0.1495

CONCLUSIONS

In this research, we proposed a decision support method using a multi-criteria decision-making tools for a government and companies to evaluate sustainable supply chain management, using a framework of analytic network process to select the best a practice for supply chain management. We focused on three enablers environment, economic and social for sustainable supply chain evaluation. However, based on our model, we considered social enabler as one of the main criteria due to been ignored or been imaged in the environmental enabler. Hence, this model is well design and intact that can assist companies to evaluate their supply chain management practices by improving the performance, monitoring and benchmarking. Our research has two main findings as follows:

The result of the study shows the main driving powers for achieving sustainable supply chains are quality management, strategic management, sharing information, technology efficiency and voice of customers. Moreover, this result agrees with most of the literature reviews used in this study and to be precisely Seuring and Müller who insisted mainly on government, customers and stakeholders (Seuring and Müller, 2008: 1699).

From alternatives views, the result shows management commitment for corporate sustainability, public campaigns on sustainability, tax on carbon emission, training programs for employees on sustainability and collaboration incentives on sustainability are the top-ranking scores for reaching sustainable supply chain management.

However, to develop an ANP model from scratch that has some complex relationships and interdependencies is not an easy task for a decision-maker concerning sustainable supply chains, it requires expert analyst help and well set of data with maximum attention before achieving the objectives. Finally, the study was made based on the general context, but the proposed approach and methodologies are good enough to be applied in other sectors.

In this study, the model was built based on experts' assessment and using the available literature reviews, but different companies might have a different way of assigning weights and priorities for their supply chains. Therefore, there is a need for professionals and experts to help to provide an accurate weighting and assessment for evaluating alternatives and criteria. Also, there is a room for adding more alternatives and sub-criteria based on companies' standard and perspectives. All we do was considering data that may generally represent the industries' supply chains, and due to the interaction with limited supply chains expert, the final result might change with the number of participants.

The future study would involve the use of different criteria and the correlation between the existing result to validate the interpretive structural modelling (ISM)-ANP method using comparisons. Furthermore, to develop intelligent decision support software to ease these difficulties.

REFERENCES

Abbas, J. (2020). Impact of total quality management on corporate sustainability through the mediating effect of knowledge management. *Journal Of Cleaner Production, 244*, 118806. https://doi.org/10.1016/j.jclepro.2019.118806.

Aljoghaiman, A., Saad, M. & Kumar, V. (2020). *Investigating the motivators, barriers and enablers associated with the ımplementation of sustainable supply chain in Saudi manufacturing ındustry*. *3rd IEOM European International Conference On Industrial Engineering And Operations Management.* Retrieved from https://uwe-repository.worktribe.com/output/850732.

Babagolzadeh, M., Shrestha, A., Abbasi, B. & Zhang, Y. (2020). Sustainable cold supply chain management under demand uncertainty and carbon tax regulation. *Transportation Research Part D*, *80*, 102245. https://doi.org/10.1016/j.trd.2020.102245.

Büyüközkan, G. & Çifçi, G. (2012). Evaluation of the green supply chain management practices: a fuzzy ANP approach.*Production Planning and Control, 23(6),* 405-418. https://doi.org/10.1080/09537287.2011.561814.

Carter, C. R. & Rogers, D. S. (2008). *A framework of sustainable supply chain management: moving toward new theory*. *International Journal of Physical Distribution And Logistics Management*, *38*, 360–387. https://doi.org/10.1108/09600030810882816.

Carter, C. R. & Jennings, M. M. (2002). Social responsibility and supply chain relationships. *Transportation research part E: Logistics And Transportation Review, 38(1),* 37-52. https://doi.org/10.1016/S1366-5545(01)00008-4.

Campos-Guzmán, V., García-Cáscales, M. S., Espinosa, N. & Urbina, A. (2019). Life cycle analysis with multi-criteria decision making: a review of approaches for the sustainability evaluation of renewable energy technologies. *Renewable And Sustainable Energy Reviews, 104,* 343-366. https://doi.org/10.1016/j.rser.2019.01.031.

