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CONTENT

EVALUATION OF THE SUSTAINABILITY OF PARTY LOGISTICS SERVICE PROVIDERS WITH FAILURE MODES AND EFFECTS ANALYSIS METHOD: APPLICATION IN A COMPANY

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ABSTRACT

Purpose- The purpose of this research is to increase customer satisfaction and business performance in the sector to eliminate failure situations of the processing phases of the departments of the business and to develop the quality of the system. The objective of this research is to enhance customer satisfaction and business performance by addressing and eliminating failure situations in the processing phases of the business departments and improving the quality of the system. To achieve this, the study focuses on evaluating third-party and fourth-party logistics service providers in the context of sustainability. While there are existing approaches to evaluate party logistics under general headings, there is a lack of specific studies focusing on companies operating in a single field. Therefore, this study aims to fill that gap by examining the business evaluation criteria of third-party and fourth-party logistics service providers for a white goods company in Turkey.

Methodology- During the research, the concept of third-party logistics has gained attention within the scope of sustainability, the competition among organizations providing this service has become more intense, as have customer expectations. The research utilizes Failure Mode and Effects Analysis (FMEA) and Pareto Analysis (PA) to assess the sustainability of the supply chain and batch logistics for the company.

Findings- As a result of the research, the findings in the direction of quality improvement-development within the scope of the service provided by the business are presented. The initial phase of process enhancement for logistics operations begins with the FMEA results. Development initiatives may begin if improvement initiatives are maintained. Development activities and resources ought to be distributed in accordance with this level of priority with regard to the first work that has to be performed to enhance the process.

Conclusion- All risk considerations might not be realized inside a particular process since there are only a limited number of possibilities to be assigned for enhancement prosperity. By conducting risk prevention studies in accordance with the priorities that will be decided upon each period, it is intended to produce continuous improvement. Overall, while it may not be possible to address every risk, prioritizing risks and conducting risk prevention studies can help organizations achieve continuous improvement and increase their chances of success.

Keywords: Failure Mode and Effects Analysis (FMEA), Pareto Analysis (PA), party logistics, quality, supply chain, sustainability.
JEL Codes: O30, N01, L15, L21, L84

1. INTRODUCTION

Sustainability is defined as maintaining the balance and continuity of a system, such as an ecosystem or supply chain, while avoiding disruptions, excessive strain on resources, and waste. It involves ensuring the long-term viability and well-being of both the natural environment and human societies. Sustainability encompasses the concept of balancing ecological, economic, and social factors to ensure the long-term well-being of our planet and future generations. It recognizes the interconnectedness of environmental, economic, and social systems and aims to minimize negative impacts while maximizing positive outcomes. Responsible resource management is a crucial aspect of sustainability. It involves using resources efficiently, minimizing waste and pollution, and promoting renewable and sustainable alternatives.

To achieve sustainability, it is important to involve stakeholders and communities in decision-making processes. Participatory approaches allow for diverse perspectives to be heard, knowledge to be shared, and solutions to be collectively developed. This helps to create a sense of ownership, inclusivity, and transparency in the pursuit of sustainable practices. It involves finding a

harmonious equilibrium between the environmental limits of the planet, the economic needs of society, and the values and aspirations of communities. In order to determine the best strategies for achieving sustainability, researchers advocate for participatory methods that involve community engagement. This means involving various stakeholders in the decision-making process to analyze choices, assess trade-offs, and make informed decisions that align with their values and aspirations. By involving the community, it becomes possible to tailor restoration efforts and sustainable practices to the specific needs and conditions of each location. Researchers believe that participatory methods of community engagement, in which various individuals analyze the choices and trade-offs facing their community, are the best ways to determine how restoration should really be carried out in each specific site or condition. Overall, sustainability requires a holistic and integrated approach that considers the interconnectedness of environmental, economic, and social factors. It strives for a balance that enables current and future generations to thrive while preserving the integrity of our natural systems and promoting social well-being (Munasinghe, 1993; Hueting and Reijnders, 1998; Sezgin and Kalaman, 2008).

There are two components to the idea of sustainable development. These components are discussed in the first section, and the ability of the environment to satisfy both present-day wants and demands in the second. The use of technology has its limitations. To put it another way, sustainable advancement refers to a strategy which ensures the wise management of natural supplies and leaves a natural, physical, and social surroundings deserving of future generations in a way that will support ongoing economic advancement through preserving human wellness and the natural equilibrium. Such a strategy necessitates those environmental issues be managed concurrently with global economic and social strategies at every level of growth. When it is taken into account for society, sustainable development becomes more significant in the context of social, economic, cultural in nature and natural assets (Munasinghe, 1993; Dulupçu, 2000; Altunbaş, 2003). A sustainable population, contraception, health care, and education are all guaranteed by sustainable development. The centralized government, regional governments, and departments all benefit from this idea's development of relationships. It involves everyone in society in the decision-making procedure so that they may help create ethical and moral standards which ensure sustainable growth and take into account how the environment and the economy are interdependent. It encourages multidisciplinary research and helps students comprehend natural systems via science and education. Resource distribution and population are both important factors in the pursuit of sustainable development. It needs to be compatible with demographic changes (Munasinghe, 1993; Hamilton, 1995; Dulupçu, 2000; Dollar and Kraay, 2001; Redclift, 2005; Hepburn, 2006).

Terms like "logistics outsourcing," "logistics alliances," "third party logistics," "contract logistics," and "contract distribution" have recently been utilized interchangeably to refer to the business practice of contracting-out all or a portion of logistics operations that were formerly handled internally. A company or a person that requires cargo, freight, products, commodities, or merchandise moved from point A to point B is known as a first-party logistics provider (1PL). Institutions like government organizations, as well as people or families migrating, might also fall under this category. *First party logistics providers are those who arrange for the transportation of products from their origin to their final destination. *An asset-based carrier known as a second-party logistics provider (2PL) really controls the transportation equipment. Shipping firms that own, lease, or chartered their vessels, airlines that own, lease, or charter their planes, and trucking businesses that own or lease their automobiles are examples of conventional 2PLs. * Third-Party Logistics (3PL) facilitates supply chain connections between buyers and providers. The top automakers in the world today are taking use of 3PL, and their demand for this idea is expanding daily. 3PL is the practice of outsourcing most or all of a company's logistical functions to a specialist business. A company known as a third-party logistics provider offers consumers a variety of logistical services. These services are ideally merged or "bundled" by the supplier. These businesses streamline the flow of components and supplies from suppliers to manufacturers as well as completed goods from manufacturers to wholesalers and retailers. Transportation, storage, cross-docking, inventory management, packing, and shipping are just a few of the services they offer (Holweg and Miemczyk, 2003; Reeves et al., 2010; Ko et al., 2010; Jayaram and Tan, 2010; Rajesh et al., 2011; Ho et al., 2015). Numerous environmental problems have an impact on logistics, some of which are outside of its purview and others which are. The aspects of logistics that are all impacted by the environment are as follows: Controlling transportation, fuel economy, emissions, warehousing, office and administrative functions, and manufacturing (Remmel, 1991; Prendergast, 1995). Due to the importance of following lean principles, distribution and logistics may appear crucial to the company's continuing the competitive edge. As a result, businesses might either improve and supply these goods and services locally, hire a third-party logistics company, or adopt a combination approach in which some functions are transferred and others are supplied internally. In particular, for both dynamic forward flows and reverse flows, 3PLs could supply dependable services to meet client requests thanks to advanced information systems and specialized equipment. Due to 3DayCar, distribution of the finished car costs 28% of the entire cost of the sold vehicle, while inbound logistics costs 1%, outbound logistics costs 1.2% (Holweg and Miemczyk, 2003; Ko et al., 2010; Reeves et al., 2010; Rajesh et al., 2011).

The scope of this research focuses on evaluating third-party (3PL) and fourth-party (4PL) logistics service providers in the white goods sector, specifically for sustainability. The evaluation criteria for these logistics companies are determined based on existing studies, and the Failure Modes and Effects Analysis (FMEA) method and Pareto Anlysis (PA) are applied to the supply chain of XYZ white goods manufacturing business in Turkey. . FMEA is a method used to identify potential failures, their causes, and their effects, allowing for preventive measures to be implemented. PA, on the other hand, helps prioritize issues based on their significance and impact. By applying these analytical techniques, the study aims to identify areas of improvement due to criteria of sustainability the supply chain and batch logistics processes, enhance the sustainability of operations, and ultimately improve customer satisfaction and business performance. These criteria are established based on existing studies and are aligned with the goal of sustainability. When choosing a 3PL or 4PL supplier, white goods firms in Turkey should consider a variety of business assessment criteria that were established by the authors of the research. it has become more important for businesses to meet customer needs accurately and to be a leader in the sector for this issue. By conducting this issue and this research, the aim is to assess the performance and sustainability of 3PL companies serving the white goods manufacturing industry. This evaluation helps identify the business's position in the market and its strengths and weaknesses compared to competitors. It also sets clear objectives for improving operations and maintaining a strong market presence. To enhance its market exposure and competitiveness, the XYZ Company needs to address areas where it falls short compared to other logistics services. This may involve strengthening technical requirements, such as technology infrastructure and physical equipment. The FMEA analysis serves as a practical roadmap for the company, providing guidance for operational and strategic goals. It is worth noting that with appropriate adjustments, the findings and methodologies of this research can potentially be applied to various industries or businesses beyond the white goods sector. The insights gained from evaluating logistics service providers and utilizing FMEA can be adapted to suit different contexts, helping businesses enhance their sustainability and operational performance.

The flow of the paper is organized as; Section 2 presents information about research methodology, the importance of Party Logistics Service Providers for the development of the industry and the company as a significant scientific scope so as to the future research in development organization and process for prioritization of the identified product recovering option and drivers In addition, this second section elaborates and comprises the subjects about 3PL Market in Competitive Marketplace. Section 3 and Section 4 present Failure Mode and Effects Analysis (FMEA) and Pareto Analysis model approach. These sections highlight and utilize Failure Mode and Effects Analysis (FMEA) and Pareto Analysis (PA) to assess the sustainability of the supply chain and batch logistics for a company in white goods sector. Companies may improve their operational performance and sustainability by applying the lessons learned from analyzing Failure Mode and Effects Analysis (FMEA) and assessing logistics service providers (LSPs) to various scenarios. Companies may increase their sustainability and efficiency in operation, lower their risk of expensive interruptions, and obtain a competitive edge by exploiting the insights acquired from reviewing LSPs and implementing FMEA and PA. Finally, Section 5 concludes the findings of this study along with limitations and assessing logistics service providers, FMEA and PA due to application of the issue for white goods sector.

2. LITERATURE REVIEW

2.1. Definition of the Concepts of Party Logistics Service Providers

Supply Chain Management (SCM) is indeed beneficial for organizations in terms of financial efficiency, customer loyalty, and partner revenues. An effective SCM system enables organizations to respond quickly and efficiently to demand fluctuations. This can be achieved through agile production and distribution processes, efficient inventory replenishment strategies, and flexible supply chain networks. SCM helps in achieving a stable and reliable supply of materials and products. It involves building strong relationships with suppliers, implementing robust supplier management processes, and establishing backup plans for supply disruptions. Some of the business potential of supply chain management are listed below. Through utilizing the period between customer orders and distribution effectively, it boosts revenues, contributes to a decrease in industry investment in capital, optimizes response to demand fluctuations, and boosts supply stability. In the context of this study, the integration of Failure Modes and Effects Analysis (FMEA) programs with SCM offers an enhanced output configuration. It addresses the application of FMEA in the context of SCM systems and provides examples of its utilization as a supply chain management strategy and continuity guideline. By implementing SCM with the FMEA approach, organizations can proactively identify and mitigate potential failures and risks in their supply chains. This ensures a more resilient and efficient supply chain operation. It is important to recognize the significance of customers within the supply chain network, as meeting their demands and expectations is crucial for sustainable business success (Gunasekaran and Ngai 2009; Jayaram and Tan, 2010).

2.2. Why 3PL

It is evident from the preceding slide that in a time-constrained, global marketplace, the efficacy and effectiveness of the logistics procedure, together with a synchronized and coordinated supply chain management, performs a critical strategic role. Many manufacturers have also recognized that their core competencies are not in the area of logistics in this competing environment where financial resources are restricted and have gradually sought to purchase logistics capabilities and operations from third party suppliers (see Figure 1; Gunasekaran and Ngai, 2009; Jayaram and Tan, 2010; Rajesh et al., 2011).The certain Marketing automation approach- Customer Relations Management (CRM) should develop a vision and plan that outlines the goals and objectives of the company. So, you need to change the procedures and internal systems so that you can successfully enforce the approach. Such systems need to be underpinned by a CRM system that integrates contact networks with CRM software and consumer data repositories. In fact, the expenditure in CRM will provide resources from all three application areas – integrated, organizational and strategic CRM – in order to serve the four stages of the CRM lifecycle (Gray and Byun; 2001; Greenberg, 2004; Bohling et al., 2006; Kumar, 2010).

Figure 1: Supply Chain Integration with Capabilities and Operations Third-Party Logistics Providers
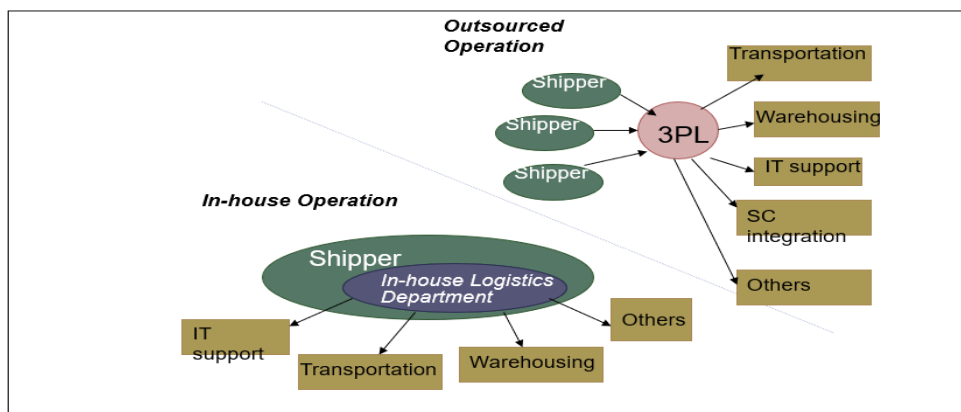
Supply Chain Integration with Third-Party Logistics Providers, by Jayanth Jayaram and Keah-Choon Tan, is the research. The research titled "Supply Chain Integration with Third-Party Logistics Providers" by Jayanth Jayaram and Keah-Choon Tan highlights four crucial components of supply chain management. Four supply chain management components are identified in this research as being crucial elements. The degree of these characteristics' believed significance was analyzed between the two groups of businesses in order to predict company performance. The data backs up the assertion that developing connections, performance assessment, information integration, and 3PL selection criteria are all positively connected with company success. , the research demonstrates that companies that involve 3PLs in their supply chain management efforts tend to place a greater emphasis on these supply chain management structures compared to companies that do not engage 3PLs. This, figure 1 highlights the importance of integrating and leveraging the capabilities of 3PLs to enhance supply chain performance and achieve better business outcomes (see Figure 1; Gunasekaran and Ngai, 2009; Jayaram and Tan, 2010; Rajesh et al., 2011).

The model created in Strategic logistics outsourcing: An integrated QFD and fuzzy AHP approach by William Ho, Ting He, Carman Ka Man Lee, and Ali Emrouznejad is chosen as the foundation to use on the automotive sector in order to construct a house of excellence for 3PL Business after reviewing examines about the 3PL notions (Jayaram and Tan, 2010; Rajesh et al., 2011; Ho et al., 2015) .

Customer requirements can be accommodated by third-party logistics in the white goods industry using their descriptions without the need for substantial adjustments. Below are attempts that describe these 8 conditions (Gunasekaran and Ngai, 2009; Jayaram and Tan, 2010; Ho et al., 2015).

1. Lower overall logistics expenses: Rather than focusing on lowering the costs of specific logistical operations, the goal ought to be to minimize overall logistics costs. Transportation, storage, handling of materials, packaging, reorganization, and other charges are all included in the overall cost of logistics.

2. Shorten cycle times: Getting 100% of deliveries done on time and cutting down on client wait times may both be accomplished by getting the correct number of items to the right place at the right time.

3. Guarantee distribution quality: To guarantee product delivery security and lower the risk of damage and malfunction, special packaging, devices, and attention are required.

4. Offer specialized logistical services. Various outsourcing organizations will have different requirements for specialized logistical services. It is crucial to choose a 3PL that can offer adaptable, custom solutions to match their changing demands.

5. Increase customer happiness: By maintaining a high level of service quality, the 3PL may assist in increasing customer satisfaction.

6. Possess cutting-edge hardware and software: The 3PL could assist to increase the competitiveness of the outsourcing business by possessing both cutting-edge hardware (such as a fleet of vehicles, storing and handling equipment, RFID, or radio frequency GPS satellite tracking equipment) and software (vehicle routing containers, carrier transferring optimization software, data transfer and reception structures).

7. Capable of giving timely advice: This relates to the 3PL's capacity to advise and offer insights to the outsourced firm in a prompt, effective way.

8. Effective problem-solving skills: This pertains to the 3PL's capacity to handle issues successfully and lessen their effects on the outsourced firm.

Considering some necessary adjustments, 20 assessment elements are adapted to the automobile industry as 15 technical performance metrics. Performance indicators and measures are crucial managerial instruments for wisely allocating precious resources for the production of high-quality products and services and maintaining competitiveness in order to succeed in a global marketplace. Performance measures are shown below (Gunasekaran and Ngai, 2009; Jayaram and Tan, 2010; Ho et al., 2015);

(1) Proactively reducing costs; (2) Accountability for additional expenses brought through 3PL; (3) Low cost sustainability leveraging; (4) Shipping Quantity fulfillment consistency; (5) Delivery circumstance; (6) The capacity to meet deadlines for delivery; (7) Flexibility when it comes to changing the manufacturing capacity; (8) Services offered; (9) Quality, Accuracy, and Dependability; (10) Knowledge of the industry and Client References; (11) Capabilities of technology-based information systems; (12) Capabilities for optimization; (13) Size and quality of physical equipment are two aspects of fixed assets; (14) Risk Capacity for spotting and avoiding possible issues; (15) Financial endurance and strength.

A thorough study of 3PL services is given in "Third Party Logistics (3PL) Market Outlook to 2022 - By Freight Forwarding and Warehousing 3PL Services and By International Companies and Domestic Companies." The market size for third party logistics in Vietnam as a whole, segmentation of the market according to industry (freight forwarding and storing), and market fragmentation by firms (local and foreign) are the main subjects of this research. The general competitive environment in the Vietnam 3PL marketplace is also covered in the study. The expert recommendations and market prediction for third party logistics are included in the conclusion of the report, which also highlights the key potential and risks for the Vietnam 3PL industry (Holweg and Miemczyk, 2003; Gunasekaran and Ngai, 2009; Jayaram and Tan, 2010; Rajesh et al., 2011; Vietnam Third Party Logistics, 2023).

2.3. The 3PL Market in Competitive Marketplace

As more businesses throughout the world outsource their logistical tasks to 3PL suppliers because they are reluctant to handle their complicated supply chains, third-party logistics outsourcing is rapidly acquiring prominence in the nation. Due to reduced capacity and greater supply chain combining, which has led to fewer partners for 3PLs and higher costs, competitiveness in the logistics sector is escalating. Through providing a variety of value-added services to the clients, the businesses operating in the Vietnam 3PL market compete with one another. DHL Logistics, Damco, FedEx, and APL are the industry leaders. Nevertheless, a lot of Vietnamese brand names, such Gemadept, Vinafco, and Transimex Saigon, have lately entered the marketplace (Holweg and Miemczyk, 2003; Gunasekaran and Ngai, 2009; Jayaram and Tan, 2010; Rajesh et al., 2011; Vietnam Third Party Logistics, 2023).

3. FAILURE MODE AND EFFECT ANALYSIS

Failure Mode and Effects Analysis (FMEA) is a versatile and effective method used in various stages of operations, including product development, process improvement, and service enhancement. It helps identify and evaluate potential failure modes, their causes, and their effects on products, services, systems, or processes. During the FMEA process, failure modes are examined individually or in comparative groupings to determine their potential impact. This evaluation involves assigning

weights or ratings to failure modes based on factors such as severity, occurrence, and detectability. These weights help prioritize the most critical failure modes and guide decision-making regarding preventive actions. The measurement and evaluation phase of FMEA is crucial as it helps uncover significant failure modes that require attention. By identifying these outstanding failure modes, organizations can focus their resources and efforts on mitigating the associated risks and improving the overall performance and quality of their operations. It's important to note that the specific details and outcomes of the FMEA process, including the weights assigned to failure modes, may vary depending on the specific context and application. Organizations may have their own criteria for assigning weights or ratings based on their industry, expertise, and risk tolerance. By addressing potential failure modes proactively, organizations can reduce risks, enhance product and service quality, improve customer satisfaction, and increase operational efficiency. Overall, FMEA is a valuable tool for organizations to identify and mitigate risks, prioritize improvement efforts, and drive continuous improvement in their operations (Ford, 1992; Pillay and Wang, 2003; Estorilio and Posso, 2010).

In the early years of FMEA analysis, its use was more common in technical issues such as product design, but later it shifted to system, process and service designs and development and improvement applications. FMEA is a tool used to detect and prevent problems that may arise in the design, service and process stages before they occur. In FMEA applications, errors that may arise are identified and eliminated before they reach the Customer (Denson, 1992; Yılmaz, 1997; Dizdar, 2001; Elitaş and Eleren, 2007). It is a systematic approach to analyzing the causes of product and service defects. The preventive quality strategy has many tools for error prevention, virtual prevention of the probability of occurrence of a defect that has not fully occurred, error proofing, performance failure, consequences and risk. These tools apply to both proactive and reactive defect types. FMEA focuses on the type of failure (fatigue, leakage, kink, fracture, too salty, eraser stain, pencil stain), mechanism, effects. FMEA is a tool to identify problems that may arise in the design, service and process stages before they occur and to take actions. Errors that may arise are identified and eliminated before they reach the customer. It can be based in 2 ways (Dale and Shaw, 1990; Ford, 1992; Sahnı, 1993; Yılmaz, 1997; Dizdar, 2001).

-   To bring the customer's value definition to the system by making use of previous data
-   Deciding on the state of the process based on statistical data.

In preventive applications, FMEA is indeed a flexible and valuable tool for analyzing and improving products, services, systems, and processes in their early stages. It allows for the identification and evaluation of potential failure modes and their associated effects, enabling proactive measures to be taken to prevent or mitigate them. FMEA is adapted to focus on error prevention. Often, the failure type is thought of as the physical description of the failure, whereas the failure mechanism relates to the process that produces the failure. FMEA seeks methods to find and identify possible failure modes, mechanism, effects or consequences indicating failure modes, and preventive tools. Product and process action plans are used to eliminate significant types of defects resulting from an effective FMEA study. Nowadays, it is seen that studies are carried out in combination with methods such as fuzzy logic, multi-criteria decision making, artificial neural networks, simulation, etc., which have recently become widespread. An example is the use of Analytic Hierarchy Process or Fuzzy TOPSIS methods from multi-criteria decision-making methods in the calculation of the risk priority indicator, which is an important part of the FMEA analysis, and the ranking of risk factors accordingly. FMEA is more effective at the following points: Systematic evaluation of the product or process at certain levels of system complexity, assumption of individual failures, identification of possible failure mechanisms and determination of their respective effects, probability and preventive measurements of occurrences, adverse situations caused by potential failure to fulfill the product or Process (Dale and Shaw, 1990; Sahni, 1993; Yılmaz, 1997; Dizdar, 2001).

Three factors are taken into account when examining defects with FMEA. These are: Occurrence (frequency), Impact (severity), Detection (detection). In line with these three factors, the Risk Priority Indicator (RPI) of the failure in question is calculated. RSI is an indicator of criticality ranging from 1 to 1000. By calculating this number, the error sources that need to be addressed first are identified and corrective actions are performed in this order. The aim is to develop a variety of preventive actions to move the RPI towards 1. For an FMEA exercise to be optimally effective, the work should be initiated at the earliest possible time. However, this is often not done due to insufficient available data and the FMEA study is never started. This has detrimental consequences, especially for organizations implementing total quality management philosophy. The support of the management should definitely be provided before starting the FMEA application. Considering that FMEA is a team work, the animator (motivator) should emphasize the rules to be followed during the meetings in order to keep the FMEA project group alive until the end of the project. When forming the group, it should be ensured that everyone related to the process to be examined is included in the group. In this way, more objective results can be achieved. It is generally accepted that there are four types of FMEA. Accordingly, FMEA: System FMEA, Design FMEA, Process FMEA and Service FMEA (Denson, 1992; Gilchrist, 1993; Teng and Ho, 1996; Yılmaz, 1997; Dizdar, 2001; Seung, 2003; Eryürek and Tanyaş, 2003; Baykasoğlu et al., 2003; Teoh and Case, 2004; Elitaş and Eleren, 2007).

When developing or improving systems, processes, methods, models, services or products, FMEA is a method developed to identify and rank existing or potential types of errors/risks in advance and to set priorities in the improvement/development phase. The FMEA method is a simple but effective method applied to identify, classify, eliminate or prevent potential failure/risk types and reduce their effects. Risks or changes in products or processes are usually caused by the variability of inputs. Variability can be categorized in two groups (Denson, 1992; Elitaş and Eleren, 2007). These are general variability arising from the natural structure of the processes themselves and special variability arising from a number of unexpected effects. While general variability affects the whole mass, special variability affects only a limited structure. Although FMEA studies are aimed at the management of variability in both groups, the primary goal is to eliminate or reduce the variability in the second group (Gilchrist, 1993; Teng and Ho, 1996; Seung, 2003; Teoh and Case, 2004).

Sinha et al. utilized FMEA to content datasets to support party logistics reduces the energy needed for transportation, enhances to support the seriousness of risk criteria, which includes the airline/aircraft generating Supply chain, (Sinha et al., 2004). Utilization for the medical industry includes FMEA implementations, which describe the risk of each stage of reverse logistics actions (Kumar et al., 2009). This idea allows for the analysis of risk arranging while considering reasonable monitoring of drugs (Van Leeuwen et al., 2009). In order to broaden his research and evaluate the impact of invisible failures, such as consumer complaint and the failure of bazaar proportion including the volume of service levels, Chuang (2010) examined and revealed the 126 influences of demands and objectives.

FMEA enables the identification and calculation of risks and unfavorable outcomes. FMEA, nevertheless, has a wide range of application stages and is a challenging assessment technique for preventing failures through roughly assessing the important risks. FMEA is a powerful method for identifying and assessing risks and potential adverse outcomes. It provides a structured approach to systematically analyze potential failure modes, evaluate their effects, and determine the associated risks. (Chin et al., 2009; Wang et al., 2009; Liu et al., 2013).

The advantages of the system FMEA are given below (Franceschini et al., 2001; Pillay and Wang , 2003; Chin et al., 2009);

(i) İmproving the project's overall quality, dependability, and safety. (ii) Boosting client happiness and provide for it. (iii) Cutting down on the time, money, and resources spent on product or system improvement. (iv) Determining the order of importance for design or development of processes tasks. (v) Looking at all possible failure modes, their impacts, and commonalities across all goods and processes. (vi) Offering an analysis of the design requirements and design options. (vii) Aiding in the defining of possible, vital, and crucial traits. (viii) Offering feedback on new manufacturing or research processes. (ix) Continuing an extensive brainstorming session for failure prevention. (x) Improving and realize the explanation of preventative measures. (xi) Identifying and keep monitoring on the infrastructures that reduce risk.

3.1. Failure Mode Effect Analysis (FMEA) Elements and Calculation Method

The objective of this research is to identify advancements and improvements that can enhance logistics systems and propose effective delivery structures and attributes for system populations. To achieve this, the study incorporates the analysis of Failure Modes and Effects Analysis (FMEA) and the utilization of Pareto Analysis (PA) to control and prevent potential failures in the third-party (3PL) logistics for Supply Chain Management (SCM) in the white goods industry. Building on previous research, the study aims to develop specific business assessment criteria that are relevant to sustainability for third-party (3PL) and fourth-party (4PL) logistics service providers in the white goods industry. These criteria will then be applied using the FMEA approach to evaluate the sustainable development of the Supply Chain for XYZ White Goods Manufacturing Company, considering the involvement of Party Logistics providers in Turkey. Additionally, the research includes a sample study focusing on process failure types and impact analysis to proactively prevent potential failure types encountered in the logistics department. The aim is to ensure the sustainability of third-party logistics within the scope of the Supply Chain in a white goods manufacturing enterprise located in the Marmara region. By combining FMEA and PA, the research intends to provide valuable insights into identifying critical factors and mitigating risks in the 3PL logistics and processes OF SCM. The ultimate goal is to enhance the sustainability and performance of the logistics systems within the white goods industry.

