

ISTANBUL TECHNICAL UNIVERSITY ★ GRADUATE SCHOOL

**PRIORITIZATION OF SOCIAL MEDIA ADVERTISING CHANNELS IN
ONLINE RETAILING BY AN AI-DRIVEN MCDM FRAMEWORK**



M.Sc. THESIS

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Department of Industrial Engineering

Industrial Engineering Programme

MAY 2025

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İSTANBUL TEKNİK ÜNİVERSİTESİ ★ LİSANSÜSTÜ EĞİTİM ENSTİTÜSÜ

**ÇEVİRİMİÇİ PERAKENDECİLİKTE SOSYAL MEDYA REKLAM
KANALLARININ YAPAY ZEKA DESTEKLİ BİR ÇKKV ÇERÇEVESİYLE
ÖNCELİKLENDİRİLMESİ**

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To my spouse and my parents,



FOREWORD

As an Industrial Engineering student, I am constantly seeking optimized solutions. The breadth of this major has allowed me to choose a topic focused on understanding and addressing real-world problems in management and advertising. Additionally, my work in the social media and advertising industry has provided me with valuable insights into current challenges in this field.

I would like to express my gratitude to my supervisor, Prof. Dr. Yusuf İlker Topçu. Without his help, effective feedback, and guidance, this thesis would not have been possible. I also want to thank my spouse for his unwavering support and for standing by my side throughout this process. Finally, I appreciate my friends and colleagues who offered their assistance and academic support whenever I had questions.

April 2025

Saba Mostafaei



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ABBREVIATIONS

AHP	: Analytic Hierarchy Process
AI	: Artificial Intelligence
MCMD	: Multi-Criteria Decision-Making





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PRIORITIZATION OF SOCIAL MEDIA ADVERTISING CHANNELS IN ONLINE RETAILING BY AN AI-DRIVEN MCDM FRAMEWORK

SUMMARY

This research aims to bridge the current gap in online retail advertising by developing an AI-powered Multi-Criteria Decision Making (MCDM) framework by combining the Analytical Hierarchy Process (AHP) with Artificial Intelligence (AI). The main objective of the research is to prioritize key evaluation criteria and strategic options to help online retailers improve their social media advertising strategies.

In this study, a comprehensive literature review was conducted to determine the key social media advertising channels and the criteria to be used to evaluate these advertising channels. The determined criteria were validated by marketing experts and the list was finalized. Then, the criteria were prioritized with expert opinions and the judgments of AI tools such as ChatGPT and Gemini. In this context, the pairwise comparison questions suggested by the AHP method were asked to experts and AI tools. In the next stage, experts and AI tools scored six strategic alternatives: Data-Driven Advertising, Content-Driven Strategy, Optimized Campaigns, Influencer Partnerships, Gamified Advertising Campaigns, and Social Responsibility-Based Advertising. The results were checked to see whether the data fit the experts' criteria and if the prioritization of the tools for AI was correct. Then the importance of the criterion was checked for each option rating through sensitivity analysis as a step. This research is likely to unveil the most important management results for a better resource allocation and strategic efficiency in social media marketing.

This analysis will provide valuable managerial insights for optimizing resource allocation and strategic effectiveness in social media advertising. The aim of this study is to support online shopping platforms in improving their social media advertising strategies and to present a multi-criteria decision-making framework that evaluates and ranks key factors to enable decision makers to use resources more effectively. As a result, it is expected that this study will reveal valuable managerial implications for businesses.



ÇEVİRİMİÇİ PERAKENDECİLİKTE SOSYAL MEDYA REKLAM KANALLARININ YAPAY ZEKA DESTEKLİ BİR ÇKKV ÇERÇEVESİYLE ÖNCELİKLENDİRİLMESİ

ÖZET

Son on yılda çevrimiçi perakendenin hızlı büyümesi, modern ticaretin çehresini önemli ölçüde değiştirmiş ve işletmeleri, müşterilere ulaşmak ve onları elde tutmak için yenilikçi ve rekabetçi yaklaşımlar benimsemeye zorlamıştır. Tüketici davranışının giderek dijital platformlara kaymasıyla birlikte, sosyal medya çevrimiçi mağazaların pazarlama stratejilerinde vazgeçilmez bir araç haline gelmiştir. Geleneksel reklam kanallarının aksine, sosyal medya platformları hedef kitlelere doğrudan erişim, anlık geri bildirim döngüleri ve dinamik etkileşim fırsatları sunmaktadır. Ancak, aynı dijital alanda dikkat çekmek için yarışan çok sayıda işletmeyle birlikte, çevrimiçi perakendeciler, kullanıcılarla etkileşim kuran ve bu etkileşimi somut ticari sonuçlara dönüştüren etkili reklam stratejileri tasarlama ve uygulama konusunda ciddi zorluklarla karşı karşıyadır.

Sosyal medya reklamcılığı stratejik açıdan büyük önem taşımasına rağmen, birçok çevrimiçi işletme karar verme süreçlerini yönlendirecek açık ve yapılandırılmış bir çerçeveden yoksundur. Reklam çalışmaları çoğunlukla parçalı bir şekilde, deneme-yanılma yöntemleriyle, içgüdüsel yaklaşımlarla ya da kısa vadeli trendlere göre yürütülmekte; bu da sistematik analizlerden uzak, rastlantısal stratejilere neden olmaktadır. Sonuç olarak, kaynaklar yanlış tahsis edilebilmekte, kampanyalar hedeflerine ulaşamamakta ve uzun vadeli marka gelişimi sekteye uğrayabilmektedir. Birden fazla performans kriterini dikkate alan ve insan uzmanlığı ile ölçeklenebilir yapay zekâ gücünü dengeleyen kapsamlı bir değerlendirme modelinin eksikliği, hem akademik araştırmalarda hem de uygulamada önemli bir boşluk olarak göze çarpmaktadır. Bu çalışmada geliştirilen bütünlük, yapay zekâ destekli karar verme çerçevesi, çevrimiçi perakendecilerin sosyal medya platformlarında en uygun reklam stratejilerini seçmelerine ve önceliklendirmelerine yardımcı olmayı amaçlamaktadır.

Bu çalışmada geliştirilen çerçeve, Çok Kriterli Karar Verme (ÇKKV) ilkelerine dayanmaktadır ve reklamcılık etkinliğinin çok boyutlu ve karmaşık doğasına uygun olarak tasarlanmıştır. Analitik Hiyerarşi Süreci (AHS) gibi yerleşik bir yöntem ile ChatGPT ve Gemini gibi ileri düzey Yapay Zekâ (YZ) araçlarının bir araya getirilmesi sayesinde, bu model değerlendirme sürecine mantıksal yapı, tutarlılık, ölçeklenebilirlik ve öngörü gücü kazandırmaktadır. AHS, uzman yargılarına dayalı olarak alternatiflerin kriterlere göre hiyerarşik yapıda karşılaştırılmasını sağlarken; YZ araçları, veriye dayalı içgörülerini, dil işleme yeteneklerini ve geniş kapsamlı analiz kapasitesini sürece dahil ederek, karar vermedeki öznelliği azaltmakta ve sürecin verimliliğini artırmaktadır. İnsan ve yapay zekânın entegrasyonu, bilişsel önyargıları azaltmak, kararların tutarlılığını artırmak ve modelin farklı senaryolara uygulanabilirliğini genişletmek açısından kritik öneme sahiptir.

Araştırmanın temel amacı, çevrimiçi işletmelerin sosyal medya reklamcılığı alanında optimize edilmiş kararlar almasını sağlayacak bir karar destek çerçevesi geliştirmek ve doğrulamaktır. Bu kapsamda, çalışmada öncelikle sosyal medya reklam etkinliğini etkileyen temel kriterlerin belirlenmesi ve geçerliliğinin sağlanması, ardından bu kriterlere göre stratejik alternatiflerin önceliklendirilmesi ve son olarak da kısa ve uzun vadeli kampanya planlamalarına yönelik uygulanabilir öneriler sunulması hedeflenmektedir. Geliştirilen çerçeve, yalnızca teorik bir model olarak değil; aynı zamanda dijital pazarlama uzmanları, e-ticaret yöneticileri ve stratejik karar vericiler için pratik bir araç olarak tasarlanmıştır. Uzman görüşleri ile yapay zekâ destekli analizlerin bir araya getirilmesi, sürdürülebilir ve stratejik bir pazarlama temeli oluşturmayı amaçlamaktadır.

Bu hedeflere ulaşmak üzere, araştırma üç aşamalı bir yöntem izlemektedir. İlk aşamada, sosyal medya reklamcılığı performansını etkileyen kriterler ve alt kriterler, bilimsel literatür taraması yoluyla belirlenmiştir. Akademik makaleler, sektör raporları ve dijital pazarlama göstergelerine dayalı olarak yapılan analiz sonucunda, Kullanıcı Deneyimi ve Arayüz, Güvenlik ve Güven, Ürün ve Fiyatlandırma, Müşteri Desteği gibi 9 ana kriter: C1 (User Experience & Interface), C2 (Trust & Security), C3 (Customer Support & Responsiveness), C4 (Product & Pricing), C5 (Marketing & Brand), C6 (Digital Presence & Engagement), C7 (Information & Accessibility), C8 (Transaction & Payment), C9 (Customer Satisfaction & Experience) ve toplamda 34 alt kriter tanımlanmıştır. Bu kriterler, altı deneyimli pazarlama uzmanı ve iki akademisyenden oluşan sekiz kişilik uzman paneli tarafından değerlendirilmiş ve geçerlilikleri doğrulanmıştır. Bu sayede model, sektörel gerçekliklerle uyumlu ve güncel uygulamalara entegre edilebilir bir nitelik kazanmıştır.

İkinci aşamada, karar verme sürecini biçimlendirmek amacıyla hiyerarşik bir AHS modeli oluşturulmuştur. Hiyerarşinin en üst seviyesinde, "En Uygun Reklam Stratejisinin Seçilmesi" hedefi belirlenmiştir. Alternatifler olarak, Veri Odaklı Reklamcılık, İçerik Merkezli Strateji, Optimize Edilmiş Kampanyalar, Influencer İşbirlikleri, Oyunlaştırılmış Reklamcılık ve Sosyal Sorumluluk Temelli Reklamcılık olmak üzere altı strateji tanımlanmıştır. Bu alternatifler, farklı güçlü yönleri ve potansiyel sınırlamalara sahip özgün yaklaşımlar sunmaktadır. Uzmanlar ve YZ araçları, yapılandırılmış ikili karşılaştırmalar yoluyla her kriterin ve alternatifin göreceli önemini değerlendirmiş; bu değerlendirmeler sonucunda, hem öznellik hem de veriye dayalı analiz dikkate alınarak kriter ağırlıkları belirlenmiştir. ChatGPT ve Gemini'nin bu aşamada kullanılması, olası sonuçların daha geniş bir perspektiften incelenmesini sağlamış ve stratejik önceliklerin daha derinlemesine analizine olanak tanımıştır.

Üçüncü aşamada, modelin dayanıklılığı test edilmiş ve kriter ağırlıklarındaki değişimlerin nihai strateji sıralamalarına etkisi incelenmiştir. Bu duyarlılık analizi, modelin esnekliğini ve değişen piyasa koşullarına ne derece uyum sağlayabildiğini ortaya koymak açısından büyük önem taşımaktadır. Elde edilen sonuçlar, uzman görüşleri ile YZ tabanlı analizlerin öncelikleri konusunda belirli farklılıklar taşıdığını göstermiştir. İnsan uzmanlar, Kullanıcı Deneyimi ve Güvenlik & Güven kriterlerine daha yüksek önem verirken; yapay zekâ araçları, Ürün & Fiyatlandırma ile İşlem & Ödeme süreçlerine öncelik vermiştir. Bu farklılıklar, karar verme süreçlerinde çoklu bakış açılarının entegrasyonunun önemini vurgulamaktadır. Bununla birlikte, hem uzmanlar hem de yapay zekâ araçları, kişiselleştirilmiş hedefleme, etkileşim artırma ve reklam harcamalarının verimli kullanımı gibi nedenlerle Veri Odaklı Reklamcılığı en etkili strateji olarak belirlemiştir.

Duyarlılık analizi ayrıca modelin tepkiselliği hakkında da değerli içgörüler sunmuştur. Uzman temelli senaryolarda, örneğin Kullanıcı Dostluğu kriterine verilen ağırlık arttıkça sıralamalarda anlamlı değişimler gözlenmiş ve %25.96 eşiği aşıldığında Oyunlaştırılmış Reklamcılık en üst sıraya yükselmiştir. Buna karşılık, yapay zekâ verilerine dayalı sıralamalar daha istikrarlı olmuş ve Veri Odaklı Reklamcılık, farklı ağırlık senaryolarında tutarlı biçimde en yüksek sırada kalmıştır. Bu durum, YZ tabanlı değerlendirmelerin tutarlılık sağladığını; uzman görüşlerinin ise bağlamsal derinlik ve sektörel sezgi kattığını göstermektedir.

Elde edilen bulgular, e-ticaret ve dijital pazarlama alanlarında faaliyet gösteren yöneticiler için önemli yönetsel çıkarımlar sunmaktadır. Kısa vadede, ölçülebilir yatırım getirisi sağlayan ve performans göstergeleriyle yönetilebilen veri odaklı kampanyalara öncelik verilmesi önerilmektedir. Bu stratejiler, tüketici eğilimlerini hızlı şekilde anlamaya ve kampanya etkinliğini anlık olarak optimize etmeye olanak tanır. Uzun vadede ise içerik merkezli stratejiler ve influencer iş birlikleriyle marka sadakatini güçlendirmek, sürdürülebilir büyüme açısından kritik olacaktır. Çalışma, karar verme süreçlerinde yapay zekâ içgörülerinin insan uzmanlığı ile harmanlandığı hibrit bir yaklaşımın benimsenmesini savunmaktadır.

Her ne kadar geliştirilen çerçeve kapsamlı ve yenilikçi bir yaklaşım sunsa da, belirli sınırlamalar içermektedir. Uzman doğrulama sürecinde kullanılan katılımcı sayısının sınırlı olması, elde edilen sonuçların genellenebilirliğini etkileyebilir. Ayrıca model, durağan piyasa koşulları varsayımıyla geliştirilmiş olup, rakip faaliyetleri, platform algoritma değişiklikleri veya makroekonomik etkenler gibi dışsal faktörleri hesaba katmamaktadır. Gelecekte yapılacak araştırmalar, daha geniş katılımlı uzman panelleriyle modelin geçerliliğini pekiştirmeli, gerçek dünya performans verileriyle çıktıları doğrulamalı ve kriter ağırlıklarındaki belirsizliği yönetmek amacıyla bulanık AHS veya makine öğrenimi gibi ileri düzey teknikleri entegre etmelidir. Ayrıca, bu modelin sağlık, lojistik veya eğitim gibi farklı sektörlerde uygulanması, esnekliğini ve kapsayıcılığını değerlendirmek açısından yararlı olacaktır.

Sonuç olarak, bu çalışma çevrimiçi perakendecilerin sosyal medya reklamcılığı konusundaki kararlarını daha bilinçli ve stratejik şekilde almalarını sağlayacak, yapay zekâ destekli yeni bir AHS çerçevesi sunmaktadır. İnsan uzmanlığı ile yapay zekâ gücünü birleştirerek kriterlerin sistematik biçimde değerlendirilmesini ve stratejik alternatiflerin önceliklendirilmesini sağlayan bu model; yapılandırılmış, esnek ve veriye dayalı bir dijital pazarlama yaklaşımı sunmaktadır. Uzman görüşleri ile YZ bulguları arasındaki uyum, çerçevenin güvenilirliğini desteklerken; duyarlılık analizi, değişen önceliklere uyum sağlama kapasitesini ortaya koymaktadır. Sonuç olarak, bu araştırma hem akademik literatüre hem de uygulamalı pazarlama dünyasına önemli katkılar sunmakta; işletmelere dijital dünyada rekabet avantajı sağlayacak güçlü bir karar destek aracı sunmaktadır.



1. INTRODUCTION AND RESEARCH BACKGROUND

1.1 Purpose of Thesis

Due to the increase in customer computer literacy and widespread access to the internet, the traditional way of purchasing is being gradually replaced by online shopping (Ajripour, 2020). Online retailing is a fast-growing sector with many opportunities for growth. To take full advantage of these opportunities, businesses need to focus on improving customer experience and satisfaction. This means personalizing the shopping experience, making websites easy to navigate, offering helpful customer service, and providing secure payment options. By doing so, businesses can create a smooth and enjoyable shopping experience that drives growth and success (Vineet Kaushik, 2020). It has become increasingly common for consumers to buy products and services from e-stores, driven by the convenience and accessibility these platforms offer. As a result, it is crucial for e-store managers to effectively manage business operations and marketing strategies, as the success of an online store heavily depends on proficient management and accurate marketing techniques (Wan-Yu Chiu, 2013).

