School of Social Sciences

Master's Degree Program in Supply Chain Management

Postgraduate Dissertation

Digitalization and Environmental, Social and Governance factors in Supplier Selection

Chatzipavlis Konstantinos

Supervisor: Michail Geranios

Patras, Greece, June 2024

HELLENIC
OPEN
UNIVERSITY

Digitalization and Environmental, Social and Governance factors in Supplier Selection

Chatzipavlis Konstantinos

Supervising Committee

Supervisor: Co-Supervisor:

Michail Geranios   Faidon Komisopoulos

Patras, Greece, June 2024

Abstract

In today's sustainability and efficiency-driven era, incorporating the environmental, social, and governance criteria and digital technologies in supplier selection processes present itself as a prime subject of further research and study in the area of supply chain management. For this dissertation paper, a focus will be made on the dual impact of such factors as Environmental, Social, and Governance (ESG) principles and digitalization on the supplier selection and evaluation process. The study aims to elucidate whether and how the incorporation of ESG factors and digital tools enhances the effectiveness of supplier selection strategies.

This study conducted a quantitative questionnaire that was sent to professionals across various business sectors. The questionnaire was designed to collect data on current practices, perceptions, and outcomes related to the integration of ESG criteria and digital technologies in the supplier selection process.

Preliminary data show that companies who are concerned with the implementation of ESG criteria in suppliers' selection process see significant improvements in their compliance with the global sustainability standards with no negative impacts on their performance.

Additionally, the use of digital tools significantly improves the accuracy of the supplier selection process and allows for faster decision making with the help of advanced data analytics and automated evaluation systems.

This research provides empirical examination on the benefits and challenges associated with the adoption of the ESG factors and digitalization in supplier selection while also offering a range of theoretical insights to the academic literature.

A dissertation on this topic would offer insights into best practices and strategic considerations for enhancing the sustainability and efficiency of procurement processes.

By integrating the empirical data along with theoretical frameworks, the dissertation indicates that the processes of selecting suppliers have been transformed with the adoption of ESG factors and digital technologies. Furthermore, such a transition not only responds effectively to the increasingly growing demands of sustainability and efficiency in global supply chain even as it also provides a significant competitive advantage to those firms that would be able to execute these strategies effectively.

Keywords

Περίληψη

Στην εποχή της βιωσιμότητας και της αποδοτικότητας που διανύουμε σήμερα, η ενσωμάτωση των κριτηρίων περιβαλλοντικής, κοινωνικής και διακυβέρνησης (ESG) και των ψηφιακών τεχνολογιών στις διαδικασίες επιλογής προμηθευτών αποτελεί πρωταρχικό θέμα περαιτέρω έρευνας και μελέτης στον τομέα της διαχείρισης της εφοδιαστικής αλυσίδας. Για τη διατριβή αυτή, θα επικεντρωθούμε στη διπλή επίδραση τέτοιων παραγόντων όπως οι αρχές ESG και η ψηφιοποίηση στη διαδικασία επιλογής και αξιολόγησης προμηθευτών. Η μελέτη αποσκοπεί να διαφωτίσει κατά πόσο και πώς η ενσωμάτωση των παραγόντων ESG και των ψηφιακών εργαλείων ενισχύει την αποτελεσματικότητα των στρατηγικών επιλογής προμηθευτών.

Η μελέτη αυτή διεξήγαγε μια ποσοτική έρευνα μέσω ερωτηματολογίου, το οποίο εστάλη σε επαγγελματίες διαφόρων επιχειρηματικών τομέων. Το ερωτηματολόγιο σχεδιάστηκε για να συλλέξει δεδομένα σχετικά με τις τρέχουσες πρακτικές, αντιλήψεις και αποτελέσματα που σχετίζονται με την ενσωμάτωση των κριτηρίων ESG και των ψηφιακών τεχνολογιών στη διαδικασία επιλογής προμηθευτών.