Chen, L., Zhao, X., Tang, O., Price, L., Zhang, S. & Zhu, W. (2017). Supply chain collaboration for sustainability: a literature review and future research agenda. *International Journal Of Production Economics*, *194*, 73-87. https://doi.org/10.1016/j.ijpe.2017.04.005.

Chen, J. Y., Dimitrov, S. & Pun, H. (2019). The ımpact of government subsidy on supply chains' sustainability ınnovation. *Omega, 86,* 42-58. https://doi.org/10.1016/j.omega.2018.06.012.

Cruz, J. M. (2008). Dynamics of supply chain networks with corporate social responsibility through ıntegrated environmental decision-making. *European Journal Of Operational Research, 184(3),* 1005-1031. https://doi.org/10.1016/j.ejor.2006.12.012.

Cruz, J. M. & Wakolbinger, T. (2008). Multiperiod effects of corporate social responsibility on supply chain networks, transaction costs, emissions, and risk. *International Journal Of Production Economics,* *116(1),* 61-74. https://doi.org/10.1016/j.jclepro.2019.118806.

Cooper, M. C., Lambert, D. M. & Pagh, J. D. (1997). Supply chain management: more than a new name for logistics. *The International Journal Of Logistics Management, 8(1),* 1-14. https://doi.org/10.1108/09574099710805556.

Dağdeviren, M., Dönmez, N. & Kurt, M. (2013). Bir işletmede tedarikçi değerlendirme süreci için yeni bir model tasarımı ve uygulaması. *Gazi Üniversitesi Mühendislik Mimarlık Fakültesi Dergisi, 21 (2)*, 247-255. Retrieved from https://dergipark.org.tr/tr/pub/gazimmfd/issue/6668/89359.

Dai, R., Liang, H. & Ng, L. (2021). Socially responsible corporate customers. *Journal Of Financial Economics, 142(2),* 598-626. https://doi.org/10.1016/j.jfineco.2020.01.003.

Ellegood, W. A., Solomon, S., North, J. & Campbell, J. F. (2020). School bus routing problem: contemporary trends and research directions. *Omega, 95*, 102056. https://doi.org/10.1016/j.omega.2019.03.014.

Faisal, M. N. (2010). Sustainable supply chains: a study of ınteraction among the enablers. *Business Process Management Journal, 16(3),* 508–529. https://doi.org/10.1108/14637151011049476.

Figueira, J., Greco, S. & Ehrgott, M. (Eds.). (2005). *Multiple criteria decision analysis: state of the art surveys.* New York, NY: Science And Business Media Springer, 78. Retrieved from https://link.springer.com/content/pdf/10.1007/978-1-4939-3094-4.pdf.

Gianni, M., Gotzamani, K. & Tsiotras, G. (2017). Multiple perspectives on ıntegrated management systems and corporate sustainability performance. *Journal Of Cleaner Production, 168*, 1297-1311. https://doi.org/10.1016/j.jclepro.2017.09.061.

Govindan, K., Mina, H., & Alavi, B. (2020). A decision support system for demand management ın healthcare supply chains considering the epidemic outbreaks: a case study of coronavirus disease 2019 (COVID-19). *Transportation Research Part E: Logistics and Transportation Review, 138,* 101967. https://doi.org/10.1016/j.tre.2020.101967.

Gunasekaran, A. & Spalanzani, A. (2012). Sustainability of manufacturing and services: ınvestigations for research and applications. *International Journal Of Production Economics, 140(1),* 35-47. https://doi.org/10.1016/j.ijpe.2011.05.011.

Huang, Y. S., Fang, C. C. & Lin, Y. A. (2020). Inventory management ın supply chains with consideration of logistics, green ınvestment and different carbon emissions policies. *Computers & Industrial Engineering, 139,* 106207. https://doi.org/10.1016/j.cie.2019.106207.