When the 2019 pandemic hit, many more people started to buy and sell stuff online. All around the world, it's clear that technology is changing how people talk and work together to better connect with and know what customers need. This shift made businesses to re-evaluate their strategies and change towards digital techniques in order to maintain their competitive benefits. One challenging aspect of this transformation is the transition from conventional marketing approaches to digital marketing strategies. Globally, the general development trend shows that, with the aid of technology, communication activities are gradually evolving to meet the growing need for customer interaction and understanding. This shift has significantly contributed to promoting and accelerating the sales processes of businesses, marking a new phase of growth in the media industry (Thanh, 2022).

A major challenge for marketers is understanding how consumers use digital and social media in the purchase decision process. At what stages do people rely on social media

to help them make decisions about products and services, and how do they utilize these platforms to manage their purchases (Todd Powers, 2012) ? To keep people who buy things online happy and stay on top, shops on the web need to see these changes and change how they do things too. Now, buyers can find a lot of info with ease, search for things, look at different products, think about options, and choose wisely. As people use the web more to help them decide, those who sell things online need to come up with new ways to get attention, keep customers, and make them want to come back. This requires a deep understanding of consumer behavior and satisfaction throughout the online purchasing process (Anil Kumar, 2018). With the growth of digital marketing, a key decision-making task for top executives, particularly marketing managers, is selecting the right digital marketing strategies to attract, engage, and motivate customers to shop online. As a result, marketing managers are continually looking for new methods and promotional tactics to encourage and persuade customers to make purchases (Ajripour, Applying MCDM Technique in analyzing the effect of promotion items based on online shopping factors, 2020).

As mentioned in (Shangsong Liu, 2021), most work on making web ads better mainly looks at two things: (1) getting better at finding who to show ads to using new technology, and (2) making click rates guessing more accurate. A big part of running online stores is putting out ads. Ads help sell by aiming at the right target and making ad pay based on how well the ad does. Online ads on shopping sites are not like old ads in papers or TV. They use deep data checks. These sites can watch what users do, like clicking on ads, their web use, and what they buy. This makes ads more on point and fits each person better. (Shangsong Liu, 2021).

A distinctive feature of online shopping environments is their ability to offer a high level of interactivity. This interactivity is a multidimensional concept, with key elements including the reciprocal exchange of information, on-demand access to information, responsive feedback, content customization, and real-time user feedback (Gerald Haubl, 2000).

Evaluating and selecting digital marketing technologies is challenging due to the numerous competing criteria and objectives involved. The MCDM model addresses the complexities of real-world decision-making caused by a number of potentially conflicting criteria and alternatives and the subjectivity of these criteria with limited measurement systems. The Multi-Criteria Decision-Making (MCDM) model is a

robust and widely used approach for addressing such complex decision-making problems (Thanh, 2022). MCDM provides managers with a multidimensional framework to consider various related elements and evaluate all potential options under varying degrees of importance. In group decision-making, experts collaborate to reach a consensus and formulate the optimal strategy. Decision-making, often referred to as "problem solving," involves selecting one or more alternatives that are most favorable in a given context. An essential aspect of developing a sales and marketing plan is choosing the right media to convey your message. There are no definitive rules about which media is best, as what works for one business may not work for another. As a result, selecting the appropriate media for advertising is influenced by multiple factors and can be assessed through different perspectives. This makes it a suitable example of a Multiple Criteria Decision-Making (MCDM) problem (Sarfaraz Hashemkhani Zolfani, 2013).

Many marketing researchers apply multiple criteria decision making (MCDM) and several other approaches to e-commerce related problems, such as Analytical Network Process (ANP), Analytical Hierarchy Process (AHP) and also Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) and VIKOR (Vlsekriterijumska Optimizacija I Kompromisno Resenje) are often used for multi-criteria evaluations. The Analytic Hierarchy Process (AHP) method, developed by Thomas L. Saaty in the 1970s, is widely used in Multiple Criteria Decision Making (MCDM) across various fields. It can be used in its pure form or in combination with other methods. AHP is commonly used to determine preferences or importance weights for criteria and alternatives in different research areas. Some advantages of this method include its ability to handle both qualitative and quantitative criteria, its structured decision-making process that allows for traceability, and the assurance of quality through consistency indices (Goceri M. , 2020). In digital marketing, the Analytical Network Process (ANP) is utilized to evaluate and prioritize marketing strategies by considering the complex interdependencies among various factors, including consumer behavior, platform effectiveness, and budget constraints. Unlike traditional hierarchical methods, ANP features a network structure that can model the dynamic interactions within digital ecosystems. This includes the feedback loop between consumer engagement and brand visibility across different platforms (WH Tsai, 2009).

The Characteristic Objects METHod (COMET) and the Stable Preference Ordering Towards Ideal Solution (SPOTIS) method are new ranking techniques that are free from rank reversal issues. In contrast, the Technique for Order of Preference by Similarity to the Ideal Solution (TOPSIS) and Vlse Kriterijumska Optimizacija I Kompromisno Resenje (VIKOR) are well-established methods that have been widely used for many years and were utilized as reference points in this study. The final rankings are influenced by the specific multi-criteria decision-making (MCDM) algorithm used, highlighting the importance of benchmarking in the exploration of multi-criteria problems. The findings suggest that the proposed approach could be a promising solution for consumer decision support systems (A Bączkiewicz, 2021).

1.2 Defining the Problem

This shift in advertising from traditional to data-driven online methods highlights the need for a more structured and optimized approach to social media advertising for online stores. To be more effective, digital marketing must now be supported by digital technology (Thanh, 2022). These technologies include; AI, Big data, Machine learning (ML), Augmented Reality (AR). The rapid advancement in artificial intelligence (AI) technologies offers potential solutions to these challenges. AI can analyze consumer data and behavior in real time, enabling more personalized and efficient advertising. Despite the availability of AI tools, many online shops struggle to decide which advertising strategies will result the best.

The increasing sophistication of products and devices in the market has led to a more complex decision-making process for consumers. It is essential to carefully consider various selection criteria, navigate trade-offs, and harmonize conflicting goals. Given the complexity of these decision-making situations, consumers require effective decision support methods and systems. The rapid advancement of product and device features in the market has led to a complex decision-making process for consumers. It's crucial to consider multiple criteria, make trade-offs, and resolve conflicting priorities. As consumers navigate through these complex decisions, they require

support from decision-making methods and systems (Aleksandra Bączkiewicz, 2021).

A key challenge lies in how businesses can systematically evaluate and choose the most effective advertising strategies among several alternatives. Existing studies often lack a structured framework that integrates AI-driven decision-making with online advertising strategies in a way that considers multiple criteria. This goal could be achieved by providing consumers with the ability to use the Decision Support System with advanced decision-making tools, including multi-criteria decision-making (MCDM). Multi-Criteria Decision-Making (MCDM) methods, such as the Analytic Hierarchy Process (AHP) and Analytic Network Process (ANP), TOPSIS, VIKOR, and DEMATEL offer a structured approach to addressing this issue by enabling businesses to compare various factors when selecting advertising strategies.

In this context, multi-criteria decision-making (MCDM) methods appear to be a valuable tool for assisting customers in choosing the right products and enhancing the appeal of e-commerce stores that offer them. Multi-criteria decision problems involve the decision-maker evaluating a range of alternatives by taking into account all decision factors or criteria relevant to the analysis. The primary challenge in decision-making lies in aggregating the relevant criteria (Bączkiewicz, 2021).

1.3 Research Objective

This study is focused on bridging the existing gap by creating a model that combines Multiple Criteria Decision Making (MCDM) technique Analytic Hierarchy Process (AHP) with Artificial Intelligence (AI).

The goal is to support online shopping in enhancing their social media advertising strategies. This study aims to develop an AI-driven multi-criteria decision-making framework that helps online retailers prioritize and optimize their social media advertising strategies. By utilizing AI to assess and rank key factors framework will assist decision-makers in allocating resources more effectively, ultimately leading to improved campaign performance. So it will establish a comprehensive framework for decision-makers to take into account various factors and make well-informed

decisions that result in more effective and efficient advertising outcomes. Ultimately, the findings of this research will offer valuable managerial insights for businesses.

1.4 Research Methodology

Our research methodology begins with a comprehensive literature review to identify the primary social media advertising channels and critical decision-making criteria relevant to optimizing online retail advertising. After compiling these factors, we engage marketing experts to review and validate the identified alternatives and criteria, ensuring relevance and accuracy. While using experts' opinion for pairwise comparisons, we also intend to leverage advanced AI tools such as Chat GPT and Gemini to conduct pairwise questioning based on the identified criteria.

By comparing the AI-generated results with the insights provided by the validated experts, we aim to establish a well-structured rating framework for the identified alternatives, prioritized according to the criteria. Finally, we will conduct a sensitivity analysis to evaluate how varying the criteria weights impacts the prioritization, providing valuable managerial insights for optimizing resource allocation and strategy effectiveness in social media advertising.

1.5 Conclusion

The organization of the remaining sections of the paper is as follows: Section 2 presents the review of literature on Multi-Criteria Decision-Making approaches and digital marketing. In Section 3, the methods utilized in this study are explained. Research framework is provided in Section 4 which includes the analysis of results and implications of the outcomes are also provided in this section. Finally, conclusion and directions of future research are mentioned in Section 5.

2. LITERATURE REVIEW

2.1 Online Shopping Advertising and Digital Marketing

The practice of promoting and advertising products and services over the internet, known as online marketing, has fundamentally reshaped the competitive landscape for businesses today. Sultan and Rohm (2004) highlight that the rise of the internet has caused a significant shift in how companies reach their audiences, making online marketing a critical component of a company's success or failure. This shift has resulted in online marketing becoming the primary channel for many companies. Unlike traditional marketing, online marketing amplifies consumer-to-consumer conversations through social media and other digital platforms, often beyond the direct control of marketing managers. This amplification, as Mangold and Faulds (2009) point out, presents both opportunities and challenges, as managers have limited control over how information is shared or perceived by consumers. However, while direct control over online discussions is limited, ignoring the positive influence that strategic online communication can have on consumer behavior, such as by increasing purchase intentions, would mean missing a valuable opportunity. Therefore, companies must adopt strategic online marketing approaches that help shape consumer interactions to align with their objectives, reinforcing the brand's desired messaging within consumer networks (Ecarma, 2021).

With the rise of technology and evolving customer expectations, e-commerce businesses, including online shops, are driven to adopt increasingly innovative and creative approaches. Online platforms have not only made product transactions easier but have also significantly enhanced the user experience, allowing customers to access a wealth of information such as interactive product details, videos, digital catalogs, discounts, and promotions. This convenience enables customers to make purchasing decisions from the comfort of their homes, thereby reducing barriers to purchasing. However, as many online shops offer similar types of products with varying prices and discounts, consumers can experience difficulty in selecting the most suitable product

from the appropriate online shop. Here, customers' satisfaction often depends on aspects beyond price alone—factors such as product quality, safe and quick delivery, and ease of transaction are critical determinants of consumer choice and satisfaction (Iswavigra D. U., 2020). In this context, offering a high price does not guarantee consumer satisfaction if other elements of the service fall short. Instead, a comprehensive approach that combines competitive pricing with quality service is essential for online shops to meet consumer expectations and differentiate themselves in a crowded market.

The digital transformation and rapid development of internet technologies have also profoundly influenced the fundamental nature of marketing. E-commerce enables both consumers and companies to buy or sell products online, offering access to quality products and services that save time and maximize profit potential. This shift reflects a broader trend as e-commerce gains popularity among consumers eager to conduct transactions online. The appeal of e-commerce lies in its ability to streamline the buying and selling process, making products and services more readily available to a broader audience. Consequently, the success of e-commerce businesses has attracted significant interest from researchers seeking to understand how these platforms inspire consumer engagement and drive purchasing behavior in the online marketplace. In this digital era, understanding the factors contributing to e-commerce success is essential, as it enables companies to refine their strategies and meet the demands of increasingly digital consumers (Li, 2020).

As mentioned by (Thanh, 2022); to be more effective, digital marketing must now be supported by digital technology. AI is a branch of computer science; an intelligence created by humans with the goal of helping computers to automate intelligent behaviors like humans. Artificial intelligence has been used in a variety of industries, including labor, health care, security, transportation, and marketing, as technology has advanced. The application of AI in marketing is connected to researching consumer behavior, collecting customer information, and answering customers about the company's offerings. The future of digital marketing will be shaped by artificial intelligence. The power of AI creates new opportunities for digital marketing in the near future. Lots of other productivity techniques, strategies, and levers will be made possible by artificial intelligence.

2.2 Multi-Criteria Decision-Making (MCDM) in Advertising

As the volume of information on the internet grows exponentially, consumers face increasing challenges in processing and efficiently using available data. In an era where customers' needs and habits are rapidly evolving, only a comprehensive understanding of these preferences can enable e-commerce platforms to offer products that align with users' expectations. E-commerce businesses leverage data from the internet to understand individual customer needs, enabling them to provide personalized products and services. This personalization, driven by automated features, not only increases income but also strengthens customer relationships. In contexts where multiple criteria must be weighed, such as choosing between competing products or services, balancing conflicting goals becomes essential. Multi-Criteria Decision Making (MCDM) methods offer a solution by helping customers navigate these complex decisions and enhancing the attractiveness of e-commerce stores. MCDM allows decision-makers to evaluate a set of alternatives based on multiple relevant factors, though the primary challenge lies in aggregating these diverse criteria into a cohesive decision-making framework (Bączkiewicz, 2021) (Thanh, 2022).

MCDM is broadly defined as the process by which the most suitable solution is selected from a set of alternatives based on multiple evaluation criteria. This approach is commonly addressed in operations research literature, where MCDM methods guide decision-makers in identifying the best option among various choices. Algorithms now play a fundamental role in MCDM models, bringing structured insights to decision-making processes that reflect certain aspects of human thought and preferences. Each MCDM problem involves two core parameters: alternatives and criteria, with the goal of ranking alternatives according to criteria weights (Aleksandra Bączkiewicz, 2021). The application of algorithms in MCDM has enhanced the effectiveness of decision-making in e-commerce, where customers often need support in selecting products that best meet their preferences.

Decision-making is a daily activity with significant implications, particularly in commercial contexts where optimal product selection is critical to user satisfaction. MCDM, by facilitating the evaluation of various alternatives under multiple criteria, aids in the identification of the most preferred options. However, each MCDM method

has its strengths and weaknesses, making it difficult to determine a universally "best" approach. Aktas and Demirel emphasize the complexity of selecting an appropriate MCDM method, suggesting that employing multiple methods can enhance result robustness. The combination of various MCDM approaches can compensate for individual method limitations, thereby providing decision-makers with more reliable insights when assessing product alternatives (You Rang Lim, 2021).

MCDM is broadly classified into two categories: Multi-Attribute Decision Making (MADM) and Multi-Objective Decision Making (MODM). In MADM, decision-makers evaluate and prioritize several alternatives based on identified criteria, while MODM focuses on optimizing multiple goals simultaneously (Ajripour, Applying MCDM Technique in analyzing the effect of promotion items based on online shopping factors, 2020). Because MADM techniques provide an organized means of prioritizing "promotion items" according to predetermined criteria, they are appropriate given the scope of this study. A number of popular MADM techniques offer structured frameworks for ranking options in intricate decision scenarios, including the Analytic Hierarchy Process (AHP), Analytic Network Process (ANP), ELimination Et Choix Traduisant la REalité (ELECTRE), Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), and Preference Ranking Organization METHod for Enrichment Evaluations (PROMETHEE) (4). Every approach offers distinct benefits for particular decision-making needs, enabling decision-makers to methodically assess goods and promotions in light of several factors..

2.3 Application of AHP/ANP

The AHP (Analytic Hierarchy Process) method is a multi-criteria analysis technique that uses an additive weighting approach, assigning relative importance to various attributes (Saaty, 1980). In AHP, the significance of each feature is determined through pairwise comparisons, where attributes or categories—such as drivers of intangible assets—are compared in pairs within a hierarchical framework.