Προκαταρκτικά δεδομένα δείχνουν ότι οι εταιρείες που ενδιαφέρονται για την εφαρμογή των κριτηρίων ESG στη διαδικασία επιλογής προμηθευτών βλέπουν σημαντικές βελτιώσεις στη συμμόρφωσή τους με τα παγκόσμια πρότυπα βιωσιμότητας, χωρίς αρνητικές επιπτώσεις στην απόδοσή τους. Επιπλέον, η χρήση ψηφιακών εργαλείων βελτιώνει σημαντικά την ακρίβεια της διαδικασίας επιλογής προμηθευτών και επιτρέπει τη γρηγορότερη λήψη αποφάσεων με τη βοήθεια προηγμένων αναλύσεων δεδομένων και αυτοματοποιημένων συστημάτων αξιολόγησης.

Η έρευνα αυτή παρέχει εμπειρική εξέταση των ωφελειών και των προκλήσεων που συνδέονται με την υιοθέτηση των παραγόντων ESG και της ψηφιοποίησης στην επιλογή προμηθευτών, ενώ προσφέρει επίσης μια σειρά θεωρητικών ιδεών στην ακαδημαϊκή βιβλιογραφία.

Μια διατριβή πάνω σε αυτό το θέμα θα προσφέρει γνώσεις για τις βέλτιστες πρακτικές και στρατηγικές σκέψεις για την ενίσχυση της βιωσιμότητας και της αποδοτικότητας των διαδικασιών προμηθειών. Με την ενσωμάτωση των εμπειρικών δεδομένων μαζί με θεωρητικά πλαίσια, η διατριβή δείχνει ότι οι διαδικασίες επιλογής προμηθευτών έχουν μετασχηματιστεί με την υιοθέτηση των παραγόντων ESG και των ψηφιακών τεχνολογιών. Επιπλέον, αυτή η μετάβαση όχι μόνο ανταποκρίνεται αποτελεσματικά στις ολοένα αυξανόμενες απαιτήσεις βιωσιμότητας και αποδοτικότητας στην παγκόσμια εφοδιαστική αλυσίδα, αλλά παρέχει επίσης σημαντικό ανταγωνιστικό πλεονέκτημα σε εκείνες τις επιχειρήσεις που μπορούν να εκτελέσουν αυτές τις στρατηγικές αποτελεσματικά.

Λέξεις – Κλειδιά

Τεχνητή Νοημοσύνη, Επιλογή προμηθευτή, Αξιολόγηση προμηθευτή, Περιβαλλοντική, Κοινωνική και Διακυβέρνηση (ESG), Ψηφιοποίηση

Table of Contents

List of Figures

List of Tables

List of Abbreviations & Acronyms

AI Artificial Intelligence

ESG Environmental, Social, Governance

IOT Internet of Things

EU European Union

SFDR Sustainable Finance Disclosure Regulation

Chapter 1: Introduction

1.1 Background

Supplier selection has always played a critical role in procurement departments and generally in businesses. The traditional way of selecting a supplier was mainly focused on cost, delivery, and quality criteria. However, over the years, the critical factors and criteria have changed in the supplier selection process. The Environmental, Social, and Governance (ESG) criteria are considered essential for a business's sustainable supply chain management (Carter & Rogers, 2008), and sustainable supply chain management can be defined as the achievement of an organization's environmental, social, and governance goals that will drive a company's continual economic improvement (Carter & Rogers, 2008).

The environmental factor estimates an organization's impact on climate change, pollution, waste, and carbon emissions (Matos, 2020). The social dimension considers an organization's factors such as working conditions, health and safety measures in the workplace, and diversity (Matos, 2020), while the governance factor considers ethical practices among an organization's workforce, transparency, and compliance with regulations (Krause et al., 2009). The achievement of these three factors from an organization not only drives financial improvement but also minimizes risk and strengthens the organization's reputation (Awaysheh & Klassen, 2010).

The rapid rate at which technology is developing provides new opportunities to optimize the supplier selection and evaluation process. New digitalized and big data analysis tools, give businesses the opportunity to evaluate a supplier's capabilities more efficiently and accurately. Artificial intelligence technologies such as machine learning and Bayesian networks have been proven by researchers to improve the performance and effectiveness of supplier selection models (Toorajipour et al., 2021).