Weak/strong sustainability: trade-offs and minimal standards- the idea of include governance as a fourth dimension has been floated. Systems for supply chain management have a wide range of implications on ecological, social, cultural, and economic factors as well as on land use and urban situations. The provision of sustainable transportation system actually depends on these elements.

The aim of FMEA is to sort the failure modes in order of importance, three indexes are defined for each failure mode: the occurrence rating (O), the severity rating (S), and the detectability rating (D). A ten-point scale is used to score each category, ten being the number indicating the most severe, most frequent and least detectable failure mode, respectively.

The priority of a failure mode is determined through the Risk Priority Number (RPN), which is defined as the product of the Occurrence (O), Severity (S) and Detection (D) of the failure,

Those potential causes, with high RPN values, are selected for the corrective action to reduce the risk of failure occurrence.

Risk priority Number (RPN) for FMEA; is calculated by multiplying the Occurrence (O), Severity (A), and Detectability (S) levels

RPN= S(Severity)* O(Occurrence) * D(Detectability)   (1)

The probable issues including high Risk Priority number (RPN) variables are preferred in order to decrease the risk level of the failure situations for the suitable action. Concentration is also presented to the components of a system, where failure could construct unfavorable consumer opinion and loss of business prestige. Risk priority levels (RPL) or numbers (RPN) for FMEA - Eq. (1) is measured by accumulating the Occurrence (O), Severity (S), and Detectability (D) levels (Chin et al, 2009; Xiao et al, 2011; Su et al, 2012).

To reduce the chance of failure scenarios preventing appropriate action, likely issues with high RPN variables are chosen. The parts of a system also require attention since failure might result in a negative consumer perception and a loss of corporate status. For FMEA Eq. (1), risk priority levels (RPL) or numbers (RPN).

Severity (S) : The importance of the influence on consumer circumstances frequently leaves little room for action outside of building innovative system fundamentals or reassessment structures.

Occurrence (O): Frequency with which certain occasions, problem, and failure modes are generated (or perhaps this could happen).

Detectability (D): The capacity of the current oversight and disciplinary methods to find earlier or subsequent growth, the occurrence of a stated cause.

According to Table 1, the three components O, S, and D have the ability to be evaluated using point sequences that range from 1 to 10. Higher RPN failures are implied to offer greater significance and necessity and may be claimed to have higher preferences.

3.2. Risk Priority Number

Risk Priority Number (RPN) shows the relative likelihood of a failure mode, in that the higher the number, the higher the failure mode. It must be calculated for each cause of failure. From the RPN, a critical summary can be drawn up to highlight the areas where action is mostly needed. Regardless of the resultant RPN, special attention must be given to any cause of failure with a severity rating of "9" or "10". The higher the RPN, the higher the priority for taking action to mitigate or eliminate the associated failure mode. It helps in identifying the failure modes that require immediate attention and allocation of resources for improvement. While it is essential to address failure modes with high RPN values, it is equally important to pay special attention to failure modes with severity ratings of "9" or "10". These severity ratings indicate that the failure mode could have severe consequences, potentially leading to significant impacts on safety, quality, or other critical aspects of the system or process. By highlighting the failure modes with high RPN values and focusing on those with severe consequences, organizations can prioritize their improvement efforts and allocate resources effectively to address the most critical risks. As shown in Table 1, On a rating system of 1 to 10, the three RPN components, occurrence (O), severity (S), and detection (D), could be rated. The likelihood that the failure mode may occur increases with increasing RPN. Corrective steps ought to be given priority to failure scenarios with greater RPNs.

The Three Factors of System FMEA: S (Severity), O (Occurrence) and D (Detection) Table 1 was modified from Slinger's research, the literature of FMEA subject, opinions of experts of this sectors, author and applied to the application of this research. For all fatal failure causes at the root, the RPN is taken into account. The bigger the statistics variable, the greater the failure mode, with this value defining the connection likelihood of a failure mode. A large overview might be carried up to highlight the subjects, corresponding the RPN, where the procedure is often necessary. Despite the impact RPN, every component of failure may be given special concern by receiving a severity rating of "9" or "10" (Ford, 1992; Van Leeuwen et al., 2009). The firm should ensure that the fundamental flaws are removed from the detection after generating RPN values arithmetically. There are three options, which undoubtedly encompass (Sankar et al., 2001; Pillay and Wang, 2003). The firm should ensure that the fundamental flaws are removed from the determination after computing RPN values arithmetically. Three options are available, including (Sankar et al., 2001; Pillay and Wang, 2003).

(i) Reduce the likelihood that the failure could happen or show up, (ii) eliminate the problem as a whole via an arrangement change, (iii) increase the prospects for finding around developmental quality control.

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Table 1: The three factors O(Occurrence), S(Severity) and D (Detection) of System FMEA
(modified by opinions of experts of this sectors and author from Slinger, 1992)

Rating	Severity How severe is the effect on the customer?	Occurrence How often does the cause or failure mode occur?	Detection How well can you detect the cause or the failure mode before passing to next step?
10	Serious hazard to people or damage to equipment	Very high chance of occurence	Almost impossible to detect, no controls in place
9	Loss of primary function- serious of medium level	High repeated failures	Impossible chance of detection
8	Loss of primary function- serious of normal level	Medium High repeated failures	Medium chance of detection (less than high)
7	Customer dissatisfied, disruption to business	Moderate chance of occurence	Low chance of detecting, may have some controls in place
6	Loss of secondary function- medium level	Moderate failure	Moderate chance of detection
5	Loss of secondary function-normal level	Occasional failure	Good chance of detection
4	Customer may notice but only minor concern, minor disruptıon to business	Low chance of occurence	High chance of detecting, controls are in place
3	Minor effect	Less Low chance of occurence	Higher chance of detecting
2	Less Minor effect	Failure unlikely	More High chance of detecting
1	No effect	Remote chance of occurence	Almost certain to detect, reliable controls are in place

With the help of failures and their sub-failure components, a fault tree structure was developed. On the FMEA form, the potential severity, likelihood, and detectability levels of various failure modes have been established and noted (Zairi and Duggan, 1999; Franceschini and Maurizio, 2001). Risk Priority Levels (RPL-RPN) were derived from these reported values. These estimated values have been arranged according to the level of danger, and preventive research has been done to lower the danger Priority Levels. Observing the development operations, performing a fresh evaluation of the severity, occurrence, and detection values, and computing a new RPN value are all undoubtedly options. The unpredictability of the mode's fall is greater the higher the RPN value, and this mode ultimately asks a higher configuration for enforcement (Franceschin and Maurizio, 2001; Chang and Sun, 2009; Chin et al., 2009).

3.3. Implementing FMEA and Calculating Risk Priority Levels (RPL) in Quality-Oriented System Design

For the purpose of addressing potential risk variables and challenges that may arise during the design, process system, and application of the quality focused system design, it is important to conduct failure control, quality analysis, social, economic, and ecological sustainability, among other dominations, at each stage of production system concentrated quality-oriented science and technology system design. This reality necessitates the implementation of an effective risk execution strategy for both the dimensions and the goals of these flaws. This inquiry and its directives will provide a sound framework for the upcoming investigations to be planned on dimensional frameworks while enabling the seamless development of adopted quality-based investigations. This comprehensive approach ensures that the design and implementation of the quality-oriented science and technology system align with desired outcomes and minimize potential flaws. To achieve this, it is important to implement an effective risk execution strategy that encompasses the dimensions and goals of these potential flaws. By incorporating risk management practices and risk mitigation strategies, organizations can proactively identify and address risks throughout the production system. This inquiry and its directives aim to provide a solid framework for future investigations, focusing on dimensional frameworks that enable the seamless development of quality-based investigations. By emphasizing quality-oriented research and development, organizations can continually improve their systems and processes, ensuring better outcomes and sustained success. By integrating the principles of failure control, quality analysis, and sustainability considerations, organizations can enhance their understanding of potential risks, address them effectively, and drive continuous improvement in their quality-focused system design.

The Failure Mode and Effects Analysis (FMEA) table, as shown in Appendix 1, serves as a valuable tool for conducting a comprehensive evaluation of potential risk aspects and failures in fundamental investigation applications and engineering measurements. It provides a structured framework to identify and analyze potential failure modes, their causes, effects, and

associated risk levels. The FMEA table typically includes columns for different parameters such as the failure mode description, potential causes, current controls or prevention measures, detection methods, severity of the failure mode, occurrence probability, and the resulting Risk Priority Number (RPN) or Risk Priority Level (RPL). These parameters allow for a systematic assessment of the risks associated with each failure mode and prioritize them based on their potential impact.

Evaluations for these investigations determining via FMEA methods and in accordance with experts' experience form Risk Priority Numbers- Levels (RPN-RPL) table (see Appendix 1). The RPN or RPL values in Appendix 1 indicate the relative priorities or levels of risk for each failure mode. These values are calculated based on the severity, occurrence, and detectability ratings assigned to each failure mode during the FMEA process. The higher the RPN or RPL, the higher the priority for taking corrective or preventive actions to reduce the associated risks. Additionally, you mentioned the importance of business requirements in guiding the project and ensuring alignment with client or market needs. Business requirements specify the goals and objectives that the client, corporation, or project team wants to achieve. These requirements serve as a framework for the project, guiding the development of functionality and specifications that meet the market demands. It's important to note that business requirements alone may not provide sufficient information for developers to determine exactly what to build. This is where additional inputs, such as technical specifications, user feedback, and collaboration with the project team, come into play to define the detailed requirements and guide the development process effectively. Business requirements evaluate the business goals that the client, corporation or project team wishes to achieve. The business objectives set a guidance framework for the remainder of the project. All other functionality and specifications of the company should comply with market requirements. Company specifications therefore do not have adequate information to tell developers what to build. By utilizing FMEA and considering business requirements, organizations can identify and address potential risks and failures, align their project objectives with market needs, and ensure that the final product or solution meets the desired standards and expectations. FMEA table is a valuable resource that promotes a thorough evaluation of potential risks and failures, helping researchers and engineers make informed decisions and take necessary actions to enhance the quality and reliability of their investigations and engineering measurements.

4. PARETO ANALYSIS

The range of the data may be divided into groups to create a pareto graphic. In a Pareto chart, the frequency or count of each category is plotted on the left vertical axis. The categories are listed on the right vertical axis. The categories are typically sorted in descending order based on their frequency or impact, with the most frequent or impactful category at the top. The bars representing each category are arranged from left to right in decreasing order of frequency or impact. The cumulative frequency is also shown as a line graph, usually plotted against a secondary vertical axis on the right side. The Pareto chart provides a visual representation of the distribution of the categories and helps to identify the vital few categories that contribute the most to the total count or impact. This allows decision-makers to prioritize their efforts and focus on addressing the most significant issues or factors. The frequency vertical axis on the pareto chart's left side lists the total counts for each category. The collective names of the response variables are indicated on the pareto chart's right-side vertical axis (Akın, 1996; Akın and Ozturk, 2005).

This approach entails investigating the root causes of issues in order to promote a workable solution. This method often follows the 80/20 rule. The visual aid used in Pareto analysis is the Pareto diagram. Quality oriented process development is applied in this study. In the implementation critical risk value is chosen as 80 %.

Pareto analysis (PA) focused on failures and risks that could happen when designing transportation-based sustainable engineering projects and ranked according to the severity of the risk factors with regard to the nature of each risk factor, and calculated values of relevant percentage. In this investigation, quality-oriented development of processes is used. The critical risk threshold for implementation is set at 80%. These failure modes (critical risks) are unacceptable risk factors. It must be absolutely avoided, in taking measures. Due to the severity of the risk variables in relation to the features of each risk component, Pareto analysis rated potential failures and risks which may occur while planning transportation-based sustainable engineering initiatives and computed values of pertinent percentages.

Table 2: Designed Pareto Analysis in Sustainability Assessment of Party Logistic Providers
   **(XYZ White Goods Manufacturing Business)**

	# of Failure Modes	Failure Modes Potential	Risk Priority Number (RPN)	Percentage of RPN	Cumulative of percentage of RPN	Situation
1	11	Industry knowledge and References from current customers	175	14,286	14,286	Unacceptable Risk
2	10	Risk Ability in identifying and preventing potential problems	150	12,245	26,531	Unacceptable Risk
3	5	Improve transportation consistency	150	12,245	38,776	Unacceptable Risk
4	6	Stock accounting	150	12,245	51,020	Unacceptable Risk
5	2	Return on total assets Sales over assets	120	9,796	60,816	Unacceptable Risk
6	3	Assure quality in distribution	100	8,163	68,980	Unacceptable Risk
7	8	Increased microbial activity in food due to inappropriate temperature in transport vehicles	100	8,163	77,143	Unacceptable Risk
8	9	Chemical contamination of belts due to poor rinsing after cleaning	100	8,163	85,306	Medium Risk
9	7	Contamination of the product with chemicals used in storage area cleaning and carcinogenic effect	80	6,531	91,837	Medium Risk
10	4	Able to provide guidance on time	64	5,224	97,061	Medium Risk
11	1	Foreign material contamination during stacking and storage	36	2,939	100,000	Medium Risk

In the framework of quality-oriented engineering research as seen Table 2, eleven points of control that might serve risk criteria are evaluated between existing control dimensions that could enhance risk dimensions, of which four are designated as Medium Risk degrees. These are little significant and there are benefits in taking measures. In the context of quality-oriented engineering research, the evaluation of eleven control points that can address risk criteria is crucial. Among these control points, four have been identified as having a Medium Risk level. While these risks may not be highly significant, there are still benefits in taking measures to address them. Identifying and evaluating risks in the early stages of engineering research is essential for ensuring the quality and reliability of the final product or process. By addressing these risks, you can prevent potential failures, improve performance, and enhance overall system effectiveness. Taking measures to mitigate even moderate-risk factors is important because they can still have an impact on the overall quality and performance of the system. Addressing these risks helps to minimize potential issues, increase efficiency, and reduce the likelihood of failures or negative outcomes. Implementing control measures for medium-risk factors demonstrates a proactive approach to risk management and highlights the commitment to delivering high-quality results. It allows for better control over the variables that can affect the system's performance and helps to ensure the successful implementation of quality-oriented engineering research. By evaluating and addressing risks, including those with medium significance, you can enhance the overall effectiveness and reliability of the system, leading to improved outcomes and increased stakeholder satisfaction (see Table 2).

The preventative measures that have been supplied will be evaluated for lowering the high and medium risk variables that are specified by providing referencing in the Failure Mode and Effects Analysis (FMEA) application. Risk Priority Level variables are determined to be lower as a result of the substantial protective actions stated in the FMEA, particularly during quality-oriented engineering investigations. Therefore, it is intended that high and medium risk factors be eliminated for the benefit of the advancement of research in a proper and healthy manner. The PA is added on top of the Failure Mode Effect Analysis and addresses the 75–80% important demanding barrier risk measurement. Combining FMEA and PA provides a comprehensive approach to risk management and improvement. It helps researchers and practitioners identify and address the most significant risks that have the potential to hinder progress or impact the desired outcomes. By prioritizing and mitigating these risks, the research can proceed in a more effective, efficient, and reliable manner. Overall, the integration of FMEA and Pareto Analysis

allows for a systematic and targeted approach to risk reduction and problem-solving, ensuring that the research progresses in a robust and healthy manner.

Figure 2: Pareto Analysis (PA) Chart for Assessment Logistic Sector
      (Sustainability of Supply Chain-white goods business System Problem) in Turkey
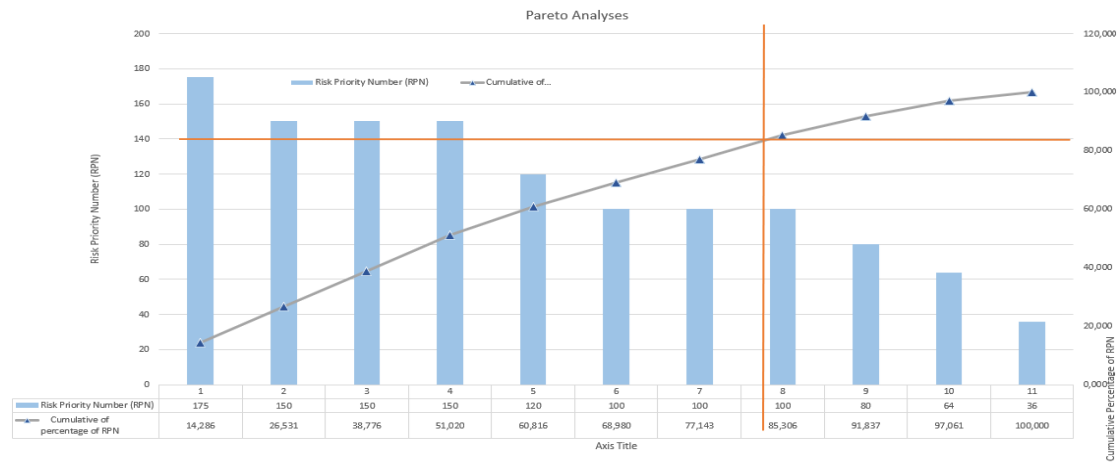
The pertinent schematic is displayed in Figure 2 and Appendix 1 and Table 2. As a result, the following are listed in priority order of importance while creating and making modifications to engineering studies that are quality-focused and seeking ordered failures and oversights:

- Industry knowledge and References from current customers

- Risk Ability in identifying and preventing potential problems

- Improve transportation consistency

- Stock accounting

- Return on total assets Sales over assets

- Assure quality in distribution

- Increased microbial activity in food due to inappropriate temperature in transport vehicles

The previously mentioned issues are found to keep out in the group of high-risk ones. When determining and evaluating the high-risk level supporting failure point sources in a Pareto analysis, conformance with 80% threshold risk variable, the first seven failure point sources precedence. This method aids in identifying the top 20% of reasons that must be addressed in order to fix the other 80% of issues.

Figure 3 demonstrates the trend observed in the Risk Priority Numbers-Levels (RPN-RPL) of identified potential errors in the system before and after implementing preventive measures as part of the FMEA procedure. The initial assessment of the RPN values indicated a high level of risk associated with these failures. However, after conducting the second risk analysis, which involved reviewing and implementing preventive measures, a diminishing trend in the RPN risk levels is observed. This diminishing trend suggests that the actions taken based on the preventive measures have been effective in reducing the severity, occurrence, and detectability of the identified failures. As a result, the overall risk associated with these failures decreases, leading to lower RPN values.

Figure 3: Before and After the FMEA Critical Risk Values (Risk Priority Numbers-RPN) Graphical Representation

FMEA APPLİCATION FOR THİRD PARTY LOGİSTİCS IN WHİTE GOODS BUSİNESS

	Foreign material contamination during stacking and storage	Return on total assets Sales over assets	Assure quality in distribution	Able to provide guidance on time	Improve transportation consistency	Stock accounting	Contamination of the product with chemicals used in storage area cleaning and carcinogenic effect	Increased microbial activity in food due to inappropriate temperature in transport vehicles	Chemical contamination of belts due to poor rinsing after cleaning	Risk Ability in identifying and preventing potential problems	Industry knowledge and References from current customers	Commitment to quality
R.P.N Before FMEA	80	252	150	100	216	245	120	210	210	210	240	180
R.P.N After FMEA	36	120	100	64	150	150	80	100	100	150	175	100

Exactly, the declining trend of RPN indicates that the implemented preventive measures have been effective in mitigating risks and improving the system's performance. The FMEA procedure allows for a systematic analysis of potential failures, their impact, and the implementation of preventive measures to reduce associated risks. By assigning RPN values to failure modes and continuously monitoring them throughout the FMEA process, you can track the progress in risk reduction. This helps in identifying the most critical failure modes that require immediate attention and prioritizing the allocation of resources for preventive actions. The declining RPN trend signifies that the implemented preventive measures have successfully reduced the likelihood and severity of potential failures. It indicates that the system's performance is improving and moving closer to the desired standards and objectives. Regularly evaluating and updating the FMEA analysis allows for ongoing improvement and ensures that the system remains robust and resilient against potential risks. It provides valuable insights into the effectiveness of the preventive measures and helps in identifying any areas that may require further attention or enhancement. Overall, the declining RPN trend in the FMEA process is a positive indication of the system's progress in risk reduction, highlighting the successful implementation of preventive measures and the continuous improvement of the system's performance. This allows for the identification of areas where further improvements can be made and helps prioritize actions to address the remaining risks. Overall, Figure 3 provides visual evidence of the positive outcomes achieved through the application of the FMEA procedure and highlights the importance of proactive risk management in enhancing system reliability and performance.

Managing the assets is different from FMEA, which is a classified decision perspective that could not be done on subjective foundation. Group elements from an FMEA might provide a unique evaluation approach. Risk factors are compiled in a most undoubtedly nonlinear manner that neither extends the scope of the risk aspects nor serves as their fundamental component. If this framework is necessary, other risk factors may be implicated. The recommended FMEA is applicable to a variety of risk criteria and is not just limited to O, S, and D.

In order to support the risks items being focused on the priority regulation of significance and the development studies for these researches to be focused on and made expeditiously, FMEA analysis plays a significant role in sustainability researches, particularly during the design stage of research. It appears that there might be some repetition in the provided statement. However, based on the information provided, it is clear that FMEA analysis plays a significant role in sustainability research, particularly during the design stage. The identification and prioritization of risk factors through the RPL are important for the sustainability of lifecycle studies. Figure 3 demonstrates the diminishing tendency of high-Risk Priority Levels (RPN) following the implementation of preventive measures as part of the FMEA procedure. This indicates that the actions taken after reviewing the preventive measures have been effective in reducing the risk associated with potential failures. The presence of the first seven important risk factors suggests that these factors require special attention and should be addressed promptly. The FMEA procedure provides a suitable approach for specialists in their field who are conducting development research.

5. CONCLUSION

Process improvement and development methods are frequently used in studies aimed at increasing productivity, performance and quality, as well as reducing transaction times, losses and costs. When target costs are exceeded due to past problems in target costing applications, implementing process improvement and development methods becomes essential to effectively control and reduce costs. In this context, if our target costs are exceeded due to some problems experienced in the past in target costing applications and these problems, process improvement and development methods can be applied to control and reduce costs. FMEA provides us with very easy but very useful data in terms of use and interpretation. Through the application of FMEA, organizations can identify potential failures in their processes, evaluate the severity and impact of each failure, determine the likelihood of occurrence, and assess the effectiveness of current controls or preventive measures. This information can then be used to prioritize improvement efforts and allocate resources effectively to reduce costs and enhance overall performance.

By utilizing FMEA alongside other process improvement and development methods, organizations can streamline their operations, identify areas for optimization, and make informed decisions to achieve their target costs while maintaining or improving the quality of their products or services.

FMEA constitutes the beginning of these methods, functionally evaluating past systems or processes, evaluating possible risks with the help of past statistical or experience-based data, and seeking answers to the question of which risks should be spent primarily to remove our scarce resources such as time, money and energy.

In this study, the risks that negatively affect the service status, do not bring profitability and increase costs have been identified, taking into account the past data and experience of our sample business. The study is based on a qualitative basis, so the relative valuation of the person or persons making the valuation directly affects the results. In addition, the accuracy of the data on recurring risks in the past is another influencing factor. The continuation of this research is the process improvement and development application. At this stage, the risks ranked according to the RPN scores given in Table-6 will be evaluated in order of importance. However, this will be discussed in another study. FMEA analysis is a method that can be used in many studies such as product, technology development, method, process improvement and development, reorganization, etc. It is foreseen that our study will contribute to the literature for the dissemination and development of such met. In this study, the risk factors that adversely affect logistics activities within the scope of supply chain management were identified and ranked with the FMEA method. As a result of the evaluation of the individual weights of the risk factors by taking into account the Risk Priority coefficients, the relative weight of the risks occurring in the measurement and evaluation phase stands out.

The results obtained from the Failure Mode and Effects Analysis (FMEA) provide valuable insights into the potential risks and failures in logistics activities. These results serve as the first step in the process improvement phase, allowing for the identification of areas that require remedial measures and further studies. By prioritizing the risks based on their Risk Priority Number (RPN) scores, resources can be allocated efficiently. Focusing on the most significant risks allows for effective utilization of scarce resources such as physical facilities, time, and money. By addressing the high-risk areas first, organizations can maximize the impact of their improvement activities and achieve more effective results. The improvement activities initiated based on the FMEA results aim to mitigate the identified risks, prevent failures, and enhance the overall performance of the logistics activities. Remedial measures can be implemented to eliminate or minimize the potential failure modes that have high RPN scores. This targeted approach ensures that the improvement efforts are directed towards the most critical areas, maximizing the chances of success. Continued improvement activities, guided by the FMEA results, enable organizations to refine their logistics processes and achieve higher levels of efficiency, reliability, and effectiveness. By systematically addressing and reducing the identified risks, organizations can enhance their operational performance, optimize resource utilization, and improve overall customer satisfaction.

In summary, FMEA results provide a foundation for process improvement in logistics activities. By focusing on the most important risks identified through the analysis, organizations can allocate their resources effectively and achieve more significant improvements in their logistics processes. FMEA can be easily applied in the early stages of product, service, system and process development/improvement activities and provides useful results. With the initial work to be done to improve the process, improvement activities and resources should be allocated according to this level of importance. Since the opportunities to be allocated for improvement development are limited, all risk factors may not be realized within a certain process. It is aimed to develop continuous improvement by repeating risk preventive studies according to the priorities to be determined each period.

REFERENCES

Akın, B. (1996). İşletmelerde istatistik proses kontrol Bilim Teknik Yayınevi, İstanbul, Türkiye.

Akın, B. and Öztürk, E. (2005). İstatistik Proses Kontrol Tekniklerinin Bilgisayar Ortamında Uygulanması. 7. Ulusal Ekonometri ve İstatistik Sempozyumu, 2-15, İstanbul.

Altunbaş, D. (2003). Uluslararası sürdürülebilir kalkınma ekseninde Türkiye'deki kurumsal değişimlere bir bakış. Yönetim Bilimleri Dergisi, 1(1-2), 103-118.

Baykasoğlu, A., Dereli, T., Yılankıran, N. and Yılankıran, A.(2003). Hata Türü ve Etkileri Analizi ve Gaziantep'te Orta Ölçekli Bir Firmaya Uygulanması, II. Makine Tasarım ve İmalat Teknolojileri Kongresi, Konya, 157-163.

Bohling, T. , Bowman,D., LaValle, S., Mittal, V. and Narayandas, G.D.(2006). CRM implementation: effectiveness issues and insights. Journal of Service Research, 9(2), 184-194.

Vietnam Third Party Logistics (3PL) Market Outlook to 2022 - By Freight Forwarding and Warehousing 3PL Services and By International Companies and Domestic Companies, https://www.kenresearch.com/automotive-transportation-and-warehousing/logistics-and-shipping/vietnam-3pl-market/145653-100.html, (Access Date: 10.04.2023).

Chang, D-S. and Sun, KLP. (2009). Applying DEA to enhance assessment capability of FMEA. International Journal of Quality & Reliability Management, 26(6), 629-643.

Chuang, PT. (2010). Incorporating disservice analysis to enhance perceived service quality. Industrial Management & Data Systems, 110(3), 1-22.

Chin, K.S., Wang, Y.M., Poon, G.K.K. and Yang J.B. (2009). Failure mode and effects analysis using a group-based evidential reasoning approach. Computers & Operations Research, 36, 1768–1779.

Dale, B.G. and Shaw, P. (1990), Failure mode and effects analysis in the U.K. motor industry: a state of the art study. Journal Quality and Reliability Engineering International, 6(3), 179-188.

Denson, W. K.,(1992). The Use of Failure Mode Distrubitions in Reliability Analyses, RAC Newsletter (Reliability Analyses Centre, a Department of Defense Information Analyses Centre), p.3.

Dizdar, E. N. (2001). Tehlike Analiz Teknikleri, Gazi Üniversitesi, Fen Bilimleri Enstitüsü, Yardımcı Ders Kitabı, Ekim, Ankara.

Dollar, D. and Kraay, A. (2001). The World Bank Development Research Group Macroeconomics and Growth April 2001, Policy Research Working Paper. https://documents1.worldbank.org/curated/en/419351468782165950/pdf/multi0page.pdf (Access Date: 10.04.2023)

Dulupçu, M. A. (2000). Sürdürülebilir kalkınma politikasına yönelik gelişmeler. Dış Ticaret Dergisi, 6(20), 46-70.

Elitaş, C. and Eleren, A. (2007). Hedef maliyetlemede hata türü ve etkileri analizi yöntemi ile risklerin değerlendirilmesi. Muhasebe ve Finansman Dergisi, 3(6), 114-124.

Eryürek, Ö. and Tanyaş, M. (2003). Hata türü ve etkileri analizinde maliyet odaklı yeni bir karar verme yaklaşımı. İTÜ Dergisi, 2(6), 31-40.