Jayant, A. (2016). An application of analytic network process (anp) to evaluate green supply chain management strategies: a case study. *In MATEC Web of Conferences* (Vol. 57, p. 03003). EDP Sciences. https://doi.org/10.1051/matecconf/20165703003.

Jerónimo, H. M., Henriques, P. L., de Lacerda, T. C., da Silva, F. P. & Vieira, P. R. (2020). Going green and sustainable: the ınfluence of green hr practices on the organizational rationale for sustainability.

Journal Of Business Research, *112,* 413-421. https://doi.org/10.1016/j.jbusres.2019.11.036.

Kainuma, Y. & Tawara, N. (2006). A multiple attribute utility theory approach to lean and green supply chain management. *International Journal Of Production Economics, 101(1),* 99-108. https://doi.org/10.1016/j.ijpe.2005.05.010

Kay, M. J., Kay, S. A. & Tuininga, A. R. (2018). Green teams: a collaborative training model. *Journal Of Cleaner Production*, *176*, 909-919. https://doi.org/10.1016/j.jclepro.2017.12.032

Kumar, A., Aswin, A. & Gupta, H. (2020). Evaluating green performance of the airports using hybrid BWM and VIKOR methodology. *Tourism Management*, *76,* 103941. https://doi.org/10.1016/j.tourman.2019.06.016

Lechler, S., Canzaniello, A. & Hartmann, E. (2019). Assessment sharing ıntra-ındustry strategic alliances: effects on sustainable supplier management within multi-tier supply chains. *International Journal Of Production Economics, 217*, 64-77. https://doi.org/10.1016/j.ijpe.2019.01.005

Luthra, S., Garg, D. & Haleem, A. (2015). Critical success factors of green supply chain management for achieving sustainability ın ındian automobile ındustry. *Production Planning & Control*, *26(5)*, 339-362. https://doi.org/10.1016/j.ijpe.2019.01.005

Mani, V., Gunasekaran, A., Papadopoulos, T., Hazen, B. & Dubey, R. (2016). Supply chain social sustainability for developing nations: evidence from India. *Resources, Conservation And Recycling*, *111*, 42-52. https://doi.org/10.1016/j.resconrec.2016.04.003

Melkonyan, A., Krumme, K., Gruchmann, T., Spinler, S., Schumacher, T. & Bleischwitz, R. (2019). Scenario and strategy planning for transformative supply chains within a sustainable economy. *Journal Of Cleaner Production*, *231*, 144-160. https://doi.org/10.1016/j.jclepro.2019.05.222

Padhi, S. S., Pati, R. K. & Rajeev, A. (2018). Framework for selecting sustainable supply chain processes and ındustries using an ıntegrated approach. *Journal Of Cleaner Production*, *184*, 969-984. https://doi.org/10.1016/j.jclepro.2018.02.306

Panda, S. (2014). Coordination of a socially responsible supply chain using revenue sharing contract. *Transportation Research Part E: Logistics And Transportation Review*, *67*, 92-104. https://doi.org/10.1016/j.tre.2014.04.002

Paul, S. K., Chowdhury, P., Moktadir, M. A., & Lau, K. H. (2021). Supply chain recovery challenges ın the wake of COVID-19 pandemic. *Journal Of Business Research*, *136*, 316-329. https://doi.org/10.1016/j.jbusres.2021.07.056

Porter, P. K., & Scully, G. W. (1995). Institutional technology and economic growth. *Public Choice, 82(1),* 17-36. https://doi.org/10.1007/BF01047727

Rostamzadeh, R., Ghorabaee, M. K., Govindan, K., Esmaeili, A. & Nobar, H. B. K. (2018). Evaluation of sustainable supply chain risk management using an ıntegrated fuzzy TOPSIS-CRITIC approach.