Recent research studies have shown that the adoption of digital tools can have a major impact on an organization's processes. For example, the digitalization of supplier selection has shown that it has an impact on the overall performance and efficiency of the organization (Sharma & Joshi, 2023).

Although ESG and digitalization factors are considered important in the wider community, businesses struggle to adopt these strategies in their supplier selection models. For the above reason, it is considered that this struggle needs further investigation in terms of the obstacles and benefits of developing models that can help the adoption of ESG and digitalization strategies (Bai & Sarkis, 2010).

This thesis aims to dive deeper on the supplier selection process and answer some questions regarding the role and impact of ESG practices and technological advancements in supplier selection practices.

1.2 Statement of the Problem

The integration of Environmental, Social and Governance factors into supplier selection is becoming increasingly mandatory and not just optional, as businesses must be compliant with ESG regulations such as the European Union Taxonomy Regulation and the European Union Sustainable Finance Disclosure Regulation (SFDR). Despite the well-known importance of sustainability, many organizations struggle to effectively adopt the ESG criteria into their procurement processes.

The digitalization of procurement processes and artificial intelligence (AI) have the potential to increase the efficiency and effectiveness of supplier selection. However, the obstacle observed is the understanding of the way in which digitalization can integrate the ESG criteria into the supplier selection process.

This research will examine the challenges that companies face in integrating these factors into their business strategies. Additionally, this study will explore how ESG (Environmental, Social, and Governance) factors and digitalization have influenced supplier selection and evaluation processes. It will also consider how these processes differ from traditional supplier selection methods and how the importance of traditional methods has been adjusted to integrate ESG and digitalization factors.

According to what we mentioned above, the two main research questions of this thesis are:

- Research Question 1: How does the integration of ESG practices impact supplier selection in a company?
- Research Question 2: How has technology (e.g., digital platforms, AI) impacted the process of supplier selection?

1.3   Methodology and Approach

Methodology

This dissertation utilizes a quantitative research methodology, specifically deploying a structured questionnaire to gather data from professionals involved in supplier selection within various industries. The questionnaire includes a mix of ranking scales, multiple-choice, and frequency-based questions to comprehensively assess factors influencing supplier selection and evaluation. Key questions include ranking the importance of different criteria when selecting a supplier, identifying methods used to evaluate supplier performance, and examining the frequency and factors influencing the decision to switch suppliers. Additional questions explore the integration of Environmental, Social, and Governance (ESG) criteria, the role of digital technology, and the potential impact of artificial intelligence (AI) in supplier selection processes. This design allows for a detailed analysis of current practices and perspectives, which are pivotal in understanding and enhancing supplier management strategies.

Approach

Prior to the distribution of the questionnaire, it was initially administered to a small sample of professionals for validation. Following the positive feedback received from these professionals, the questionnaire was disseminated via email to various categories of respondents who had different geographical locations and industries of business. The total number of respondents was 71. The collected data are analyzed using descriptive statistics to summarize the responses and inferential statistics to explore relationships and trends among the variables. For questions that involve ranking or selecting multiple options, frequency distributions and cross-tabulations are utilized to provide insights into the prioritization and decision-making processes in supplier selection. This comprehensive analysis aims to offer a granular understanding of the criteria and technologies influencing supplier evaluations and the strategic incorporation of ESG factors in procurement decisions.

1.4   Significance of the Study

This study is significant as it deals with two major factors of our day, ESG and digitalization, within the context of supplier selection, which is a key area for an organization and especially for supply chain management. As the international market continues to evolve, organizations must adapt to digitalization and ESG, not only to remain competitive but also to comply with all relevant regulations and sustainable practices.

This thesis not only contributes to academic knowledge but also relates to businesses and society. For businesses, the key is how to improve the supplier selection process by integrating the factors of ESG and digitalization, which leads to better compliance with the ESG regulations and potentially improved overall performance. For society, the development of a sustainable supply chain aligns with the global goals for sustainability.