Estorilio, C, and Posso, RK. (2010). The reduction of irregularities in the use of process FMEA. International Journal of Quality & Reliability Management, 27(6), 721-733.

Ford (1992). FMEA Handbook, Ford Motor Company Engineering Materials and Standarts, Dearborn, Michigan.

Franceschini, F. and Maurizio Galetto, M. (2001). A new approach for evaluation of risk priorities of failure modes in FMEA. International Journal of Production Research, 39(13), 2991-3002.

Gray, P. and Byun, J. (2001). Customer Relationship Management, Center for Research on Information Technology and Organizations University of California, March 2001.

Greenberg, P. (2004). CRM at the Speed of Light: Capturing and Keeping Customers in Internet Real Time, McGraw-Hill, Berkeley, CA.

Gunasekaran, A. and Ngai, E. W. T. (2009). Modeling and analysis of build-to-order supply chains. European Journal of Operational Research, 195(2), 319–334.

Hamilton, K. (1995). Sustainable development, the Hartwick rule and optimal growth. Environmental and Resource Economics, 5(4), 393-411.

Hepburn, C. (2006). Valuing the far-off future: discounting and its alternatives, (Ed.) G. Atkinson, S. Dietz, & E. Neumayer, Handbook of Sustainable Development, Edward Elgar, Cheltenham, 109-24.

Ho, W., He, T., Lee, C. K. M. and Emrouznejad, A. (2012). Strategic logistics outsourcing: An integrated QFD and fuzzy AHP approach. Expert Systems with Applications, 39(12), 10841–10850.

Holweg, M. and Miemczyk, J. (2003). Delivering the 3-day car—the strategic implications for automotive logistics operations. Journal of Purchasing and Supply Management, 9(2), 63-71.

Hueting, R. and Reijnders, L. (1998). Sustainability is an objective concept. Ecological Econonomics, 27(2), 139-47.

Jayaram, J. and Tan, K.-C. (2010). Supply chain integration with third-party logistics providers. International Journal of Production Economics, 125(2), 262–271.

Kumar, S., Dieveney, E. and Dieveney, A. (2009). Reverse logistic process control measures for the pharmaceutical industry supply chain. International Journal of Productivity and Performance Management, 58(2), 188-204.

Ko, M., Tiwari, A. and Mehnen, J. (2010). A review of soft computing applications in supply chain management. Applied Soft Computing, 10(3), 661 - 674.

Liu, H.-C., Liu, L. and Liu, N. (2013). Risk evaluation approaches in failure mode and effects analysis: a literature review. Expert Systems with Applications, 40(2), 828-838.

Munasinghe, M. (1993), Environmental Economics and Sustainable Development. The World Bank, Washington, D.C., p.95. https://documents1.worldbank.org/curated/en/638101468740429035/pdf/multi-page.pdf

Pillay, A. and Wang, J. (2003). Modified failure mode and effects analysis using approximate reasoning. Reliability Engineering & System Safety 79, 69–85.

Prendergast, G. P. (1995). The EC directive on packaging and packaging waste. Logistics Information Management, 8(3), 10–17.

Rajesh, R., Pugazhendhi, S., Ganesh, K., Muralidharan, C. and Sathiamoorthy, R. (2011). Influence of 3PL service offerings on client performance in India. Transportation Research Part E: Logistics and Transportation Review, 47(2), 149–165.

Reeves, K. A., Caliskan, F. and Ozcan, O. (2010). Outsourcing distribution and logistics services within the automotive supplier industry. Transportation Research Part E: Logistics and Transportation Review, 46(3), 459–468.

Redclift, M. (2005). Sustainable Development (1987-2005): An oxymoron comes of age. Sustainable Development, 13, 212-227.

Remmel, U. (1991). Integration of marketing and logistics: a way to competitive advantage in South Africa. International Journal of Physical Distribution & Logistics Management, 21(5), 28-41.

Sahnı, A. (1993). Using failure mode and effect analysis to improve manufacturing processes. Journal of Medical Device Diagnostic, 47-51.

Sankar, NR and Prabhu, BS. (2001). Modified approach for prioritization of failures in a system failure mode and effects analysis. International Journal of Quality & Reliability Management, 18(3), 324–35.

Sezgin, M. and Kalaman, A. (2008). Turistik destinasyon çerçevesinde sürdürülebilir turizm yönetimi ve pazarlaması. Selçuk Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 19, 429-437.

Sinha, P.R., Whitmann, L.E. and Malzan, D. (2004). Methodology to mitigate supplier risk in an aerospace supply chain. Supply Chain Management of International Journal, 9(2), 154-168.

Slinger, M. (1992). To practise QFD with success requires a new approach to product design. Kontinuert Forbedring, 20-21.

Su, X., Deng, Y., Mahadevan, S. and Bao, Q. (2012). An improved method for risk evaluation in failure modes and effects analysis of aircraft engine rotor blades. Engineering Failure Analysis, 26, 164-174.

Types of Logistics & Its Difference, https://www.ithinklogistics.com/blog/types-of-logistics-its-difference/ (Access Date: 10.04.2023)

Van Leeuwen, JF., Nauta, MJ., de-Kaste, D., Odekerken-Rombouts, YMCF., Oldenhof, MT., Vredenbert, MJ. and Barends, DM. (2009). Risk analysis by FMEA as an element of analytical validation. Journal of Pharmaceutical and Biomedical Analysis, 50(5), 1085-1087.

Wang, Y.-M., Chin, K.-S., Poon, G. K. K. and Yang, J.B. (2009). Risk evaluation in failure mode and effects analysis using fuzzy weighted geometric mean. Expert Systems with Applications, 36(2), 1195-1207.

Xiao, N., Huang, H-Z., Li, Y., He, L. and Jin, T. (2011). Multiple failure modes analysis and weighted risk priority number evaluation in FMEA. Engineering Failure Analysis, 18(4), 1162-1170.

Yılmaz, A. (1997). Hata Türü ve Etki Analizi, İstanbul Teknik Üniversitesi F.B.E. Yüksek Lisans Tezi, İstanbul.

Zairi, M. and Duggan, R. (1999). Best Practice-Process Innovation Management in Slinger M (1992). To practise QFD with success requires a new approach to product design. Kontinuert Forbedring, Butterworth-Heinemann, 104-139.

Appendix 1: Comprehensive Analysis of Potential Risks and Failures to be Encountered During the Sustainability Assessment of XYX Sustainability of Supply Chain-white Goods Manufacturing Business (Party Logistic Providers) in Turkey

Firm Name

Product/Item : **Third Party Logistics in Business**

Assesment Party Logistic (for Sustainability of Supply Chain-white goods business) in _FMEA_

Model / vehicle

Process Resp.: **A**

Core Team: **AE-Project Team Members**

Key Date :

FMEA No :   **125-1**   Security Class ::

Prepared By ::   **FMEA Team**

FMEA Date :   Rev :

Proses / Steps	Function	Potential Failure Mode	Potential Effect(s) of Failure	Severity (S)	Potential Cause(s)/ Mechanism(s) of Failure	Occurrence (O)	Current Process Control Prevention	Current Process Control Detection	Detection (D)	R:P:N	Recommended Action(s)	Responsibility & Target Complet Date	Action Taken	Severity	Occurence	Detection	R:P:N
1		Foreign material contamination during stacking and storage	Pro-active in cost reduction	5	Sustainable low cost through	4	Delivery Accuracy of quantity fulfillment	Industry knowledge and References from current customers	4	80	Risk Ability in identifying and preventing potential		assess ongoing service performance.	4	3	3	36
2		Return on total assets Sales over assets	Strategic commitment to customers	6	Heavy metals and formaldehyde in stripping and depigmentation	6	Improve process responsiveness	Increase supply chain flexibility	7	252	Help to focus on core competencies.		Reduce logistics costs	5	4	6	120
3		Assure quality in distribution	Improvement in sales revenue	5	Working capital improvement	5	Capital asset reduction	Production cost reduction	6	150	Labour cost reduction		Logistics cost reduction	4	5	5	100
4		Able to provide guidance on time	Fixed Logistics asset	5	reduction Average order cycle length	5	Cash-to-cash cycle reductions	Service level improvements	4	100	Customer satisfaction		Employee morale	4	4	4	64
5		Improve transportation consistency	Risk minimisation	6	Supply chain optimisation	6	Marketing Performance Indicators	Profit margin	6	216	Return on sales		Approved supplier list Input acceptance/Specifications	6	5	5	150
6		Stock accounting	Order planning and processing	5	IT management	7	Invoicing	check every hour	7	245	Payment collection		Approved supplier list Input	5	6	5	150
7		Contamination of the product with chemicals used in storage area cleaning and carcinogenic effect	Contamination of foreign substances such as band-aids, gloves, etc. used by	4	Improve process lead time	5	Strategic Service	offerings Reliability Cost Reputation	6	120	Employee training Reliability		Cost Reputation	4	4	5	80
8		activity in food due to inappropriate temperature in transport vehicles	Value Chain Service Offerings	6	Reduce total logistics costs	5	Reduce cyle time -Increase customer satisfaction	-Possess state-of-the-art hardware and software	7	210	Able to provide guidance on time		Able to resolve problems effectively	4	5	5	100
9		contamination of belts due to poor rinsing after cleaning	Compatibility with the users	6	Flexibility in increasing production capacity	5	Service category	Perfect rate	7	210	References from current customers		Able to resolve problems effectively	4	5	5	100
10		Risk Ability in identifying and preventing potential	On Time Delivery/ Service Delivery	7	Quality Production/Service	5	Ability to meet delivery due dates	Flexibility in increasing or decreasing production capacity	6	210	Service category		Quality Perfect rate and Reliability	6	5	5	150
11		Industry knowledge and References from current customers	Value Chain Service Offerings	8	Physical equipment - Size and quality of fixed assets	5	Risk Ability in identifying and preventing potential problems	Financial stability and staying power	6	240	Key tenets of the theory (or mid-range theory)		Firms consider attributes of transactions when deciding on integrating business processes through internal governance mechanisms or	7	5	5	175
12		Commitment to quality	Reserve capacity or the ability to respond to unexpected	6	Financial stability and staying power	6	Reduce cycle time -Increase customer satisfaction	-Possess state-of-the-art hardware and software	5	180	Able to provide guidance on time		Ongoing assessment of transactions/business processes to ensure re-visiting of past decisions in favor of either internal or external governance	5	4		100

UNDERSTANDING CONSUMER CONFIDENCE EVOLUTION IN RESPONSE TO ADVERSE SHOCKS AND HOW MARKETING CONTRIBUTES TO BUSINESS SUCCESS IN ECONOMIC DOWNTURNS

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ABSTRACT

Purpose- Firstly, this paper examines how current measurements of consumer confidence might be used to forecast future household spending by using economic variable (i.e. unemployment rate, national adjusted income per capita) data in China, with the help of statistic tools (i.e. Python and Pandas) for the job of data cleaning and analyzing. Secondly, I will focus on the ways in which businesses alter their marketing mix in the face of economic hardship to survive by understanding the importance of utilizing effective marketing strategies during economic downturns.
Methodology- This paper examines the predictive performance of consumer confidence index on change in consumption growth by constructing three different OLS regression models and by integrating several existing proposals for effective marketing strategies for businesses in times of low consumer confidence to help business managers to make wise and effective response to economic downturns.
Findings- It is shown both 1 year lagged consumer confidence and 3 years lagged consumer confidence are good predictors for current change in consumption patterns, whereas 2 years lagged consumer confidence shows negative correlation with consumption change, and consumer confidence have their own predictive power regardless of the macroeconomic variables.
Conclusion- Therefore, this paper contributes to the existing literature by providing empirical findings that consumer confidence cannot always fulfill the role of anticipating consumption change and by further providing concrete policy recommendations for consumer confidence' revival during recessions in an effort to fill the gap.

Keywords: Consumer confidence, marketing, consumption, consumer behavior, forecasting.
JEL Codes: B16, B22, E21, E27, M21, M31

1. INTRODUCTION

Consumption makes up the majority of GDP in virtually every economies and is thus crucial to comprehending the dynamics of economic activity. The private consumption in China is increasing in recent decade as it plays an important role in Chinese economy (Figure 1). However, information about the economy's true state is released with a significant delay. For this reason, timely data, such as consumer confidence indices, can serve as useful predictive signals of long term economic development. The Survey Research Center (SRC) at the University of Michigan in the United States developed the index of consumer sentiment in the 1940s to empirically quantify the confidence of consumers. Consumer confidence indexes were later introduced by the Conference Board of Canada in 1967. Both indices have proven to be remarkably beneficial due to wealth of data provided by end users. In the middle of the twentieth century, consumer confidence index became a standard economic measure due to the strong correlation between consumer confidence and household spending. Consumers may be less likely to spend money if they are experiencing the effects of a tight financial situation or have pessimistic expectations about their future family's financial state. This follows the Precautionary Savings Theory, which theorizes that when income is uncertain, people will accumulate more assets. Accordingly, we should see more current spending in comparison to future spending when consumer confidence is strong, since the former predicts the latter. As a result, the traditional life-cycle or permanent-income theories of consumption are not contradicted by the concurrent association between consumer confidence and private consumption. Neither does it automatically simplify the task of

predicting future spending patterns. From the perspective of an economic prognosticator, it is of importance to determine whether consumer confidence has any independent predictive power for future changes in household expenditure, and how business can adopt effective marketing strategies to survive during the economic downturns.

Figure 1: China's Private Consumption: % of GDP, 2011-2020

Private Consumption: % of Nominal GDP: Annual: China
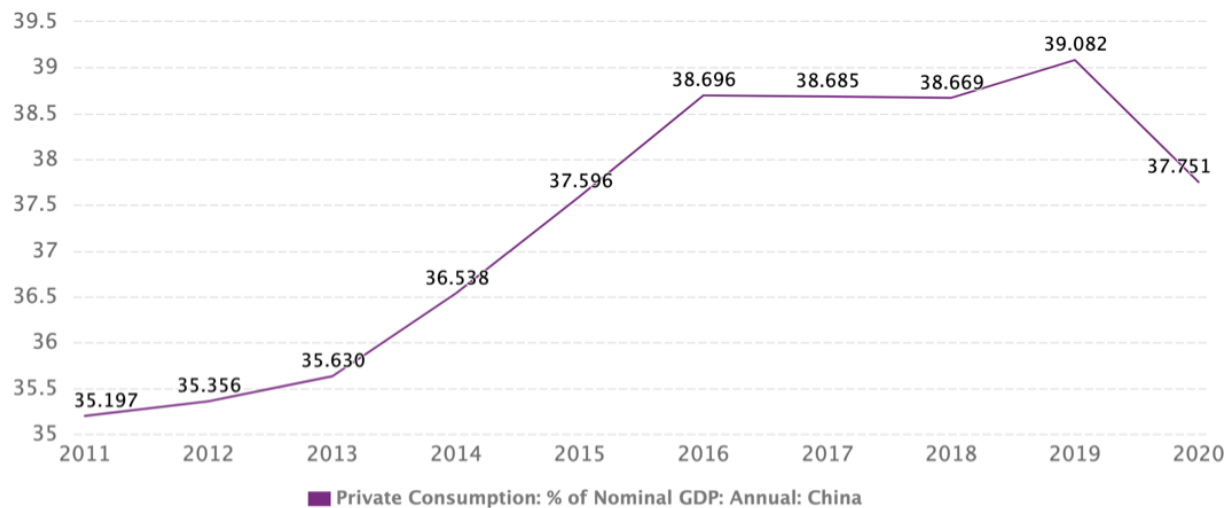
Source: CEIC Data (2018), an ISI Emerging Markets Group Company. www.ceicdata.com/en/indicator/china/private-consumption--of-nominal-gdp

The consumer confidence index's most valuable characteristic is that it serves as the first piece of publicly available data on consumer behavior, making it an essential instrument for understanding the factors that ultimately determine the level of real consumption. For this reason, it is used by most economic agents in their predictions (i.e. the stock market responds swiftly to the official launch of the consumer confidence index because it reveals future consumption and growth). Understanding the factors that influence this index could also help us draw more accurate conclusions about its relevance to household spending. Noticeably, the consumer confidence index has become increasingly vital in recent years, despite the fact that its major determinants remain unclear. The widespread agreement about the index's ability to explain variance in real consumption trends validates this finding. There is a rising number of scholars demonstrated that real consumption estimations are strengthened by the use of the consumer confidence index. This finding appears to hold true for numerous nations around the world, including the USA (Desroches & Gosselin, 2002), the EU (Demirel & Artan, 2017), Turkey (Karasoy Can & Yüncüler, 2018), Belgium (Beltran Lopez & Durré, 2003), Brazil (Ghosh, 2020), Nigeria (Oduh et al., 2015), South Africa (Khumalo, 2014), and Croatia (Kuzmanović & Sanfey, 2012).

Between 2000 and 2022, the complexity of commercial markets increased. The correlation between consumer confidence index and private consumption can be affected by a number of external factors, including financial instability and stock market volatility (Figure 2). The housing bubble in the United States, which exploded in 2008 due to the subprime mortgage crisis. Global economic instability was exacerbated by a decline in US dwelling-related assets. Canadians life was transformed because of the country's close ties to the United States. Meanwhile, the stock market's dismal view is a fundamental result of the economic recession. As a result, the correlation between consumer confidence index and household spending may weaken as the stockholders, which are the consumers, takes on greater risk. However, there is debate about whether or not consumer confidence actually helps anticipate future consumption expenditures. In reality, it has been shown through out-of-sample forecasting exercises (e.g. Bram & Ludvigson (1998); Ludvigson (2004)) and Croushore (2005) that confidence does not add statistically significant information to that included in other macroeconomic and financial variables. The majority of these investigations rely on information collected in the United States.

According to Ferrell & Hartline, "if businesses want to succeed, they need to create a plan or road map" to get there (2002)". The ever-evolving situation serves as the starting point for any effective marketing plan. Finding the optimal

marketing mix is crucial for any successful company. It is widely known that the four components of a successful marketing strategy are the "4Ps" (Product, Price, Place, and Promotion) (Wang, 2006). According to Nilson (1995), market leaders and challenger brands are treated differently when it comes to developing a strategy in a dynamic market. While market leaders must move with the flow and gradually adjust to the new circumstances, innovative challengers might use the situation to their advantage by rapidly adapting to new circumstances. The market is volatile, and in times of crisis or other environmental shifts, businesses need to adjust their strategy and marketing mix to maintain or increase their market share. Kieth Roberts (2003) presented research showing that businesses that maintain or raise their marketing spending during a recession perform much better than those who cut costs, both during and after the recession.

Figure 2: China's Consumer confidence index, 2000-2022
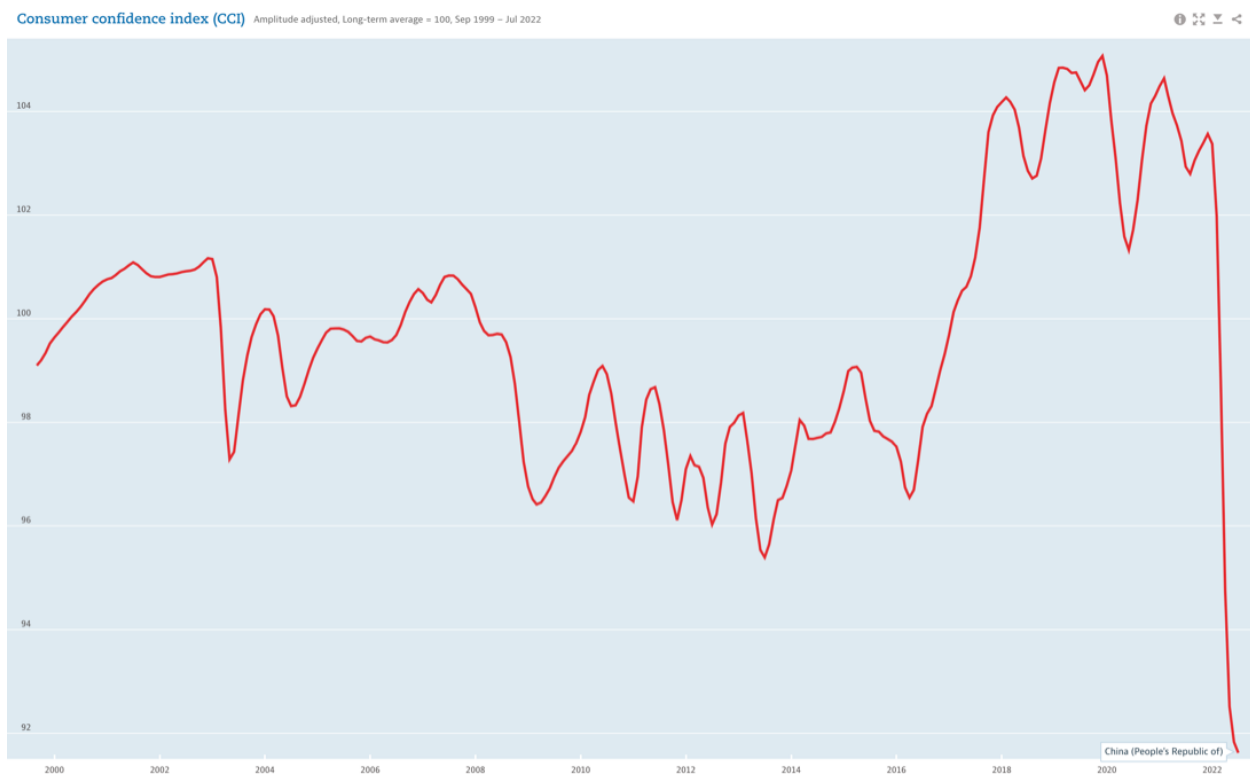
Source: OECD(2023). Business tendency ad consumer opinion survey. Main economic indicators database. www.oecd-ilibrary.org/economics/data/main-economic-indicators/business-tendency-and-consumer-opinion-surveys_data-00041-en

Given that the marketing mix, or 4Ps, is the medium through which businesses implement and adapt to their strategies. Companies must consider marketing strategies prior to and during a recession if they are to become resistant to external shocks or emerge from it successfully. Numerous studies have examined the relationship between marketing techniques and economic downturn, but they all take a slightly different approach. Latham and Braun (2009) state that despite the extensive literature on recessions, only a handful of studies have explored the problem of how to assist businesses during a crisis. Based on the past studies, the performance of firms in dealing with the business risks and challenges posed by the Covid-19 crisis is highly correlated with the degree to which these firms have implemented successful marketing techniques and strategies (Fuciu, 2020). The profitability and survival of businesses during the epidemic hinges on their ability to make successful marketing decisions. Managers need understanding about marketing practices that will enable them to succeed throughout and after the Covid- 19 pandemic, when the market will be extremely unstable.

Therefore, I have a dual objective. Firstly, I will examine how current measurements of consumer confidence might be used to forecast future household spending by using economic variable (i.e. unemployment rate, national adjusted income per capita) data in China, with the help of statistic tools (i.e. Python and Pandas) for the job of data cleaning and analyzing.

Secondly,I will be on the ways in which businesses alter their marketing mix in the face of economic hardship to survive by understanding the importance of utilizing effective marketing strategies during economic downturns. I will arrang this report in six sections, I will discuss relevant literature in Section 2, and the description for the data used in the investigation will be introduced in Section 3. I will include the method of the research in Section, which contains both theoretical and empirical approaches, and I will share the empirical findings in Section 4. Lastly, I will draw conclusion based on the results in Section 4 and evaluated the limitations and suggestions for future economic scholars in Section5.

2. LITERATURE REVIEW

2.1. Usefulness of CCI in Consumption Context

Several literatures has proved that by utilizing consumer confidence index, and it is possible to forecast private consumption within an economy. A research done by Li (2016) shows that at the national scale, the consumer confidence indexes are capable of predicting total consumption to a considerable degree. For most spending categories, such as durables, non-durable products, and services, the incremental predictive power of consumer confidence indexes is positive. At the provincial level, the lagged confidence indexes effectively explain the spending in most provinces' various consumption categories. However, for national-level data, the introduction of other control variables in the model diminishes the incremental predictive ability. Another investigation done by Kłopocka (2016) suggests that some consumer confidence indices (subjective indicators) appear to have predictive power exceeding macroeconomic variables (objective indicators) and are valuable for assessing and anticipating domestic saving and borrowing activities. In the case of South Africa (Khumalo, 2014), Ng-Perron tests are used to determine the relationship between consumer confidence and consumer expenditure. The outcomes of the regression indicate that consumer confidence and economic expansion have a positive effect on consumer consumption, and as a consequence, aggregate expenditure will increase when consumer confidence in the economy is prominent. The overall findings of the research demonstrate that both the private and public sectors have a significant impact on total consumption. This implies that policymakers should examine the welfare effect of consumer optimism and can utilize consumer confidence in the future to estimate persona spending behaviours. Similarly, in Italy, the least financially liberalized country and one where collateralization of housing stays very tough, represents the only country in which recent housing price surges have been strongly correlated with the rising the consumer confidence in the nation (AL-EYD et al., 2009). Likewise, Bruno (2012) finds an asymmetric threshold effect in the context of durables, which allows one to foresee a dramatic drop in this category of consumption provided that confidence is below a particular threshold. The empirical evidence reveal that the consumer confidence index has a high level of explanatory power for both durable and non-durable goods, but is of little relevance for semi-durable goods. When confidence is examined in lagged conditions, it becomes evident that services have boosted. Anticipating entire consumption directly is one area where confidence becomes effective. According to Ghosh's research, the Brazilian CCI is a prominent measure of household consumption spending. Along with other macroeconomic factors, they have uncovered a long-term strong link. Consumers effectively utilize the data at their reach to change their prior assumptions. They draw the central conclusion that, in addition to other macroeconomic indicators often used to forecast consumption behavior, consumer confidence might be a significant explanatory component of expenditures of Brazilian consumers. It has been shown in their paper that CCI is more reliable as a predictor of future price movements during economic downturns. Their research also provides support for the idea that consumers' reactions to various equilibrium situations are asymmetrical through the use of the asymmetric error correction model. Moreover, their findings are consistent with those of Bovi (2009), who investigates the concept of psychological bias related to individual consumption. Finally, Kuzmanovi and Sanfey (2012) draw the conclusion that the index of Croatian consumer confidence is explanatory of retail turnover, which is highly correlated with GDP activities and domestic imports.

The use of consumer sentiment is well-known in most countries across the globe, as it is considered as a similar measure to consumer confidence index. The ability of lagged consumer sentiment to explain recent shifts in household expenditure has been verified in the past (D. CARROLL et al., 1994). While following periods' expenditure will still be lower than they would have been without the disruption, the consumption growth rate will be higher as the importance of additional deposit declines due to the expanding stock of assets. Therefore, current economic uncertainty will have a negative effect on consumption growth whereas lagged uncertainty would have a positive effect.

Although numerous studies verified the explanatory power of consumer confidence in predicting future consumption, there are plenty of research suggests that it is not effective to use consumer confidence for forecasting private consumption all the time, but do in exceptional periods. According to work by Desroches and Gosselin (2002), confidence

indices don't tell us much about what Americans will spend as a whole in the future. During times of high volatility, their study reveals, changes in consumers' levels of confidence have a notable impact on their purchasing behavior. Notably, these findings are robust after accounting for discretionary income, which may indicate that confidence provides additional information under challenging conditions. Their study has demonstrated the usefulness of these indices by highlighting the extreme fluctuations that are recorded during exceptional periods. It is during situations of considerable uncertainty that confidence indices are most likely to effect expenditure. Stephane and Pedro's (2011) findings further demonstrate that the consumer confidence index is a robust predictor of spending under certain conditions. In example, their out-sample data demonstrates that consumer confidence adds explanatory weight to private consumption when household survey variables undergo substantial swings, suggesting that confidence indicators may gain in predictive ability at such periods. Similarly, Kuzmanovi and Sanfey (2015) begin by investigating the short-term forecasting ability of confidence indexes during the past two decades. The results reveal substantial variation in the primacy of confidence across nations and time periods. During times of financial hardship particularly in countries that had more severe downturns, like Italy and Portugal, consumer confidence indexes have a stronger predictive power. In addition, the sub-index measuring expectations for one's own financial situation turns out to be even more predictive than the customers' overall confidence in France. Moreover, they provide evidence that unexpected changes in customer confidence are a separate cause of business cycle oscillations. Results from Oduh's research (2012) indicate a positive correlation between consumer confidence and budgeted household expenditures. While changes in the price of food tend to catch the attention of consumers more than those of durable goods, both present and foreseeable income have a positive effect on spending behaviors; nevertheless, as consumers look farther into the medium and long term, the impact of income on anticipated expenditures weakens. If consumers' income is unpredictable for an extended period of time, they will likely cut spending rather than increase it. This means that the short run marginal propensity to consume (MPC) is significantly higher than the long run MPC, which is both unexpected and descriptive. And this is induced by increase in pessimism towards future. It is worth pinpointing that the explanatory power of lagged consumer confidence indexes on future expansion of total consumer spending was demonstrated in a 2018 study by Karasoy Can and Yüncüler. As soon as other financial and economic factors that are thought to affect consumption growth are incorporated into the models, the models' predictive power either falls or disappears altogether. Even when additional indicators are taken into account, CNBC-e's ability to predict increase in overall consumption and CBRT's and propensity to Consume Index (PCI)'s predictive ability in the growth of nondurable consumption remain unchanged. Consequently, consumer confidence might offer useful insights into how to increase consumption, however this will rely on the precise meaning assigned to the term 'consumer sentiment'. The effect of consumer attitude on foreseeable total growth momentum was not supported by their findings, which were contrary to the predictions of the permanent income hypothesis and the precautionary savings incentive. For goods that won't last forever, which are the nondurables, the evidence is weak.