Journal Of Cleaner Production, *175*, 651-669. https://doi.org/10.1016/j.jclepro.2017.12.071

Saaty, T. L., & Ozdemir, M. S. (2021). *The Encyclicon-Volume 1: A dictionary of decisions with dependence and feedback based on the analytic network process*. RWS Publications. Retrieved from https://www.researchgate.net/publication/258258276_The_Encyclicon_A_Dictionary_of_Decisions_with_Dependence_and_Feedback_Based_on_the_Analytic_Network_Process

Saaty, T. L. & Vargas, L. G. (2006). *Decision making with the analytic network process*. New York: Science + Business Media, LLC, Springer, 282. Retrieved from https://link.springer.com/book/10.1007/978-1-4614-7279-7

Sarkis, J., Gonzalez, E. D. S. & Koh, S. L. (2019). Effective multi-tier supply chain management for sustainability. *International Journal Of Production Economics*, *217*, 1–10. https://doi.org/10.1016/j.ijpe.2019.09.014

Seuring, S. & Müller, M. (2008). From a literature review to a conceptual framework for sustainable supply chain management. *Journal Of Cleaner Production, 16(15),* 1699-1710. https://doi.org/10.1016/j.jclepro.2008.04.020

Suhi, S. A., Enayet, R., Haque, T., Ali, S. M., Moktadir, M. A. & Paul, S. K. (2019). Environmental sustainability assessment ın supply chain: an emerging economy context. *Environmental Impact Assessment Review*, *79*, 106306. https://doi.org/10.1016/j.eiar.2019.106306

Tjader, Y., May, J. H., Shang, J., Vargas, L. G., & Gao, N. (2014). Firm-level outsourcing decision making: a balanced scorecard-based analytic network process model. *International Journal Of Production Economics*, *147*, 614-623. https://doi.org/10.1016/j.ijpe.2013.04.017

Todeschini, B. V., Cortimiglia, M. N. & de Medeiros, J. F. (2020). Collaboration practices ın the fashion ındustry: environmentally sustainable ınnovations ın the value chain. *Environmental Science & Policy*, *106*, 1-11. https://doi.org/10.1016/j.envsci.2020.01.003

Triantaphyllou, E. (2000). *Multi-criteria decision making methods. In multi-criteria decision making methods: a comparative study*. Boston: Science and Business Media Springer, 5-21. Retrieved from https://link.springer.com/chapter/10.1007/978-1-4757-3157-6_2

Tzeng, G. H. & Huang, J. J. (2011). *Multiple attribute decision making: methods and applications*. Boca Raton, FI, USA: CRC Press. https://doi.org/10.1201/b11032

Vachon, S. (2007). Green supply chain practices and the selection of environmental technologies. *International Journal Of Production Research*, *45(18-19)*, 4357-4379. https://doi.org/10.1080/00207540701440303

Walley, N. & Whitehead, B. (1994). *It's not easy being green*. *Harvard Business Review*, *72*, 46-52. Retrieved from https://hbr.org/1994/05/its-not-easy-being-green

Walker, H., Di Sisto, L. & McBain, D. (2008). Drivers and barriers to environmental supply chain management practices: lessons from the public and private sectors. *Journal Of Purchasing And Supply*

Management, 14(1), 69-85. https://doi.org/10.1016/j.pursup.2008.01.007

Wang, J., & Dai, J. (2018). Sustainable supply chain management practices and performance. *Industrial Management & Data Systems*, 118(1), 2–21. https://doi.org/10.1108/IMDS-12-2016-0540

Yadavalli, V. S., Darbari, J. D., Bhayana, N., Jha, P. C. & Agarwal, V. (2019). An ıntegrated optimization model for selection of sustainable suppliers based on customers' expectations. *Operations Research Perspectives*, *6*, 100113. https://doi.org/10.1016/j.orp.2019.100113

Yu, M. & Cruz, J. M. (2019). The sustainable supply chain network competition with environmental tax policies. *International Journal Of Production Economics, 217*, 218-231. https://doi.org/10.1016/j.ijpe.2018.08.005