1.5   Chapter outline

Below is a brief overview of the following chapters.

Chapter 2: Literature Review
In this chapter, the main concept of the supplier selection process will be discussed, comparing the traditional and modern approaches when selecting a supplier and the roles of ESG and digitalization.

Chapter 3: Methodology:
The design and approach of the research used in the study, along with the data collection methods and the statistical techniques used for analyzing the data. The design of the questionnaire is also included.

Chapter 4: Analysis of Questionnaire Results
It will be presented the analysis of the data collected through the questionnaire, including the demographic trends, the importance of the criteria, and the integration of digitalization.

Chapter 5: Conclusions and Recommendations
A summarize of the key findings and some recommendations and suggestions to businesses that look to incorporate digitalization and ESG factors into the supplier selection process.

Chapter 6: References
List of all the sources cited inside the dissertation.

Chapter 7: Appendices
Included additional material such as the research questionnaire, data tables, and analyses.

2 Chapter 2: Literature Review

2.1 Concept of Supplier Selection

2.1.1 Importance in Supply Chain Management

As mentioned in Section 1.1, supplier selection is essential in supply chain management, having a huge impact on the implementation of the organization's strategy and efficiency in daily operations. Effective supplier selection directly influences the quality, cost, and reliability of inputs, affecting overall supply chain performance and sustainability (Sarkis & Dhavale, 2015). Additionally, effective supplier selection ensures product quality and customer satisfaction, while managing costs and maintaining delivery schedules, critical for sustaining competitive advantage in dynamic markets (Dubey et al., 2017).

There are several reasons for integrating suppliers into the organization's processes. The first key benefit is to build stronger and more strategic relationships, which can be advantageous for both the organization and the supplier. When suppliers are directly involved in the organization's process, it can lead to higher-quality products or services as both sides can cooperate to maintain quality standards. With integrated relationships, organizations can adapt more swiftly to market changes due to improved communication from both sides and the ability to set production and supply quickly. By working closely with suppliers, companies can tap into a broader pool of knowledge and expertise. This can foster innovation, as suppliers often have deep insights into product components and might offer innovative solutions that the organization has not considered.

Moreover, the process of choosing suppliers now intersects significantly with Corporate Social Responsibility (CSR). It is becoming increasingly important for companies to ensure that their suppliers adhere to ethical standards, encompassing environmental responsibility, fair labor practices, and governance. This alignment with CSR principles assists in meeting regulatory requirements, supporting CSR objectives, and bolstering the company's reputation with consumers who are more conscious of sustainability and ethical considerations (Winter & Knemeyer, 2013).

2.1.2 Traditional methods of Supplier Selection

Organizations that use the traditional way of selecting and evaluating a supplier focus on criteria such as price, quality, and delivery reliability. The factors mentioned above are used in scorecards or weighted systems, this approach provides a clearer picture for the selection of suppliers (Beske-Janssen et al., 2015).The focus on price is to hold buying expenses low whilst preserving high quality and provider requirements. However, this will occasionally lead to compromises in product pleasantness or patron self-assurance, increasing the overall price of possession (Govindan et al., 2014).

Quality is measured based on a supplier's ability to satisfy predetermined standards and conform to operational requirements. Industry-specific certifications and exceptional assurances are commonplace equipment to evaluate a dealer's high-quality assurance abilities (Rajeev et al., 2017). Delivery reliability measures the supplier's capacity to deliver items and services on time, which is critical to retaining continuity of operations and preventing fabric shortages. Performance metrics regularly encompass well-timed shipping and responsiveness to urgent demand (Schoenherr & Speier-Pero, 2015).

While these conventional techniques have laid a robust foundation for provider choice, they frequently lack the flexibility to conform to hastily converting market situations and might not seize the strategic fee of long-term provider relationships fully.

Even though the traditional approach to selecting suppliers is based on price, quality, and delivery reports, this method is unlikely to incorporate numerous elements of the supplier relationship that might be of the highest strategic value to the organization. Particularly, while the traditional model helps meet the standard operational objectives in an organization, at times, such important elements as supplier innovation, sustainability, and the opportunity to work in collaboration with the supplier to design an innovative product or service are not observed. With the current state of the market, which requires a supply chain to be particularly flexible and innovative, these factors are of utmost importance.