Nonetheless, few past scholars states that consumer confidence index do not have any explanatory power to explain future consumer expenditure significantly based on their empirical findings. Adopting the most up-to-date data, Croushore (2005) conclude that consumer confidence indexes are substantial in some specifications, but that there is no indication that using these indexes significantly improves projections in any specification. These findings imply that consumer confidence indices can be disregarded by economists when attempting to predict consumer expenditure. However, the results are inconclusive because they are dependent on the accuracy of the prediction model. They have only used models that have already been employed by past researchers in their practice exercises. Better predictive methods, if they can be found, might be able to demonstrate that consumer confidence indices do, in fact, have marginally considerable explanatory power. In addition, consumer confidence indexes may potentially serve a useful use in anticipation. Monthly releases of the indexes provide data that can be used to forecast quarterly consumption patterns. Although, in order to put this theory to the test, they will need to utilize distinct tools and frameworks. Surprisingly, there are two studies demonstrated that consumer sentiment failed to forecast consumer spending patterns both in the short run and long run (Haniff & Masih, 2016; Cotsomitis & Kwan, 2006). According to Haniff and Masih's research, consumer sentiment's usefulness in predicting short-run private consumption is predicated on the fact that it can reveal information not found in other financial and economic factors. Based on their paper's ECM-ARDL findings, real purchasing power of consumer is a key factor in real household consumption, consumer sentiment and the index of real stock. Additionally, there is no correlation between consumer sentiment in long run or short run real consumer consumption. These results may indicate that the information obtained from consumer sentiment is already captured by other financial and economic elements. Since the index of consumer sentiment does not appear to add anything to the scenario, it cannot be relied on to forecast private consumption in the foreseeable future. Likewise, Cotsomitis and Kwan found that the in-sample incremental predictive power of CCI and ESI varies significantly across the European nations they surveyed. In addition, the findings of their out-of-sample

experiments suggests that these confidence indices offers minimal information regarding the future route of consumer expenditure. Their paper serves as a cautionary tale to European politicians and economic analysts who rely on the Consumer Confidence Index and the Economic Sentiment Index to anticipate rising consumer expenditure in the EU region.

2.2. Marketing Strategies in Era of Low Consumer Confidence

The importance of economics concepts to marketing strategies during economic downturns, when the consumer confidence index is low, is illustrated by Marks et al (2012) and Ou et al (2013). Mark's group's research report emphasizes the utility of macroeconomic and industry-specific data in formulating a marketing plan for a period of recession. Moreover, given the diversity of industries, it can be crucial for marketers to have an in-depth knowledge of their own sector's facts and present outlook while debating the course of their campaign. Meanwhile, the results of Ou's research suggest that varying levels of consumer confidence moderate the positive benefits of customer equity drivers on loyalty intentions. Customers with lower consumer confidence tend to place a higher premium on value equity in all sectors, giving credibility to the anecdotal belief that these customers are more wary and sensitive than their more confident counterparts during economic downturns. The effects of customer equity drivers are moderated by consumer confidence more in non-contractual than in contractual contexts. In contractual contexts, customers may have varying levels of confidence since it is more challenging for them to adjust their behavior in accordance with their desires. Whether an organization operates in a contractual or non-contractual scenario has an impact on how loyalty initiatives are adapted. In addition, they observe that contractual firms are more abnormal than non-contractual firms, while finding a trend that value equity is helpful for boosting customer loyalty for clients with weaker consumer confidence across service industries. In light of these findings, it is clear that contractual firms need to exercise greater caution than non-contractual enterprises when employing value equity as a technique to enhance poor consumer confidence and customer loyalty.

Surprisingly, numerous studies demonstrated that recession is considered as an great opportunity for marketing and hence leading to potential growth of firms, which contradicts the traditional view of cutting down marketing cost during periods of downturn. There is a great chance to boost retention during a downturn by gradually honing company's multi-channel communication strategies. Companies can methodically learn which value-based offerings appeal most with specific clients by adopting a real-time marketing strategy (Ginn et al., 2010). Srinivasan's research in 2002 confirms claims from the business press about corporations such as Microsoft, BMW and Dell using economic downturns to their advantage through strategic advertising campaigns. The results of their study imply that there are also short-term benefits of utilizing effective marketing strategies. They conclude that proactive marketing has both a direct and indirect impact on company success. Therefore, it is a positive sign that their research shows companies can reap returns on marketing expenditures made during a recession even before it's finished. Their findings also imply that not all businesses take preventative measures during economic downturns. During a downturn, companies are more likely to increase their marketing efforts if they have a strong emphasis on marketing, an entrepreneurial culture, flexible resources, and the freedom to reallocate them. Their findings suggest that proactive marketing helps to moderate the impact of its organizational forebears and offers a substantial rationale for performance in a down economy. Research conducted in 2014 by Akyüz and Ercilasun reaches the same conclusion. Companies shouldn't ignore the benefits a down economy might provide. Maintaining a vigorous marketing campaign during a crisis may help a company stand out from the competition, who are likely to cut back on their own marketing campaign as a result of the economic climate. Since most businesses are cutting back on advertising strategies, this can be the ideal time to get the firm's name out there. As a result, even in a recession, a company that invests heavily in advertising has a better chance of increasing its market share, maintaining its brand's visibility, and expanding its customer base. Businesses who put money into advertising during a downturn will see a rise in sales both while the economy is in a downturn and after it has recovered. Notta (2014) also utilized simple linear regression analysis to discover the connections between the dependent variables and the independent factors in his investigation of the effects of marketing strategy variations on firm performance. Her findings demonstrate the effectiveness of advertising techniques of Greek dairy companies prior to and throughout the economic crisis. While costly television ads reduce the profits of successful corporations in the years leading up to a crisis, the lower costs of magazine advertisements can boost those profits once the crisis has hit. According to Malley et al (2011)'s research, spending money on marketing during tough economic times increases long-term profitability, customer loyalty, and shareholder value. It seems that companies that cut costs lose ground to their competition. Proactively responding companies, on the other hand, get the most advantages, especially if their rivals do not retaliate due to defensive cost-cutting. Preparing for and responding effectively to such challenging situations is not only possible, but also vital. During a downturn, stepping up marketing activity could prove especially rewarding.

There is, however, a single research that argues that, depending on the specifics of the firm's circumstances, a downturn can either be a fantastic opportunity or a disaster. The emergence of new consumers necessitates the development of alternative approaches for customer segmentation, as well as the development of products and marketing tactics that are specifically targeted to the needs of these groups. Remember that every recession hits different sectors of the economy and business in distinct ways. Consequently, recessions may produce severe obstacles for some businesses or industries while providing advantages to others. As a result, entrepreneurs need to keep a careful eye on the markets, assess whether or not the recession poses a threat to their company and their industry, and then swiftly adjust their plans accordingly. When considering whether or not to take proactive measures in this unpredictable market, businesses must take into account not just the external environment, such as competition and evolving consumption pattern, but also their internal environment, including their resources, cultures, etc (Civi, 2013).

A plethora of studies shows that businesses may thrive even during economic downturns, provided they employ the right marketing techniques. Whether or not a company is prosperous in all times depends largely on marketing methods with respect to its main industry. However, macroeconomic factors do not diminish the performance of marketing programs. Growth of the sales team and promotion are two examples of marketing activities that are beneficial at any point in the business cycle, although cautious expansion is more relevant to the growth phase. It is possible for a company to survive a downturn with consistent marketing efforts. Pearce and Michael (1997) offers multiple suggestions to startup businesses: First of all, preventing a loss in revenue during a downturn requires first guaranteeing continued marketing efforts for the core business. Second, grow with prudence and an eye on marketing efficiency throughout the peak season. In a nutshell, a company's pre-recession status matters because it boosts the firm's resilience against the forces of disaster. Similarly, Grundey (2009) claims that a firm can lessen its vulnerability to brand risk by diversifying the strategies it employs to establish and promote its brand, and it can decrease the likelihood that its consumers will leave for a competitor by acquiring more of their personal data and utilizing it to effective use. The paper's mini-cases of Nike, Nokia, Kellogg's, Chrysler, and the global hotel network show that there are a variety of techniques that can be used to establish and sustain brands in order to compete successfully on a global scale. These strategies include: mean- ing management; brand extension; glocalization; global brand consistency; brand awareness; brand investment maintenance; and meeting customers' needs. Several viable marketing tactics are presented by Ang (2020) in his research. To improve productivity by capitalizing on resource-saving tools like public relations and social media and to recognize a more value- conscious customer, businesses must be more focused, identify target segments more precisely, cut non- essential costs by pruning marginal product lines and channels, and greater spread of information of the goods to decrease the perceived financial risk of consumers. Asian enterprises that want to succeed need to look beyond their own region and into less conventional markets. They must to take their marketing and commercial dealings with customers and clients more seriously and develop some professionalism. They should take advantage of consumers' desire to buy regional products by fostering the growth of local businesses. When it comes to marketing strategy, Asian companies should think in the long-term. Successful Asian companies will be the ones who find and capitalize on market chances throughout the region's current period of uncertainty. Lastly, Oana (2018) discovered that a company's resources and long-term goals need to be considered when developing a communication strategy, which in turn requires a clear understanding of the company's image in the eyes of its target audience. Further, the marketing communication experts' awareness of the way in which consumers perceive external stimuli, specifically of the influential aspects that determine the appearance of overt behavior, is of greatest importance in choosing the proper communication skills according to the features of the target users.

Following the breakout of COVID- 19, the companies that put the most resources into marketing programs had the best chance of becoming victorious. As a result of the COVID- 19 crisis, there have been substantial shifts in customers' expectations and buying patterns, making it more more crucial for a business to constantly experiment with new marketing techniques. As shown in Figure 3, the marketing tactics that businesses should adopt to survive and flourish both before and after the pandemic were listed (Nikbin et al., 2021). Polat and Nergis's 2011 research also gives a specific example of a marketing strategy that might be employed during a downturn, suggesting that businesses should think creatively about how they can reach out to customers. The growing awareness among consumers about the significance of reducing their products' negative effects on the environment (Neff, 2019) has led to an increase in the importance consumers place on a company's commitment to its social responsibilities and the degree to which it demonstrates this commitment when purchasing goods (Quelch & Jocz, 2009). The term "social responsibility," "social media," and "green marketing" all rise to prominence, but in ways that differ from past research.

Figure 3: Marketing Strategies during Covid-19 and Recessions

Product
- Avoid cutting R&D costs and emphasise more on it
- Withdraw non-profitable products
- Redesign product lines
- Introduce new and also affordable products
- Emphasise durability and functionality characteristics in new product development
- Reduce the size of non-food products
- Increase the size of food products
- Improve services

Price
- Keep the same prices, but offer products with higher quality/offer superior value
- Do not reduce the price by reducing quality.
- Reduce the price by reducing the size.
- Keep the original price and offer temporary price discounts

Marketing Mix Strategies During COVID-19 and Recessions

Promotion
- Offer price discount
- Increase advertisement and promotion budget
- Reduce the costs of traditional advertisement
- Invest more in online marketing
- Invest more in social media marketing
- Offer coupons, bonuses, and free sample
- Use of celebrities for product launch
- Send direct mails to customers

Place
- Find new profitable markets.
- Eliminate costly channels and intermediates
- Move to online channels
- Leave markets that you are not strong in it and reallocate scarce resources on markets in which you are stronger in them

Source: Asia-Pacific Journal of Business Administration, https://www.emerald.com/insight/publication/issn/1757-4323

However, adjusting business's marketing approach is just as crucial as putting in place the right marketing strategies during a recession to ensure continued success. In order to fulfill the demands of the market and win the loyalty of their customers, businesses must revise the components of their marketing mix in response to the dramatic shifts in the market condition (Alina & Lelia, 2012). Because of its low barrier to entry and high return on investment, pricing is the element that can be altered with the greatest frequency and least amount of hassle (Ferrell & Hartline, 2002). The companies in the study are aware of this since they have all adjusted their prices in some way. Additionally, in their work, Ang et al. (2000) detail two distinct approaches to pricing during economic downturns. The first involves charging market rates for goods of a better quality in order to sustain that high standard. By offering low pricing on daily necessities, the company may maintain or expand its market share with the support of the second method. One thing to keep in mind about advertising during a recession is that firm shouldn't reduce its advertising budget (Koksal & Ozgul's, 2007). Both Real and Carrefour want to increase their usage of offline commercials as a means of enhancing their two-way communication with consumers. Commercials displayed in-store and customer loyalty programs are excellent strategies for maintaining and, ideally, deepening relationships with existing buyers (Nistorescu et al., 2009).

It is undeniable that social media contributes to marketing largely during recession and maintain businesses' success (Kaur, 2020). Maintaining and expanding brand recognition and customer interactions are two areas that can greatly benefit from the use of social media (Morrissey, 2008). Strategically expanding various forms of advertising could unlock enormous long-term possibilities for businesses (Malley et al., 2011). Interactive marketers continue to employ some type of social media, and other businesses plan to spend more in social media (Owyang et al., 2009). As a result, social media provides many relative advantages, such as efficiency, its low cost, and longevity. Businesses of all sizes can benefit more from social media than from traditional advertising methods. It's the most efficient means of communicating with clients around the world and gathering their thoughts. Organizations of all size, from startups to multinationals, can benefit from advertising their goods online at the lowest price possible, or even for free, as a means of surviving in the market until the economy recovers (Kirtis & Karahanb, 2011). According to Suharto (2021)'s research, e-commerce customer satisfaction, e-commerce customer loyalty, and e-commerce customer satisfaction all have significant effects on each other. Posting content that can intrigue consumers' interest on Instagram is the single most important indicator of the personalization

dimension's value in developing social media marketing. Therefore, businesses in the e-commerce sector can encourage consumer to recommend their Instagram accounts to others by posting engaging con-tent that is both informative and entertaining. Indirectly, this can raise consumer confidence and increase the reach of information. By keeping and improving the consistency between product descriptions and actual conditions, businesses in the e-commerce industry can win back the trust of their customers. E-commerce businesses can rely on the support of brand-loyal customers to help ensure the market's continued growth and success. This is due to the fact that consumers are more likely to shop online during recessions and make repeat purchases there if they have a positive experience. In Liang (2022)'s study, it is demonstrated that using the celebrity impact, which adopts an influencer marketing technique, will be advantageous for persuading consumers to purchase, and it will assist businesses in generating profits during a recession. The appeal of information relates to consumers' psychological states and buying intention, according to their findings on recommendation credibility. Based on their study, celebrities' consistency with a good increases the credibility of their product suggestions. Additionally, they found a positive correlation between a recommender's credibility and the recommendation's. The influencer marketing sector must explore how to pick the proper influencer. The influencers they chose must have particular traits: their personal experience demonstrates they are trustworthy, and their charisma attracts followers who trust their product recommendations . In term of their empirical contributions to the field of marketing, their findings strongly indicate that marketing teams must never ignore the importance of social media to brand-consumer relationships. Marketing staff should thoroughly develop and manage social media product information. High source trustworthiness improves consumers' purchasing moods and buying intention, according to their research. A company's partnership with a famous person boosts sales, brand exposure, and product awareness. Their research suggests that corporations should strongly consider working with beautiful celebrities for marketing. To choose the ideal celebrity partners, a marketing department must guarantee that the celebrities "fit" the recommended product. It is necessary to find a reliable partner as consumers' psychological states and buying intentions depend on recommendation trustworthiness.

2.3. Suggestions for Marketing in the Future

Marketers of the future will prioritize sustainability and the digital world (Danciu, 2013). To a greater extent than in the past, global environmental conditions will be influenced by transformations. In the future, international and regional factors will both be increasingly significant in marketing. Using inventory sharing and regional or global mapping, consumers are able to not only locate nearby deals, but also view detailed information about those deals in real time, shop for discounts based on their own tastes, and receive personalized recommendations. By 2020, consumers are expected to have an average of seven Internet-connected devices, and other predictions put that number as high as 50 billion (Mengerink, 2011; Goodson, 2012). Without a digital marketing plan, firms risk losing a big portion of their target audience and consequently, a lot of sales. Convergence is necessary if the organization is to maintain profitability and success in an era of decreased spending, cost cutting, and a search for bigger, more long-lasting influence. Social marketing's ultimate goal is to encourage consumption change that is better for the environment and the economy. This could serve as an incentive for lowering expenditure and strengthening sustainable development. However, the pricing system is insufficient to balance the needs of the economy with those of the environment and sustainability. That's why sustainable consumption studies need a bigger role in future marketing. Every company that wants to prosper in the coming decades must master the skill of marketing in order to successfully bring together seemingly different needs and meet them with appropriate solutions. Marketers for these companies need to focus on both revenue maximization and environmental sustainability (Nassar, 2012). Successful firms understand that brand maintenance, customer experience enhancement, and competitive differentiation are the keys to long-term marketing success. Multi-dimensional marketing–scientific, psychological, social, spiritual, and durable–must be tried by enterprises in the coming decades (Kjaer, 2012). In order to effectively communicate with their customers, businesses need to concentrate on social media. It is crucial for the organization to obtain a digital power. Enterprises need to increase production of environmentally friendly products and services until they account for the bulk of sales. Finally, organizations should assess their current pricing structure and consider how they can make sustainable solutions cost about the same.

3. DATA AND METHODOLOGY

3.1. Data

In order to fully investigate the effect of external shocks on consumer confidence and consumption growth, the data span the period 2006Q1 - 2020Q4. Change in household consumption is the dependent variable, whereas the lagged household consumption change, consumer confidence index, change in unemployment rate and change in national

adjusted income per capita are the dependent variables for the investigation. Due to the scarcity of housing price data in China, this element is not included in this study.   For data such as household consumption, consumer confidence index are downloaded from OECD Data (https: / / data. oecd. org/) , while unemployment rate and national unemployment per capita are accessed to general public on World Bank Catalog https: / / datacatalog. worldbank. org/ home. I will use both monthly data and yearly data, which all being transformed to monthly data for the purpose of easiness of making comparisons. Table 1 presents the summary statistics of change in consumption and the independent variables, whereas Figure 4 displays the correlation matrix between these variables.

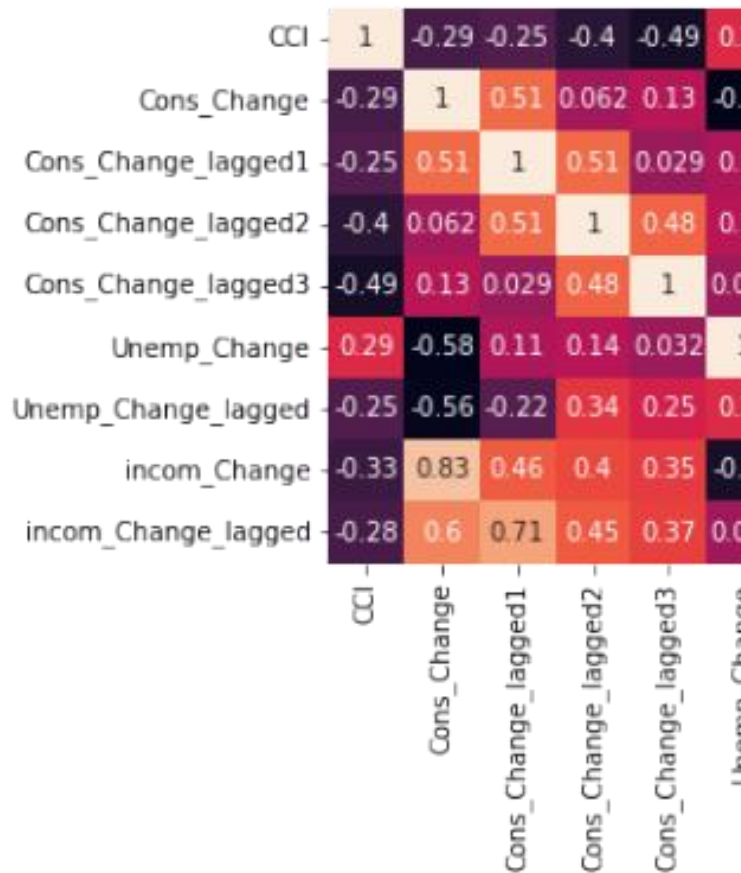**Figure 4: Correlation Matrix Heat Map**

Table 1: Summary Statistics

	count	mean	std err	Min	Max
CCI	166.000	99.483	2.753	95.395	105.068
CCI_ lagged	166.000	99.459	2.728	95.395	105.068
Cons_ Change	166.000	0. 100	0.044	-0.011	0. 177
Unemp_ Change	166.000	0.009	0.039	-0.040	0. 106
Cons_ Change_ lagged1	166.000	0.111	0.032	0.064	0.177
Cons_ Change_ lagged2	166.000	0.115	0.032	0.064	0.177
Cons_ Change_ lagged3	166.000	0.116	0.032	0.065	0.177
Unemp_ Change_ lagged	166.000	0.001	0.029	-0.040	0.056
incom_ Change	166.000	0.073	0.026	0.017	0.140
incom_ Change_ lagged	166.000	0.081	0.024	0.057	0.140

3.2. Theoretical Framework of Consumer Spending

The conceptual model for the effect of consumer confidence on the future household consumption is motivated by work in the behavioral economics literature on modern theories of consumption(Ghosh, 2020). This section outlines this conceptual model to formalize the effect of consumer confidence on household spending patterns. To better focus on the impact of consumer confidence on future consumption, I simplified the model by abstracting away dynamic considerations, permanent income, real labor income, and consumption in the previous model.

Modigliani, Brumberg, and Friedman's Permanent Income Hypothesis (PIH) from the 1950s suggests that people concentrate their long-term utility. In this way, the PIH suggests that people spread out their spending across time rather than immediately responding to fluctuations in their income. In this view, consumers are less likely to adjust their spending when they believe that fluctuations in their income would be short-lived. According to the research done by Hall (1978) and Flavin (1981), the impact of shifts in confidence indicators on future consumption is small. Therefore, it is possible to explain, based on the pertinent information that is readily available to the customer, that the household spending decisions of the t-th period are already determined in the spending of the (t-1)th period or in S_t. Therefore, $(S_{t-1} - S_t)$ is a expression of spending behavior in the t-th period based on old information regarding the adjusted income in the (t-1)th period.

As stated by the PIH, consumer spending is directly proportional to a person's permanent in- come. Respectively, it can be inferred that

$$S_t = Y_{a_t} \tag{1}$$

where S_t shows the household spending during t-th time period, and Y_{at} is the adjusted income of consumer. Consequently, there is a balance between consumption and adjusted income throughout all time periods. Income after adjustments is the present value of cash flow and possessions,

$$Y_{a_t} = r[P_t + \sum_{t=0}^{\infty} d^{i+1} Ex_t D_{t+i}] \tag{2}$$

where r denotes the adjusted interest rate after inflation, W_t indicates the actual value of possessions at the start of period t, d is the rate of interest after discount. Based on the nature of the data available to consumers at time t, Ex displays the expectation parameter and D_{t+i} represents the household disposable income.

The random wall behavior modified by Hall in 1978 states that consumers make their current purchasing decisions based on the predicted current value of the flow of future earnings rather than on their actual, immediate cash flow. In order to maximize their expected utility, consumers must take into account their inter-temporal budget constraint. The temporary utility function of this hypothetical buyer is supposed to be divided through all time periods, with segments depending on the products purchased during different time periods. Following equation demonstrates the temporary utility function of the consumer:

$$U(S) = E_t \sum_{t=0}^{\infty} (1 + \zeta)^{t-1} U(S_t) \tag{3}$$

where S denotes the total spending of the representative consumer, E represents the expectations, which are based on the knowledge available during the timespan t, ζ represents the discount rate at the subjective level. Therefore, the third equation shows the discounted expected utility.

Furthermore, the equation (3) can be maximised subject to an inter-temporal budgetary restriction, and thus the first-ranking condition is presented as:

$$E_t U_m(S_{t+1})(1 + \delta)/(1 + \zeta) = U_m S_t \tag{4}$$

in this equation, U_m represents the marginal utility of consumer spending, which demonstrates the equation of Euler consumption. The marginal consumption utility for today is equal to the present value of the predicted marginal utility of spending for tomorrow, in accordance with the Euler consumption equation. Consequently, the current consumer spending is affected by past consumer's spending behavior. The real rate of interest, denoted by δ, is supposed to be equivalent to the discount factor, denoted by ζ, associated with the customer. When this marginal utility consumption function's dependent variables and independent variable is proved to be in a linear correlation, the Equation(4) can be reworked to:

$E_t S_t = S_{t-1}$ (5)

Equation (5) suggests that past consumer spending patterns are the most accurate indicators of present ones, and it can be further converted to:

$S_t \cdot S_{t-1} = \epsilon_t$ (6)

Equation (6) is an demonstration of a regression of individual spending's growth, where ϵ denotes the forecast error term under rational circumstance and it has no connections to data that people at time t would normally be familiar with. This last equation demonstrates the only thing that can be used to estimate the difference between today's and yesterday's consumption is the forecast error epsilon.

3.3. Empirical Model of Consumption Change

This subsection introduces the baseline model of measuring change in consumer consumption using Ordinary Least Squares (OLS) methodology. I will examine the effect of consumer confidence with addition of other economic variables (i.e. Unemployment rate, National adjusted income per capita) on change in private expenditure.

The following equation can be used to estimate shifts in consumer spending by linearizing the consumption function I discussed above in terms of economic factors.

$\Delta C_t = \alpha + \beta_1 \Delta C_{t-1} + \zeta_1 CCI_{t-1} + \eta_1 \Delta Unem_t + \lambda_1 \Delta Inc_{t-1}$ (7)

whereby ΔC_t denotes the change in consumer consumption in the t-th time period, ΔC_{t-1} represents the lagged variable for consumption change in one year. It is well known that consumer confidence index plays an essential role in predicting consumer spending, therefore CCI_{t-1} denotes the consumer confidence index in the timespan t-1. Economic indicators such as $\Delta Unem_t$ that demonstrate the change in unemployment in one year, ΔInc_{t-1} that shows the lagged variable for change in national adjusted income per capita in one year are included in this regression model.

The second regression model can also act as an tool to evaluate the change in consumer consumption spending by linearizing the function I mentioned in Section 3.2.

$$\triangle C_t = \alpha + \beta_2 \triangle C_{t-1} + V_2 \triangle C_{t-2} + \zeta_2 CCI_{t-1} + \eta_2 \triangle Unem_t + \lambda_2 \triangle Inc_{t-1} \tag{8}$$

here, $\triangle C_t$ denotes the change in consumer consumption in the t-th time period, $\triangle C_{t-1}$ represents the lagged variable for consumption change in one year, $\triangle C_{t-2}$ shows the lagged variable for consumption change in two years. Similarly, CCI_{t-1} denotes the consumer confidence index in the timespan t-1. Economic indicators such as $\triangle Unem_t$ that demonstrate the change in unemployment in one year, $\triangle Inc_{t-1}$ that shows the lagged variable for change in national adjusted income per capita in one year are included in this regression model.

$$\triangle C_t = \alpha + \beta_3 \triangle C_{t-1} + V_3 \triangle C_{t-2} + u_3 \triangle C_{t-3} + \zeta_3 CCI_{t-1} + \eta_3 \triangle Unem_t + \lambda_3 \triangle Inc_{t-1} \tag{9}$$

In the last model, $\triangle C_t$ denotes the change in consumer consumption in the t-th time period, $\triangle C_{t-1}$ represents the lagged variable for consumption change in one year, $\triangle C_{t-2}$ shows the lagged variable for consumption change in two years, $\triangle C_{t-3}$ denotes the lagged variable for consumption change in three years. Likewise, CCI_{t-1} denotes the consumer confidence index in the timespan t-1. Economic indicators such as $\triangle Unem_t$ that demonstrate the change in unemployment in one year, $\triangle Inc_{t-1}$ that shows the lagged variable for change in national adjusted income per capita in one year are included in this regression.