The AHP (Analytic Hierarchy Process) method employs a scale to assess the importance of each criterion and uses a pairwise comparison matrix to rank their relative significance. By requiring only pairwise comparisons among alternatives, AHP simplifies the decision-making process. However, a drawback of AHP is its

vulnerability to rank reversal. Originating from the American school of thought, like TOPSIS and VIKOR, AHP is grounded in utility or value functions. These methods assess relationships between alternatives using indifference and preference but do not account for situations where options are incomparable (Aleksandra Bałczkiewicz, 2021).

Developed by Saaty in 1980, the Analytic Hierarchy Process (AHP) is one of the most effective and adaptable methods in Multi-Attribute Decision Making (MADM), well-suited to solving complex problems. Its structure, which resembles a hierarchical tree, divides a decision problem into various levels, including the objective, criteria, sub-criteria, and alternatives. This hierarchical organization allows AHP to integrate both objective and subjective assessments using pairwise comparisons. The process emphasizes the importance of intuitive judgments and the consistency of comparing alternatives, with decision-makers basing their evaluations on their knowledge and experience (Ajripour, Applying MCDM Technique in analyzing the effect of promotion items based on online shopping factors, 2020).

AHP enables decision-makers to compare alternatives based on given criteria, with sensitivity analysis possible at both the criteria and sub-criteria levels. It is particularly useful in decision-making scenarios with a limited set of choices, each containing multiple attributes. A similar method, the Analytic Network Process (ANP), also falls under MADM but allows for dependency among criteria, sub-criteria, or alternatives. ANP, essentially a broader application of AHP, provides a comprehensive framework for accurate decision-making, drawing on both experimental data and personal judgments to evaluate the relative importance of criteria and preferences across alternatives (Ajripour, Applying MCDM Technique in analyzing the effect of promotion items based on online shopping factors, 2020). For instance, ANP has been employed to assess the effectiveness of social media channels by comparing the mutual influences of reach, engagement, and conversion rates. This approach provides marketers with a strategic ranking of platforms, helping them optimize their advertising budgets.

2.4 Key Factors in Social Media Advertising for Online Shops

Social media advertising has emerged as a key tactic for online stores as it allows them to interact with a wide range of consumers and increase brand recognition globally. But using social media effectively necessitates carefully weighing a variety of variables that affect advertising results (Alalwan, 2023). This section examines the main elements—such as audience targeting, platform selection, content quality, and engagement metrics—that significantly affect the effectiveness of social media advertising for online retailers. By looking at these variables, this section seeks to provide a thorough summary of the main elements that internet companies should focus on in order to enhance their advertising tactics and get the results they want. We have presented our findings from the literature review to choose the relevant criteria in next section.

2.5 Conclusion

We identified the crucial significance that digital methods and tools play in online buying decision-making by examining studies in this area. In investigating several Multi-Criteria Decision-Making (MCDM) techniques, we looked at studies that applied these techniques to improve online marketing decision-making. The Analytic Hierarchy Process (AHP) is the approach that best fits our study goals out of all those that were considered. This study's decision-making methodology, the Analytic Hierarchy Process (AHP), was chosen due to its capacity to manage intricate decision-making issues with numerous criteria and options. AHP is particularly effective in situations where decision-making requires prioritizing competing factors based on their relative importance. This will be examined in detail in Section 3, Methodology.

3. METHODOLOGY

3.1 Research Design

The main focus of my study is to devise a multi-step advertising strategy via social media for e-commerce brands. It consists of a well-structured combination of literature review, expert input and AI driven analysis. The strategic procedure carried out is mentioned below:

1. Literature Review: To start our project, we conducted extensive background research. This required us to look at current research to establish what is an effective way to measure advertising on social media. We gained insights into the current state of knowledge through examining recent similar studies. The biggest contribution of this report to the literature is to establish the key criteria for measuring the success of advertising in this dynamic digital environment.

2. Expert Validation: After conducting the literature review, we consulted 6 marketing experts from a manufacturing factory in Iran, which their experience in this field ranges from 2 years to 6 years. Besides, we used insights from 2 professors in field of marketing management from Tabriz university of Iran to validate our preliminary list to ensure the criteria and alternatives. This process ensured that the criteria and alternatives we identified were both comprehensive and relevant.

3. Utilization of AI Tools: We leveraged ChatGPT and Gemini notably to eke out that our identified set of criteria is not merely comprehensive but also pertinently high-impact towards the study aims. Trial chatgpt and gemini for these very reasons Observe them for the same and get the references in creating these criteria The use of an already-defined set of items to consider can serve as a good starting point. It helps move things out of the realm of completely open-ended decision making.

“These AI aids were crucial for the validation of the criteria to determine whether anything was missing, or had been added that needed to be, refocusing attention and

work on the list itself. They also helped tremendously with sorting the criteria and organizing things as we proceeded, allowing us to engage them iteratively as well!” This process ensured a structured and logical framework, which was essential for the subsequent analysis and decision-making stages of our study.

4. Assessment and Sensitivity Analysis: Our main goal is to determine the best strategy in social media advertising. For this purpose, we prioritized the criteria and alternatives utilizing the analytic hierarchy process (AHP) proposed by (Saaty, 1980). A comparative questionnaire was prepared and submitted to the aforementioned marketing professionals and researchers.

For refining our outcomes, a sensitivity analysis was conducted on the evaluated alternatives' ratings. Based on the mechanism, one can assess the overall prioritization of advertising strategies based on the alterations in the criteria's relative importance value. These insights are quite helpful to the decision-making of administration regarding the stability and reliability of our framework.

3.2 Criteria and Sub Criteria Definition

The effectiveness of social media advertising strategies for online shops can be evaluated across multiple criteria. Based on our literature review and expert validation, we identified the following primary criteria: The criteria and sub-criteria are listed in Table 3.1 below. The criteria and sub-criteria were identified from the corresponding references, which they were extracted. Also, the criteria were categorized based on the extracted sub criteria. Each sub-criteria is further explained based on the mentioned references in the subsequent sections.

Table 3.1 : Criteria and sub criteria.

Main Criteria	Sub Criteria	References
1. User Experience & Interface	1.1 User Friendliness	(Abd Aziz, 2024)
	1.2 Convenience	(Ecarma, 2021)
	1.3 Design	(Li, 2020)
	1.4 Web Quality & Performance	(Ajripour, Applying MCDM Technique in analyzing the effect of promotion items based on online shopping factors, 2020) (Rani,

		2023) (Yilmaz Z. , 2022)
2. Trust & Security	2.1 Trustworthiness	(Abd Aziz, 2024)
	2.2 Reliability	(Ecarma, 2021)
	2.3 Credibility	(Ecarma, 2021)
	2.4 Security/Privacy	(Li, 2020)
		(Rani, 2023)
		(Ajripour, Applying MCDM Technique in analyzing the effect of promotion items based on online shopping factors, 2020)
	2.5 E-reputation	(Ecarma, 2021)
3. Customer Support & Responsiveness	3.1 Responsiveness	(Abd Aziz, 2024)
	3.2 Customer Support	(Goceri M. S., 2020) (Li, 2020)
	3.3 Chat Responses	(Iswavigra D. U., 2020)
		(Ajripour, Applying MCDM Technique in analyzing the effect of promotion items based on online shopping factors, 2020) (Rani, 2023)
	3.4 Incentives & Post-purchase Service	(Ecarma, 2021)
		(Goceri M. S., 2020) (Iswavigra D. U., 2020)
4. Product & Pricing	4.1 Price	(Iswavigra D. U., 2020)
	4.2 Discount	(Iswavigra D. U., 2020)
	4.3 Production Rating	(Iswavigra D. U., 2020)
	4.4 Product Variety	(Yilmaz Z. , 2022)
		(Thanh, 2022)
5. Marketing & Brand	5.1 Brand Image	(Goceri M. S., 2020)
	5.2 Advertising	(Goceri M. S., 2020) (Yilmaz Z. , 2022)
	5.3 Promotions	(Thanh, 2022)
	5.4 Market Layout Design	(Goceri M. S., 2020)
	5.5 Brand Awareness	(Bulut, 2023)
6. Digital Presence & Engagement	6.1 Use of Social Media	(Thanh, 2022)
	6.2 Digital Creativity	(Rani, 2023)
	6.3 Engagement	(Bulut, 2023)
	6.4 Sales	(Bulut, 2023)
7. Information & Accessibility	7.1 Information	(Li, 2020) (Rani, 2023)
		(Ajripour, Applying MCDM Technique in analyzing the effect of promotion items based on online shopping factors, 2020)
	7.2 E-service	(Thanh, 2022)
	7.3 Accessibility of Product	(Thanh, 2022)

Table 3.1 (continued): Criteria and sub criteria.

Main Criteria	Sub Criteria	References
9. Customer Satisfaction & Experience	8.2 Delivery and Guarantee	(Yilmaz Z. , 2022)
	9.1 Past Experience	(Yilmaz Z. , 2022)
	9.2 Customer Satisfaction	(Thanh, 2022)
	9.3 Family/Friend Effect	(Yilmaz Z. , 2022)

User Experience & Interface: This criteria looks at how effortless and enjoyable or effective the online shopping experience is. It touches on the design for the website, the ease of navigation and use.

4.1 User Friendliness: A feature of a computer system that makes it easier to use, expressed in single scalding terms.

4.2 Convenience: The extent to which systems are understandable for customer goals are met easily and bring back their checkpoints, including availability of features executed from the device.

4.3 Design: An interface developer should have a perfect amalgamation of engaging design with features to increase functionality of a website. This is where the design team handles to code the design ideas in HTML.

4.4 Web Quality & Performance: A through a website need to submit your site is fully dependent on to make an impression all that quality and enable us open it they frequently encounter.

Trust & Security: This category is recognizing a digital store which gains faithfulness of customer as factors such as the shop's trustworthiness, data security and the reliability of information that has delivered with that., the diverse models and rational

measures proposed above could be defied in favor of the content validity testing performed in the study.

- **Trustworthiness:** Is Users trust in the trustworthiness or credibility of the trust herein platform from honest and reliability to promise by owner.
- **Reliability:** consistent performance, reliable delivery of services.
- **Credibility:** Trust and the reputation/perceived authority in the field.
- **Security/Privacy:** reference security on user data and protection of transactions.
- **E-reputation:** his combines online reviews, ratings, and consumer feedback that has driven the purchasing decisions.

Customer Support & Responsiveness: This criterion evaluates how well the store manages customer inquiries and assistance, including the time taken to respond and both pre-purchase and post-purchase help to guarantee customer satisfaction.

- **Responsiveness:** Responsiveness means how quickly and effectively a company responds to user inquiries or issues.
- **Customer Support:** This evaluates how long a participant is in fact talking to a user or a bot.
- **Chat Responses:** Evaluates how responsive and helpful the chatbot or live human response.
- **Incentives & Post-purchase Service:** The range of incentives, benefits or other rewards provided after purchase, such as warranties, refunds, and loyalty programs post-purchase.

Product & Pricing: This category examination can help you determine the quality and diversity of online stores. It often involves measuring the cost of an item and how the maker will communicate with the consumer.

- **Price:** determined by the expense of production, competition, and customer perception of value (CPV).
- **Discount:** Several types of discounts can be classified as cash discounts or shortcuts.
- **Product Rating:** This represents the customer reviews and ratings to tell how products are rated.

- **Product Variety:** Highlights the range of products available, catering to diverse customer needs.

Marketing & Brand: This criterion examines the online store's branding, marketing, and spending strategies. Analysis of the website includes aspects that contribute to brand image, brand familiarity, and brand perception.

- **Brand Image:** It refers to how the brand is perceived by the market in general.
- **Advertising:** How effective are campaigns that were put in place to reach the customer base.
- **Promotions:** These can be combined special deals, discounts, or bundles to bring about a higher package transaction for the client.
- **Market Layout Design:** It is the first page of a Category for any website on which a user lands when they click through Search Engine Results, an online advertisement or an email message. Or Any distribution or business model within an industry that divides the market by specializing in a specific niche or segment. What are the key topics we cover?
- **Brand Awareness:** A marketing term that describes the degree of consumer awareness of a product.

Digital Presence & Engagement: This looks at the appearance of whether a digital store has a crosspost to a major social platform like the Facebook, Instagram Et cetera and whether it makes an online effort to engage with its customers online. It's the number of people who will see or be interested in what its customers might have to say about a company or brand.

- **Use of Social Media:** The participation and impact that the company has in pages of each network.
- **Digital Creativity:** Strategy and creativity in the digital space – digital media, digital marketing, social media strategy, such as content marketing strategy, paid organic promotion. From Facebook posts to a full-service

website, It's all about the clever ways that advertisers use digital technology and social media and brand fans to tell great stories.

- **Engagement:** Increases conversion rates, gain leads and nurture the relationships.
- **Sales:** Represents the ecommerce value based on ecommerce revenue.

Information & Accessibility: This criterion evaluates the quality and accessibility of information given about the products and services and is composed of the essential details, and understanding customers feel is available

- **Information:** Refers to the quality of product descriptions and details.
- **E-service:** Shows digital tools and services that enhance the shopping experience, such as live chat or virtual try-ons.
- **Accessibility of Product:** Indicates the easiness of locating and purchasing products.

Transaction & Payment: This category expands the store's payment and delivery options to ensure that consumers have seamless, secure ways to transact and obtain items as promised.

- **Payment Methods:** This boils down to the different types of payment the retailer can accept i.e., cash in store to bank transfer etc. and the security of such.
- **Delivery and Guarantee:** Includes the reliability of shipping and assurances like money-back guarantees or warranties.

Customer Satisfaction & Experience: This concept reflects the satisfaction levels that customers had from their shopping experience in the past, their recommendations to others, or the general impression of the shop.

- **Past Experience:** Refers to past issues related to the service and how it influences future conditions.
- **Customer Satisfaction:** Refers to the level of comfort customers feel on the platforms.

- **Family/Friend Effect:** family/friends has a large influence on the speculation these individuals are more likely to share information on your behalf than someone they have just met.

For each of these primary criteria, we structured a pairwise comparison framework using AHP to assign relative weights. These weights reflect the priority each criterion holds in evaluating the effectiveness of online shop advertising across social media platforms. This structured, multi-criteria approach enabled a balanced and comprehensive evaluation tailored to both short-term and long-term advertising goals.

3.3 Data Collection

In order to apply the AHP methods effectively, our study collected data from both secondary sources and expert input. This data collection phase included several steps to ensure a well-rounded and accurate assessment of social media advertising strategies for online shops. Secondary sources, such as journal articles and reports, were used to identify and refine the criteria and sub-criteria. Expert input was then gathered to validate these criteria and provide context-specific evaluations, ensuring a comprehensive assessment of social media advertising strategies for online shops.

1. Secondary Data Collection: Literature review: We reviewed academic literature to obtain baseline metrics and insights into social media advertising performance. This secondary data helped in identifying prevalent criteria and establishing realistic performance benchmarks for each social media platform.

2. Expert Surveys and Interviews:

1.3 Interviewing Experts: To validate and prioritize our identified criteria, we conducted structured interviews and surveys with 6 marketing experts from a manufacturing factory in Iran, which their experience in this field ranges from 2 years to 6 years. Besides, we used insights from 2 professors in field

of marketing management from Tabriz university of Iran to validate our preliminary list to ensure the criteria and alternatives.

2.3 Pairwise Comparisons through AI: Using advanced AI tools like ChatGPT, we automated the pairwise questioning process, asking AI models to generate responses based on insights from experts. This AI-supported approach provided additional validation by ensuring that the ratings were comprehensive and free from individual bias.

3. Development of the Rating Framework: We collected data from AI pairwise comparisons and expert surveys, and then utilized the findings to figure out the relative weights of each criteria and sub-criterion. This weighted methodology enabled direct comparison across multiple channels and offered an organized foundation for assessing social media advertising tactics.

This thorough approach to data collecting made sure that our AHP model was based on both expert qualitative insights and quantitative platform metrics. These data sources were combined to create a well-rounded basis for further research and decision-making.

3.4 AHP Process

We used the Analytic Hierarchy Process (AHP) techniques to assess and rank social media advertising campaigns. We were able to evaluate intricate, interconnected factors and provide a reliable foundation for decision-making thanks to this systematic methodology.

1. Hierarchy and Network Construction:

- **AHP Hierarchy:** In accordance with the AHP methodology, we arranged the criteria and sub-criteria in a hierarchical fashion. At the highest level, the major objective was to evaluate social media advertising tactics; this was followed by the levels of main criteria and sub-criteria.