In sum, it is important to note that while traditional methods of supplier selection continue to be useful due to the existing solid framework for evaluating performance, assimilating more comprehensive, strategic, and relational aspects of the process can prove beneficial in the long run. As a result, a holistic approach toward supplier selection deserves a closer investigation in terms of both supply chain resilience and the enhancement of competitive advantage. In addition, the suggested method remains efficient in terms of the alignment between operational processes and broader business goals concerning sustainability and innovation.

2.1.3 Modern Approaches to Supplier Selection

The approaches to supplier selection change, and nowadays, they lean towards new technologies and sustainability criteria. Modern methods of choosing suppliers are based on big data, artificial intelligence, and machine learning. These methods help to make objective, sustainable supplier selections. Such systems help to interpret large amounts of data and provide a more favorable decision regarding the abilities of suppliers to satisfy the needs of their customers and comply with the standards of sustainability. AI algorithms are good at predicting supplier performance and risks. This happens taking into consideration the specifics of the company and some hidden risks not visible at first sight.

The sustainability perspective is the second criterion that strongly influences decision-making. It involves the environmental, social, and governance performance of the asset. This change was caused by a range of reasons: regulatory policy, customers who increasingly ask for more 'ethical' goods, and financial reasons, in particular, the state of the environment and unstable societies, which can cause unexpected problems for companies. Sustainable supplier selection relies on some common methods, such as scorecard evaluation, audits, and certificates.

Innovations in the field of supplier selection include the switch to collaborative networks. Businesses are choosing their suppliers at the design stage in order to start the innovation of new products that can be both sustainable and cost-effective. This approach allows businesses to participate actively in the creation process and not just wait for the supplier to finalize the product. For example, early supplier integration may lead to a considerable improvement in sustainability through waste management and the use of recycled materials. EcoVadis, SourceMap, and Sedex are three examples of specialized tools enabling businesses to assess the sustainability of their suppliers (Risk Management Tools, n.d.). In particular, these tools provide metrics that can help companies make better choices concerning environmental impact, labor practices, and ethics and select suppliers meeting their sustainability conditions.

2.1.4 Categories of Suppliers and Their Strategic Implications

The right understanding of supplier categorization is essential for businesses as it allows them to manage their supply chain better and adjust their procurement strategy as needed. Different categories of suppliers play different roles, meaning that operational and strategic procurement efforts should be adjusted accordingly. The main categories of suppliers are strategic, tactical, niche, commodity, and transactional. Additionally, there are local and global suppliers, which can be strategically important as well, depending on the goals of the supply chain.

1. **Strategic Suppliers**

Strategic suppliers are those that are selected to provide critical goods or services that are important for the company's core operation, and therefore the relationship with this category of suppliers is characterized by trust and collaboration. These cooperations with these kinds of suppliers are usually long-term partnerships, as this kind of supplier cannot be easily replaced by organizations (Thomas Y. Choi, 2013).

2. **Tactical suppliers**

Tactical supplier partners are sourced for their ability to provide goods and services of objective importance, but with no substantial strategic importance. The relationships with this type of supplier are transactional and short-term, implying that procurement activities with these suppliers are associated mainly with cost-effectiveness and efficiency considerations. Oftentimes, businesses change their tactical suppliers to negotiate better prices or take advantage of supplier-induced innovations. Examples of tactical suppliers can range from packaging and printing companies to an array of transportation providers (Heckmann et al., 2015).

3. **Niche suppliers**

Niche suppliers are specialists in the field, providing unique products and/or highly specialized services. Niche supplier partners are often sourced by businesses that require high-level, custom-ordered solutions from suppliers, whose products cannot be subsided by mainstream suppliers. The volume of interaction between a business and a niche supplier is usually relatively low, particularly in comparison to its strategic partners, and can be a single-order deal (Tachizawa & Wong, 2014).