3.4. Robustness Check

Separating consumer confidence into a fundamentals-based component and a sentiment based component allows me to further investigate the premise that consumer confidence represents sentiment irrespective to economic fundamentals. The methodology I employ, which is comparable to that of Lemmon and Portniaguina (2006), is as follows: First, I will conduct a regression analysis of consumer confidence in relation to a number of current macroeconomic variables:

$$CCI = \delta_4 \triangle Unem_t + \epsilon_4 \triangle Inc_t \tag{10}$$

By establishing equation(10), I am able to capture the dependency of consumer confidence index on macroeconomic variables such as unemployment rate and national adjusted income per capita. In this equation, $\triangle Unem_t$ represents the change in unemployment rate in t-th time period, whereas $\triangle Inc_t$ shows the change in income in the timespan t.

To continue, I use the residual in Equation (10) as a gauge of inappropriate optimism or pessimism in consumer confidence. Then, I investigate the predictive potential of this high consumer confidence for future spending:

$$\triangle C_t = \beta_5 \triangle C_{t-1} + CCI_{res} + \eta_5 \triangle Unem_t + \lambda_5 \triangle Inc_t \tag{11}$$

With the construction of equation(11), I take in consideration that part of consumer confidence index is not dependent on macroeconomic variables, which are the residuals of the regression. In this particular equation, $\triangle C_{t-1}$ denotes the consumption change in lagged one year, CCI_{res} shows the residuals of consumer confidence index, and the remaining variables kept the same meaning with that of equation(10).

4. FINDINGS

This section presents the results obtained from the aforementioned empirical specification. For the sake of brevity, I only report our results for the most crucial factors. The fundamental trend is that the consumer confidence index correlates strongly with the shift in consumption, however this relationship is not statistically significant in model 2

TABLE 4: Regression Results of Model 1, 2 and 3

Change in consumption	Model 1	Model 2	Model 3
Cons_Change_lagged1	0.3917***	0.5026***	0.6908***
Cons_Change_lagged2		-0 3548***	-0 4675***
Cons_Change_lagged3			0.2702***
CCI_lagged	0.0014*	1.598e-05	0.0012
Unemp_Change	-0.7439***	-0.6848***	-0.7144
incom_Change_lagged	0.8054***	0.8683***	0.6615***
No Observations	166	166	166

Df Residuals	161	160	159
Adj. R2	0.764	0.805	0.821
Estimator	OLS	OLS	OLS

*p≤0.05, **p≤0.01, ***p≤0.001

Model 1 – The first regression model in table 4 incorporates variables such as the lagged value of consumer confidence index, change in unemployment rate, change in consumption for lagged in 1 year and the lagged value of income change. Among these elements, change in unemployment rate and change in consumption for lagged in 1 year and the lagged value of income are regarded as macroeconomic variables that affects consumer confidence. The assumption is that the lagged value of consumer confidence index will be positively correlated to change in private consumption, and other economic factors also contributes to change in consumption.

As the findings show, the data add credibility to the theoretical framework. Given the results in table 4, it can be deduced that one unit increase in the consumption change for 1 year lagged will lead to 39% upturn for change in consumption, with p-value statistically significant at 5%. Therefore, it verifies the initial assumption that made in previous paragraph and is in line with most literature findings presented in Section 2. Other factors that remain statistically significant includes the lagged change in income, with p-value reaching 0.1% significance and shows positive coefficient in the regression, and it also demonstrates a positive relationship with the dependent variable (change in consumption). Lastly, the adjusted r-square value for model 1 is 0.76, which enhances that this model is suitable for the data obtained and the reliability of interpretation of the results will be strengthened.

Model 2 -The second regression model in table 4 includes one more variable – the lagged value of consumption change in 2 years. Based on the theory presented in Section 4.1, consumers spending patterns nowadays depend on their consumption behavior in the past and they are the most effective indicators of present consumption. Therefore, I add this variable to test the second hypothesis – the lagged value of consumption change in 2 years also has positive relationship with consumption change.

The performance of the results presented in table 4 appears to disprove the initial assumption, where only the consumption change for 1 year lagged shows positive correlation with consumption change with p-value statistically significant to 0.1%. The adjusted r-square value is boosted by 4% comparing to model 1, suggesting that this model is more capable of carrying out the experiments.

Model 3 - The third regression model adds another lagged variable for consumption change in three years, in order to test the conjecture of whether or not consumer's spending behaviors nowadays are still determined by their consumption change in the lagged 3 years time. I assumed that the lagged value of consumption change for three years will not have obvious positive relationship with current consumption change due to the fact that the development of the society transforms people's spending pattern at a vast pace.

However, the surprising findings demonstrates an opposite stand to the hypothesis. Based on the results in table 4, it can be inferred that one unit expansion of consumption change for lagged 3 years will raise the value of consumption change by 27% with p-value statistically significant to 0.1%, indicating that the consumption change for lagged 3 years still contributes to current consumption change, whereas the negative coefficient of lagged value for consumption change for two years reveals a negative correlation with consumption change. Finally, the adjusted r-square value escalates by 2% compared to model 2, suggesting that this model fits the data better than previous one, leading to higher reliability of results drawn.

Table 5: Robustness Check Results of the Change in Unemployment Rate and Change in Income

	Coef	Std err	t	P>|t|
Intercept	101.3133	0.707	143.238	0.000
Unemp_ Change	11.7098	5.847	2.003	0.047
incom_ Change	-26.4648	8.838	-2.994	0.003
	No.Observations	**Df Residuals**	**Adj. R2**	**Estimator**
Model 1	166	163	0.119	OLS

Robustness model 1 - Table 5 displays the estimated outcomes for Equation (10). Both measures of confidence are statistically significantly predicted by the present unemployment rate and by the national adjusted income per capita. The

adjusted r-square for the regression is around 12%, which means that only tenth of the variance in consumer confidence can be accounted for by underlying economic factors.

Table 6: Robustness Check Results of 1 Year Lagged in Consumption Change, the Lagged Residual of Consumer Confidence Index, the Change in Unemployment Rate and Change in Income

	Coef	Std err	t	P>|t|
Intercept	-0.0086	0.006	-1.410	0.161
Cons_Change_lagged1	0.4639	0.061	7.664	0.000
CCI_res_lagged	0.0012	0.001	2.017	0.045
Unemp_ Change	-0.4311	0.049	-8.726	0.000
incom_ Change	0.8377	0.084	10.003	0.000
	No.Observations	Df Residuals	Adj. R2	Estimator
Model 2	166	163	0.800	OLS

Robustness model 2 - Table 6 displays the predicted outcomes of Equation (11). All of the variables' estimated coefficients are statistically significant. Overall, I find evidence supporting the hypothesis and draw the conclusion that confidence measurements not only stand in for other basic factors that leads to business cycle variations, but also have predictive ability on their own.

5. CONCLUSION

Recent years' market fluctuations brought up the importance of understanding consumer confidence to make effective marketing strategies during times of high uncertainty. This study finds evidence that consumer confidence has predictive power for future consumption behavior, which is consistent with the results from a variety of past scholars in the field of consumer economics. However, there are few studies focusing on incorporating the use of consumer confidence index for implementing corresponding marketing mix for businesses' survival during recessions. I will examine the predictive performance of consumer confidence index on change in consumption growth by constructing three different regression models and integrated several studies' contribution to marketing strategies for business in era of low consumer confidence to help business managers to make wise and effective response to economic downturns. Variables such as consumer confidence index, lagged consumer confidence index, 1 year lagged change in consumption , 2 year lagged change in consumption, 3 year lagged change in consumption, change in unemployment rate, lagged changed in unemployment rate, change in income and lagged change in income are included in the regression models to explore the predictive power of consumer confidence on consumption change.

I included several hypotheses in the investigation: (1) 1 year lagged consumer confidence index will be positively correlated to change in private consumption, and other economic factors also contributes to change in consumption. (2) The lagged value of consumption change in 2 years also has positive relationship with consumption change. (3) The lagged value of consumption change for three years will not have obvious positive relationship with current consumption change. (4) Business cycle fluctuations can be explained by a variety of fundamental variables, but consumer confidence indicators also have their own predictive power. I tested the conjectures above using OECD and World Bank data.

Firstly, using Visual Studio Code, I combined and analyzed data from the two sources stated in the previous paragraph covering the time period 2006Q1 to 2020Q4. Due to the scarcity of monthly unemployment rate data in China, I uses the yearly data to make identical monthly data for unemployment rate instead given the assumption that the monthly unemployment rate will be kept the same through one year. Secondly, I built three different ordinary least square models to examine the relationship between consumer confidence index and change in consumption by adding one addition lagged control component in the next model. Thirdly, I perform a series of robustness tests to ensure the reliability of the main conclusions. For instance, I decompose consumer confidence into two components, one rooted in fundamentals and one reflecting consumer sentiment unrelated to fundamentals, to deal with the problem that consumer confidence index reflects knowledge that are already enclosed in economic fundamentals like unemployment rates and national adjusted income per capita. The findings, which imply that past confidence measures do in fact contain meaningful information for current consumption predictions, still hold after this robustness test. Finally, I uses the empirical findings to verify the assumptions and come up with conclusions.

Most of the initial hypothesis is proven to be correct based on the empirical findings presented in Section 6. In particular, results in table 4 supports the (1) hypothesis as the signs for both lagged consumer confidence index and 1 year lagged

change in consumption are positive. However, (2) hypothesis contradicts with the results demonstrated in table 5, where there is a negative correlation between 2 year lagged change in consumption and consumption change. This results may be caused by a huge change in people's income or personal preferences of spending. Surprisingly, the results shown in table 6 disprove (3) hypothesis, where the sign of 3 year lagged change in consumption is positively correlated with consumption change and it could be the outcome of stable economy conditions with no significant change in three years lagged. Lastly, (4) hypothesis is verified in table 8, which is the robustness check results of the regression model.

In the literature review section, I combine the theories of numerous studies in order to help businesses to survive in periods of recession by utilizing effective marketing tools. In contrast to the common belief that businesses should reduce their marketing budgets during recessions, a large body of academic research has shown that this time of economic uncertainty can really be a golden opportunity for marketing, ultimately leading to prosperity. Nonetheless, it is worth to keep in mind that businesses should choose suitable marketing strategies that are specific to their market conditions wisely instead of adopting the general measures that most businesses does. Sustainable practices and digital innovation should be at the most crucial factors for future marketers to consider. Both global and local aspects will play an ever-increasing role in the future marketing landscape.

6. LIMITATIONS AND IMPLICATIONS

Although this study does make a contribution, it has some obvious problems, the most apparent being the very small size of the sample used. If a more trustworthy result is desired, the remaining 166 data selected between 2006Q1 and 2020Q4 for examination provided by the OECD and the World Bank are insufficient. Information on home prices, wealth, and interest rates in China is also unavailable, therefore these elements are left out of the analysis. In order to effectively represent the dependence of consumer confidence on macroeconomic variables, the literature gap of using additional economic variables with consumer confidence to explore their effects on consumption behavior still needed to be filled. As a result, I wish researchers in the future will make use of a wider range of economic indicators to investigate the impact of consumers' confidence on their spending habits in a longer time period.

In addition, this study excludes the potential predictive power of the consumer confidence index on the purchasing behavior of consumers in different economic downturns, which is a significant limitation as I only focus on general consumption patterns. For instance, the 2008 crisis was one of the worst economic downturns at the beginning of the 21st century, leading to the closure of countless businesses. Considering this, it would be intriguing to compare the 2008 crisis's predictive power to that of the recent COVID-19, in order to determine which event was more catastrophic and to evaluate whether or not the lagged consumer confidence is useful for predicting future consumption behavior. Therefore, I recommend future researchers to break down the large time frame and explore thoroughly into the various economic downturns to examine the impact of consumer confidence on consumption patterns.

7. SOCIAL PROBLEMS AND POLICY SUGGESTIONS

It is important for government to implement effective policy to alleviate the impact of unexpected shocks on consumer confidence. Policymakers in the major economies should work together to revive and maintain confidence levels, and changes in confidence indicators play a critical role in investors' risk assessments, so it's crucial to consider the many implications on this qualitative macroeconomic measurement. Volatility in the economic cycle, the corresponding movements in employment and unemployment levels and corporate investment intentions are among the most prominent factors that have the ability to produce noticeable changes in consumer confidence (5 Factors That Impact Business and Consumer Confidence, 2016). For example, to boost worker skills during COVID-19 without raising the risk of viral spread, governments should be able to make supply-side policy adjustments, such as offering free remote training. Further, in order to motivate businesses to hire more people, the government could subsidize those companies who made the fewest redundant staffing decisions. As a result, employees will feel more secure in their employment and continue to be productive despite the harsh economic climate, leading to sustained economic growth and high levels of consumer confidence.

REFERENCES

5 Factors that impact business and consumer confidence. (2016, May 25). Www.macquarie.com.au. https://www.macquarie.com.au/advisers/business-consumer-confidence-australia.html

Ang, S. H., Leong, S. M., & Kotler, P. (2000). The Asian apocalypse: crisis marketing for consumers and businesses. Long Range Planning, 33(1), 97–119.

CEIC Data. (2018, June). China Private Consumption: % of GDP. Ceicdata.com; CEICdata.com. https://www.ceicdata.com/en/indicator/china/private-consumption--of-nominal-gdp

Civi, E. (2013). Marketing strategies to survive in a recession. International Journal of Business and Emerging Markets, 5(3), 254-261.

Croushore, D. (2005). Do consumer-confidence indexes help forecast consumer spending in real time? The North American Journal of Economics and Finance, 16(3), 435–450.

Danciu, V. (2013). The future of marketing: an appropriate response to the environment changes. Theoretical and Applied Economics, 20(5), 33–52.

Demirel, S., & Artan, S. (2017). The causality relationships between economic confidence and fundamental macroeconomic indicators: empirical evidence from selected European Union Countries. International Journal of Economics and Financial Issues, 7(5), 417–424.

Duralia, O. (2018). Integrated marketing communication and its impact on consumer behavior. Studies in Business and Economics, 13(2), 92–102.

Flavin, M. A. (1981). The adjustment of consumption to changing expectations about future income. Journal of Political Economy, 89(5), 974–1009.

Ghosh, S. (2020). Consumer confidence and consumer spending in Brazil: A nonlinear autoregressive distributed lag model analysis. Journal of Economic Theory and Practice, 20(1), 53–85.

Ginn, J., Stone, M., & Ekinci, Y. (2010). Customer retention management in the recession. Journal of Direct, Data and Digital Marketing Practice, 12(2), 115–127.

Grossberg, K. A. (2009). Marketing in the Great Recession: an executive guide. Strategy & Leadership, 37(3), 4–8.

Hall, R. E. (1978). Stochastic implications of the life cycle-permanent income hypothesis: theory and evidence. Journal of Political Economy, 86(6), 971–987.

Karasoy Can, H. G., & Yüncüler, Ç. (2018). The explanatory power and the forecast performance of consumer confidence indices for private consumption growth in Turkey. Emerging Markets Finance and Trade, 54(9), 2136–2152.

Khumalo, J. (2014). Consumer spending and consumer confidence in South Africa: cointegration analysis. Journal of Economics and Behavioral Studies, 6(2), 95–104.

Kirtiş, A. K., & Karahan, F. (2011). To be or not to be in social media arena as the most cost-efficient marketing strategy after the global recession. Procedia - Social and Behavioral Sciences, 24, 260–268.

Kłopocka, A. M. (2016). Does consumer confidence forecast household saving and borrowing behavior? evidence for Poland. Social Indicators Research, 133(2), 693–717.

Ludvigson, S. C. (2004). Consumer confidence and consumer spending. Journal of Economic Perspectives, 18(2), 29–50.

O'Malley, L., Story, V., & O'Sullivan, V. (2011). Marketing in a recession: retrench or invest? Journal of Strategic Marketing, 19(3), 285–310.

OECD. (2015). Business tendency and consumer opinion surveys. OECD ILibrary. https://www.oecd-ilibrary.org/economics/data/main-economic-indicators/business-tendency-and-consumer-opinion-surveys_data-00041-en

Srinivasan, R., Rangaswamy, A., & Lilien, G. L. (2005). Turning adversity into advantage: Does proactive marketing during a recession pay off? International Journal of Research in Marketing, 22(2), 109–125.

Suharto, S., Junaedi, I. W. R., Muhdar, H. M., Firmansyah, A., & Sarana, S. (2022). Consumer loyalty of Indonesia e-commerce SMEs: The role of social media marketing and customer satisfaction. International Journal of Data and Network Science, 6(2), 383–390.

DETERMINATION OF THE BEST TRANSPORT ALTERNATIVES BY ENTROPY BASED WASPAS METHOD: A COMPARATIVE STUDY ON CROSS-COMPETITIVE ROUTES

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ABSTRACT

Purpose- Users typically choose the option that is most convenient for them in terms of time or cost based on their preferences when multiple options are presented on the same line. In this regard, users' preferences are significantly impacted by the product components given by competing travel options. The aim of this study is to evaluate the criteria that are considered to be effective in competition and user preferences in transport corridors where there is cross-competition, and to rank the routes according to these criteria.
Methodology- In this context, transport corridors in Turkey and some European countries have been selected. The criteria evaluation of the selected routes was carried out using the Entropy method and then the ranking of the routes was carried out using the WASPAS method.
Findings- It can be seen that the London-Manchester air route is ranked first, while the Paris-Lyon air route is ranked last in the study. Taking into account the HSR ranking, the London-Manchester corridor is in first place, as in the airline sector. Among the selected routes, the Ankara-Istanbul HSR corridor is ranked the last. When it comes to bus transport, the Ankara-Istanbul route is in the top position. On the other hand, the Berlin-Frankfurt corridor comes last.
Conclusion- The results of the research are important in terms of understanding the factors that are effective in cross-competition By considering the performance criteria of these routes and their respective weightings, it can inform decisions related to the regulation of fares or the development of investment programmes to enhance the competitiveness of public transport modes such as High Speed Rail (HSR). In essence, this research fills a gap in transport decision studies by providing a comprehensive analysis of routes across all modes and providing actionable insights for policy makers.

Keywords: Cross competition, transportation modes, airline, WASPAS, entropy.
JEL Codes: D61, L91, L93.

1. INTRODUCTION

Cross-competition in the transportation industry refers to competition between several modes of transportation or among various transport providers (Airline, Coach or High Speed Rail: HSR) operating within a single mode. Competition for passengers or freight as well as initiatives to draw in and keep consumers are all included. The competitive environment may significantly affect the transportation system's effectiveness and efficiency. Additionally, there is cross-competition in the transportation industry, particularly in the distribution of transport flows among various modal subsystems (Costescu, 2018). Government rules and regulations are just one of the many variables that might affect competition in the transportation industry (Vilakazi, 2018). On the other hand, when multiple options are offered along the same route, consumers typically choose the one that best suits their needs in terms of cost or time. In this regard, users' preferences are significantly influenced by the product components provided by competing transport options.

Decisions related to the transport sector affect almost all aspects of human life in contemporary societies. Additionally, decisions are continually needed in the transportation sector, from strategic planning of projects and policies, to designing infrastructure projects, to choosing between alternatives, to putting specific policies into place (Yannis et al., 2020, p. 414). Therefore, decision-making is a crucial component of managing transport systems and typically entails steps like identifying current issues, defining the issue, and coming up with potential solutions (Karleuša et al., 2013, p. 620).

Complex decision making is an unavoidable part of any transport project. A large range of potential alternatives (answers to a stated issue) are available in addition to the numerous major repercussions that are present, many of which are frequently

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expressed in quantitative and qualitative terms (economic, environmental, technical, geographical, and social aspects) (Macharis & Bernardini, 2015, p. 177). There are occasions when a lot of parties are involved in the decision-making process. The decision-making process is complicated by all of these factors (Janic, 2003). Modeling, organizing, and structuring technologies give decision-makers an advanced tool for increasingly complex circumstances. It is possible to analyze several alternative projects or variants in accordance with various quantitative and qualitative criteria thanks to the Multi-Criteria Decision Analysis Aid (MCDA), which is derived from operations research (Stoycheva et al., 2018; Hansson et al., 2019).

Looking at the research in the literature, it is seen that there are many studies that use multi-criteria decision making methods in the field of transport, but some of them focus on areas such as pairwise comparisons (Sirikijpanichkul et al., 2017), while others focus on the evaluation of urban transport alternatives (Fearnley et al., 2018). Although there are studies that evaluate all transport modes together, it can be seen that these studies also examine areas such as transport policy (Hey et al., 1999), investment decisions (Cavone et al., 2018) or freight transport (Kopytov and Abramov, 2012). Unlike other studies, this study focuses on real corridors with similar characteristics where cross-competition in passenger transport exists.

The purpose of this study is to prioritize the factors that are thought to be important for user preferences and competitiveness in cross-competitive routes and to identify which route is superior in terms of these factors. Entropy and WASPAS approaches, which are among the multi-criteria decision-making techniques, were used to assess the effectiveness of a few selected routes in Turkey and Europe that had similar characteristics.

The remainder of the study is structured as follows. Firstly, a summary of the literature on the subject is given. This is followed by the methodology section, which presents the methods and data used in the analysis. The third section provides information on the application and explains the research findings. Finally, the conclusion and recommendations section is presented.

2. LITERATURE REVIEW

There are many studies in the literature on transport where more than one mode is evaluated together. Some of these are listed in Table 1.

Table 1: Literature Summary

Authors (Year)	Method	Scope
Giuliano (1985)	ELECTRE	Santa Ana corridor in CA, USA
Hey et al. (1999)	REGIME	Common EU transport policy
Tsamboulas and Kopsacheili (2003)	AHP-MAUT	Athens Olympic Games transportation policies
Arslan (2009)	Fuzzy AHP	Selection of appropriate transportation projects
Shelton and Medina (2010)	AHP-TOPSIS	El Paso, Texas transportation improvement
Ramani et al. (2010)	AHP-MAUT	Nonlinearity in Transportation Planning
Sawadogo and Anciaux (2011)	ELECTRE	Intermodal transportation in green supply chain
Kopytov and Abramov (2012)	AHP	Multi modal freight transport system
Hickman et al. (2012)	MCA	Oxfordshire sustainable transport
Barfod and Salling (2015)	AHP-SMARTER	Most attractive alternative between D-S
Cavone et al. (2017)	TPN-DEA	Intermodal terminal in Bari
Cavone et al. (2018)	Fuzzy DEA	Intermodal terminal planning with uncertainty
This Study	*ENTROPY-WASPAS*	*Ranking of 6 European city pair routes*

Note: AHP: Analytic Hierarchy Process; TOPSIS: Technique for Order Preference by Similarity to Ideal Solution; MAUT: Multi-attribute utility theory; TPN: Timed Petri Nets; ELECTRE: Elimination and Choice Expressing Reality; WASPAS: Weighted Aggregated Sum Product Assessment; MCA: Multi-criteria assessment; D-S: Denmark-Sweden; SMARTER: Simple Multi-Attribute Rating Technique Exploiting Ranks.

Giuliano (1985) used the ELECTRE method to identify criteria for transport investment planning in a case study of a transport corridor in Orange County, California. The results show that the method identifies a small set of significantly different best compromise transport investment alternatives. Hey et al (1999) evaluated scenarios for European transport policy using the REGIME multi-criteria decision making method and formulated some strategic policy implications for future EU policy.

Three commonly used MCDM methods are the foundation of the evaluation framework presented by Tsamboulas and Kopsacheili (2003), which offers a thorough framework for the strategic assessment of instruments for spatial and environmental transport policy. To assist in the selection of suitable transportation projects for implementation, Arslan (2009) proposes a decision support model that integrates public involvement and public supervision using the Fuzzy AHP technique. A streamlined methodology for rating transportation projects using an integrated multi-criteria decision making (MCDM) procedure for prioritizing transportation projects is presented by Shelton and Medina (2010) in their research.

Ramani et al (2010) evaluated the impact of considering the non-linearity of the selected value functions in order to develop a multi-attribute utility theory approach for transport planning applications. As a result of the research, it was concluded that non-linear value functions can differentiate project outcomes. Sawadogo and Anciaux (2011) evaluated intermodal transport in a green supply chain using the ELECTRE method. Kopytov and Abramov (2012) presented the AHP method as the most appropriate approach for comparative evaluation of different routes and modes of freight transport. Hickman et al. (2012) examined the selection of alternatives for sustainable transport in the context of the Oxfordshire case study. Barfod and Salling (2015) aimed to identify the most attractive transport alternatives between Denmark and Sweden using AHP and SMARTER methods. Cavone et al. (2017) analysed intermodal terminal planning with TPN-DEA and Cavone et al. (2018) analysed intermodal terminal planning under uncertainty conditions with Fuzzy DEA.

3. DATA AND METHODOLOGY

3.1. Entropy Weighting Method

In multi-criteria decision making, the weighting process is performed in two different ways, either objective or subjective. The determination of criterion weights is a common problem in many multi-criteria decision making (MCDM) techniques. It is important to pay special attention to the objectivity factor of criterion weights, considering that criterion weights can significantly affect the outcome of the decision making process (Odu, 2019, p. 1449). Objective weighting is more preferable because it provides healthier results in terms of analysis. Nowadays, many objective weighting methods are used together with MCDM. One of the most preferred methods among these objective methods is the entropy method (Zou et. al., 2006; Liu et. al., 2010). Although the entropy method was first proposed by Rudolf Clausius, it was not widely used. Later, the entropy method was used in the field of information by Shannon in 1948 (Wu et al., 2011, p. 5164). Wang et al. (2005) were the first to use the entropy method as a weighting method. The application steps of the entropy method are as follows (Wang and Lee, 2009, p. 8982).

Stage 1: The first step in the entropy method is to normalise the decision matrix..

$$p_{ij} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}} \tag{1}$$

In the above equation; the value "*j*" represents the criteria, "*i*" the alternatives, "*x_{ij}*" the utilities and "*p_{ij}*" the normalised values.

Stage 2: In the second stage of the entropy method, the weight value " e_j " is calculated.

$$e_j = -k \sum_{j=1}^{n} p_{ij} ln p_{ij} \tag{2}$$

In the above equation, the value of "k" is calculated by the formula $(\ln (n))^{-1}$.

Stage 3: In the last step of the entropy method, after the " e_j " value and "*1- e_j* " values are calculated, the weight value " w_i " is calculated.

$$w_i = \frac{1 - e_i}{\sum_{i=1}^{m}(1 - e_i)} \tag{3}$$

In the above equation, the sum of " w_i " values is equal to 1.

3.2. Waspas Ranking Method

The WASPAS (Weighted Aggregated Sum Product Assessment) method, developed by Zavadskas et al. (2012), is defined as an integrated sum product assessment (Alinezhad and Khalili, 2019). The Waspas method, which is frequently used in MCDM, is a method that emerged as a result of the combination of the Weighted Sum Model (WSM) and the Weighted Product Model (WPM) models (Chakraborty and Zavadskas, 2014, p. 2). The Waspas method measures the performance of decision alternatives according to the relevant criteria by using the criterion weight value in multi-criteria decision problems and ranks the alternatives from best to worst as a result of the measurement (Chakraborty et al., 2015). The application steps of the Waspas method are described below (Chakraborty and Zavadskas, 2014: 2-3).

Stage 1: As in the entropy method, the decision matrix in the Waspas method is formed by Equation (4).

$$Y = \left[y_{ij}\right] = \begin{bmatrix} y_{11} & y_{12} & \dots & y_{1n} \\ y_{21} & y_{22} & \dots & y_{2n} \\ \dots & \dots & \dots & \dots \\ y_{m1} & y_{m2} & \dots & y_{mn} \end{bmatrix} \tag{4}$$

Stage 2: In the second step of the Waspas method, the relevant alternatives are normalised using equation (5) if they are cost-oriented or equation (6) if they are benefit-oriented.

$$\text{For cost-orientated criteria; } n_{ij} = \frac{x_{ij}}{max_i x_{ij}} \quad i = 1, 2, \dots m \text{ ve } j = 1, 2, \dots n \tag{5}$$

$$\text{For benefit-orientated criteria: } n_{ij} = \frac{min_i x_{ij}}{x_{ij}} i = 1, 2, \dots m \text{ ve } j = 1, 2, \dots n \tag{6}$$

Stage 3: In the third step of the Waspas method, the total relative importance value $Q_i^{(1)}$ for all alternatives according to the WSM (Weighted Sum Model) model is calculated with the help of Equation (7).

$$Q_i^{(1)} = \sum_{j=1}^{n} w_j n_{ij} \tag{7}$$

Stage 4: In the fourth step of the Waspas method, the relative product importance value $Q_i^{(2)}$ for all alternatives according to the WPM (Weighted Product Model) model is calculated by means of Equation (8).

$$Q_i^{(2)} = \prod_{j=1}^{n} n_{ij}^{wj} \tag{8}$$

Stage 5: In the fifth step of the Waspas method, as a result of the calculation process performed with both WSM and WPM models, the total relative importance value of the decision alternatives is determined with the help of Equation (9).

$$Q_i = \lambda Q_i^{(1)} + (1-\lambda) \, Q_i^{(2)} \tag{9}$$

The value of "λ" in the above equation can take a value between 0 and 1. If the value of "λ" is equal to 0, the relevant model becomes a weighted product model, and if it is equal to 1, the relevant model becomes a weighted total model.