2. Pairwise Comparisons: We conducted pairwise comparisons for each criterion and sub-criterion. In this step, marketing experts assessed the relative importance of each factor through comparisons, providing numerical values that express the preference of

one criterion over another. The AI tools (ChatGPT and Gemini) also supported this step by generating additional comparisons, ensuring robustness in the results.

3. Priority Vector Calculation: A final weighting for each criteria and sub-criterion was determined by the priority vectors that were produced by the AHP model. Because of this weighting, we were able to rank every social media advertising plan according to how well it scored overall across all categories.

4. Sensitivity Analysis: We performed a sensitivity study by varying the weights of important criteria and evaluating the effect on the total rankings in order to evaluate the robustness of the prioritizing. We performed the sensitivity analysis for both the expert and AI outcomes. In addition to highlighting the consistency of each alternative's ranking, this stage shed light on the relative significance of each criterion and offered recommendations for strategic decision-making.

3.5 Conclusion

In conclusion, our methodology developed a thorough framework for making decisions on social media advertising tactics for online retailers using MCDM and the Analytic Hierarchy Process (AHP). Through a review of the literature and expert validation, we first identified pertinent criteria and alternatives. Pairwise comparisons were then made easier with the use of AI tools and expert insights. The hierarchical structure of the criteria among them was handled by means of AHP. Finally, our sensitivity analysis allowed us to test our findings, offering valuable managerial insights for prioritizing effective social media advertising strategies. This framework lays the foundation for analyzing and ranking social media platforms based on the unique priorities and objectives of online shops. In the following chapter, we will present and analyze the results of our AHP model.

4. RESULTS

4.1 Building the AHP model

The main goal of this model is choosing the best advertising strategy. The criteria and sub criteria were mentioned in previous chapter. Also, we identified 6 alternatives: Data-Driven Advertising, Content-Centric Strategy, Optimized Campaigns, Influencer Partnerships, Gamified Advertising Campaigns, and Socially Responsible Advertising for this purpose. Here we have a figure of the proposed model which we will study in upcoming sections. The model is shown in Figure 4.1.

For the identified criteria we asked experts' insights and used AI tools for pairwise comparison. The result of the pairwise comparison matrix for main criteria is shown below:

Table 4.1 : pairwise comparison matrix based on experts' insights.

Criteria	C1	C2	C3	C4	C5	C6	C7	C8	C9
C1	1	0.14	2.97	5.13	4.93	6.92	4.96	0.34	5.01
C2	6.99	1	2.92	5.12	3.06	7.16	2.97	4.95	2.94
C3	0.34	0.34	1	3.01	3.03	4.98	3	0.33	1.01
C4	0.19	0.19	0.33	1	4.99	0.19	7.05	0.34	7.06
C5	0.20	0.33	0.33	0.20	1	5.05	4.89	2.97	0.33
C6	0.14	0.14	0.20	5.07	0.20	1	2.89	3.07	0.20
C7	0.20	0.34	0.33	0.14	0.20	0.35	1	0.33	0.34
C8	2.90	0.20	3.04	2.92	0.34	0.33	3.03	1	0.32
C9	0.20	0.34	0.99	0.14	3.06	5.11	2.98	3.09	1

Then we asked Chat gpt to generate a pairwise comparison based on the goal for given criteria. The results are shown as below:

Table 4.2 : pairwise comparison matrix based on ChatGPT.

Criteria	C1	C2	C3	C4	C5	C6	C7	C8	C9
C1	1	3	2	3	4	3	4	3	5
C2	1/3	1	1/2	3	2	3	3	4	5
C3	1/2	2	1	3	3	3	3	4	4
C4	1/3	1/3	1/3	1	3	4	2	3	4
C5	1/4	1/2	1/3	1/3	1	4	3	3	4
C6	1/3	1/3	1/3	1/4	1/4	1	2	2	3
C7	1/4	1/3	1/3	1/2	1/3	1/2	1	2	2
C8	1/3	1/4	1/4	1/3	1/3	1/2	1/2	1	2
C9	1/5	1/5	1/4	1/4	1/4	1/3	1/2	1/2	1

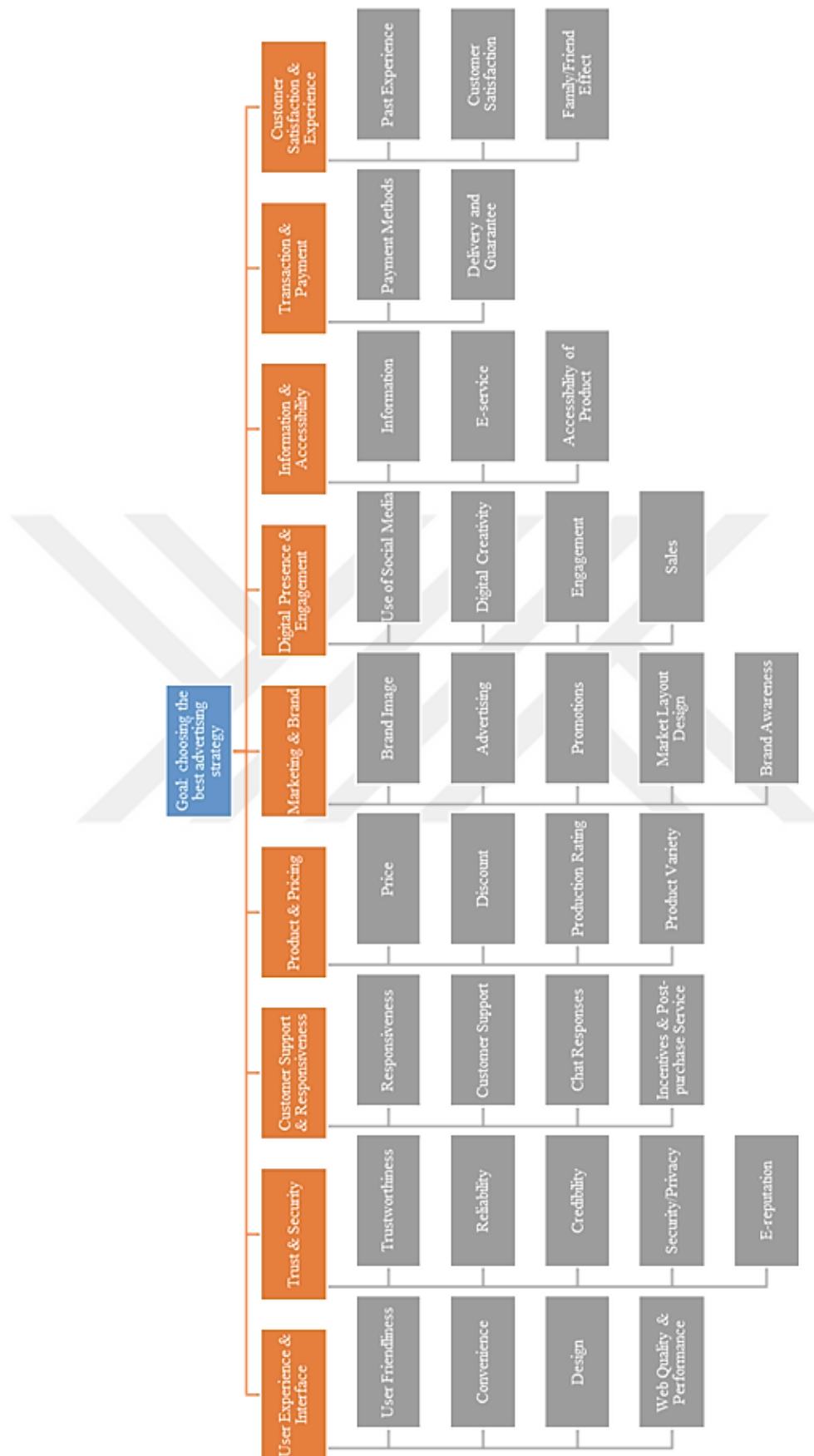


Figure 4.1 : AHP model.

After that, we also asked the other AI tool; Gemini to generate this matrix of pairwise comparison for the criteria based on the mentioned goal and its knowledge. The results are shown below:

Table 4.3 : pairwise comparison matrix based on Gemini

Criteria	C1	C2	C3	C4	C5	C6	C7	C8	C9
C1	1	1/2	1/3	1/4	1/3	1/2	1/3	1/4	1/3
C2	2	1	1/2	1/3	1/2	1/2	1/2	1/3	1/2
C3	3	2	1	1/2	1/2	1/2	1/2	1/3	1/2
C4	4	3	2	1	1/2	1/2	1/2	1/2	1/2
C5	3	2	2	2	1	1	1	1/2	1
C6	2	2	2	2	1	1	1	1/2	1
C7	3	2	2	2	1	1	1	1/2	1
C8	4	3	3	2	2	2	2	1	1
C9	3	2	2	2	1	1	1	1	1

Now, to have a matrix of pairwise comparison by AI tools, we aggregated the results from AI tools (chat gpt and Gemini) by calculating geometric means. The final matrix is provided below:

$$\begin{bmatrix}
 1 & 1.2247 & 0.8165 & 0.8660 & 1.1547 & 1.2247 & 1.1547 & 0.8660 & 1.2910 \\
 0.8165 & 1 & 0.5 & 1 & 1 & 1.2247 & 1.2247 & 1.1547 & 1.5811 \\
 1.2247 & 2 & 1 & 1.2247 & 1.2247 & 1.2247 & 1.2247 & 1.1547 & 1.4142 \\
 1.1547 & 1 & 0.8165 & 1 & 1.2247 & 1.4142 & 1 & 1.2247 & 1.4142 \\
 0.8660 & 1 & 0.8165 & 0.8165 & 1 & 2 & 1.7321 & 1.2247 & 2 \\
 0.8165 & 0.8165 & 0.8165 & 0.7071 & 0.5 & 1 & 1.4142 & 1 & 1.7321 \\
 0.8660 & 0.8165 & 0.8165 & 1 & 0.5774 & 0.7071 & 1 & 1 & 1.4142 \\
 1.1547 & 0.8660 & 0.8660 & 0.8165 & 0.8165 & 1 & 1 & 1 & 1.4142 \\
 0.7746 & 0.6325 & 0.7071 & 0.7071 & 0.5 & 0.5774 & 0.7071 & 0.7071 & 1
 \end{bmatrix}$$

Based on the resulted matrices, we calculated the weights for each criteria to evaluate their priority. And the priority for the criteria based on the matrix of experts are shown in Figure 4.2:

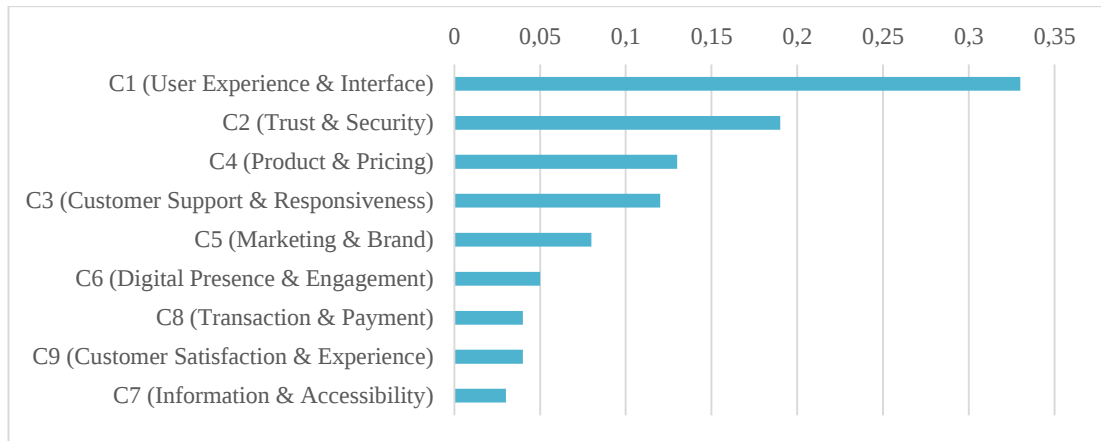


Figure 4.2 : Priority of criteria by experts.

These priorities indicate that User Experience & Interface (C1) is the most important criterion, followed by Trust & Security (C2), while Information & Accessibility (C7) has the lowest priority.

For the AI results we have the calculated priorities in Figure 4.3:

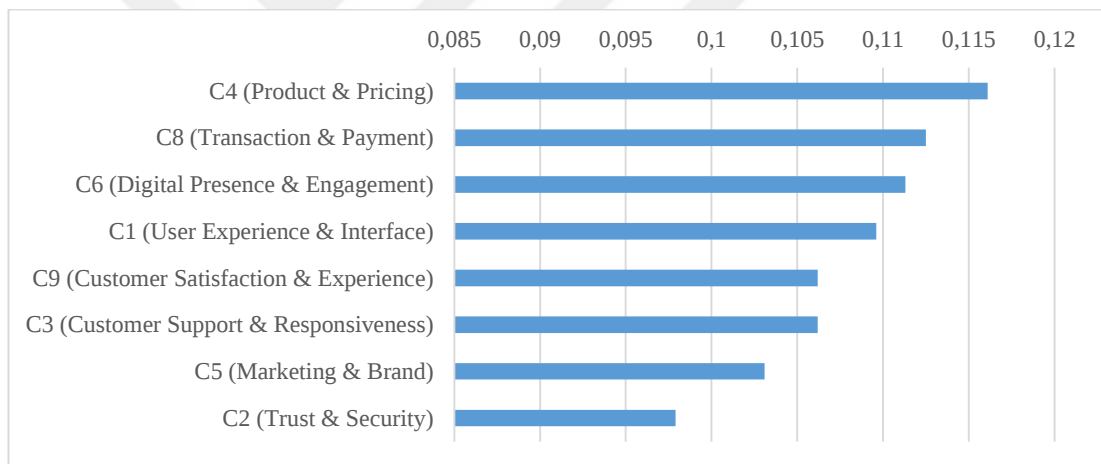


Figure 4.3 : Priority of criteria by AI.

According to this results, It shows the priorities in a whole different way. In this version by AI, The most important criterion is C4 (Product & Pricing), followed by C8 (Transaction & Payment). While C2 (Trust & Security) was one of the top in experts priorities here it is the lowest.

To better compare the results, we have them both in a single chat in Figure 4.4.

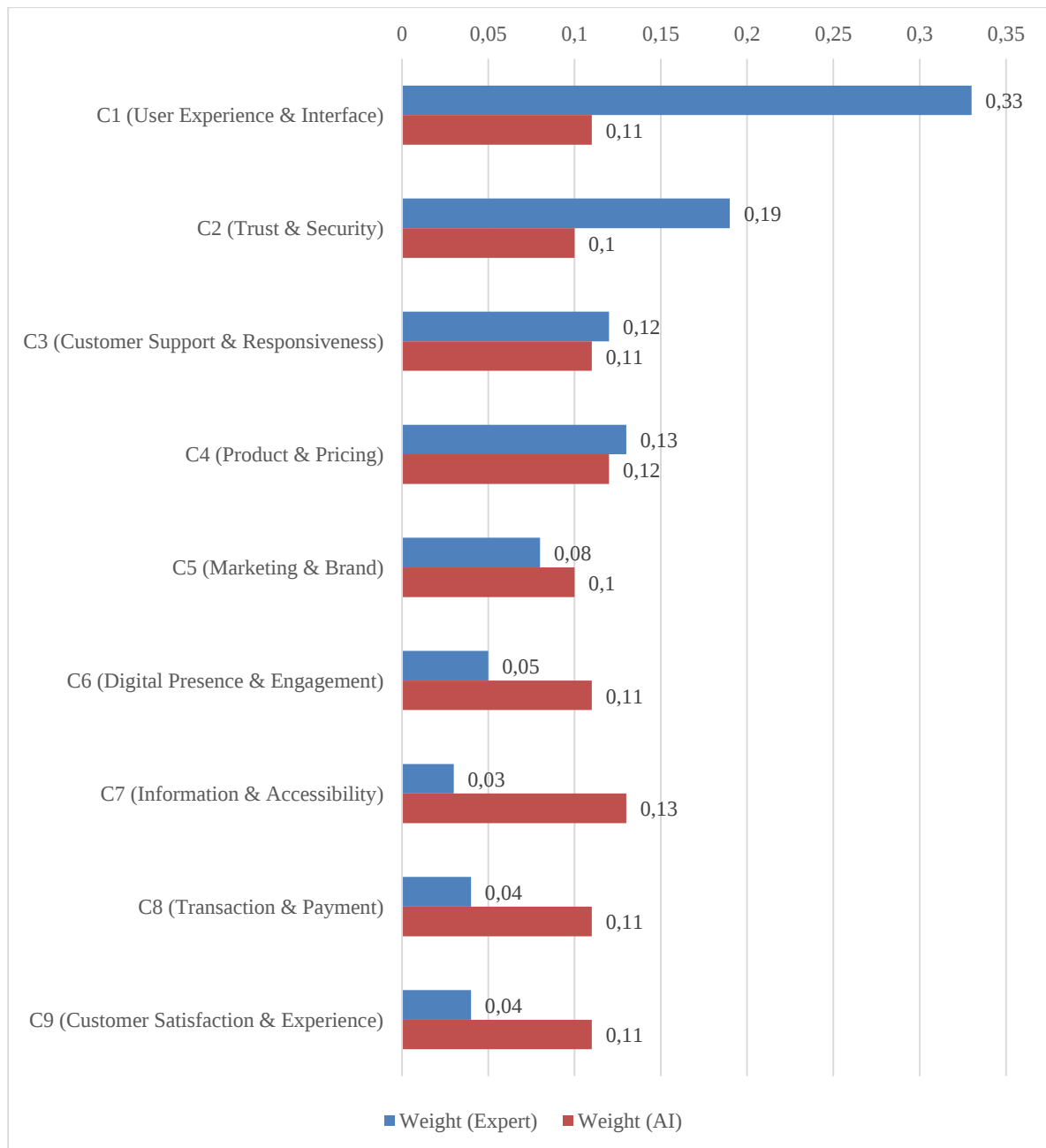


Figure 4.4 : comparing weights of AI and Experts.