4. Commodity Suppliers

The products that commodity suppliers offer is standard and do not vary in their characteristics, such as raw material or generic component suppliers. The main focus in these types of relationships is on price, reliability, and delivery consistency. The relationship between commodity suppliers and organizations is characterized by minimum interaction and negotiation (Glock & Hochrein, 2011).

5. Transactional suppliers

Transactional suppliers are generally used for one-off purchases or for non-regular purchases. This type of supplier is usually preferred for a company's immediate needs. These types of engagements do not usually contribute to long-term strategic objectives but rely on flexibility both on the buyer and supplier sides. Suppliers in this category have special requirements in place, and the costs are based on achieving high efficiency (Arjan van Weele, 2018).

6. Local vs. global suppliers:

Another major decision to be made in this matter is whether to have a local or global supplier. The aspects a company may consider in this regard are cost, quality, and delivery logistics. Local suppliers might provide lower shipping costs and quicker delivery, but the company might not be able to purchase unique materials that are not available in the local market. It may also be possible to have a global supplier provide cost-effective supplies (Christopher, 2016).

Strategic implications: the decrease in production costs for non-strategic suppliers is a real benefit that has to be accounted for in business planning and economics. By acknowledging the range of suppliers a business interacts with, it can create a more operationally efficient plan for the division and allocation of resources and improve its interaction with these suppliers. Understanding the supplier categories also allows businesses to manage risk more effectively by managing the diversity of the supplier base and, therefore, not relying on the excessive amount of one type of supplier.

2.2 ESG Practices in Supplier Selection

2.2.1 Environmental Considerations

As businesses seek to make their supply chains compliant with the principles of sustainable development, the role of environmental considerations in supplier selection becomes increasingly essential. This is no longer a matter of responding to the requirements of

regulating authorities, as the adoption of principles that support ESG criteria can be a powerful strategic move that will help the company increase its corporate reputation and make its operations more resilient. From this perspective, being able to select the right list of suppliers based on the ESG criteria surely helps to ensure that the selected companies will not expose the beneficiary company to new unexpected risks while providing an opportunity to benefit from new perspectives and emerging market opportunities.

ESG Integration in Supplier Selection: The importance of ESG integration into the process of selecting the supplier is discussed by McKinsey as follows (Erlandsson et al., 2021). In order for a business organization to identify suppliers that support environmental standards while still ensuring profitability and operation excellence, it is very important to incorporate ESG metrics and policies across the procurement and supply management processes. Besides, it may be a good idea for a company to collaborate with its value chain partners to reduce carbon emissions in intensive categories and support the scaling of successful sustainability initiatives throughout the company.

Additionally, it is important to note that alongside the development of advanced technologies facilitating the evaluation of suppliers' ESG compliance, the number of data-driven approaches to supplier selection has been rapidly increasing. As McKinsey states (Achieving Sustainable Procurement | McKinsey, n.d.), in order for businesses to ensure that operational decisions truly match sustainability objectives, businesses must take a data-driven and analytical approach. One of the examples in the source is the development of resource clean sheets that help to evaluate both the monetary cost and the environmental impact of the approach or the material being used, making sure that only cost-efficient and environmentally friendly options are chosen.

Therefore, the growing interest of companies in selecting only environmentally responsible suppliers is not just a matter of increasing the level of compliance with regulatory requirements and reducing the risks; it may also have positive impacts, such as the example of Zuno Carbon (Sustainable Supplier Selection: A Comprehensive Guide, n.d.), which achieved substantial savings through waste reduction and more efficient processes by prioritizing sustainable suppliers.

In conclusion, the role of environmental considerations in the supplier selection process is not just about compliance but is a key factor for businesses to ensure long-term sustainability and value creation.

2.2.2 Social Responsibility

The ethical operation of businesses and sustainability in their supply chains have become an essential part of their awareness. As a result, the integration of social responsibility criteria in supplier selection has become a crucial requirement. Modern businesses are increasingly aware of the value of sustainable supplier selection since it guarantees a company's better operation, decreased risk of operations, improved brand reputation, and enhanced stakeholder confidence.