Stage 6: In the sixth step of the Waspas method, the decision alternatives are ranked according to their "Q_i" values in order to make the final ranking of the decision alternatives. The decision alternative with the lowest "Q_i" value is considered the worst alternative, while the decision alternative with the highest "Q_i" value is considered the best alternative.

3.3. Data

The data obtained from secondary sources was used as a dataset in the research and information on the data in question is given in Table 2.

Table 2: Data Definitions

Data	Abv.	Definition / Calculation
Number of Firms Served	NFS	Number of companies (Airline-Coach or HSR) operating in the market
HSR/Coach/Airline Price for Km	MPRICEKM	Price for transport mode / Length of route
Total Price for Km	TPRICEKM	Total price that the user has to pay, including access to the transport mode / Total distance from centre to centre
Km for minutes	KMFM	Distance travelled in km per minute when travelling from centre to centre
Frequency	FREQ	Number of daily trips offered by the mode of transport on the route
Ratio of Access time to Travel Time	RATT	Ratio of access time from the centre to transport mode to travel time
Emissions for km (kg)	KMCO2	Emission release in kg per km

Table 2 provides brief descriptions of the data related to the criteria used in the research. For the NFS criterion, the number of airlines on the route was obtained from websites such as Google flights and skyscanner and verified by visiting the airlines' own websites. For the number of bus operators, the number of operators on the selected route was obtained separately

from comparison sites such as omio.com, checkmybus.com and busbud.com. For HSR, thetrainline.com, where train tickets can also be bought, was accessed and analysed separately for each line, as for other modes. For another criterion, TPRICE, the fare paid for the mode was divided by the length of the route in km. The fare paid for the mode of transport was obtained from the sources mentioned above. For the length of the route, different sources were used for each mode of transport. For air, gcmap.com, for road, Google maps and for rail, official documents (official sources of the HSR operators such as Deutsche Bahn, TCDD, TGV) were used.

In addition to the fare paid for the mode of transport, the TPRICEKM criterion also includes the fare paid for the public transport alternative used to access the mode of transport from the city centre. For this data, the fare was obtained from the website of the operator providing the service in question. This fare is then added to the HSR, coach and airline fares to obtain the total fare data. For the KMFM criterion, total travel time data from centre to centre is required. This is done by adding the travel time from the city centre to the relevant mode (e.g. city centre- airport). The FREQ criterion uses the same data sources as the NFS criterion. RATT is a criterion obtained by the ratio of the author's access time from the centre to the mode to the travel time. Finally, for the KMCO2 criterion, which indicates the emissions emitted, the relevant data was obtained by entering the length of the line using the calculation tool on the carbonfootprint.com website.

4. FINDINGS AND DISCUSSIONS

In this section of the study, performance criteria are introduced and the application steps of Entropy and Waspas methods are mentioned. The study analyses the performance criteria of selected routes in Turkey and Europe where there is cross-competition. In the study, 6 criteria were used for HSR and 7 criteria were used for Coach and Airline.

4.1. Criteria Used in the Study

In assessing the performance of the selected routes where there is cross-competition, the criteria used were those that best reflect the performance of the routes in question. The criteria and ratios used in the study are shown in Table 3.

Table 3: Criteria and Codes Used in the Study

High Speed Train		Coach		Airline	
Performance Indicators	**Code**	**Performance Indicators**	**Code**	**Performance Indicators**	**Code**
Number of Firms Served	C1	Number of Firms Served	C1	Number of Airlines Served	C1
HSR Price for Km	C2	Coach Price for Km	C2	Airline Price for Km	C2
Total Price for Km	C3	Total Price for Km	C3	Total Price for Km	C3
Km for Min	C4	Km for Min	C4	Km for Min	C4
Frequency	C5	Frequency	C5	Frequency	C5
Ratio of Access time to Travel Time	C6	Ratio of Access time to Travel Time	C6	Ratio of Access time to Travel Time	C6
		Emissions for km (kg)	C7	Emissions for km (kg)	C7

4.2. Entropy Application

In this study, which examines the performance of city pairs with similar characteristics, the entropy method is used in the process of determining the weights of the criteria to be included in the analysis. The application of the entropy method was carried out separately for each mode of transport. However, for reasons of space, only the weighting table is presented in this section. The weight values obtained as a result of the entropy weighting procedure are given in Table 4.

Table 4: Criteria Weight Values Obtained by Entropy Method

Modes	C1	C2	C3	C4	C5	C6	C7
HSR	0,1083	**0,2963**	0,2831	0,0562	0,1688	0,0870	N/A
Coach	**0,5278**	0,0201	0,0198	0,0022	0,3991	0,0292	0,0014
Airline	0,2239	**0,2297**	0,1933	0,0756	0,1292	0,1380	0,0098

According to the results presented in Table 4, the criterion weights of HSR, Coach and Airline are between 0.0562-0.2963, 0.0014-0.5278 and 0.0098-0.2297 respectively. In this respect, it can be seen that the variable with the highest weight on the

cost-benefit performance of the selected routes for HSR is MPRICEKM, expressed by the C2 code, while the variable with the lowest weight is KMFM, expressed by the C4 code. If we look at the coach, we see that the variable with the highest weight on the cost-benefit performance of the selected routes is NFS, expressed with code C1, while the variable with the lowest weight is KMCO2, expressed with code C7. Finally, when evaluating the performance criteria on the selected routes where the airline operates, it can be seen that the C2 criterion (MPRICEKM) has the highest weight and the C7 criterion (KMCO2) the lowest.

4.3. WASPAS Application

In this part of the study, the criteria weighting values obtained by the Entropy method were added to the application part of the Waspas method and the performance of the selected routes was evaluated. The evaluation process is repeated for each mode.

The first step of the Waspas method is to organise the decision matrix of the evaluation criteria. In this direction, the decision matrix consisting of 6 lines (alternatives) and 6 criteria included in the analysis for HSR was arranged by equation (4). The decision matrix of the corresponding HSR routes is shown in Table 5.

Table 5: Decision Matrix (HSR)

	MAX	MIN	MIN	MAX	MAX	MIN
Routes	C1	C2	C3	C4	C5	C6
Ankara- İstanbul	1	0,0243	0,0268	1,7831	12	0,1222
Barcelona-Madrid	3	0,0935	0,0997	3,5954	46	0,16
Roma-Milano	2	0,0802	0,0865	2,8713	72	0,0666
Berlin-Frankfurt	2	0,1108	0,1217	1,6184	22	0,064
Paris-Lyon	3	0,1584	0,1650	2,9021	29	0,1833
Londra-Manchester	1	0,3256	0,3387	1,8075	45	0,1230

The same step was repeated for the Coach. In this direction, the decision matrix consisting of 6 routes (alternatives) and 7 criteria included in the analysis was arranged through Equation (4). The decision matrix of the related Coach routes is shown in Table 6.

Table 6: Decision Matrix (Coach)

	MAX	MIN	MIN	MAX	MAX	MIN	MIN
Routes	C1	C2	C3	C4	C5	C6	C7
Ankara- İstanbul	50	0,0292	0,0313	1,0453	115	0,1075	0,0898
Barcelona-Madrid	2	0,0607	0,0665	1,2339	6	0,075	0,0958
Roma-Milano	3	0,0367	0,0424	1,0460	17	0,0901	0,1050
Berlin-Frankfurt	1	0,0326	0,0385	1,1924	4	0,0333	0,0907
Paris-Lyon	3	0,0343	0,0419	1,3010	8	0,1090	0,1072
Londra-Manchester	3	0,0535	0,0643	1,0268	12	0,0761	0,0892

Finally, the same procedure was applied to air transport. In this direction, the decision matrix consisting of 6 routes (alternatives) and 7 criteria included in the analysis was arranged by equation (4). The decision matrix of the corresponding airline routes is shown in Table 7.

Table 7: Decision Matrix (Airline)

	MAX	MIN	MIN	MAX	MAX	MIN	MIN
Routes	C1	C2	C3	C4	C5	C6	C7
Ankara- İstanbul	3	0,1128	0,1079	0,5643	13	2,0714	0,1417
Barcelona-Madrid	3	0,1611	0,1744	0,3822	20	0,55	0,1074
Roma-Milano	3	0,1624	0,1738	0,4207	13	1,5384	0,1291
Berlin-Frankfurt	1	0,3602	0,3496	0,4157	12	0,8285	0,1247

| Paris-Lyon | 1 | 0,2524 | 0,2795 | 0,3398 | 6 | 1,4923 | 0,1359 |
| Londra-Manchester | 1 | 0,5144 | 0,4773 | 0,7818 | 7 | 1,1230 | 0,1522 |

In the second step of the Waspas method, after the decision matrix has been arranged, the evaluation criteria are normalised according to whether they are cost or benefit oriented using equations (5) and (6). The normalised decision matrix for HSR is shown in Table 8.

Table 8: Normalised Decision Matrix (HSR)

	MAX	MIN	MIN	MAX	MAX	MIN
Routes	C1	C2	C3	C4	C5	C6
Ankara- İstanbul	0,3333	0,0748	0,0792	0,4959	0,1666	0,6666
Barcelona-Madrid	1	0,2872	0,2944	1	0,6388	0,8727
Roma-Milano	0,6666	0,2465	0,2554	0,7986	1	0,3636
Berlin-Frankfurt	0,6666	0,3403	0,3593	0,4501	0,3055	0,3490
Paris-Lyon	1	0,4864	0,4870	0,8071	0,4027	1
Londra-Manchester	0,3333	1	1	0,5027	0,625	0,6713

The initial decision matrix for coach was also normalised. The normalised decision matrix for the coach is shown in Table 9.

Table 9: Normalised Decision Matrix (Coach)

	MAX	MIN	MIN	MAX	MAX	MIN	MIN
Routes	C1	C2	C3	C4	C5	C6	C7
Ankara- İstanbul	1	0,4812	0,4701	0,8034	1	0,9854	0,8377
Barcelona-Madrid	0,04	1	1	0,9483	0,0521	0,6875	0,8932
Roma-Milano	0,06	0,6058	0,6377	0,8039	0,1478	0,8267	0,9793
Berlin-Frankfurt	0,02	0,5381	0,5795	0,9165	0,0347	0,3055	0,8457
Paris-Lyon	0,06	0,5656	0,6306	1	0,0695	1	1
Londra-Manchester	0,06	0,8825	0,9663	0,7892	0,1043	0,6984	0,8321

Finally, the initial decision matrix for Airline is normalised using equations (5) and (6). Accordingly, the normalised decision matrix for Airline is shown in Table 10.

Table 10: Normalised Decision Matrix (Airline)

	MAX	MIN	MIN	MAX	MAX	MIN	MIN
Routes	C1	C2	C3	C4	C5	C6	C7
Ankara- İstanbul	1	0,2194	0,2262	0,7217	0,65	1	0,9308
Barcelona-Madrid	1	0,3132	0,3655	0,4888	1	0,2655	0,7056
Roma-Milano	1	0,3157	0,3643	0,5381	0,65	0,7427	0,8482
Berlin-Frankfurt	0,3333	0,7003	0,7325	0,5316	0,6	0,4	0,8190
Paris-Lyon	0,3333	0,4907	0,5856	0,4345	0,3	0,7204	0,8926
Londra-Manchester	0,3333	1	1	1	0,35	0,5421	1

In the third step of the Waspas method, the total relative importance of these banks was calculated according to the Weighted Sum Model (WSM) using equation (7). During the calculation process, the criterion weight (W_j) value obtained in the entropy method was multiplied by the normalisation value of each mode of transport and summed. As a result of the summation process, the value $Q_i^{(1)}$ was obtained. The relative importance values of the associated HSR routes according to the Weighted Sum Modelling (WSM) model are shown in Table 11.

Table 11: Relative Importance Values of Decision Alternatives According to WSM (HSR)

Routes	C1	C2	C3	C4	C5	C6	$Q_i^{(1)}$
Ankara- İstanbul	0,0361	0,0222	0,0224	0,0279	0,0281	0,0580	0,1948
Barcelona-Madrid	0,1084	0,0851	0,0834	0,0563	0,1079	0,0759	0,5170
Roma-Milano	0,0722	0,0731	0,0723	0,0450	0,1688	0,0316	0,4631
Berlin-Frankfurt	0,0722	0,1009	0,1017	0,0253	0,0516	0,0304	0,3822
Paris-Lyon	0,1084	0,1442	0,1379	0,0454	0,0680	0,0870	0,5909
Londra-Manchester	0,0361	0,2964	0,2831	0,0283	0,1055	0,0584	0,8078

The values obtained in Table 11 were also calculated for other modes of transport and the relative importance values of the relevant routes for coach according to the WSM model are shown in Table 12.

Table 12: Relative Importance Values of Decision Alternatives According to WSM (Coach)

Routes	C1	C2	C3	C4	C5	C6	C7	$Q_i^{(1)}$
Ankara- İstanbul	0,5279	0,0097	0,0093	0,0018	0,3991	0,0288	0,0013	0,9779
Barcelona-Madrid	0,0211	0,0202	0,0198	0,0022	0,0208	0,0201	0,0013	0,1055
Roma-Milano	0,0317	0,0122	0,0126	0,0018	0,0590	0,0242	0,0015	0,1430
Berlin-Frankfurt	0,0106	0,0109	0,0115	0,0021	0,0139	0,0089	0,0013	0,0591
Paris-Lyon	0,0317	0,0114	0,0125	0,0023	0,0278	0,0292	0,0015	0,1164
Londra-Manchester	0,0317	0,0178	0,0192	0,0018	0,0416	0,0204	0,0012	0,1337

The calculation of the relative importance value according to the WSM model, calculated using equation (7), was also performed for Airline and is shown in Table 13.

Table 13: Relative Importance Values of Decision Alternatives According to WSM (Airline)

Routes	C1	C2	C3	C4	C5	C6	C7	$Q_i^{(1)}$
Ankara- İstanbul	0,2240	0,0504	0,0438	0,0546	0,0840	0,1381	0,0092	0,6040
Barcelona-Madrid	0,2240	0,0720	0,0707	0,0370	0,1292	0,0367	0,0070	0,5765
Roma-Milano	0,2240	0,0726	0,0705	0,0407	0,0840	0,1025	0,0084	0,6026
Berlin-Frankfurt	0,0747	0,1609	0,1417	0,0402	0,0775	0,0552	0,0081	0,5584
Paris-Lyon	0,0747	0,1128	0,1133	0,0329	0,0388	0,0995	0,0088	0,4806
Londra-Manchester	0,0747	0,2298	0,1934	0,0757	0,0452	0,0748	0,0099	0,7035

In the fourth step of the Waspas method, the relative importance of these lines according to the WPM is calculated using equation (8) and the $Q_i^{(2)}$ value is determined. The relative importance values of the associated HSR routes according to the WPM are shown in Table 14.

Table 14: Relative Importance Values of Decision Alternatives according to the WPM (HSR)

Routes	C1	C2	C3	C4	C5	C6	$Q_i^{(2)}$
Ankara- İstanbul	0,8878	0,4639	0,4878	0,9613	0,7390	0,9653	4,5050
Barcelona-Madrid	1,0000	0,6909	0,7074	1,0000	0,9271	0,9882	5,3137
Roma-Milano	0,9570	0,6604	0,6795	0,9874	1,0000	0,9157	5,2000
Berlin-Frankfurt	0,9570	0,7266	0,7484	0,9561	0,8186	0,9125	5,1191
Paris-Lyon	1,0000	0,8077	0,8158	0,9880	0,8577	1,0000	5,4691
Londra-Manchester	0,8878	1,0000	1,0000	0,9620	0,9237	0,9659	5,7394

Table 15 shows the relative importance values for Coach according to WPM.

Table 15: Relative Importance Values of Decision Alternatives according to the WPM (Coach)

Routes	C1	C2	C3	C4	C5	C6	C7	$Q_i^{(2)}$
Ankara- İstanbul	1,0000	0,9853	0,9851	0,9995	1,0000	0,9996	0,9997	6,9693
Barcelona-Madrid	0,1828	1,0000	1,0000	0,9999	0,3077	0,9891	0,9998	5,4793
Roma-Milano	0,2265	0,9899	0,9911	0,9995	0,4663	0,9945	1,0000	5,6677
Berlin-Frankfurt	0,1268	0,9876	0,9892	0,9998	0,2617	0,9659	0,9997	5,3308
Paris-Lyon	0,2265	0,9886	0,9909	1,0000	0,3451	1,0000	1,0000	5,5511
Londra-Manchester	0,2265	0,9975	0,9993	0,9995	0,4057	0,9896	0,9997	5,6178

According to the WPM model calculated using equation (8), the relative importance value has also been calculated for Airline and is shown in Table 16.

Table 16: Relative Importance Values of Decision Alternatives according to the WPM (Airline)

Routes	C1	C2	C3	C4	C5	C6	C7	$Q_i^{(2)}$
Ankara- İstanbul	1,0000	0,7057	0,7502	0,9756	0,9458	1,0000	0,9993	6,3767
Barcelona-Madrid	1,0000	0,7659	0,8231	0,9473	1,0000	0,8327	0,9966	6,3656
Roma-Milano	1,0000	0,7673	0,8226	0,9542	0,9458	0,9598	0,9984	6,4481
Berlin-Frankfurt	0,7819	0,9214	0,9416	0,9533	0,9361	0,8812	0,9980	6,4135
Paris-Lyon	0,7819	0,8491	0,9017	0,9389	0,8559	0,9557	0,9989	6,2821
Londra-Manchester	0,7819	1,0000	1,0000	1,0000	0,8731	0,9190	1,0000	6,5739

In the final stage of the Waspas method, the values of $Q_i^{(1)}$ and $Q_i^{(2)}$ calculated according to the WSM (Weighted Sum Model) and WPM (Weighted Product Model) models are calculated using equation (9) and the value of " Q_i " of the corresponding routes is obtained. The value of λ in equation (9) is generally taken as (λ=0.5). The performance rankings of the related lines according to their " Q_i " values are given in Table 17.

Table 17: Ranking of Selected Lines by Q_i Value Based on Transport Mode

Routes	HSR	Coach	Airline
Ankara- İstanbul	6	**1**	2
Barcelona-Madrid	3	5	4
Roma-Milano	4	2	3
Berlin-Frankfurt	5	6	5
Paris-Lyon	2	4	6
Londra-Manchester	**1**	3	**1**

Table 17 shows that the London-Manchester route ranks first among the routes included in the study, while the Paris-Lyon line ranks last. When analysing the HSR ranking, the London-Manchester corridor ranks first, as in the airline sector. The Ankara-Istanbul HSR route ranks last among the selected corridors. If we look at the coach, we can see that the Ankara-Istanbul route is in first place this time. On the other hand, the Berlin-Frankfurt route ranks last.

When analysing the ranking of the routes by mode, the London-Manchester is in first place for HSR and air, and in third place for road. In the general evaluation of the route, it can be seen that it is ahead of the other lines in terms of cost-benefit according to the selected criteria. Of course, there could be several reasons for this. First of all, the frequency values of the route in question are quite high. The high frequency reduces the total journey time and gives the user a time advantage. Returning to the routes, the Berlin-Frankfurt line comes last in the ranking of all transport modes. The Berlin-Frankfurt corridor is an important corridor on the east-west axis of Germany, but unlike the other lines, the frequency of buses is quite low. In addition, it can be seen that ticket prices on this route are high due to the fact that only traditional airlines operate. For these reasons, this route lags behind the others in the ranking.

If we look at the Ankara-Istanbul route, the high frequency compared to other transport options and the relatively low ticket prices due to this intense competition have brought it to the first place in this field. The main reason for the high frequency is undoubtedly the fact that the Ankara-Istanbul line is also part of the road connecting Istanbul with the eastern provinces

of the country. Almost every company coming from the eastern cities passes through Ankara, and this linear line is also contains the Ankara-Istanbul route. Otherwise, the Barcelona-Madrid and Rome-Milan routes were generally in the middle of the list for each mode of transport.

5. CONCLUSION AND IMPLICATIONS

The aim of this study is to compare transport corridors (routes) with similar characteristics in terms of different criteria, and in this context the performance evaluation was carried out using Entropy and WASPAS, which are multi-criteria decision making methods. Prior to the performance evaluation, the criteria were identified and each criterion was weighted according to objective criteria. The weighted criteria were then calculated using the WASPAS method and the best and worst performing routes for each mode were ranked.

This research is considered to make several theoretical and practical contributions. Firstly, although there have been many studies of multi-criteria decision making in the transport sector, they have been either sector specific or have compared at most two modes of transport. The few studies that have included all modes have evaluated factors such as investment decisions and transport policies, as well as factors related to future steps to be taken in this direction. In contrast to other studies, this study compares and ranks the routes on which all modes of transport operate simultaneously and which have similar characteristics according to criteria established using real data. On the other hand, it is expected that the results obtained will also guide decision-makers. In particular, taking into account the weighting of the performance criteria of the routes, the tariffs of the route concerned can be regulated or an investment programme can be set up to make the public transport modes (e.g. HSR) more competitive.

The research has several limitations. The first is that the evaluations are limited to the secondary data obtained during the ranking of the lines. Although the criteria used in the research are related to the transport industry and in particular to passenger transport, they can be applied to different industries (e.g. freight, logistics, etc.). In this context, it is expected that the generalisability of the research results will increase with more different industries and more criteria in future studies.

Future studies to be carried out in the field of transport can also analyse routes in different countries and evaluate the differences between countries. Another limitation of the study is related to the methodology used. The entropy method was used to weight the criteria used in the evaluation process and the WASPAS method was used to rank the routes. Other weighting methods (BWM, F/AHP, SWARA, etc.) and ranking methods (ARAS, EDAS, VIKOR, etc.) can be used in future studies.

REFERENCES

Alinezhad, A., Khalili, J. (2019). WASPAS Method. In: New Methods and Applications in Multiple Attribute Decision Making (MADM). International Series in Operations Research & Management Science, vol 277. Springer, Cham. https://doi.org/10.1007/978-3-030-15009-9_13

Arslan, T. (2009). A hybrid model of fuzzy and AHP for handling public assessments on transportation projects. Transportation, 36, 97–112.

Barfod, M. B., Salling, K. B. (2015). A new composite decision support framework for strategic and sustainable transport appraisals. Transportation Research Part A: Policy and Practice, 72, 1-15.

Cavone, G., Dotoli, M., Epicoco, N. & Seatzu, C. (2017). Intermodal terminal planning by petri nets and data envelopment analysis. Control Engineering Practice, 69, 9-22.

Cavone, G., Dotoli, M., Epicoco, N. & Seatzu, C. (2018). Efficient resource planning of intermodal terminals under uncertainty. IFAC-PapersOnLine, 51(9), 398-403.

Chakraborty, S., Zavadskas, E. K. (2014). Applications of WASPAS Method in Manufacturing Decision Making. Informatica, 25(1), 1-20.

Chakraborty, S., Zavadskas, E. K. & Antucheviciene, J. (2015). Applications of WASPAS method as a multi-criteria decision-making tool. Economic Computation and Economic Cybernetics Studies and Research, 49(1), 5-22.

Costescu, D. (2018). Modal competition and complementarity: cost optimization at end-user level. Romanian Journal of Transport Infrastructure, 7(2), 61-76.

Fearnley, N., Currie, G., Flügel, S., Gregersen, F. A., Killi, M., Toner, J. & Wardman, M. (2018). Competition and substitution between public transport modes. Research in Transportation Economics, 69, 51-58.

Hey, C., Hijkamp, P., Rienstra, S. A. & Rothenberger, D. (1999). Assessing scenarios on European transport policies by means of multicriteria analysis. In: new contrıbutıons to transportation analysis in Europe. Atmospheric Environment, 33, 171-191.

Hansson, J., Månsson, S., Brynolf, S. & Grahn, M. (2019). Alternative marine fuels: Prospects based on multi-criteria decision analysis involving Swedish stakeholders. Biomass and Bioenergy, 126, 159-173.

Hickman, R., Saxena, S., Banister, D. & Ashiru, O. (2012). Examining transport futures with scenario analysis and MCA. Transportation Research Part A: Policy and Practice, 46(3), 560-575.

Giuliano, G. (1985). A multicriteria method for transportation investment planning. Transportation Research Part A: General, 19(1), 29-41.

Janic, M. (2003). Multicriteria evaluation of high-speed rail, transrapid maglev and air passenger transport in Europe. Transportation Planning and Technology, 26(6), 491-512.

Karleuša, B., Dragičević, N. & Deluka-Tibljaš, A. (2013). Review of multicriteria-analysis methods application in decision making about transport infrastructure. GRAĐEVINAR, 65(7), 619-631.

Kopytov,E. & Abramov,D. (2012). Multiple-Criteria Analysis and Choice of Transportation Alternatives in Multimodal Freight Transport System. Transport and Telecommunication Journal, 13(2) 148-158.

Liu, L., Zhou, J., An, X., Zhang, Y. & Yang, L. (2010). Using fuzzy theory and information entropy for water quality assessment in Three Gorges region, China. Expert Systems with Applications, 37(3), 2517-2521.

Macharis, C., Bernardini, A. (2015). Reviewing the use of Multi-Criteria Decision Analysis for the evaluation of transport projects: Time for a multi-actor approach. Transport Policy, 37, 177-186.

Ramani, T. L., Quadrifoglio, L. & Zietsman, J. (2010). Accounting for nonlinearity in the MCDM approach for a transportation planning application. IEEE Transactions on Engineering Management, 57(4), 702-710.

Sawadogo, M. & Anciaux, D. (2011). Intermodal transportation within the green supply chain: an approach based on ELECTRE method. International Journal of Business Performance and Supply Chain Modelling, 3(1), 43-65.

Shelton, J., Medina, M. (2010). ıntegrated multiple-criteria decision-making method to prioritize transportation projects. Transportation Research Record, 2174(1), 51–57. https://doi.org/10.3141/2174-08

Sirikijpanichkul, A., Winyoopadit, S., Jenpanitsub, A. (2017). A multi-actor multi-criteria transit system selection model: A case study of Bangkok feeder system. Transportation Research Procedia, 25, 3736-3755.

Stoycheva, S., Marchese, D., Paul, C., Padoan, S., Juhmani, A. S. & Linkov, I. (2018). Multi-criteria decision analysis framework for sustainable manufacturing in automotive industry. Journal of Cleaner Production, 187, 257-272.

Tsamboulas, D., Kopsacheili, A. G. (2003). Methodological Framework for Strategic Assessment of Transportation Policies: Application for Athens 2004 Olympic Games. Transportation Research Record, 1848(1), 19–28.

Vilakazi, T. (2018). The causes of high intra-regional road freight rates for food and commodities in southern africa. Development Southern Africa, 35(3), 388-403.

Wang, T., Lee, H. & Chang, M. C. (2005). A Fuzzy TOPSIS Approach With Entropy Measure for Decision-Making Problem. IEEE International Conference on Industrial Engineering and Engineering Management. Singapore: IEEM.

Wang, T.-C., Lee, H.-D. (2009). Developing a Fuzzy TOPSIS Approach Based on Subjective Weights and Objective Weights. Expert Systems with Applications, 36(5), 8980-8985.

Wu, J., Liang , L. & Zha, Y. (2011). Determination of weights for ultimate cross efficiency using shannon entropy. Expert Systems with Applications, 38(5), 5162-5165.

Yannis, G., Kopsacheili, A., Dragomanovits, A. & Petraki, V. (2020). State-of-the-art review on multi-criteria decision-making in the transport sector. Journal of Traffic and Transportation Engineering, 7(4), 413-431.

Zou, Z. H., Yi, Y. & Sun, J. N. (2006). Entropy method for determination of weight of evaluating indicators in fuzzy synthetic evaluation for water quality assessment. Journal of Environmental sciences, 18(5), 1020-1023.