4.2 Prioritization of Sub-Criteria

After prioritizing the main criteria, the next step is to conduct pairwise comparison for within each main criteria for their sub-criteria to know the priority among them. So, here you'll see the matrices and the results as shown in graphs indicating the most important sub-criteria for each criteria. For each criteria, we will see the both results from experts and from AI tools.

Table 4.4 : pairwise comparison matrix for sub-criteria of C1 based on experts.

Sub-criteria	User Friendliness	Convenience	Design	Web Quality & Performance
User Friendliness	1	2.98	5.00	6.99
Convenience	0.36	1	3.01	4.96
Design	0.20	0.33	1	3.06
Web Quality & Performance	0.14	0.20	0.33	1

C1 - User Experience & Interface (experts)

After calculating the priorities for this criteria, the results are shown below in Figure 4.5.

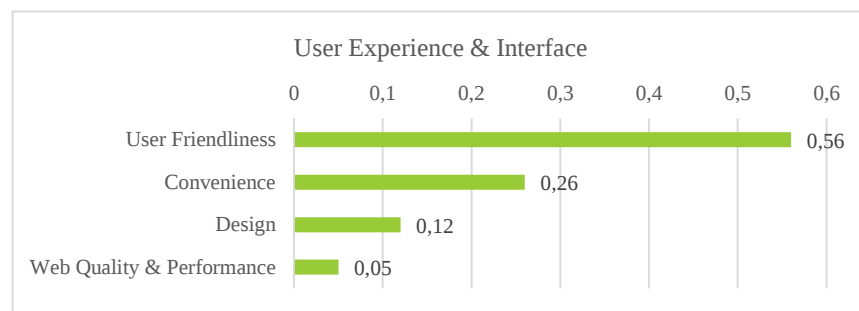


Figure 4.5 : Priorities for sub-criteria of C1 based on experts.

Table 4.5 : pairwise comparison matrix for sub-criteria of C1 based on AI

Sub Criteria	User Friendliness	Convenience	Design	Web Quality & Performance
User Friendliness	1	3	1	2
Convenience	1/3	1	1/2	1/3
Design	1	2	1	1
Web Quality & Performance	1/2	3	1	1

C1 - User Experience & Interface (AI)

After calculating the priorities for this criteria, the results are shown below in Figure 4.6.

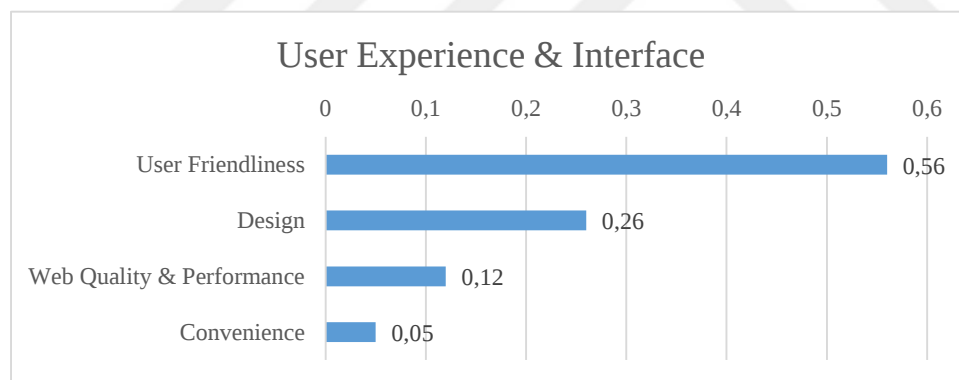


Figure 4.6 : Priorities for sub-criteria of C1 based on AI.

Table 4.6 : pairwise comparison matrix for sub-criteria of C2 based on experts.

Sub-criteria	Trustworthiness	Reliability	Credibility	Security/Privacy	E-reputation
Trustworthiness	1	1.98	3.00	3.97	3.01
Reliability	0.51	1	2.01	2.96	1.99
Credibility	0.33	0.50	1	2.06	2.00
Security/Privacy	0.25	0.34	0.49	1	1.51
E-reputation	0.33	0.50	0.50	0.66	1

C2 - Trust & Security (experts)

After calculating the priorities for this criteria, the results are shown below in Figure 4.7.

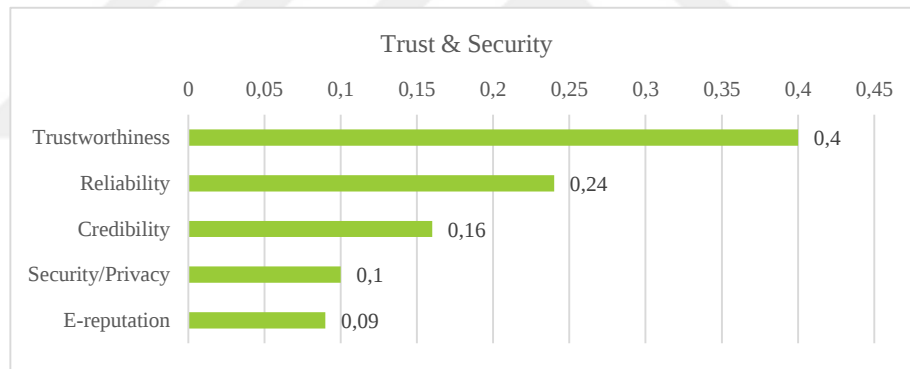


Figure 4.7 : Priorities for sub-criteria of C2 based on experts.

Table 4.7 : pairwise comparison matrix for sub-criteria of C2 based on AI.

Sub Criteria	Trustworthiness	Reliability	Credibility	Security/Privacy	E-reputation
Trustworthiness	1	3	1	2	2
Reliability	1/3	1	1/2	1/3	1/2
Credibility	1	2	1	1	1
Security/Privacy	1/2	3	1	1	1/2
E-reputation	1/2	2	1	2	1

C2 - Trust & Security (AI)

After calculating the priorities for this criteria, the results are shown below in Figure 4.8.

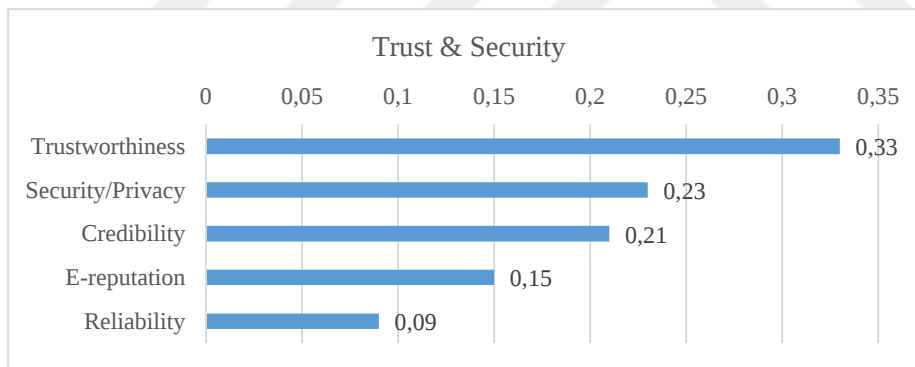


Figure 4.8 : Priorities for sub-criteria of C2 based on AI.

Table 4.8 : pairwise comparison matrix for sub-criteria of C3 based on experts.

Sub-criteria	Responsiveness	Customer Support	Chat Responses	Incentives & Post-purchase Service
Responsiveness	1	2.98	4.96	6.99
Customer Support	0.36	1	3.01	5.02
Chat Responses	0.20	0.33	1	3.06
Incentives & Post-purchase Service	0.14	0.20	0.33	1

C3 - Customer Support & Responsiveness (experts)

After calculating the priorities for this criteria, the results are shown below in Figure 4.9.

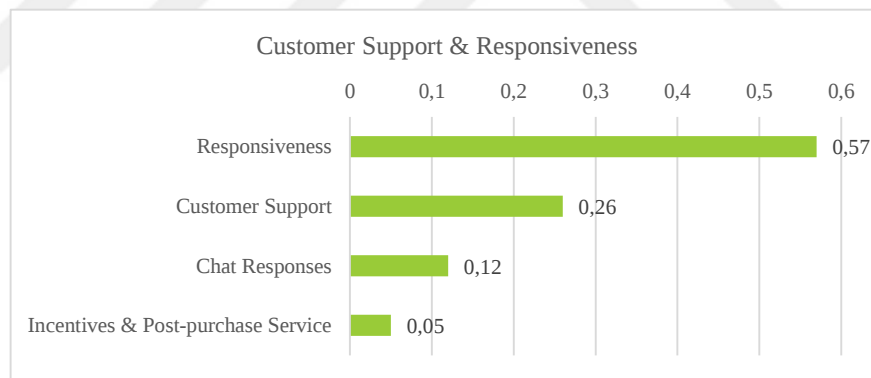


Figure 4.9 : Priorities for sub-criteria of C3 based on experts.

Table 4.9 : pairwise comparison matrix for sub-criteria of C3 based on AI.

Sub Criteria	Responsiveness	Customer Support	Chat Responses	Incentives & Post-purchase Service
Responsiveness	1	3	2	1
Customer Support	1/3	1	1/2	1/3
Chat Responses	1/2	2	1	1/2
Incentives & Post-purchase Service	1	3	2	1

C3 - Customer Support & Responsiveness (AI)

After calculating the priorities for this criteria, the results are shown below in Figure 4.10.

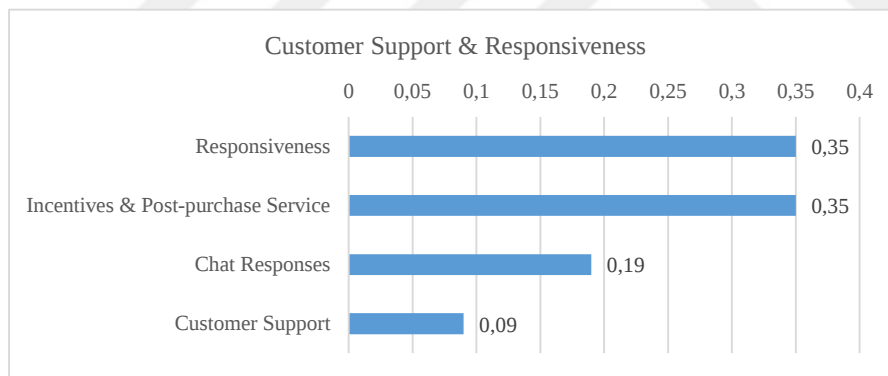


Figure 4.10 : Priorities for sub-criteria of C3 based on AI.

Table 4.10 : pairwise comparison matrix for sub-criteria C4 based on experts.

Sub-criteria	Price	Discount	Production Rating	Product Variety
Price	1	2.98	3.00	4.99
Discount	0.34	1	0.20	0.33
Production Rating	0.33	5.01	1	5.06
Product Variety	0.20	0.33	0.20	1

C4 - Product & Pricing (experts)

After calculating the priorities for this criteria, the results are shown below in Figure 4.11.

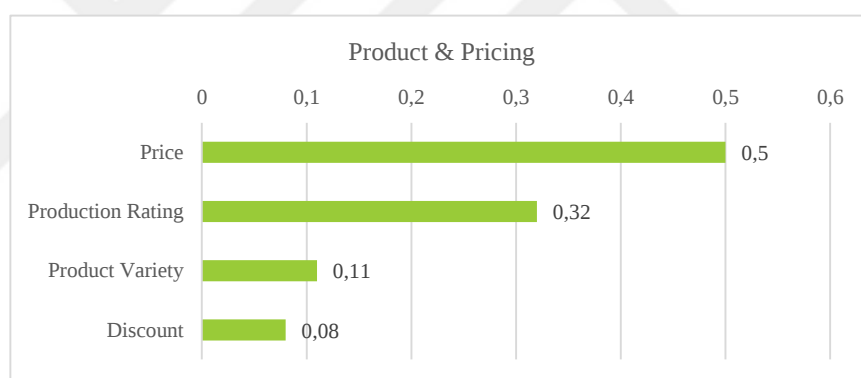


Figure 4.11 : Priorities for sub-criteria of C4 based on experts.

Table 4.11 : pairwise comparison matrix for sub-criteria C4 based on AI.

Sub Criteria	Price	Discount	Production Rating	Product Variety
Price	1	1/2	1/3	1/4
Discount	2	1	1/2	1/3
Production Rating	3	2	1	1/2
Product Variety	4	3	2	1

C4 - Product & Pricing (AI)

After calculating the priorities for this criteria, the results are shown below in Figure 4.12.



Figure 4.12 : Priorities for sub-criteria of C4 based on AI.

Table 4.12 : pairwise comparison matrix for sub-criteria C5 based on experts.

Sub-criteria	Brand Image	Advertising	Promotions	Market Layout Design	Brand Awareness
Brand Image	1	2.98	3.00	0.25	3.02
Advertising	0.34	1	0.50	0.25	5.01
Promotions	0.33	2.00	1	0.20	5.99
Market Layout Design	3.96	4.01	4.98	1	4.96
Brand Awareness	0.33	0.19	0.17	0.20	1

C5 - Marketing & Brand (experts)

After calculating the priorities for this criteria, the results are shown below in Figure 4.13.

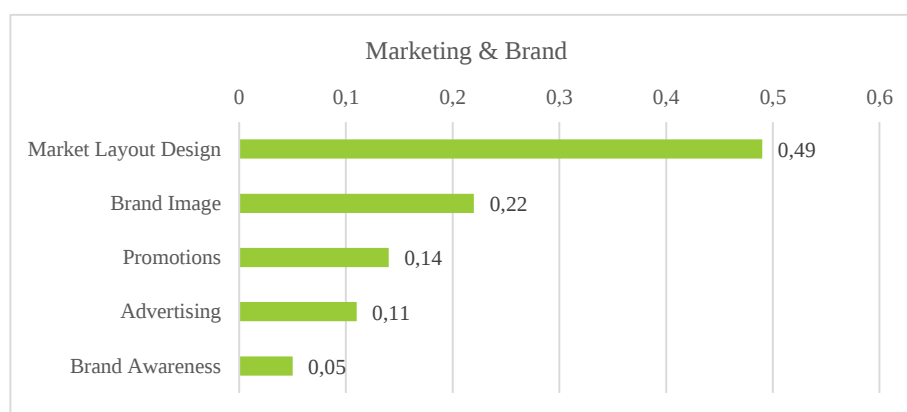


Figure 4.13 : Priorities for sub-criteria of C5 based on experts.

Table 4.13 : pairwise comparison matrix for sub-criteria of C5 based on AI.

Sub Criteria	Brand Image	Advertising	Promotions	Market Layout Design	Brand Awareness
Brand Image	1	1/2	1/3	1/4	1/2
Advertising	2	1	1/2	1/3	1
Promotions	3	2	1	1/2	2
Market Layout Design	4	3	2	1	3
Brand Awareness	2	1	1/2	1/3	1

C5 - Marketing & Brand (AI)

After calculating the priorities for this criteria, the results are shown below in Figure 4.14.