APPENDIX

Table 9. ANP Unweighted Matrix

ANP Unweighted Matrix

	A1	A2	A3	A4	A5	Eco1	Eco2	Eco3	Eco4	Eco5	EV1	EV2	EV3	EV4	EV5	SO1	SO2	SO3	SO4	SO5
A1						0.07944	0.07834	0.08130	0.08271	0.08353	0.13600	0.35938	0.36757	0.23489	0.36757	0.24410	0.08539	0.08359	0.12220	0.08441
A2						0.35446	0.13369	0.10670	0.11204	0.11976	0.09000	0.08430	0.08200	0.09388	0.24956	0.15375	0.11830	0.13203	0.09260	0.11167
A3						0.26901	0.23217	0.38990	0.17937	0.26844	0.17206	0.24852	0.18727	0.13705	0.08200	0.11090	0.40681	0.22818	0.39273	0.15718
A4						0.12595	0.38653	0.26852	0.34927	0.37977	0.37118	0.19356	0.24956	0.16795	0.18727	0.09506	0.22286	0.39631	0.21726	0.26386
A5						0.17114	0.16926	0.15358	0.27661	0.14851	0.23076	0.11425	0.11360	0.36623	0.11360	0.39620	0.16664	0.15990	0.17521	0.38288
Eco1	0.00000	1.00000	0.00000	0.00000	0.11722	0.00000	0.00000	0.25000	0.33333	0.00000										
Eco2	0.80000	0.00000	0.25000	0.00000	0.00000	0.00000	0.00000	0.75000	0.00000	0.00000										
Eco3	0.20000	0.00000	0.00000	0.00000	0.26837	0.25000	1.00000	0.00000	0.00000	0.00000										
Eco4	0.00000	0.00000	0.00000	1.00000	0.61441	0.75000	0.00000	0.00000	0.00000	1.00000										
Eco5	0.00000	0.00000	0.75000	0.00000	0.00000	0.00000	0.00000	0.00000	0.66667	0.00000										
EV1	0.00000	0.00000	0.00000	0.00000	0.75000						0.00000	1.00000	0.75000	0.75000	0.00000					
EV2	0.00000	0.00000	0.00000	0.00000	0.25000						0.75000	0.00000	0.00000	0.00000	1.00000					
EV3	0.75000	0.00000	0.75000	0.25000	0.00000						0.00000	0.00000	0.00000	0.00000	0.00000					
EV4	0.25000	0.75000	0.25000	0.00000	0.00000						0.00000	0.00000	0.00000	0.00000	0.00000					
EV5	0.00000	0.25000	0.00000	0.75000	0.00000						0.25000	0.00000	0.25000	0.25000	0.00000					
SO1	0.80000	1.00000	0.80000	0.25000	0.16667											0.00000	1.00000	0.53961	1.00000	0.16821
SO2	0.00000	0.00000	0.00000	0.00000	0.00000											0.00000	0.00000	0.29696	0.00000	0.10133
SO3	0.00000	0.00000	0.00000	0.75000	0.00000											0.00000	0.00000	0.00000	0.00000	0.23780
SO4	0.20000	0.00000	0.20000	0.00000	0.00000											0.00000	0.00000	0.16342	0.00000	0.08165
SO5	0.00000	0.00000	0.00000	0.00000	0.83333											0.00000	0.00000	0.00000	0.00000	0.41100