THE EVALUATION OF AI INTEGRATION IN INNOVATIVE DIGITAL MARKETING STRATEGIES

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ABSTRACT
Purpose- This study aims to provide a bibliometric review of publications where the terms 'digital marketing' and 'artificial intelligence' are used together. Leading publications, authors, countries, and institutions in the Web of Science (WoS) database have been examined to achieve this goal. Additionally, this article investigates the combined use of digital marketing and artificial intelligence. Furthermore, it aims to offer insights into artificial intelligence strategies for marketing that businesses can employ.
Methodology- The research employs the technique of bibliometric analysis. The Bibliometrix package within R Studio and its web-based component, Biblioshiny, were utilized for analysis. Searches were conducted in the Web of Science database using the keywords 'Digital Marketing' and 'Artificial Intelligence' in the title, abstract, and keywords sections.
Findings- As a result of the analysis, a total of 60 publications authored by 140 researchers and distributed across 46 journals between 2017 and 2023 were identified. Examination of the included publications reveals frequent usage of terms such as 'artificial intelligence,' 'creativity,' 'analytics,' 'impact,' 'expertise,' 'social networks,' 'big data,' 'governance,' 'success,' and 'AI.' Upon scrutinizing the authors' countries, India emerged as the leading contributor, followed by Spain and the USA. Moreover, Finland (370), Spain (92), and France (58) had the highest citation counts.
Conclusion- This research aims to contribute to researchers interested in working in digital marketing and artificial intelligence by examining its past and present. For this purpose, 60 relevant studies from the literature were systematically reviewed and analyzed across various categories. Additionally, the examined publications' conceptual, intellectual, and social structures were illuminated.

Keywords: Digital marketing, artificial intelligence, AI systems, bibliometric analysis, bibliometrix.
JEL Codes: M15, M30, M31

1. INTRODUCTION

With the rapid advancement of technology in today's world, digital marketing strategies are undergoing a significant transformation. Artificial Intelligence (AI) plays a critical role in this transformation. AI technologies offer marketers a range of advantages, such as big data analysis, personalized content creation, improvement of customer experience, and automation of sales processes (Murgai, 2018).

In this study, digital marketing and artificial intelligence research, indexed in Web of Science, has been examined through a multidimensional perspective using bibliometric analysis, a qualitative research method. First, this article examines how artificial intelligence is used in digital marketing and explores its potential benefits. AI technologies support digital marketing in various areas, such as personalization, customer service, data analysis, and forecasting. The article focuses on examples of usage in these areas and highlights current research in the literature. Second, digital marketing and artificial intelligence research, indexed in Web of Science, has been examined through a multidimensional perspective using bibliometric analysis, a qualitative research method.

Combining previous research results and bibliometric information is vital in progressively enhancing scientific understanding. Applying bibliometric analysis enables an impartial evaluation of scientific writings through a quantitative methodology. Such investigations deliver an open, methodical, and replicable literature survey. This bibliometric survey enlightens individuals seeking to explore pertinent scholarly works (Zupic & Cater, 2015). Bibliometrics comprises a collection of numerical and mathematical techniques employed to assess and examine the excellence and volume of articles, books, and other written works. Enhancement of information and communication endeavors, coupled with the advancement of scientific

documentation, results from a numerical appraisal of the generation, circulation, and application of data garnered from library assemblages and amenities like WoS within bibliometric investigations.

Consequently, the objective is to enrich the comprehension of the scientific research mechanism within bibliometric studies (Osareh, 1996). Numerous bibliometric metrics like citation counts, keywords, titles, partnerships, and organizations can be generated from various databases. Utilizing these databases allows for the execution of bibliometric investigations. The exploration of bibliometrics can revolve around attributes of publications, citation influence, national evaluation, and topic scrutiny. Notably, bibliometric scrutiny differentiates itself from systematic reviews and meta-analyses (Donthu et al., 2021).

Sixty accessible studies were reached by searching with the keywords "digital marketing" and "artificial intelligence" in the title, abstract, and keywords sections on WoS.

This research is organized as follows. First, the concepts of digital marketing in the literature are explained. Then, from the marketing perspective, the artificial intelligence theoretical background is based on previous research. A bibliometric analysis process followed this given in the methodology section. In the last section, our findings are detailed, and contributions of the study are presented.)

2. LITERATURE REVIEW

2.1. Digital Marketing

Digital marketing is an approach where marketing activities are carried out through the Internet and other digital technologies. Businesses aim to reach their target audience, increase customer interactions, and boost sales using digital channels (Chaffey & Ellis-Chadwick, 2019). Digital marketing is closely related to marketing itself. Businesses use digital marketing processes to reach their target audience effectively. Digital marketing offers a more measurable, customer-centric, and interactive approach than traditional marketing methods. It also helps better understand customer behavior and makes marketing efforts more efficient. Businesses that employ marketing strategies and tactics involving digital technologies, particularly the Internet, can build brand awareness, manage customer interactions, and directly reach their target audience (Mangold & Faulds, 2009).

Additionally, businesses can analyze consumer behavior, engage with their target audience, and increase sales (Ryan & Jones, 2009). Businesses aim to reach their target audience and manage customer relationships using digital marketing through websites, social media platforms, e-mail marketing, and other digital channels (Frost & Strauss, 2016). Digital marketing encompasses marketing strategies that involve the Internet and other digital technologies. Businesses can measure their marketing outcomes using digital channels (Chaffey & Smith, 2017).

It has been noted that digital marketing is a factor that influences marketing strategies (Smith & Zook, 2011). Online platforms provide various tools for businesses to reach and engage with their target audience. This has led to the adopting of digital marketing strategies that replace traditional ones. Digital marketing has made marketing activities more measurable and trackable for businesses (Mangold & Faulds, 2009). Businesses can better understand customer behavior and optimize their marketing efforts through internet-based tools and analytical methods. Digital marketing has increased customer interaction and encouraged engagement (Chaffey & Ellis-Chadwick, 2019). Social media, blogs, and online discussion forums allow businesses to interact directly with customers and receive feedback. This interaction can enhance brand loyalty and customer satisfaction. Digital marketing has allowed businesses broader global market access (Frost & Strauss, 2016). The Internet eliminates geographical limitations, allowing businesses to reach customers worldwide. This increases the growth potential for businesses in international markets. Digital marketing can reduce costs and improve business efficiency (Hollensen, 2019). While traditional marketing methods often require higher costs, digital marketing offers a more economical and scalable option. Businesses can reduce costs and increase profitability by advertising and selling online through digital platforms.

Therefore, digital marketing encompasses marketing activities through digital technologies and provides businesses with opportunities to enhance brand awareness, customer interaction, customer relationship management, and sales.

2.2. Artificial Intelligence

Artificial intelligence refers to a field that enables computer systems to utilize human-like cognitive abilities such as performing complex tasks, learning, reasoning, and decision-making (Nilsson, 1998). Therefore, it is an area that deals with the design and development of computer systems capable of modeling and performing these cognitive abilities exhibited by humans (Luger, 2009). Artificial intelligence represents the effort to mimic or achieve human-like intelligence using computer systems. These systems can possess cognitive abilities such as learning, reasoning, language processing, perception, and problem-solving. In this regard, artificial intelligence is a scientific discipline that enables computer systems to have human-like intelligence and employs intelligent algorithms to perform cognitive tasks (Russell & Norvig, 2016).

Artificial intelligence enhances automation processes in various sectors. It is effective in areas such as automated control of production lines, management of robotic systems, and automation in data analysis and predictions (Huang & Rust, 2021). Artificial intelligence is utilized in medicine for diagnosis, treatment, and patient care. It plays a significant role in disease diagnosis, image analysis, drug development, analysis of health records, and patient monitoring (Kumar et al., 2021). Artificial intelligence is employed in financial services for risk assessment, investment strategies, fraud detection, customer service, and trade analysis (Tiwari et al., 2020). Artificial intelligence plays a significant role in the automotive industry, particularly in autonomous vehicles and driver assistance systems. It analyzes sensor data of vehicles to evaluate environmental factors and make driving decisions (Tubaro & Casilli, 2019). Artificial intelligence is utilized in education for student assessment, personalized learning, adaptive learning, virtual teachers, and language learning (Elhajjar et al., 2021). Artificial intelligence is used in natural language processing techniques for text understanding, translation, analysis, and generation. It is widely employed in voice assistants, text-based chatbots, and language translation applications (Shankar & Parsana, 2022). Artificial intelligence enhances interaction in customer services through chatbots and virtual assistants. It performs tasks such as answering questions, resolving issues, providing recommendations, and enhancing the customer experience (Dimitrieska et al., 2018). Artificial intelligence is used in security for threat detection, prevention of cyber attacks, fraud detection, and video surveillance (Li, 2018). Artificial intelligence is also employed in artistic fields such as music, painting, and literature. It is utilized for music composition, image generation, and text creation (Eriksson et al., 2021).

Artificial intelligence is now considered a necessity in the modern corporate environment. Both small and large organizations are utilizing these technologies to enhance the efficiency of their business operations and provide customers with better, personalized experiences (Jain & Pandey, 2017). Artificial intelligence is now intelligently automating data-driven and repetitive tasks for marketers, reducing costs and accelerating revenue growth by improving their ability to make wide-scale predictions. The abundance of data, exponential growth in computing power, and the availability of artificial intelligence from leading technology companies are reducing, and sometimes replacing, the time-intensive, data-focused tasks commonly performed by marketers (Jarek & Mazurek, 2019). Traditional marketing strategies rely on intuitive and experience-based decision-making. Data analysis is limited, and predictability is low. Artificial intelligence can analyze large amounts of data and provide predictability. Machine learning and data analytics algorithms can assist in predicting customer behaviors, identifying trends, and optimizing marketing strategies (Fathali et al., 2022). Traditional marketing often involves messages and campaigns targeting general audiences. Personalization and targeting are limited. Artificial intelligence enables customer segmentation and personalization by analyzing collected data. Personalized messages, product recommendations, and experiences can increase customer engagement and conversion rates (Huang & Rust, 2021). Traditional marketing usually offers one-way communication and has a limited impact on the customer experience. Artificial intelligence can enhance the customer experience by providing interactive and personalized experiences. AI-based applications such as chatbots, voice assistants, and personalized recommendations increase customer interaction and provide a more positive experience (Marinchak et al., 2018). Traditional marketing processes are often manual and time-consuming. Automation is limited, and efficiency is low. Artificial intelligence improves efficiency by providing automation in marketing processes. It offers opportunities for automation in tasks such as data analysis, campaign management, and customer relationship management (Rathore, 2023). Traditional marketing strategies must be revised to predict conversion rates and increase sales. Artificial intelligence, through data analysis and predictability, has the potential to increase conversion rates and optimize sales. Analyzing customer behaviors can enhance conversions through personalized offers and campaigns (Haleem et al., 2022).

Artificial intelligence can make marketing processes more efficient, effective, and personalized. It contributes significantly to marketing in data analysis, predictability, automation, personalization, and customer experience. However, the human factor and creativity are essential in marketing strategies. Marketers who embrace artificial intelligence technologies can create significant and sustainable competitive advantages for themselves and their businesses. Artificial intelligence allows marketers to enhance their marketing strategies, improve customer experiences, and grow their businesses by providing various advantages.

3. DATA AND METHODOLOGY

This research will help identify the dynamics of the transition from digital marketing to artificial intelligence in the literature and provide a comprehensive perspective for future research where marketing sciences intersect with AI sciences. The bibliometric analysis method was used in the research. Fundamental studies, writers, nations, and organizations have been investigated. Biblioshiny, a web-oriented element of the Bibliometrix R package, was employed to perform the explanatory examination of document scanning. Bibliometric analysis has been extensively employed across various disciplines and serves a broad range of applications. It provides a comprehensive overview of a research area that articles, authors, and journals can categorize. Citation indexes are commonly used as data sources in bibliometric studies. According to Pritchard (1969), bibliometrics is a method involving the application of mathematics and statistics to the written communication medium for understanding the nature and progression of a discipline. Broadus (1987) defines bibliometrics as a quantitative study of

physically published units, bibliographic units, or both. In simpler terms, Norton (2001) characterizes bibliometrics as a measure of texts and information. Bibliometrics is a valuable contemporary tool that allows researchers to explore their research domains and assess outputs and outcomes. Aria and Cuccurullo (2017), the "bibliometrix" software package is crafted for utilization within the R coding language. This facilitates a thorough exploration of literature-based investigations and furnishes researchers with perspectives into advancements within diverse domains.

The study of bibliometric data consists of two segments. The first segment selects the source from which research can be analyzed. For this purpose, the Web of Science database has been chosen. A search query has been formulated for comprehensive data collection in the second segment. For this purpose, the field of social sciences has been selected, various filters have been applied to the search query, and it has been adjusted to align with the objectives and yield optimal results. The final search query is 'TITLE-ABS-KEY ("digital marketing" AND "artificial intelligence"). In the study, publications were examined in August 2023. Therefore, there will be more publications by the end of 2023. So, 60 accessible studies were reached by searching with the keywords in the title, abstract and keywords sections on WoS.

This research aimed to answer the following research questions:

RQ1: What is the distribution of articles related to digital marketing and artificial intelligence, indexed in Web of Science, based on years?

RQ2: Which universities and research-publishing journals contribute the most to the literature on digital marketing and artificial intelligence?

RQ3: How have the keywords of research in digital marketing and artificial intelligence changed over the years?

RQ4: Which studies and authors have made the most significant contributions regarding digital marketing and artificial intelligence citations?

In the research, these questions are answered through descriptive analysis. Furthermore, the fundamental sources, authors, countries, publications, and connections in the publications where digital marketing is used in conjunction with artificial intelligence are being analyzed. In addition to these, the analysis utilizes Bradford's Law to identify core sources (Viju & Ganesh, 2013). According to the Bradford Law, sources are divided into three zones. Zone 1 is highly productive and is considered the nuclear zone. Zone 2 is moderately efficient, and sources related to Zone 3 have low productivity. Fundamental areas of study and essential motifs are crucial in connecting diverse strands of research and shaping the future trajectory of academic inquiry. We have embraced specific technical instruments like co-occurrence maps, thematic maps, and thematic evolution analyses to achieve this objective. Our utilization of Keywords Plus is motivated by its ability to delineate the scholarly framework of the study and facilitate the recognition and interconnection of distinct research domains (Li et al., 2016). The author's chosen keywords signify the principal focal points of the investigation. Keywords sourced from the database succinctly encapsulate the article's essence. Unlike the author's designated keywords, keywords present more elaborative patterns (Tripathi et al., 2018). To unearth research streams and motifs within the literature, we employ 'biblioshiny,' a bibliometric analysis tool furnished by the R-program, centered around exploring research keywords.

4. FINDINGS

The analysis revealed 60 publications, written by 140 researchers, that were spread from 2017 to 2023. As a result of the analysis, research in scientific journals obtained from the WoS database was found in different categories during the review process. These are summarized below as the distribution of studies conducted over different years, different types of research, authors with the highest number of citations, studies with the highest number of citations, countries that produce the most research, journals that publish most frequently, and the most frequently encountered keywords in research.

4.1. Publications over the Years

Figure 1 gives the number of publications distribution in the journal from 2017 to 2023. In Figure, the publication-year distribution shows an increasing trend. One publication was made in 2017, 1 in 2018, 4 in 2019, 8 in 2020, 18 in 2021, 18 in 2022, and 10 in 2023 (August). So figure illustrates the distribution of research throughout the years within digital marketing and artificial intelligence. The annual growth rate of study counts was determined to be 44.22%. Upon considering a broad research perspective linked to marketing driven by digital marketing and artificial intelligence, a cumulative count of 60 publications of 140 authors spread across 46 journals was detected (2017-2023). In the study, publications were examined in August 2023. Therefore, there will be more publications by the end of 2023. Considering past trends, the upward trend in the number of publications will continue.

Figure 1: Publications over the Years
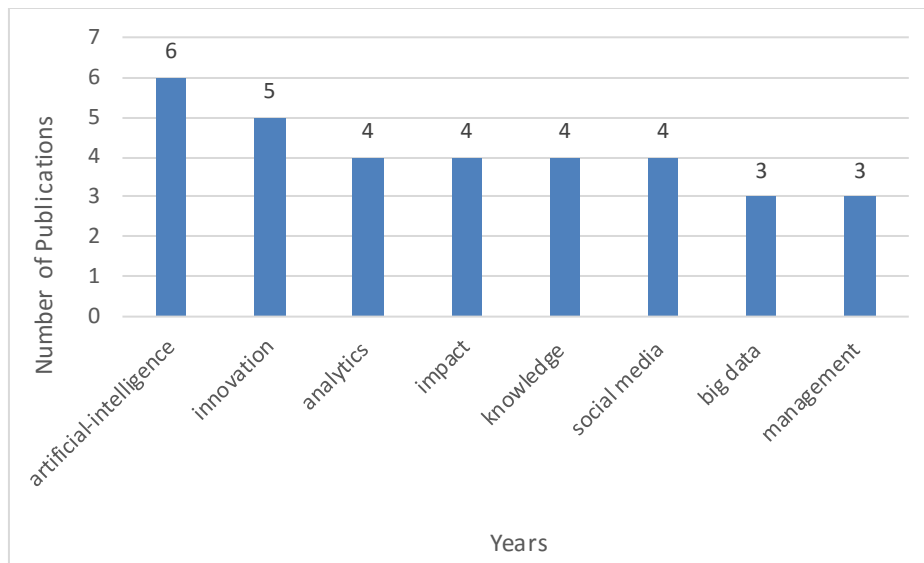


4.2. Most Relevant Sources

Most Relevant Sources refers to the most important or relevant among publications or sources in bibliometric analysis. This term is used to identify the most cited, most read, or most cited sources regarding a particular research topic or field. Figure 2 shows the most relevant sources for Digital Marketing and Articial Intellgigence in WOS. To construct this table, the beginning search results from the WOS database yielded 60 studies. When the articles examined in the field of Digital Marketing and Artificial Intelligence, these articles included in this research were most commonly published in "The Australasian Marketing Journal (AMJ)", "Industrial Marketing Management," and "International Journal of Market Research (IJMR)." So, these journals occupy the first three positions on the list, each with two publications. Subsequently, it is observed that the journals follow one publication, respectively. AMJ is an academic journal aimed at sharing cutting-edge marketing research with researchers, students, educators, scholars, and practitioners. The primary goal of AMJ is to release papers that enhance and contribute to the progress of both the field and the practical application of marketing. Industrial Marketing Management offers theoretical, empirical, and case-driven research tailored to the requirements of marketing academics and professionals who are engaged in studying and operating within industrial and business-to-business markets. Founded in 1958, the International Journal of Market Research (IJMR) is dedicated to publishing original research that tackles important challenges in the field of market research and insights. Primarily, IJMR is a practical journal that aims to foster a conversation among professionals, academics, and individuals in business or public sectors who rely on research and insights for making informed decisions, generating influence, and instigating change. The journal publishes both theoretical and empirical papers authored by established and emerging scholars with diverse methodological backgrounds. IJMR's primary goal is to create an impact through the applicability of the research it publishes. Submissions should address pertinent issues for stakeholders and offer actionable insights for practical implementation.

Figure 2: Most Relevant Sources
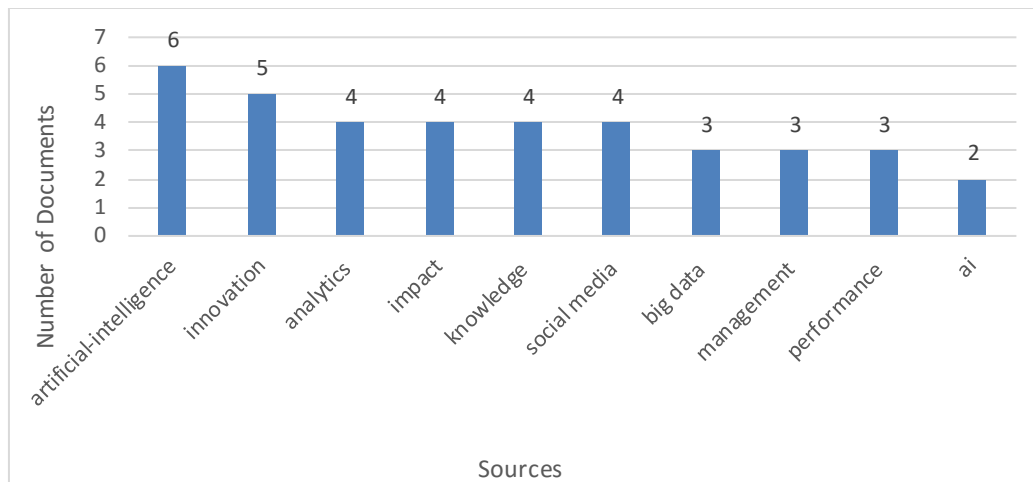
4.3. Most Relevant Affiliations

Most Relevant Affiliations refers to the institutions or organizations that are considered the most significant or important in a particular research field or for a specific set of scholarly publications. These affiliations are determined based on various bibliometric indicators, such as the number of publications, citations, or other relevant metrics associated with researchers or institutions. When conducting bibliometric analyses, researchers may be interested in identifying the institutions that are most active or influential in a given field. This information can help in assessing the research landscape, collaboration patterns, and the impact of specific organizations or academic institutions. So, this section presents the most relevant universities where the studies have been published. As shown in Figure 3, Rey Juan Carlos University (Spain) stands out with four publications. Following that, institutions like Polytech Porto University (Portugal), Swansea University (United Kingdom), University of Almeria (Spain), and University of Warsaw (Poland) each have three publications. Rey Juan Carlos University is a public university located near the capital city Madrid, founded in 1996. It offers various undergraduate, postgraduate, and doctoral programs. It is known for its strong academic presence in fields such as communication, engineering, health sciences, and social sciences. Polytech Porto University is situated in Porto, Portugal, and is considered a prominent higher education institution in the fields of engineering and technology. It offers various undergraduate programs, particularly in engineering disciplines, and prioritizes technology-focused research. Swansea University, located in the region of Wales, is one of the leading research universities in the United Kingdom. It offers a wide range of undergraduate and postgraduate programs. It is especially recognized for its research contributions in science, engineering, health sciences, and social sciences. The University of Almeria is located in the southeastern part of Spain and is known as a strong research and education center in the fields of agriculture, environmental sciences, and engineering. It plays a particularly significant role in agriculture and environmental matters. The University of Warsaw is one of Poland's oldest and largest universities. It offers a wide range of academic disciplines and makes significant contributions to science, arts, and culture. Located in the capital city of Poland, Warsaw, the university is one of the country's most prestigious educational institutions.

Figure 3: Most Relevant Affiliations
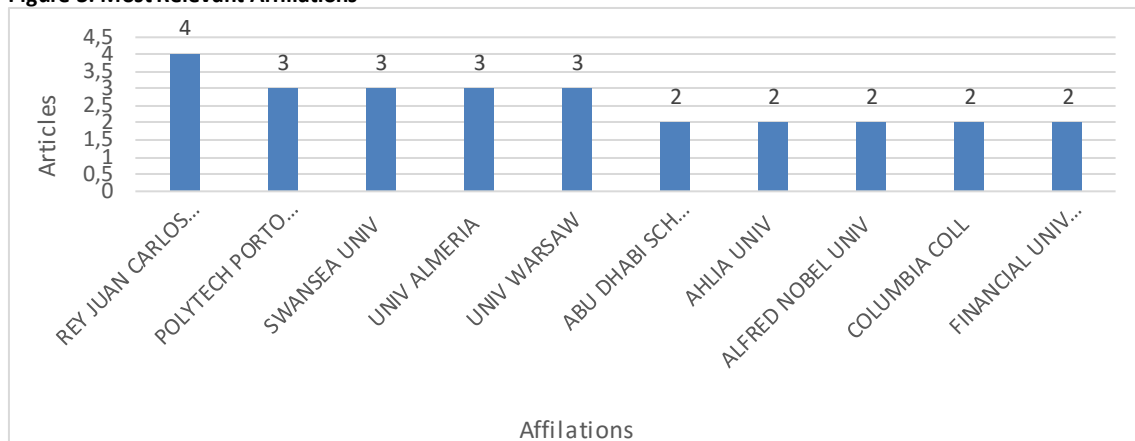
4.4. Country of the Corresponding Author

Corresponding Author's Countries information is important data to evaluate the geographical and international dimensions of the research in bibliometric analyzes and to understand how the research field is affected on a global scale. Figure 4 shows the top 20 corresponding author's countries of study. Single country publications (SCP) stands for simple country publication, and multiple country publications (MCP) stands for worldwide collaborative papers. The most striking result is that India came first, followed by Spain and the USA, for SCP and MCP. The ratio of MCP to total publications of the top 20 countries was 50% for India, indicating that Spain, Finland, France, Canada, and Ireland strongly preferred international cooperation regarding submerged study.

Figure 4: Corresponding Author's Countries
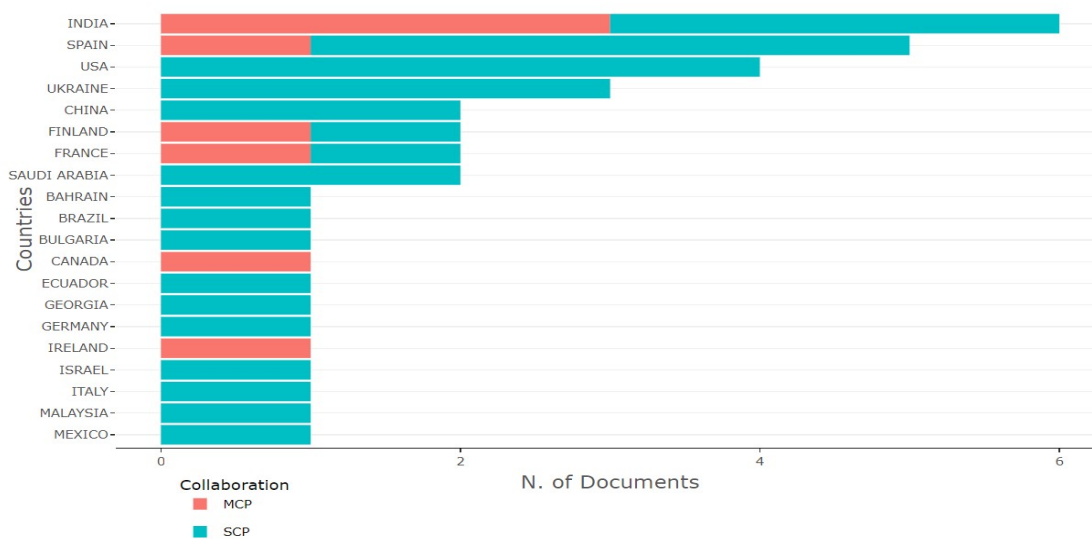
4.5. Most Cited Countries

Most Cited Countries data is important for assessing the influence of countries in a particular research area and understanding the geographical distribution of the research area. For researchers, this data provides valuable information that they can use to evaluate collaboration opportunities and improve their field. According to Figure 5, the examination of citations is applied to assess the efficiency of authors, papers, or journals by evaluating their citation frequencies. The subject of examination encompasses papers, authors, and journals. Its strengths lie in its ability to locate pivotal research within the discipline. However, a drawback is that recent publications may have a lower cumulative citation rate, with most citations being directed toward earlier works (Zupic & Cater, 2015). The most cited countries were ranked Finland (370), Spain (92), and France (58). Accordingly, citations from Finland are very high compared to other Top 9 countries. Finland stands out as the country with

the most citations on this subject and ranks first with 370 citations. This shows that Finland is influential in the production of research and publications in this field, and that work from this country has received wide international attention. Spain and France also stand out with 92 and 58 citations respectively. These countries provide significant scientific influence on a particular topic or subtopic. These results show that researchers in these countries are producing work that is recognized and cited internationally.

Figure 5: Most Cited Countries
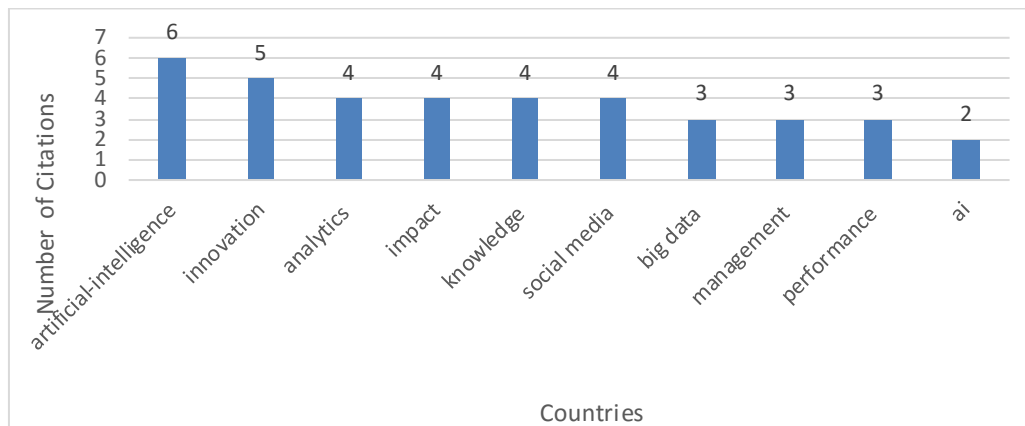
4.6. Most Local Cited References

Most Local Cited References data is important for understanding the impact, importance and collaboration opportunities of local research resources and research. Using this data, researchers can better understand local research areas and increase their scientific impact by promoting local resources internationally. This data helps measure the impact of local research on local or international literature. Seeing which local sources are cited by a wider audience can also help understand the importance and impact of those sources. This section displays the primary regional mentioned sources citation spectroscopy, prevailing terms, hierarchical visualization, lexical shifts, and emerging subjects (derived from additional keywords and the author's specified words). Regarding Figure 6, the most significant number of citations were done to Huang & Rust (2018), Huang & Rust (2021), and Kannan (2017) in the research included in this bibliometric research.