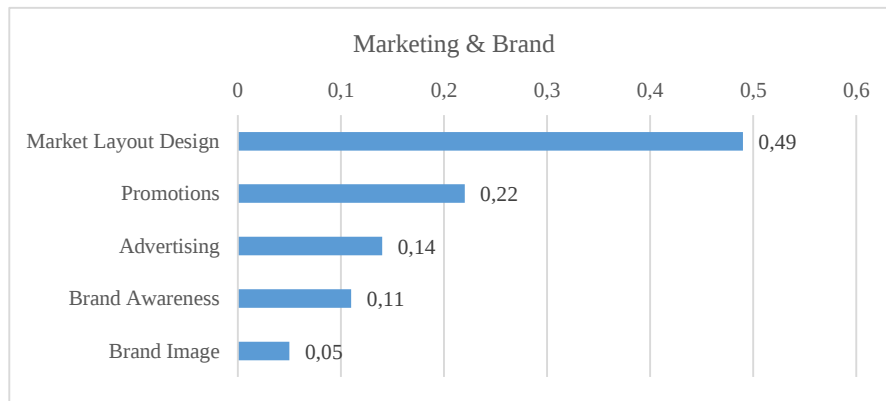


Figure 4.14 : Priorities for sub-criteria of C5 based on AI.

Table 4.14 : Pairwise comparison matrix for sub-criteria of C6 based on experts.

Sub-criteria	Use of Social Media	Digital Creativity	Engagement	Sales
Use of Social Media	1	0.20	0.34	5.04
Digital Creativity	5.00	1	2.03	4.96
Engagement	2.95	0.49	1	0.51
Sales	0.20	0.20	1.96	1

C6 - Digital Presence & Engagement (experts)

After calculating the priorities for this criteria, the results are shown below in Figure 4.15.

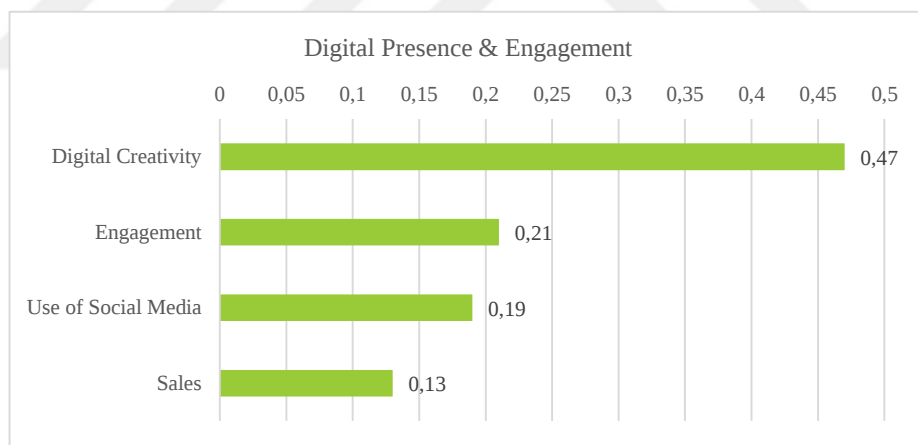


Figure 4.15 : Priorities for sub-criteria of C6 based on experts.

Table 4.15 : Pairwise comparison matrix for sub-criteria of C6 based on AI.

Sub Criteria	Use of Social Media	Digital Creativity	Engagement	Sales
Use of Social Media	1	1/2	1/3	1/4
Digital Creativity	2	1	1/2	1/3
Engagement	3	2	1	1/2
Sales	4	3	2	1

C6 - Digital Presence & Engagement (AI)

After calculating the priorities for this criteria, the results are shown below in Figure 4.16.

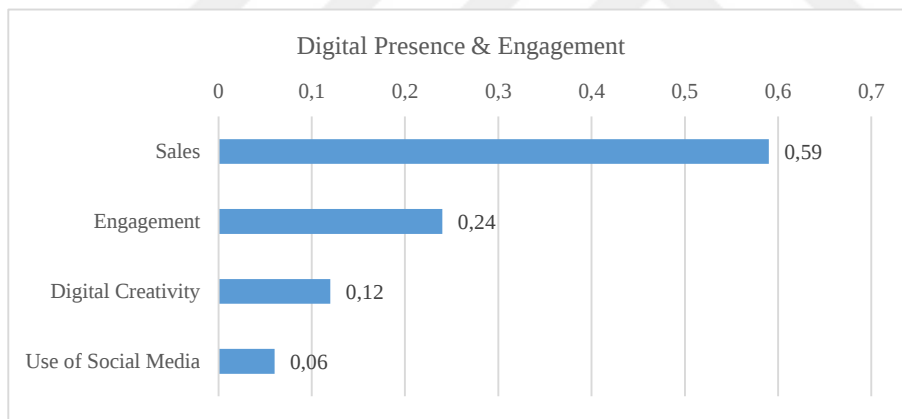


Figure 4.16 : Priorities for sub-criteria of C6 based on AI.

Table 4.16 : Pairwise comparison matrix for sub-criteria of C7 based on experts.

Sub-criteria	Information	E-service	Accessibility of Product
Information	1	2.98	0.20
E-service	0.34	1	0.33
Accessibility of Product	5.00	3.01	1

C7 - Information & Accessibility (experts)

After calculating the priorities for this criteria, the results are shown below in Figure 4.17.

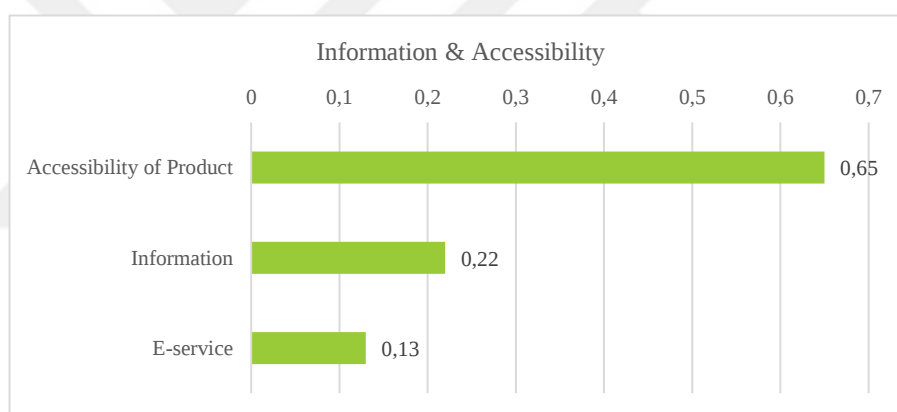


Figure 4.17 : Priorities for sub-criteria of C7 based on experts.

Table 4.17 : Pairwise comparison matrix for sub-criteria of C7 based on AI.

Sub Criteria	Information	E-service	Accessibility of Product
Information	1	1/2	1/3
E-service	2	1	1/2
Accessibility of Product	3	2	1

C7 - Information & Accessibility (AI)

After calculating the priorities for this criteria, the results are shown below in Figure 4.18.

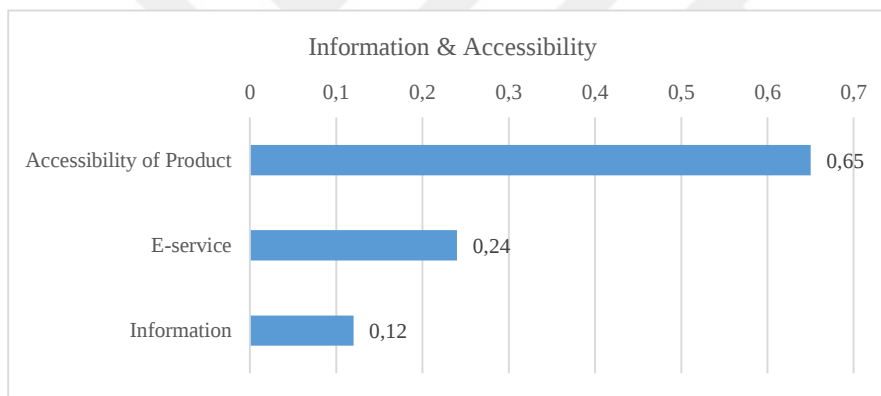


Figure 4.18 : Priorities for sub-criteria of C7 based on AI.

Table 4.18 : Pairwise comparison matrix for sub-criteria of C8 based on experts.

Sub-criteria	Payment Methods	Delivery and Guarantee
Payment Methods	1	2.98
Delivery and Guarantee	0.34	1

C8 - Transaction & Payment (experts)

After calculating the priorities for this criteria, the results are shown below in Figure 4.19.

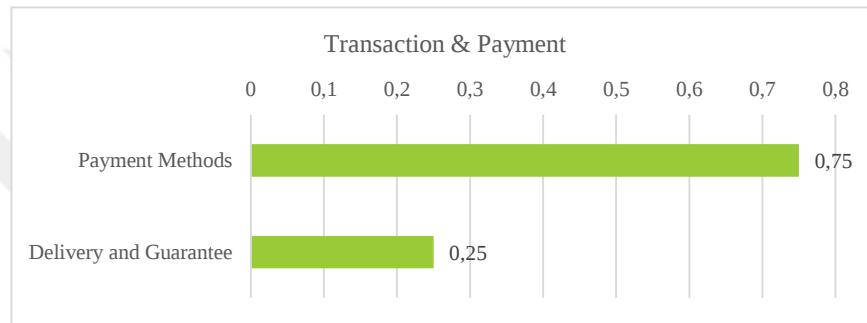


Figure 4.19 : Priorities for sub-criteria of C8 based on experts.

Table 4.19 : Pairwise comparison matrix for sub-criteria of C8 based on AI.

Sub-criteria	Payment Methods	Delivery and Guarantee
Payment Methods	1	1/2
Delivery and Guarantee	2	1

C8 - Transaction & Payment (AI)

After calculating the priorities for this criteria, the results are shown below in Figure 4.20.

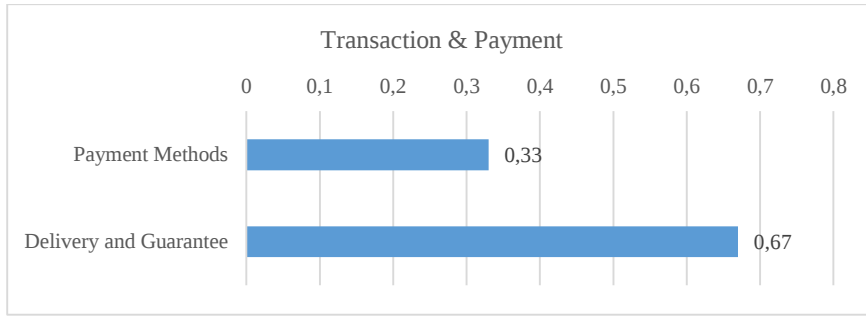


Figure 4.20 : Priorities for sub-criteria of C8 based on AI.

Table 4.20 : Pairwise comparison matrix for sub-criteria of C9 based on experts.

Sub-criteria	Past Experience	Customer Satisfaction	Family/Friend Effect
Past Experience	1	0.34	5.00
Customer Satisfaction	2.96	1	3.01
Family/Friend Effect	0.20	0.33	1

Customer Satisfaction & Experience (experts)

After calculating the priorities for this criteria, the results are shown below in Figure 4.21.



Figure 4.21 : Priorities for sub-criteria of C9 based on experts.

Table 4.21 : Pairwise comparison matrix for sub-criteria of C9 based on AI.

Sub Criteria	Past Experience	Customer Satisfaction	Family/Friend Effect
Past Experience	1	1/2	1/3
Customer Satisfaction	2	1	1/2
Family/Friend Effect	3	2	1

C9 - Customer Satisfaction & Experience (AI)

After calculating the priorities for this criteria, the results are shown below in Figure 4.22.



Figure 4.22 : Priorities for sub-criteria of C9 based on AI.

4.3 Evaluation of Alternatives

Based on the computed priorities for the sub-criteria, we proceeded to evaluate the six identified alternatives: Data-Driven Advertising, Content-Centric Strategy, Optimized

Campaigns, Influencer Partnerships, Gamified Advertising Campaigns, and Socially Responsible Advertising.

Data-Driven Advertising: This strategy focuses on leveraging data analytics to target specific audiences effectively. By analyzing user behavior, preferences, and demographics, it enables businesses to create personalized campaigns that maximize engagement and conversion rates.

Content-Centric Strategy: A content-focused approach emphasizes the creation and dissemination of high-quality, engaging, and relevant content. This strategy aims to build trust, enhance brand awareness, and foster customer loyalty through storytelling and valuable information.

Optimized Campaigns: This option focuses on simplifying and fine-tuning advertising efforts through constant testing and analysis. Adjusting campaign aspects, such as scheduling, budget allocation, and ad formats, maximizes available resources for optimal results.

Influencer Partnerships: Collaborating with influencers helps organizations reach established audiences and utilize the reputation of trusted figures. This technique improves brand awareness and engagement by partnering with influencers whose opinions and content coincide with the target market.

Gamified Advertising Campaigns: Gamified advertising combines game mechanics with marketing methods to enhance client engagement and provide an engaging experience. Encouraging engagement through challenges, prizes, and progress monitoring builds a stronger relationship with the brand. This technique rewards clients for engaging with information through online contests, quizzes, virtual competitions, or interactive marketing, leading to increased brand loyalty and memory.

Socially Responsible Advertising: Socially responsible advertising focuses on promoting the brand's commitment to social, environmental, and ethical causes. This strategy seeks to connect with consumers who value corporate responsibility and

sustainability. Ads may highlight eco-friendly practices, fair trade products, or charitable initiatives, positioning the brand as a socially conscious entity. By aligning the brand with meaningful causes, this approach builds trust, strengthens brand image, and resonates deeply with ethically-minded consumers.

Each alternative represents a distinct approach to social media advertising, with its own strengths and areas of focus. To ensure a comprehensive evaluation, we utilized pairwise comparison matrices to systematically assess these alternatives against the sub-criteria. Although ratings are a possible method for prioritization, this study employs pairwise comparisons to systematically assess alternatives against sub-criteria, ensuring consistency to the AHP methodology. This approach allowed us to rank the alternatives based on their alignment with the decision-making framework, ultimately supporting the selection of the most effective advertising strategy.

The final results for this model is shown in Figure 4.23.

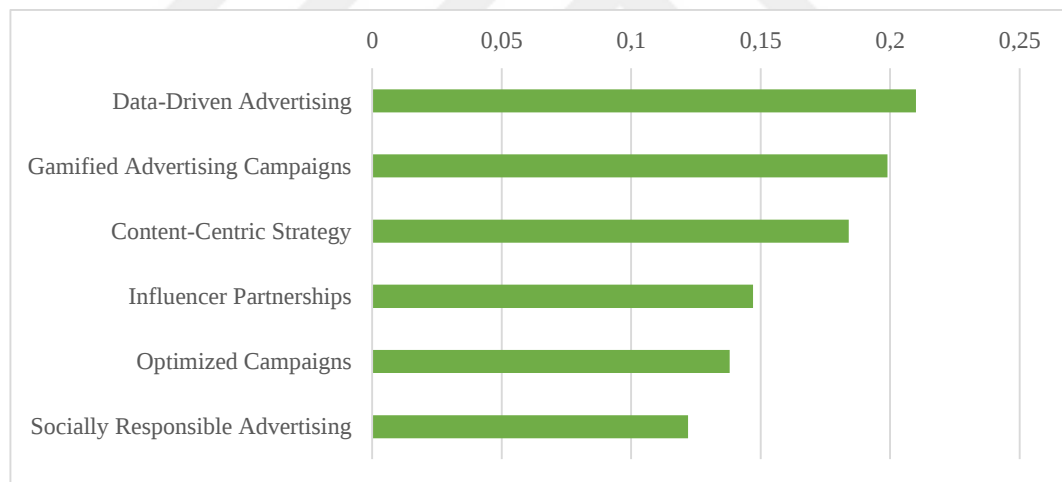


Figure 4.23 : Results from experts for AHP model for best strategy.

This figure illustrates that the most effective advertising strategy for online shopping is "Data-Driven Advertising."

After using AI, we got results in Figure 4.24 showing something similar to what experts have gotten.