Table 10. ANP Weigted Matrix

ANP Weighted Super Matrix

	A1	A2	A3	A4	A5	Eco1	Eco2	Eco3	Eco4	Eco5	EV1	EV2	EV3	EV4	EV5	SO1	SO2	SO3	SO4	SO5
A1						0.01589	0.01567	0.01626	0.01654	0.01671	0.04533	0.11979	0.12252	0.07830	0.12252	0.24410	0.02135	0.02090	0.03055	0.02110
A2						0.07089	0.02674	0.02134	0.02241	0.02395	0.03000	0.02810	0.02733	0.03129	0.08319	0.15375	0.02958	0.03301	0.02315	0.02792
A3						0.05380	0.04643	0.07798	0.03587	0.05369	0.05735	0.08284	0.06243	0.04568	0.02733	0.11090	0.10170	0.05704	0.09818	0.03929
A4						0.02519	0.07731	0.05370	0.06985	0.07595	0.12373	0.06452	0.08319	0.05599	0.06243	0.09506	0.05571	0.09908	0.05432	0.06596
A5						0.03423	0.03385	0.03072	0.05532	0.02970	0.07692	0.03808	0.03787	0.12208	0.03787	0.39620	0.04166	0.03997	0.04380	0.09572
Eco1	0.00000	0.31081	0.00000	0.00000	0.03643	0.00000	0.00000	0.20000	0.26667	0.00000										
Eco2	0.24865	0.00000	0.07770	0.00000	0.00000	0.00000	0.00000	0.60000	0.00000	0.00000										
Eco3	0.06216	0.00000	0.00000	0.00000	0.08341	0.20000	0.80000	0.00000	0.00000	0.00000										
Eco4	0.00000	0.00000	0.00000	0.31081	0.19097	0.60000	0.00000	0.00000	0.00000	0.80000										
Eco5	0.00000	0.00000	0.23311	0.00000	0.00000	0.00000	0.00000	0.00000	0.53333	0.00000										
EV1	0.00000	0.00000	0.00000	0.00000	0.37004						0.00000	0.66667	0.50000	0.50000	0.00000					
EV2	0.00000	0.00000	0.00000	0.00000	0.12335						0.50000	0.00000	0.00000	0.00000	0.66667					
EV3	0.37004	0.00000	0.37004	0.12335	0.00000						0.00000	0.00000	0.00000	0.00000	0.00000					
EV4	0.12335	0.37004	0.12335	0.00000	0.00000						0.00000	0.00000	0.00000	0.00000	0.00000					
EV5	0.00000	0.12335	0.00000	0.37004	0.00000						0.16667	0.00000	0.16667	0.16667	0.00000					
SO1	0.15664	0.19580	0.15664	0.04895	0.03263											0.00000	0.75000	0.40471	0.75000	0.12616
SO2	0.00000	0.00000	0.00000	0.00000	0.00000											0.00000	0.00000	0.22272	0.00000	0.07600
SO3	0.00000	0.00000	0.00000	0.14685	0.00000											0.00000	0.00000	0.00000	0.00000	0.17835
SO4	0.03916	0.00000	0.03916	0.00000	0.00000											0.00000	0.00000	0.12257	0.00000	0.06124
SO5	0.00000	0.00000	0.00000	0.00000	0.16317											0.00000	0.00000	0.00000	0.00000	0.30825