Figure 6: Most Local Cited References
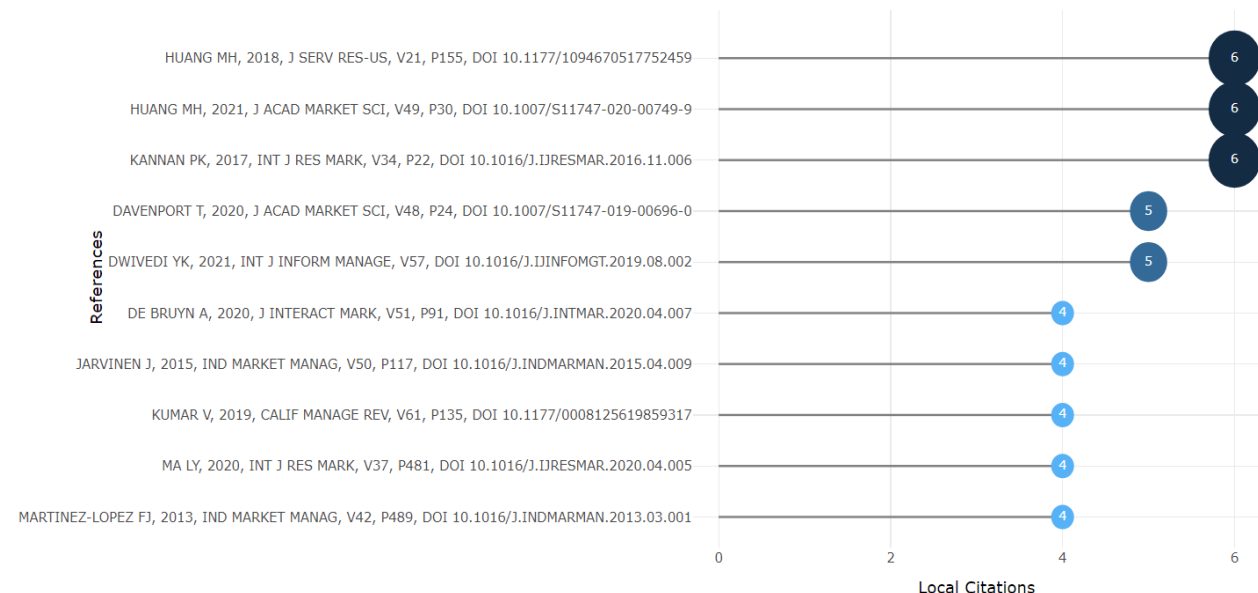
4.7. Most Frequent Words

Most Frequent Words data is useful for analyzing the content of texts, identifying major themes, identifying keywords, and examining language use. This analysis can help researchers uncover important information and patterns in texts. This field can help researchers better understand the literature, identify trends and areas of interest, create research strategies, and identify research gaps. When the articles included in this research were examined, it was seen that keywords such as artificial intelligence (f=6), innovation (f=5), analytics (f=4), impact (f=4), knowledge (f= 4), social media (f=4), big data (f= 3), management (f= 3), performance (f= 3), and ai (f= 2) were used (see Figure 7). The frequent use of the words "artificial intelligence" and "innovation" together may indicate that artificial intelligence plays an important role in innovation processes. The frequent use of the terms "analytics" and "big data" indicates that the use of data analysis and big data is important in the fields of digital marketing and artificial intelligence. A research focus could be set to examine how analytical methods and big data analysis are being used in this field. When the words "social media" and "performance" are used together, it may indicate that digital marketing strategies focus on performance on social media platforms. "Management" and " Using the words "impact" together may indicate that you want to evaluate the impact on AI and digital marketing management. Highlighting the word "information" provides an opportunity to understand how information is used as a communication tool in digital marketing strategies and AI applications.

Figure 7: Most Frequent Words
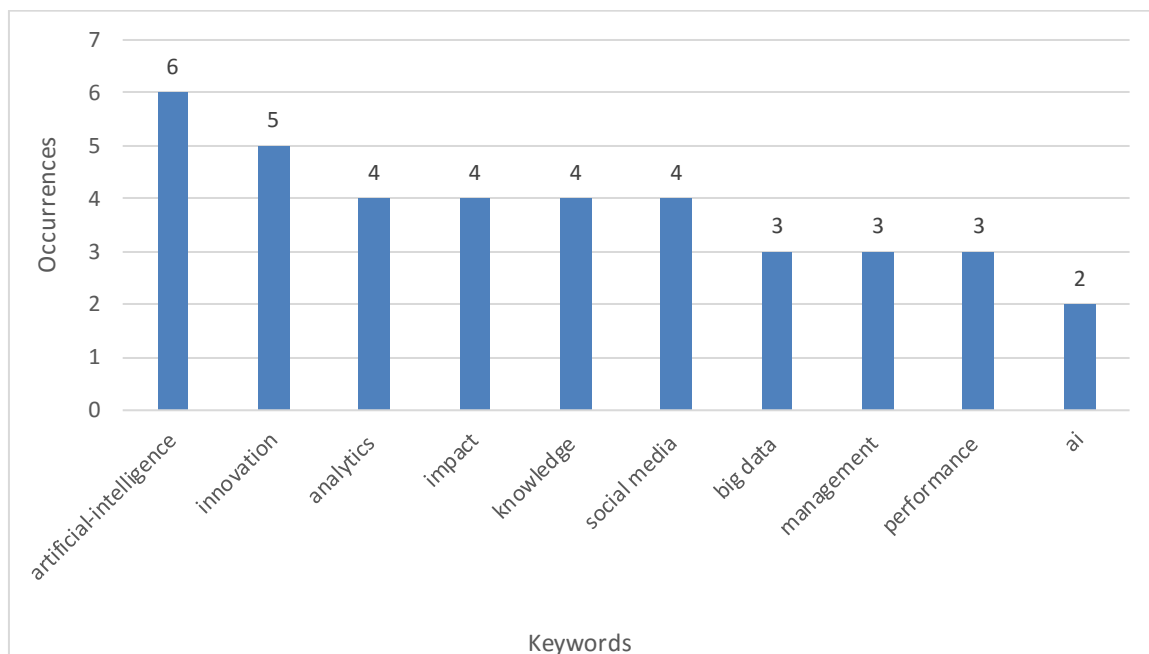
4.8. Tematic Map

Thematic maps present the results of text mining and bibliometric analyzes in a more understandable and visual way, providing researchers with deeper understanding and valuable information. These maps are an important tool for visually representing and analyzing literature. In this study, the thematic map had five clusters. When the author's keywords were considered, niche themes were internet and power (see Figure 8). Emerging theme was social media. The Basic theme was impact. Motor themes were artificial intelligence-knowledge-big data and innovation-analytics-management. The fact that the emerging theme is "social media" indicates the importance of research and literature in this field. This shows that researchers are interested in the power, influence and use of social media and that this topic is important. The underlying theme of "impact" indicates the focus of the research. The research is likely focused on understanding the impacts and implications of studies on digital marketing, artificial intelligence, or similar topics. The "motor themes" mentioned in the analysis, "artificial intelligence-information-big data" and "innovation-analytics-management," determine the sub-themes of the research. These concepts highlight specific subtopics in the literature and reflect areas of greater focus of analysis.

Figure 8: Tematic Map
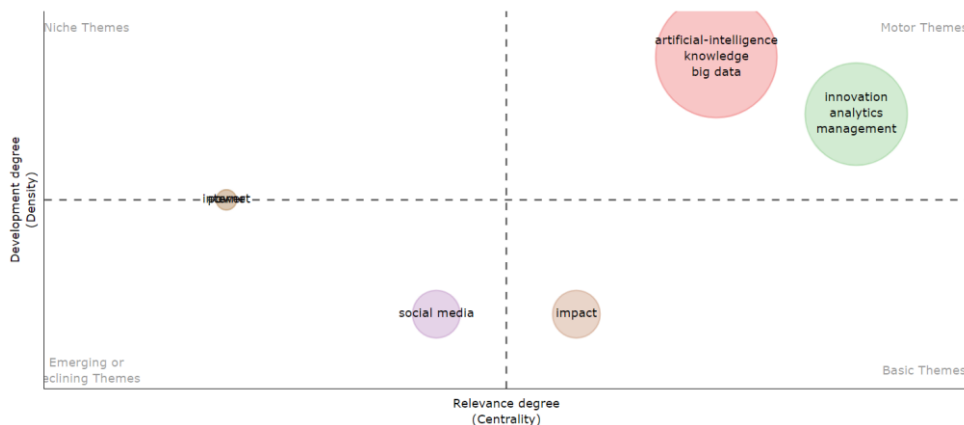
4.9. Core Sources by Bradford's Law

A domain is generally dominated by a few journals as per Bradford's law (Bradford, 1985), formulated by S. C. Bradford. It states that journals can be classified into three distinct zones, each with one-third of the total articles. Bradford's law is also utilized to gain insights into the central cluster of journals and the scholarly output of authors in this domain. In the realm of bibliometric scrutiny, various instruments are accessible, including VOSviewer, Bibliometrix, and CiteSpace; each software application presents its advantages and limitations (Batra et al., 2023). This serves as the focal point where most research papers with cross-referencing are issued. Scholars readily discern that the core journals host a substantial portion of the pertinent articles within the designated field. This holds within the realm of cross-listing investigations (See Table 1). In the first two rows of the table, there are two sources such as "AUSTRALASIAN MARKETING JOURNAL" and "INDUSTRIAL MARKETING MANAGEMENT". Both sources appear with a frequency of 2 (Freq). This indicates that these sources are important references on a particular topic or field and are frequently cited in the literature. The "CumFreq" column shows the cumulative frequency of sources. That is, it represents the total frequency of sources added sequentially, starting with the first source. For example, the source "INFORMATION SYSTEMS FRONTIERS" in rank 3 reached 6 in cumulative frequency. This means that the first six sources were cited 6 times in total The "Zones" column indicates the conclusion of Bradford's Law. This column divides sources into different zones, or "zones." Generally, Bradford's Law lists the most frequently cited sources in the first zone (Zone 1) and the second (Zone 2)) predicts slightly less frequently cited ones and so on. According to the table, all sources are located in "Zone 1", meaning that these sources are generally cited with the same frequency.

Table 1: Core Sources by Bradford's Law

Sources	Rank	Freq	cumFreq	Zones
AUSTRALASIAN MARKETING JOURNAL	1	2	2	Zone 1
INDUSTRIAL MARKETING MANAGEMENT	2	2	4	Zone 1
INFORMATION SYSTEMS FRONTIERS	3	2	6	Zone 1
INTERNATIONAL JOURNAL OF MARKET RESEARCH	4	2	8	Zone 1
13TH INTERNATIONAL CONFERENCE INTERDISCIPLINARITY IN ENGINEERING (INTER-ENG 2019)	5	1	9	Zone 1
2018 INTERNATIONAL CONFERENCE ON HIGH TECHNOLOGY FOR SUSTAINABLE DEVELOPMENT (HITECH)	6	1	10	Zone 1
2019 19TH IEEE INTERNATIONAL CONFERENCE ON DATA MINING (ICDM 2019)	7	1	11	Zone 1
2019 IEEE 9TH INTERNATIONAL CONFERENCE ON SYSTEM ENGINEERING AND TECHNOLOGY (ICSET)	8	1	12	Zone 1
2020 FIFTH INTERNATIONAL CONFERENCE ON FOG AND MOBILE EDGE COMPUTING (FMEC)	9	1	13	Zone 1
4TH INTERNATIONAL CONFERENCE ON INNOVATIVE COMPUTING (IC)	10	1	14	Zone 1

5. CONCLUSION

This article offers a different perspective on artificial intelligence for academics in digital marketing and contributes to the existing literature. AI is a significant factor in transforming digital marketing and shaping future marketing trends. AI technologies in extensive data analysis, personalized content creation, improving customer experience, and automating sales processes offer marketers a competitive advantage. AI-based marketing systems are predicted to advance, making marketing strategies more efficient, effective, and personalized. AI will intelligently automate data-driven and repetitive tasks for marketers in the future. Accordingly, digital marketing costs will decrease, and the ability to make large-scale forecasts will improve, accelerating revenue growth. Marketers must adapt to these trends and explore new opportunities by utilizing AI.

Furthermore, it aimed to conduct a bibliometric analysis of digital marketing and artificial intelligence articles searched in WoS with the biblioshiny interface obtained using the R bibliometrix package in this research. Bibliometric analysis methods are categorized in various manners. This study discussed citation, author, word, and bibliometric coupling analysis. Combining preceding research discoveries and bibliometric information constitutes a pivotal stride toward the progressive enhancement of scientific understanding. Bibliometric investigation objectively evaluates the scientific written works through a quantifiable methodology. Such inquiries offer a transparent, methodical, and replicable scrutiny of the literature. This bibliometric evaluation illuminates individuals desiring to delve into pertinent scholarly literature (Büyükkidik, 2022). Bibliometric analyzes provide researchers with a better understanding of their position in the literature and their potential contributions. These analyzes can help researchers make more informed and strategic decisions, conduct better research, and follow developments in the relevant field.

Han et al. (2021) systematically examined artificial intelligence-supported B2B marketing literature by applying a bibliometric research method on artificial intelligence and business-to-business marketing. Their study summarized 221 journal articles published between 1990 and 2021. In this regard, they suggested future research directions on this subject to researchers. Although this study considers B2B strategies and artificial intelligence, which are innovations in the field of digital marketing, since our research directly examines artificial intelligence and digital marketing, it contains more general findings and differs from the other studies. Faruk et al. (2021) examined 925 articles published in Scopus between 2000 and 2019 to understand the current situation in digital marketing and show how effective studies shape it. The findings reveal that an average of 2.18 authors contributed to each digital marketing article, and the collaboration index was 2.71. It also shows that the top contributing countries in digital marketing are the USA, India, and the UK. Research studies in the field of digital marketing It divided into three main groups: strategic planning and digital marketing, application development and mobile marketing, and studies on customer demographic profiles. Varsha et al. (2021) examined the impact of artificial intelligence on brands in their exploratory research. This research was conducted using the Scopus database, which contains 117 articles covering the period 1982-2019. The study used bibliometric methods such as collaboration, citation analysis, and co-citation analysis. The empirical research investigated the value propositions of artificial intelligence on brands. The study identified nine distinct topic clusters, four clusters of citation analysis, and four co-citation analyses. As a result, the study provided up-to-date information on the impact of AI on brands, revealing merger and spin-off patterns and multi-disciplinary involvement on the topic. Chae (2022) used a bibliometric approach, aiming to map the academic literature in digital business. The study examined 1,868 articles covering the 20 years between 2000 and early 2021. The research focused on research trends in digital business, publication sources, highly cited articles and prolific researchers, popular themes, and their changes over time. Bawack et al. (2022) combine research on artificial intelligence in e-commerce and provide guidelines through which information systems research can contribute to this field. Bibliometric analysis and literature review are combined using an innovative approach. Bibliometric data was analyzed on 4335 documents, and 229 articles published in leading information systems journals were examined. The research shows that studies on artificial intelligence in e-commerce mainly focus on recommendation systems. Additionally, main research themes such as sentiment analysis, trust, personalization, and optimization have been identified. China-based institutions have been determined to be leaders in this field. The study's literature review reveals the main topics and themes of interest to information systems experts. Based on these findings, recommendations for future research are offered.

As a result, in this bibliometric analysis study, after considering a comprehensive research perspective related to digital marketing and artificial intelligence-driven marketing, a total of 60 publications written by 140 authors distributed among 46 journals were identified (2017-2023). In the realm of Digital Marketing and Artificial Intelligence, the articles encompassed in this exploration most frequently surfaced in "Australasian Marketing Journal," "Industrial Marketing Management," and "International Journal of Market Research". For researchers who want to study this subject in the future, these resources will help them determine the most effective resources. Therefore, these sources can be an important reference source for researchers and can be used as basic sources of information for future studies. On the other hand, Rey Juan Carlos University (Spain) stands prominent with four published works. Subsequently, establishments like Polytech Porto University (Portugal), Swansea University (United Kingdom), University of Almeria (Spain), and University of Warsaw (Poland) each boast three

publications. The countries of the corresponding authors were examined, and India took the lead, followed by Spain and the USA. The countries with the highest citations were Finland (370), Spain (92), and France (58). The highest number of references were attributed to Huang & Rust (2018), Huang & Rust (2021), and Kannan (2017) within the study encompassed by this bibliometric analysis. Upon reviewing the articles included in this research, it became evident that terms such as "artificial intelligence, creativity, analytics, influence, expertise, social networks, extensive data, governance, achievement, and AI" were employed.

By examining the publications, authors, universities and authors' countries in this study, it may be possible to increase the level of collaboration between researchers from different countries. In particular, articles with communication authors from many different countries establish international collaboration and research networks. Therefore, for researchers who will work by combining digital marketing and artificial intelligence, this study provides general information about the status of the literature, trends and changes in the field are expressed, and important publications and researchers are introduced. these gains will benefit researchers in identifying research gaps. Additionally, the countries of study authors working on digital marketing and artificial intelligence are useful for understanding how a particular topic or field is affected by different geographical, cultural or social contexts. This allows you to evaluate the generalizations or contextual limitations of research results. The results obtained emphasize the importance of international cooperation. It would be especially appropriate to have a highly cited country like Finland, and for international researchers working in the field of artificial intelligence and digital marketing to cooperate with this country. Moreover, the results show that countries such as Spain and France can innovate and pioneer in a particular field of research. Researchers in these countries can also lead future studies in this field.

Digital marketing encompasses marketing activities that aim to reach target audiences, engage with them, and achieve businesses' goals through digital technologies. Digital marketing offers advantages such as reaching wider audiences, personalized marketing approaches, real-time measurement and analysis, and higher conversion rates. Businesses can gain a competitive advantage and enhance their success through digital marketing strategies.

Artificial intelligence (AI) with personalization can deliver personalized marketing content by analyzing user behaviors. AI algorithms can analyze users' preferences, past shopping experiences, and other data to provide tailored content and offers to each customer. Through big data analysis and learning capabilities, AI can give marketers more insights into customers' preferences, behaviors, and needs. This enables marketers to offer their target audience more personalized content. AI can make recommendations based on customers' past interactions and make real-time adaptations to enhance the customer experience further.

Regarding customer service, AI-powered chatbots can provide instant support to users and automate customer service processes. Chatbots can answer customer queries, resolve issues, and even facilitate sales. AI enables faster and more effective customer service. AI will accelerate the development of automated customer service tools like chatbots and virtual assistants. AI-based chatbots can answer customer questions, resolve issues, and even perform sales transactions. This enables companies to provide customer service more efficiently and increase customer satisfaction.

In content creation and creative processes, AI will play a significant role and automate content creation processes. AI algorithms can generate and edit text, videos, or graphics. This can assist marketers in producing content faster and more efficiently. Digital marketing strategies can be supported by big data analytics and predictive analysis. AI can rapidly analyze millions of data points and shape future marketing strategies with insights derived from these data. This allows companies to understand consumer behaviors better and provide more relevant content to their target audiences. AI can assist marketers in analyzing large datasets and predicting trends. AI algorithms can analyze customer behaviors and market trends to predict future demands, enabling companies to plan their strategies more effectively.

Through AI-powered automated ad management, AI can facilitate the automatic management and optimization of advertising campaigns. AI continuously monitors campaign performance and can automatically adjust advertising budgets and targeting parameters. This can improve advertising efficiency and reduce costs. AI can contribute to developing more targeted and personalized advertisements in advertising. By analyzing customer data, AI can optimize decisions such as which users to show ads to, which content to use, and which channels to prefer. This can enable more effective utilization of advertising budgets. AI algorithms can analyze large amounts of data and detect patterns indicating fraudulent activities or security breaches. Marketers can leverage AI to enhance trust and reliability, protect customer data, prevent fraud, and ensure secure transactions. Future digital marketing trends include AI and machine learning applications, integration with voice search and smart devices, data privacy, and ethical considerations. Businesses need to adapt to these trends and stay updated to remain competitive. There are numerous benefits for businesses in utilizing AI and digital marketing, including improved customer experience, more effective marketing strategies, increased efficiency, and competitive advantage. However, there are also challenges associated with this integration. For instance, AI algorithms must be trained correctly, and issues such as data privacy and ethics should be carefully addressed.

AI provides marketers with valuable insights, automation capabilities, and personalized customer experiences. By harnessing AI technologies, marketers can optimize their strategies, improve campaign performance, and ultimately accelerate business growth in today's data-driven and customer-centric environment. Including AI in marketing can significantly enhance productivity, efficiency, and performance.

6. LIMITATIONS

This study provides a significant resource for researchers working in artificial intelligence and digital marketing and acknowledges that the results come with certain limitations. The resources examined in the study have been restricted to the WoS (Web of Science) database. While the WoS database is recognized as an essential repository by numerous international academic institutions, it has excluded a considerable portion of the studies available in the literature. Future researchers could conduct similar bibliometric analyses using different databases. Another constraint within the study stems from the number of publications examined. Subsequent studies could explore the intersection of artificial intelligence and marketing using different keywords.

REFERENCES

Aria, M., & Cuccurullo, C. (2017). Bibliometrix: An R-tool for comprehensive science mapping analysis. Journal of Informetrics, 11(4), 959-975.

Bala, M., & Verma, D. (2018). A critical review of digital marketing. M. Bala, D. Verma (2018). A Critical Review of Digital Marketing. International Journal of Management, IT & Engineering, 8(10), 321-339.

Batra, S., Saini, M., Yadav, M., & Aggarwal, V. (2023). Mapping the intellectual structure and demystifying the research trend of cross listing: a bibliometric analysis. Managerial Finance, 49(6), 992-1016.

Bawack, R. E., Wamba, S. F., Carillo, K. D. A., & Akter, S. (2022). Artificial intelligence in e-commerce: a bibliometric study and literature review. Electronic Markets, 32(1), 297-338.

Bradford, S.C. (1985), Sources of information on specific subjects, Journal of Information Science, 10(4), 173-180.

Broadus, R. N. (1987). Toward a definition of "bibliometrics". Scientometrics, 12, 373-379.

Büyükkidik, S. (2022). A Bibliometric Analysis: A tutorial for the bibliometrix package in R using IRT literature. Journal of Measurement and Evaluation in Education and Psychology, 13(3), 164-193.

Chae, B. (2022). Mapping the evolution of digital business research: A bibliometric review. Sustainability, 14(12), 6990.

Chaffey, D., & Smith, P. R. (2017). Digital marketing excellence: Planning, Optimizing, and Integrating Online Marketing. Taylor & Francis.

Chaffey, D., & Ellis-Chadwick, F. (2019). Digital Marketing. Pearson UK.

Dimitrieska, S., Stankovska, A., & Efremova, T. (2018). Artificial intelligence and marketing. Entrepreneurship, 6(2), 298-304.

Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W.M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. Journal of Business Research, 133, 285-296.

Elhajjar, S., Karam, S., & Borna, S. (2021). Artificial intelligence in marketing education programs. Marketing Education Review, 31(1), 2-13.

Eriksson, T., Bigi, A., & Bonera, M. (2020). Think with me, or think for me? On the future role of artificial intelligence in marketing strategy formulation. The TQM Journal, 32(4), 795-814.

Fathali, Z., Kodia, Z., & Ben Said, L. (2022). Stock market prediction of Nifty 50 index applying machine learning techniques. Applied Artificial Intelligence, 36(1), 2111134.

Faruk, M., Rahman, M., & Hasan, S. (2021). How digital marketing evolved over time: A bibliometric analysis on scopus database. Heliyon, 7(12). https://doi.org/10.1016/j.heliyon.2021.e08603

Frost, R., & Strauss, J. (2016). E-marketing. Routledge.

Haleem, A., Javaid, M., Qadri, M. A., Singh, R. P., & Suman, R. (2022). Artificial intelligence (AI) applications for marketing: A literature-based study. International Journal of Intelligent Networks, 3, 119-132.

Han, R., Lam, H. K., Zhan, Y., Wang, Y., Dwivedi, Y. K., & Tan, K. H. (2021). Artificial intelligence in business-to-business marketing: a bibliometric analysis of current research status, development and future directions. Industrial Management & Data Systems, 121(12), 2467-2497.

Hollensen, S. (2019). Marketing management: A relationship approach. Pearson.

Huang, M. H., & Rust, R. T. (2018). Artificial intelligence in service. Journal of service research, 21(2), 155-172.

Huang, M. H., & Rust, R. T. (2021). A strategic framework for artificial intelligence in marketing. Journal of the Academy of Marketing Science, 49, 30–50.

Jain, A., Yadav, A. K., & Shrivastava, Y. (2020). Modeling and optimization of different quality characteristics in electric discharge drilling of titanium alloy sheet. Materials Today: Proceedings, 21, 1680-1684.

Jarek, K., & Mazurek, G. (2019). Marketing and Artificial Intelligence. Central European Business Review, 8(2), 87-99.

Kannan, P. K. (2017). Digital marketing: A framework, review and research agenda. International Journal of Research in Marketing, 34(1), 22-45.

Kumar, P., Dwivedi, Y. K., & Anand, A. (2021). Responsible artificial intelligence (AI) for value formation and market performance in healthcare: The mediating role of patient's cognitive engagement. Information Systems Frontiers, 5, 1-24.

Li, J. H. (2018). Cyber security meets artificial intelligence: a survey. Frontiers of Information Technology & Electronic Engineering, 19(12), 1462-1474.

Li, H., An, H., Wang, Y., Huang, J., & Gao, X. (2016). Evolutionary features of academic articles co-keyword network and keywords co-occurrence network: Based on two mode affiliation network. Physica A: Statistical Mechanics and its Applications, 450, 657-669.

Luger, G. F. (2009). Artificial Intelligence: Structures and Strategies for Complex Problem Solving. Pearson Education.

Marinchak, C. M., Forrest, E., & Hoanca, B. (2018). Artificial intelligence: Redefining marketing management and the customer experience. International Journal of E-Entrepreneurship and Innovation (IJEEI), 8(2), 14-24.

Mangold, W. G., & Faulds, D. J. (2009). Social media: The new hybrid element of the promotion mix. Business Horizons, 52(4), 357–365.

Murgai, A. (2018). Transforming digital marketing with artificial intelligence. International Journal of Latest Technology in Engineering, Management & Applied Science, 7(4), 259-262.

Nilsson, N. J. (1998). Artificial intelligence: A new synthesis. Morgan Kaufmann.

Norton, M. J. (2001). Bibliometrics. Introductory concepts in information science. Medford: ASIS.

Osareh, F. (1996). Bibliometrics, citation analysis and co-citation analysis: A review of literature I. Libri, 46(3), 149-158.

Pritchard, A. (1969) Statistical bibliography or bibliometries? Journal of Documentation, 25, 348-359.

Rathore, B. (2023). Digital Transformation 4.0: Integration of Artificial Intelligence & Metaverse in Marketing. Eduzone: International Peer Reviewed/Refereed Multidisciplinary Journal, 12(1), 42-48.

Russell, S. J., & Norvig, P. (2016). Artificial Intelligence: A Modern Approach. Pearson.

Ryan, D., & Jones, C. (2009). Understanding digital marketing: Marketing strategies for engaging the digital generation. Kogan Page Publishers.

Shankar, V., & Parsana, S. (2022). An overview and empirical comparison of natural language processing (NLP) models and an introduction to and empirical application of autoencoder models in marketing. Journal of the Academy of Marketing Science, 50(6), 1324-1350.

Smith, A. N., & Zook, Z. (2011). Marketing communications: integrating offline and online with social media. Journal of Marketing Communications, 17(2), 123-138.

Tiwari, R., Srivastava, S., & Gera, R. (2020). Investigation of artificial intelligence techniques in finance and marketing. Procedia Computer Science, 173, 149-157.

Tripathi, M., Kumar, S., Sonker, S. K., & Babbar, P. (2018). Occurrence of author keywords and keywords plus in social sciences and humanities research: A preliminary study. COLLNET Journal of Scientometrics and Information Management, 12(2), 215-232.

Tubaro, P., & Casilli, A. A. (2019). Micro-work, artificial intelligence and the automotive industry. Journal of Industrial and Business Economics, 46, 333-345.

Viju, V. G. W., & Ganesh, V. (2013). Application of Bradford's Law of scattering to the literature of library & information science: a study of doctoral theses citations submitted to the Universities of Maharashtra, India. Library. Philosophy and Practice, 5, 1-45.

Zupic, I., & Cater, T. (2015). Bibliometric methods in management and organization. Organizational Research Methods, 18(3), 429-472.