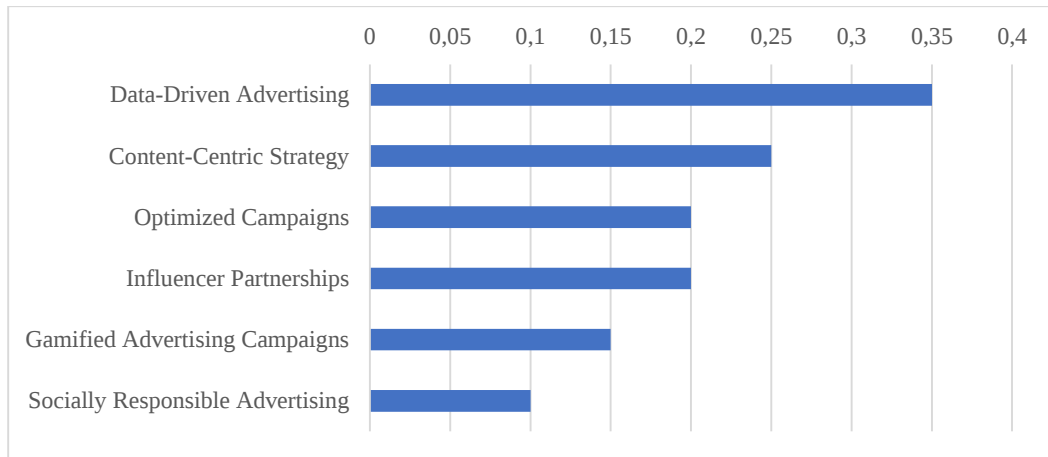


Figure 4.24 : Results from AI for AHP model for best strategy.

Even though the weights are a bit different, but the priority is the same for both AI and experts.

For better comparison, we added the results from both views to a single chart. It is shown in Figure 4.25.

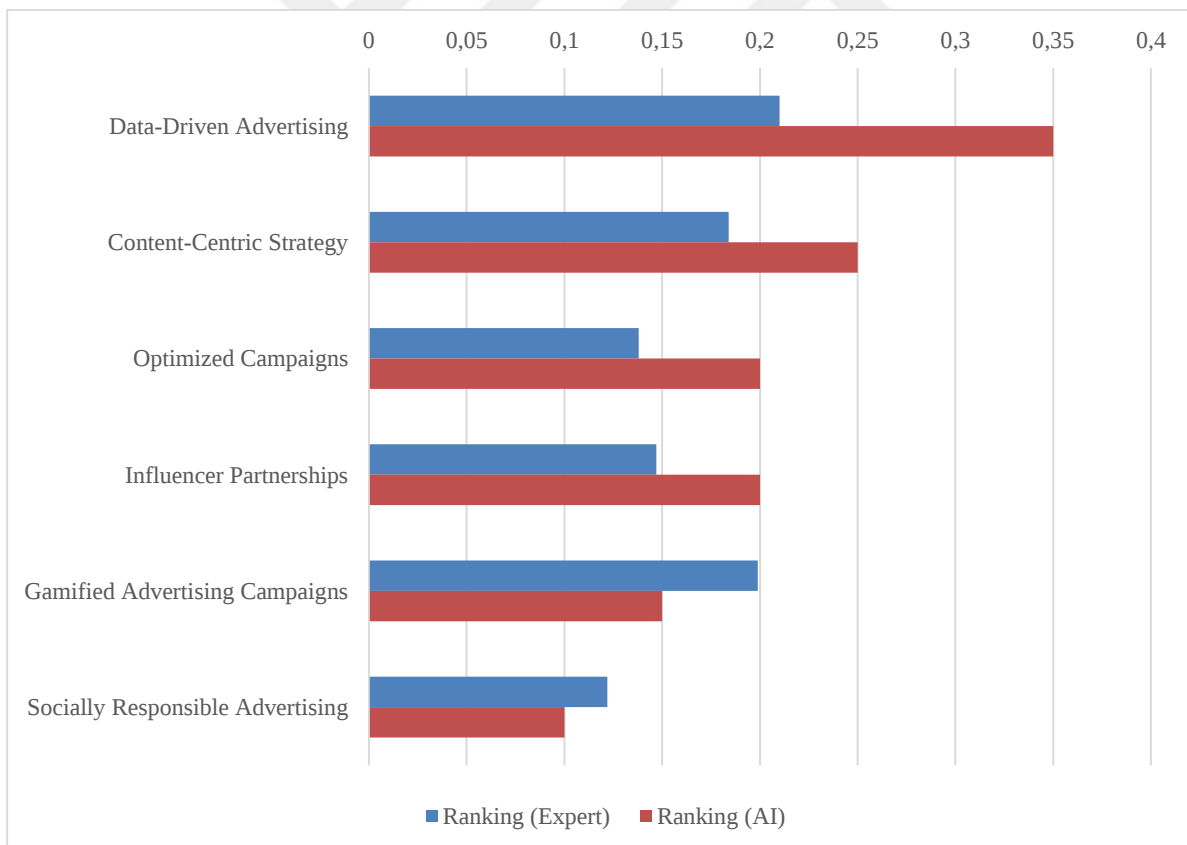


Figure 4.25 : Comparing results for ranking alternatives from both AI and Experts.

Compatibility of Priorities

To evaluate the compatibility between expert judgments and AI estimations for alternatives, a Saaty Compatibility Index (SCI) was calculated. The resulting SCI value of 1.04 indicates a reasonable alignment between priority vectors.

Table 4.22 : SCI calculation- Alternatives

SCI Calculation – Alternatives

Alternatives	Ranking (Expert)	Ranking (AI)
Data-Driven Advertising	0.21	0.35
Content-Centric Strategy	0.184	0.25
Optimized Campaigns	0.138	0.2
Influencer Partnerships	0.147	0.2
Gamified Advertising Campaigns	0.199	0.15
Socially Responsible Advertising	0.122	0.1

Pairwise comparison matrix - Alternatives

	A1	A2	A3	A4	A5	A6
A1	1.0000	0.8762	0.6571	0.7000	0.9476	0.5810
A2	1.1413	1.0000	0.7500	0.7989	1.0815	0.6630
A3	1.5217	1.3333	1.0000	1.0652	1.4420	0.8841
A4	1.4286	1.2517	0.9388	1.0000	1.3537	0.8299
A5	1.0553	0.9246	0.6935	0.7387	1.0000	0.6131
A6	1.7213	1.5082	1.1311	1.2049	1.6311	1.0000

Transpose of comparison matrix - Alternatives

	E1	E2	E3	E4	E5	E6
E1	1.0000	1.4000	1.7500	1.7500	2.3333	3.5000
E2	0.7143	1.0000	1.2500	1.2500	1.6667	2.5000
E3	0.5714	0.8000	1.0000	1.0000	1.3333	2.0000
E4	0.5714	0.8000	1.0000	1.0000	1.3333	2.0000
E5	0.4286	0.6000	0.7500	0.7500	1.0000	1.5000
E6	0.2857	0.4000	0.5000	0.5000	0.6667	1.0000

Hadamard multiplication – Alternatives

	H1	H2	H3	H4	H5	H6
H1	1.0000	1.2267	1.1499	1.2250	2.2111	2.0335
H2	0.8152	1.0000	0.9375	0.9986	1.8025	1.6576
H3	0.8696	1.0667	1.0000	1.0652	1.9227	1.7681
H4	0.8163	1.0014	0.9388	1.0000	1.8049	1.6599
H5	0.4524	0.5548	0.5201	0.5540	1.0000	0.9196
H6	0.4918	0.6033	0.5656	0.6025	1.0874	1.0000

SCI $\approx$ 1.04

This indicates very high consistency between actual and expected values.

4.4 Sensitivity Analysis

Sensitivity analysis was conducted to examine the effects of the changes in the importance of criteria on the results from both expert opinions and AI-generated data. This process involved systematically altering the weights of the top 5 sub-criteria from 0% and to 100% to observe how these changes affected the other criteria. The comparison between expert-driven results and AI-generated outcomes was done in Excel and the graphs below will show the results. This provided insights into the consistency and reliability of the decision-making framework, ensuring a comprehensive evaluation of the proposed strategies.

First, we dive into the results from experts data. The global scores matrix for sub criteria and alternatives is shown below:

Table 4.23 : Global Scores based on experts.

<i>weight</i>	<i>sub criteria</i>	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>F</i>
0.1848	C11	0.4	0.47	0.39	0.7	0.95	0.43
0.0858	C12	0.4	0.34	0.17	0.23	0.9	0.35
0.04	C13	0.36	0.43	0.13	0.12	0.9	0.38
0.0165	C14	0.45	0.27	0.2	0.18	0.85	0.08
0.076	C21	0.9	0.52	0.31	0.24	0.14	0.21
0.0456	C22	0.9	0.66	0.51	0.21	0.13	0.22
0.0304	C23	0.9	0.69	0.41	0.21	0.13	0.35
0.019	C24	0.85	0.42	0.82	0.8	0.37	0.19
0.0171	C25	0.66	0.4	0.34	0.38	0.75	0.32
0.0684	C31	0.44	0.31	0.44	0.56	0.8	0.41
0.0312	C32	0.97	0.69	0.76	0.31	0.93	0.39
0.014	C33	0.8	0.54	0.38	0.2	0.1	0.12
0.006	C34	0.8	0.29	0.32	0.46	0.47	0.16
0.065	C41	0.6	0.85	0.33	0.24	0.18	0.31
0.0104	C42	0.87	0.83	0.95	0.75	0.68	0.67
0.041	C43	0.7	0.37	0.37	0.8	0.19	0.17
0.014	C44	0.28	0.95	0.54	0.27	0.15	0.11
0.017	C51	0.82	0.75	0.39	0.84	0.63	0.95
0.0088	C52	0.34	0.39	0.33	0.75	0.33	0.47
0.0112	C53	0.64	0.66	0.85	0.95	0.54	0.49
0.0392	C54	0.52	0.85	0.34	0.35	0.31	0.79
0.004	C55	0.1	0.69	0.2	0.98	0.5	0.92
0.0095	C61	0.87	0.48	0.43	0.48	0.27	0.36
0.023	C62	0.32	0.33	0.21	0.22	0.88	0.44
0.0105	C63	0.37	0.27	0.16	0.25	0.78	0.2
0.0065	C64	0.95	0.8	0.91	0.78	0.2	0.18

Table 4.23 (contunied) : Global Scores based on experts.

<i>weight</i>	<i>sub criteria</i>	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>F</i>
0.0088	C71	0.8	0.74	0.57	0.56	0.14	0.17
0.0052	C72	0.67	0.39	0.78	0.31	0.26	0.54
0.026	C73	0.9	0.95	0.48	0.18	0.23	0.59
0.03	C81	0.55	0.66	0.78	0.47	0.12	0.58
0.01	C82	0.95	0.82	0.83	0.7	0.17	0.4
0.0096	C91	0.95	0.77	0.5	0.16	0.89	0.28
0.0171	C92	0.98	0.5	0.95	0.55	0.16	0.43
0.0033	C93	0.6	0.57	0.36	0.69	0.89	0.79
1.00		0.60968	0.546381	0.416117	0.438291	0.553988	0.381132

To conduct the sensitivity analysis, we decided to perform the analysis on the top five most important sub criteria, since the number of them is a lot to calculate. According to the evaluated weights of sub criteria, the top five most important sub criteria based on experts' opinions are colored red in the table and are :

- C11: User Experience & Interface → User Friendliness (0.1848)
- C12: User Experience & Interface → Convenience (0.0858)
- C21: Trust & Security → Trustworthiness (0.076)
- C31: Customer Support & Responsiveness → Responsiveness (0.0684)
- C41: Product & Pricing → Price (0.065)

For every sub criteria, we assigned the 0% and 100% weights and recalculated the weights for other sub criteria. By doing so, the ranking for alternatives also changed,

which allowed us to analyze the effect of each sub criteria. Here we have the result of sensitivity analysis for C11;

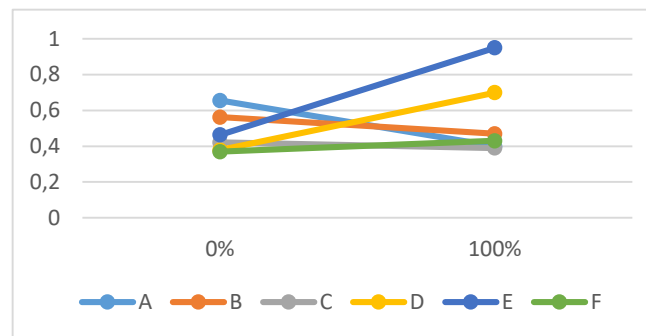


Figure 4.26 : Sensitivity Analysis for C11 (based on experts).

This figure clearly shows how much this sub criteria affects the alternatives. For alternative E (Gamified Advertising Campaigns) we have a break point, which is at 25.96%. This means that if the importance of C11 is less than 25.96%, alternative A is the most preferred alternative. This is true until the importance of C11 reaches

25.96%; In this case the importance changes to alternative E. After that alternative E is the most preferred alternative.

Next, we have the sensitivity analysis for C12 shown in Figure 4.27:

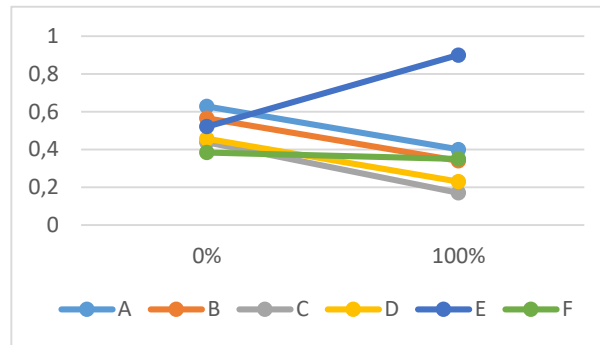


Figure 4.27 : Sensitivity Analysis for C12 (based on experts)

For C12, at 17.64% the best alternative changes from A to E. Meaning that the importance of C12 at this point affects the best alternative. After that point alternative E keeps the best alternative for any given percents.

Next, we reviewed C21 and the conducted analysis is shown in Figure 4.28 below:

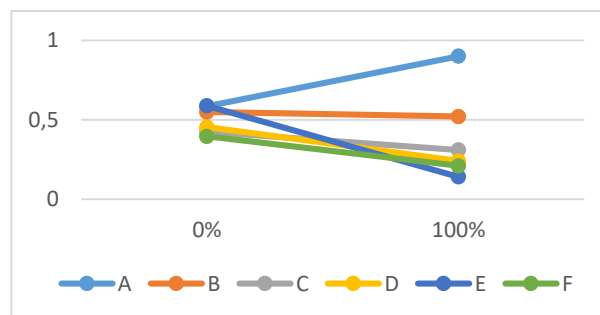


Figure 4.28 : Sensitivity Analysis for C21 (based on experts)

This was very interesting since the break point happens at the very beginning. After calculating the break point, we understand that from the 0.4% alternative A keeps

being the best alternative, while alternative E degrades to become the least important alternative.

Then we have sub criteria C31, for which the sensitivity analysis is shown in Figure 4.29:

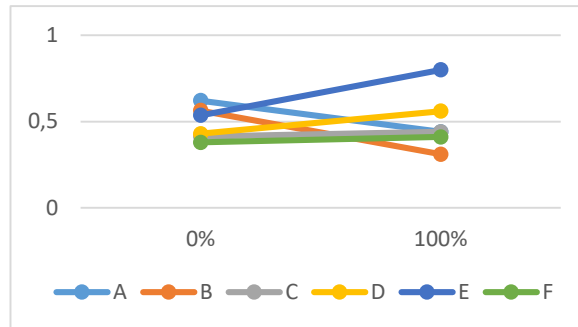


Figure 4.29 : Sensitivity Analysis for C31 (based on experts)

For C31, the break point happens at 19.16%. This shows that before this point the best alternative is alternative A, but for greater scores than 19.16% for C31, the alternative E becomes the best alternative.

Finally, for sensitivity analysis of top five sub criteria based on experts' opinion we have C41. The result is shown in Figure 30:

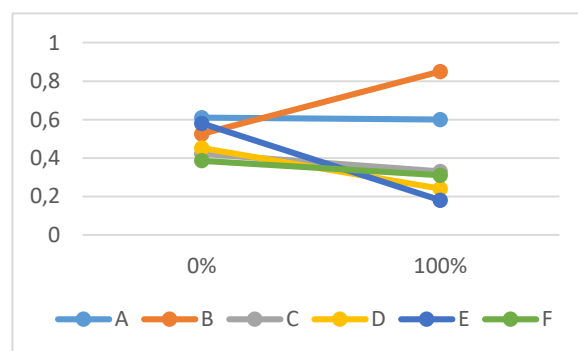


Figure 4.30 : Sensitivity Analysis for C41 (based on experts)

This figure shows that in the break point 25.28% the alternative changes. For C41 which weighs less than 25.28% the best alternative is A, but for greater value than 25.28% for C41 the best alternative becomes alternative B.