Incorporation of Social Criteria: Contemporary businesses do include social and ethical criteria in their supplier evaluations. For example, using a sophisticated decision-making methodology such as Grey Decision Making, businesses can evaluate the sustainable and social performance of suppliers and make more justified and socially responsible decisions (Nasseri et al., 2023).

Most recent studies reveal that Corporate Social Responsibility (CSR) components, such as labor issues, corporate partnerships, social effects, and environmental responsibility, are likely to be important considerations. Most recent studies also support the idea that suppliers who are dependent on socially responsible buyers tend to improve their own performance. This relationship, however, might be moderated by factors such as the supplier's prominence in the network and demand uncertainty, which can affect their ability to consistently meet CSR expectations (Cao et al., 2024).

Practical Implications and Benefits: Engaging with suppliers that are socially responsible can be very beneficial in practice. First, the risk of potential scandals and subsequent financial losses is open to prompt reaction. Second, collaborative relationships can lead to innovation. In this way, suppliers can develop new and sustainable products and services. Moreover, engaging with socially responsible suppliers provides benefits to the interacting parties.

Broader Organizational Impact: Moreover, integrating social responsibility into operational experience is likely to provide organizations with more responsiveness to global crises and demands for better operation in terms of satisfactory practices and adherence to ethical standards. Mainstreaming social responsibility issues helps build an advanced model of business and organizational behavior that combines social welfare and operational achievements in a broader context. As such, with the proper integration and further development, social responsibility-related criteria can serve the interests of the larger public while simultaneously guaranteeing a company's successful operation.

Overall, the relevance of supplier selection with respect to social responsibility criteria cannot be overstated. Modern businesses that respond to worldwide tendencies are more entitled to sustainable operation and a lower risk of operation than those with traditionally arranged supply relations. In the above-mentioned context, the approach to global demands and the well-being of stakeholders with the incorporation of social responsibility is the future establishment of global interactions between supply chains.

2.2.3 Governance and Ethical Procurement

The notions of governance and ethical procurement constitute important aspects of supplier selection, aimed at increasing the degree of transparency, accountability, and compliance with the respective standards throughout the supply chain.

Governance structures in supplier selection have to focus on the fairness of procurement processes and the integration of supplier policies into broader ethics and compliance areas. The existence of clear governance roles in procurement and the consistency of this policy with corporate ethics guidelines constitute two major elements of proper governance activity. Establishing an appropriate governance framework would therefore involve identification of the relevant roles and responsibilities, creation of respective decision-making structures, and concern with change management to ensure that the agreed governance principles are being put in place consistently enough. Proper governance frameworks have to be able to address both the likelihood of substandard processes and noncompliance with ethical norms.

Ethical procurement implies the application of morality in choosing which products to purchase. From this perspective, selecting suppliers not only based on price and quality aspects but also based on morality implies paying attention to each of the supplying organizations' adherence to ethical activity with regard to fair labor conditions, professional

integrity, and environmental respect. The increasing attention of companies to the latter implies a broader assessment along ESG criteria based on a wider array of issues. The strategies being used to fulfill these goals involve utilizing ESG ratings to assess the performance of suppliers with regard to this principle and the creation of VMS systems to track the impact of the suppliers and manage what can be measured with respect to ethical supplier practices.

The strategic implications of choosing an ethical way of procuring are numerous. On an operational level, this behavior should lead to a higher degree of reputation and more loyal customers based on ethical values. In addition, from a strategic viewpoint, this approach can help deal with the risk associated with the increasing number of social and environmental laws throughout the world. The emphasis on the sustainability of supply chains relies on the fact that new laws and regulations in these areas may conflict with existing business models and require due care. In this way, ethical supplier selection is likely to lead to both long-term customer loyalty and the sustainability of supplier relationships. Overall, governance and ethical procurement are not simply necessary for compliant behavior. Instead, these approaches should be treated as strategic possibilities to increase the degree of transparency and ethics in operations.