Table 11.ANP Limit Matrix

ANP Limit Matrix

	A1	A2	A3	A4	A5	Eco1	Eco2	Eco3	Eco4	Eco5	EV1	EV2	EV3	EV4	EV5	SO1	SO2	SO3	SO4	SO5
A1	0.04706	0.04706	0.04706	0.04706	0.04706	0.04706	0.04706	0.04706	0.04706	0.04706	0.04706	0.04706	0.04706	0.04706	0.04706	0.04706	0.04706	0.04706	0.04706	0.04706
A2	0.03057	0.03057	0.03057	0.03057	0.03057	0.03057	0.03057	0.03057	0.03057	0.03057	0.03057	0.03057	0.03057	0.03057	0.03057	0.03057	0.03057	0.03057	0.03057	0.03057
A3	0.04476	0.04476	0.04476	0.04476	0.04476	0.04476	0.04476	0.04476	0.04476	0.04476	0.04476	0.04476	0.04476	0.04476	0.04476	0.04476	0.04476	0.04476	0.04476	0.04476
A4	0.05792	0.05792	0.05792	0.05792	0.05792	0.05792	0.05792	0.05792	0.05792	0.05792	0.05792	0.05792	0.05792	0.05792	0.05792	0.05792	0.05792	0.05792	0.05792	0.05792
A5	0.05052	0.05052	0.05052	0.05052	0.05052	0.05052	0.05052	0.05052	0.05052	0.05052	0.05052	0.05052	0.05052	0.05052	0.05052	0.05052	0.05052	0.05052	0.05052	0.05052
Eco1	0.05513	0.05513	0.05513	0.05513	0.05513	0.05513	0.05513	0.05513	0.05513	0.05513	0.05513	0.05513	0.05513	0.05513	0.05513	0.05513	0.05513	0.05513	0.05513	0.05513
Eco2	0.05015	0.05015	0.05015	0.05015	0.05015	0.05015	0.05015	0.05015	0.05015	0.05015	0.05015	0.05015	0.05015	0.05015	0.05015	0.05015	0.05015	0.05015	0.05015	0.05015
Eco3	0.05828	0.05828	0.05828	0.05828	0.05828	0.05828	0.05828	0.05828	0.05828	0.05828	0.05828	0.05828	0.05828	0.05828	0.05828	0.05828	0.05828	0.05828	0.05828	0.05828
Eco4	0.12048	0.12048	0.12048	0.12048	0.12048	0.12048	0.12048	0.12048	0.12048	0.12048	0.12048	0.12048	0.12048	0.12048	0.12048	0.12048	0.12048	0.12048	0.12048	0.12048
Eco5	0.07469	0.07469	0.07469	0.07469	0.07469	0.07469	0.07469	0.07469	0.07469	0.07469	0.07469	0.07469	0.07469	0.07469	0.07469	0.07469	0.07469	0.07469	0.07469	0.07469
EV1	0.11923	0.11923	0.11923	0.11923	0.11923	0.11923	0.11923	0.11923	0.11923	0.11923	0.11923	0.11923	0.11923	0.11923	0.11923	0.11923	0.11923	0.11923	0.11923	0.11923
EV2	0.10298	0.10298	0.10298	0.10298	0.10298	0.10298	0.10298	0.10298	0.10298	0.10298	0.10298	0.10298	0.10298	0.10298	0.10298	0.10298	0.10298	0.10298	0.10298	0.10298
EV3	0.04112	0.04112	0.04112	0.04112	0.04112	0.04112	0.04112	0.04112	0.04112	0.04112	0.04112	0.04112	0.04112	0.04112	0.04112	0.04112	0.04112	0.04112	0.04112	0.04112
EV4	0.02264	0.02264	0.02264	0.02264	0.02264	0.02264	0.02264	0.02264	0.02264	0.02264	0.02264	0.02264	0.02264	0.02264	0.02264	0.02264	0.02264	0.02264	0.02264	0.02264
EV5	0.05570	0.05570	0.05570	0.05570	0.05570	0.05570	0.05570	0.05570	0.05570	0.05570	0.05570	0.05570	0.05570	0.05570	0.05570	0.05570	0.05570	0.05570	0.05570	0.05570
SO1	0.03733	0.03733	0.03733	0.03733	0.03733	0.03733	0.03733	0.03733	0.03733	0.03733	0.03733	0.03733	0.03733	0.03733	0.03733	0.03733	0.03733	0.03733	0.03733	0.03733
SO2	0.00327	0.00327	0.00327	0.00327	0.00327	0.00327	0.00327	0.00327	0.00327	0.00327	0.00327	0.00327	0.00327	0.00327	0.00327	0.00327	0.00327	0.00327	0.00327	0.00327
SO3	0.01063	0.01063	0.01063	0.01063	0.01063	0.01063	0.01063	0.01063	0.01063	0.01063	0.01063	0.01063	0.01063	0.01063	0.01063	0.01063	0.01063	0.01063	0.01063	0.01063
SO4	0.00563	0.00563	0.00563	0.00563	0.00563	0.00563	0.00563	0.00563	0.00563	0.00563	0.00563	0.00563	0.00563	0.00563	0.00563	0.00563	0.00563	0.00563	0.00563	0.00563
SO5	0.01192	0.01192	0.01192	0.01192	0.01192	0.01192	0.01192	0.01192	0.01192	0.01192	0.01192	0.01192	0.01192	0.01192	0.01192	0.01192	0.01192	0.01192	0.01192	0.011