After that we reviewed the data from AI tools and since the global score matrix was different then based on that the top five sub criteria were different.

Table 4.24 : Global Scores based on AI.

<i>weight</i>	<i>sub criteria</i>	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>F</i>
0.0451	C11	0.95	0.8	0.7	0.5	0.85	0.7
0.0121	C12	0.9	0.75	0.6	0.4	0.8	0.7
0.0286	C13	0.95	0.85	0.75	0.55	0.95	0.75
0.0242	C14	0.9	0.7	0.8	0.5	0.85	0.7
0.03234	C21	0.9	0.8	0.7	0.6	0.85	0.09
0.00882	C22	0.85	0.75	0.65	0.5	0.8	0.85
0.02058	C23	0.95	0.85	0.75	0.55	0.9	0.95
0.02254	C24	0.9	0.8	0.7	0.5	0.85	0.9
0.0147	C25	0.9	0.85	0.75	0.6	0.8	0.9
0.03717	C31	0.95	0.85	0.7	0.5	0.9	0.8
0.009558	C32	0.9	0.8	0.7	0.5	0.85	0.75
0.020178	C33	0.9	0.8	0.7	0.5	0.85	0.75
0.03717	C34	0.95	0.85	0.75	0.6	0.9	0.8
0.006966	C41	0.8	0.7	0.9	0.5	0.85	0.75
0.068499	C42	0.95	0.8	0.7	0.5	0.9	0.75
0.013932	C43	0.95	0.85	0.75	0.5	0.9	0.8
0.027864	C44	0.9	0.75	0.65	0.5	0.85	0.75
0.005155	C51	0.95	0.85	0.75	0.6	0.9	0.85
0.011341	C52	0.9	0.75	0.6	0.4	0.85	0.75
0.019589	C53	0.9	0.8	0.7	0.5	0.85	0.7
0.036085	C54	0.95	0.85	0.75	0.6	0.9	0.8
0.011341	C55	0.95	0.85	0.75	0.6	0.9	0.85
0.021341	C61	0.95	0.85	0.75	0.8	0.95	0.8
0.013356	C62	0.9	0.8	0.7	0.6	0.95	0.85
0.026712	C63	0.95	0.85	0.75	0.8	0.9	0.8
0.065667	C64	0.95	0.8	0.7	0.5	0.9	0.75
0.01536	C71	0.9	0.8	0.7	0.5	0.9	0.8
0.03072	C72	0.95	0.85	0.75	0.6	0.9	0.8
0.0832	C73	0.95	0.85	0.75	0.6	0.9	0.8
0.04729	C81	0.95	0.8	0.7	0.5	0.9	0.8
0.07578	C82	0.95	0.85	0.75	0.6	0.9	0.8
0.012768	C91	0.9	0.8	0.7	0.5	0.85	0.75
0.025536	C92	0.95	0.85	0.75	0.6	0.9	0.8
0.06916	C93	0.95	0.85	0.75	0.6	0.9	0.8
1.00		0.936961	0.821311	0.725138	0.558344	0.888627	0.763687

The most important sub criteria based on AI scores are as below:

- C42 : Product & Pricing → Discount (0.068499)
- C64: Digital Presence & Engagement → Sales (0.065667)
- C73: Information & Accessibility → Accessibility of Product (0.0832)
- C82: Transaction & Payment → Delivery and Guarantee (0.07578)
- C93: Customer Satisfaction & Experience → Family/Friend Effect (0.06916)

In sensitivity analysis of AI data, the figures all show similar trend and none of them have break points. This may show the simplicity of the results that AI provides us.

In the sensitivity analysis of AI data, the figures consistently reveal parallel trends, and notably, none exhibit breakpoints. This observation may suggest the inherent simplicity and clarity of the results that AI delivers, highlighting its ability to present

insights in a straightforward manner. However, in every figure we can see that the alternative A is the best alternative.

The figures are therefore simply provided here for reference:

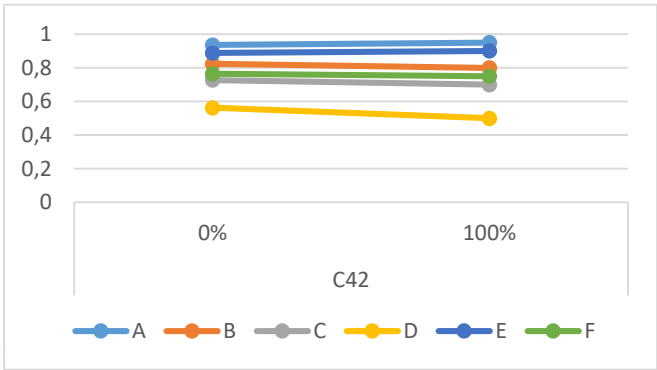


Figure 4.31 : Sensitivity Analysis for C42 (based on AI).

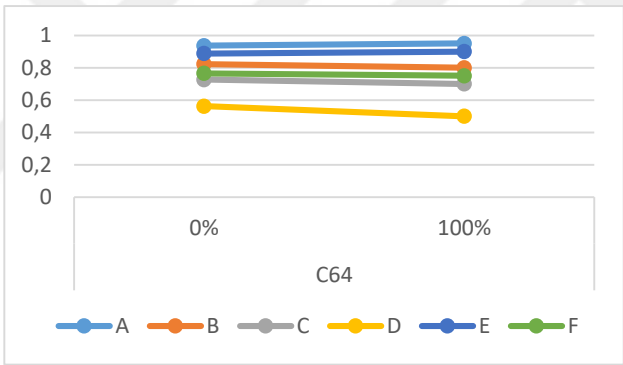


Figure 4.32 : Sensitivity Analysis for C64 (based on AI).

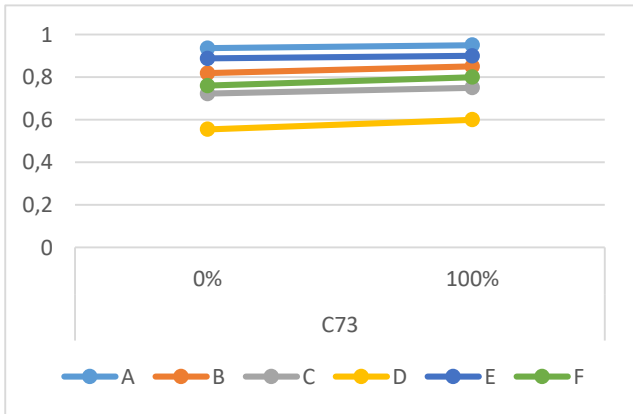


Figure 4.33 : Sensitivity Analysis for C73 (based on AI).

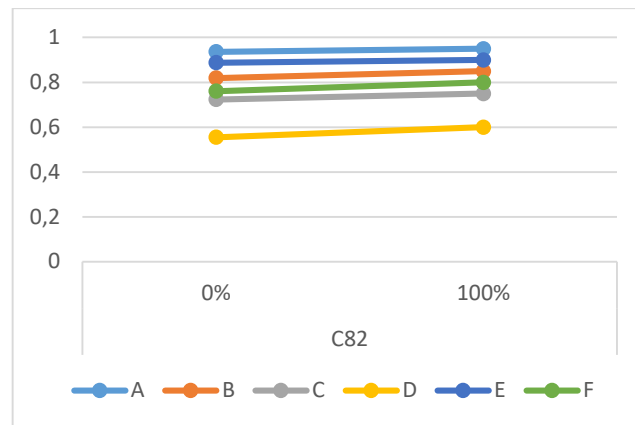


Figure 4.34 : Sensitivity Analysis for C82 (based on AI).

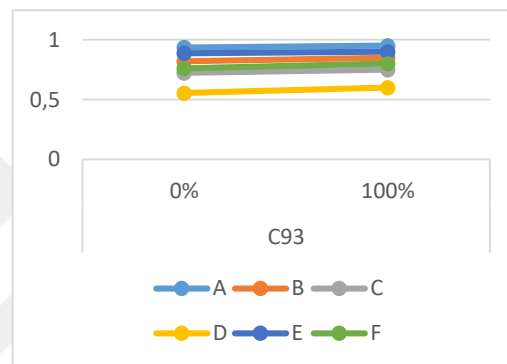


Figure 4.35 : Sensitivity Analysis for C93 (based on AI).

4.5 Insights for manager

The results of this study are insightful for decision-makers and managers in the field of online shops. Using a structured decision model, we identified the best advertising approach through expert insights and AI-created data. We later used the data to build our AHP model. Below are some of the key results that can be used by managers to optimize their advertising strategy in order to achieve maximum effect:

1. Data-Driven Advertising as the Best Strategy

The study recommends that Data-Driven Advertising is the optimal strategy for online shops. This method enables precise targeting of the audience based on user data, behavioral information, and demographics. With data-driven techniques, businesses

are able to optimize engagement and conversion rates to make the advertising fund function in an optimal way.

2. Alignment Between Expert and AI-Generated Insights

Both AI results and expert assessment ranked Data-Driven Advertising topmost as the most effective strategy, confirming the robustness of the decision model. While there were slight weight distribution differences, prioritization was always consistent. This finding means that AI may be employed to assist expert judgment in making strategic choices, lending further confirmation and eliminating bias.

3. Strategic Implications for Alternative Strategies

While Data-Driven Advertising ranked first, other strategies possess merits of their own:

- Content-Centric Strategy: Best suited for long-term brand establishment and customer trust through high-quality content and storytelling.
- Optimized Campaigns: You will be able to streamline your ad campaigns, limiting your costs and adding some actual value.
- Influencer Partnerships: A platform that connects you with the right audiences no matter how specialized they might be.
- Gamified Advertising Campaigns: Additionally, companies have seen an increase in user engagement due to rewards through gamified advertisements.
- Socially Responsible Advertising: Binds brands to ethics and sustainability concerns, which appeal to socially responsible consumers. Such strategies must be assessed by managers based on their specific business objectives and consumer preferences.

4. Data-Driven Decision-Making for Advertising Strategy Selection

To guarantee transparency and consistency for the decision-making process, AHP is vital. To heighten the objectivity of their strategic decisions, managers are afforded the same opportunity.

5. Sensitivity Analysis for Strategy Robustness

Furthermore, the study carried out another analysis to ensure validity of the results by expressly modifying the weights of the utmost significant sub-criteria. The findings indicate that while weight distribution variations affect rankings, Data-Driven Advertising is the most stable choice. Managers need to revisit their advertising priorities regularly in line with changing market conditions and consumer needs.

Through implementing a data-centered approach while at the same time keeping an ear open for synergy-driven approaches, companies can raise their online marketing effectiveness and help generate improved advertising results.

4.6 Conclusion

This study evaluated a wide range of choices and criteria using the Analytic Hierarchy Process (AHP) technique to identify the most successful advertising strategy. Levels of the model are separated according to sub-criteria, trust and security, and user experience and interface. Additional strategies covered include influencer collaborations, gamified campaigns, data-driven advertising, content-centric strategy, optimized campaigns, and socially conscious advertising. Pairwise comparisons were used to assess the alternatives' relative importance in relation to each sub-criterion.

In order to increase the strength of the AHP analysis, the model results were also compared against rankings by a panel of human experts in digital marketing. Comparison between AI-generated and expert opinion rankings showed a very high level of agreement, validating the strength of the findings. Data-Driven Advertising was the consistently highest-ranked strategy, which highlighted its strengths in optimizing online shopping advertisements' effectiveness.

The findings highlight the merit of integrating data-driven approaches in campaigns for advertising. Businesses that adopt the strategy bask in enhanced personalization, audience targeting, and optimization of resources. Besides, other strategies cannot be

wished away since they can complement data-driven efforts according to specific business needs and consumer trends.

By adopting a data-driven mentality while being open to complementary methodologies, businesses can enhance the performance of their online advertising and deliver better marketing outcomes.



5. CONCLUSION

5.1 Summary of Findings

This research has recently been undertaken to specify by means of Analytic Hierarchy Process (AHP) model the most competent online advertising strategies for online shopping enterprises. The context of the research is the background against which the research problem was formulated and put within the boundaries of this study. These criteria and sub-criteria influenced decision-making in structuring a hierarchical classification, which was used for visual and future activities like examining new eCommerce models, etc. The main criteria included User Experience & Interface, Trust & Security, and several others, each associated with detailed sub-criteria.

Six alternatives, namely Data-Driven Advertising, Content-Centric Strategy, Optimized Campaigns, Influencer Partnerships, Gamified Advertising Campaigns, and Socially Responsible Advertising, were evaluated through pairwise comparison matrices. Six alternatives are provided by decisions about preference of the researcher and the others have more alternatives coming from the opinions of the respondents which multiply preference of the alternatives by the decision maker who chooses the judgment scales selectively with respect to; on the grounds of subjectivity and some factor flow analysis provide limited results after some alternatives that automatically increase the confidence level of answers or additional tests for data, it is necessary to be more confident in some of the valuable answers to throw doubt on others that are not backed up by data.

It is found that Data-Driven Advertising is the top priority from among the alternatives considered with numerous potential points of analytic interest. To bridge this gap, AI can be served to enhance human intelligence to analyze the data analytics used by Digital marketers. In fact, this capsule model serves as a conceptual foundation for looking at performance-contextual advertising approaches across the flow of consumer online research. Also, by evaluating these different alternatives systematically, the

study provided a framework for making advertising strategy choices based on clear priorities.

5.2 Limitations of the Study

In conclusion, some limitations must be recognized with respect to this investigation, partially because of time limitations there was not more ability to obtain data or information in this area thus making research studies a bit harder to put together than if information could have been obtained easier from a wider branch of expert opinion. For example, it would potentially be useful to validate this model with the availability of additional data clusters and quantify real-world performance metrics for each advertising strategy. This would allow for a more comprehensive evaluation and improve the reliability of the model's outcomes.

Furthermore, gathering expert feedback or consumer insights on how they perceive these criteria and sub-criteria could help adjust the model for better real-world application. The proposed model does not consider that these advertising strategies are performed in a competitive environment, where other players in the market may take actions that can help or disrupt the strategies of the company and the study did not take into account external ideas to learn from or enhance the cycle that would then improve the implementation of these marketing activities which would then in turn increase the bottom line revenue generated from these marketing tactics, moreover this study is specific to the online shopping industries, and refinements may be expected for other industries or applications.

5.3 Recommendations for Future Research

Future work can add to this study by looking at more advertising strategies and goals to grow the range of study. For example, using new technologies like smart AI or AR might give fresh views on how well advertising work and provide needed insights. Researchers interested in this study could also try the AHP way in other fields or places to check how strong and flexible it is. Another recommendation for future work would be to use other MCDM methods and compare the results together to find the most suitable one for online shops. In addition, some pathways for potential future work are

evident. First, longitudinal studies were another of the selected strategies for future study. As the dataset was expanded to include more variety in experts and stakeholders, it further improved the accuracy of the pairwise comparisons. Lastly, integrating the AHP model with other decision-making frameworks (e.g., fuzzy logic or machine learning) may increasingly illuminate complex decision-making scenarios.





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Chat gpt : I am going to give a list of criteria and sub criteria which I want for modeling AHP with alternatives : Data-Driven Advertising, Content-Centric Strategy, Optimized Campaigns, and Influencer Partnerships. The main goal of this model is choosing the best advertising strategy. Do a pairwise comparison for the criteria I gave you. based on your knowledge and the goal I presented you.

Gemini: I am going to give a list of criteria and sub criteria which I want for modeling AHP with alternatives : Data-Driven Advertising, Content-Centric Strategy, Optimized Campaigns, and Influencer Partnerships. The main goal of this model is choosing the best advertising strategy. I want you to do a pairwise comparison based on your own knowledge and the provided goal. you should fill the matrix.

Chat gpt : This matrix is the one I had done based on interviewing with experts. can you generate the pairwise comparison for sub criteria based on your knowledge in this field?

Gemini : This matrix is the one I had done based on interviewing with experts. can you generate the pairwise comparison for sub criteria based on your knowledge in this field?

Gemini : can you make a normalized decision matrix, based on your own opinion about these criteria and alternatives?

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PUBLICATIONS, PRESENTATIONS AND PATENTS ON THE THESIS:

- **Mostafaei S. and Topcu Y.İ.** (2024) “Prioritization of Key Criteria for Evaluating Social Media Advertising in Online Retail Utilizing AHP”, The International Symposium on the Analytic Hierarchy Process (ISAHP) 2024 Web Conference, December 13-15, Virtual Conference (Conference site: 7 pages) <https://doi.org/10.13033/isahp.y2024.04>