2.2.4 Sustainability Metrics in Supplier Evaluation

The importance of sustainability in the context of supplier selection rises along with the worldwide concerns about environmental issues. A variety of sustainability indicators are used by contemporary businesses to determine how well suppliers comply with social and environmental ethics and environmental responsibility in their supply chains.

Development of Sustainability Metrics: One of the most important steps involved in developing sustainability metrics is identifying the quantitative scales for assessing qualitative aspects of a supplier's performance. A supplier's labor practices, waste management, or carbon footprint may all fall under the umbrella of sustainability and need to be quantified using the appropriate metrics. The first step in creating a sustainability metric is developing these metrics in accordance with global standards (Searcy, 2016).

Challenges and solutions: One of the most difficult aspects of implementing sustainability measures is assuring the accuracy and dependability of data obtained from suppliers. Many businesses have begun employing third-party auditors and certification bodies to validate data given by suppliers in order to get around this problem. Digital platforms are also being used by an increasing number of businesses to track and handle this sustainability data (Klassen & Vereecke, 2012).

Strategic benefits: Evaluation of suppliers using sustainability indicators and stated values not only ensures that manufacturers follow the company's sustainability criteria, but also enhances consumer loyalty and a company's overall brand image. It also stimulates the better performance of manufacturers and, hence, the overall sustainability of the supply chain.

2.2.5 Impact of ESG practices in Supplier Selection/Evaluation

Implementing ESG for selection of suppliers has become one of the cornerstone strategies for organizations willing to maintain business activity sustainable and ethical. That trend is in line with the focus on responsible sourcing, which is becoming more and more critical not

only for environmental conservation but also for ensuring proper corporate reputation and improved financial performance.

Integrating ESG Criteria into Supplier Selection: The incorporation of ESG criteria is now an essential part of the procurement approach of many forward-thinking companies. These companies evaluate the suppliers not only on metrics like quality and cost but also on environmental impact, social responsibility and governance standards. This approach assists on mitigating risk and utilize the long-term benefits of sustainability (Schaltegger & Burritt, 2018).

Case Study: Unilever is a good example of the fact that ESG inclusion into the criteria for selecting suppliers is a correct practice. According to the company's Sustainable Living Plan, Unilever sets the goal of sourcing 100% of their agricultural raw materials sustainably. The company plans to reduce its environmental impact and increase its social impact, which can be achieved by working side by side with its suppliers on improving their environmental and social performance. This activity is closely related to Unilever's supply chain strategy, and this company's supply chain constitutes its brand reputation (Unilever, n.d.).

Involving ESG criteria in supplier selection has enormous advantages, but also some challenges. On the one hand, there can be several challenges in this matter such as the complexity of the evaluation of different ESG practices and the cost that is associated with supplier monitoring. On the other hand, the benefits such as the long-term advantages, including enhanced brand loyalty and investor appeal are often greater than these challenges.

2.3   Technology in Supplier Selection

2.3.1 Digital Platforms

Digital platforms are becoming a powerful tool for supplier selection, revolutionizing procurement operations by increasing their efficiency, transparency, and strategic capability, and are an essential part of modern e-sourcing strategies.

Evolution of Supplier Platforms: Such platforms are an evolution beyond the traditional supplier relationship management (SRM) systems. These platforms not only manage contracts and performance metrics, but they have evolved into dynamic supplier collaboration platforms. This is important in the currently complicated global chains to enable long-distance management while still having up-to-date information and communication with suppliers. They also incorporate sophisticated technologies such as artificial intelligence (AI) to turn large amounts of data into useful information and insights and to streamline communication on electronic platforms (Supplier Collaboration Platforms: The Evolution of Supplier Relationship Management, n.d.).

E-Sourcing and Digital Platforms: E-sourcing platforms have automated and optimized procurement processes by conducting pre-purchase questionnaires, e-auctions, and supplier viability analyses. In fact, each step of the procurement life cycle is conducted through digital platforms. The processing of digital platforms allows companies to engage in more competitive and fair procurement processes. As a result, the best supplier is chosen based on a more detailed analysis of costs, quality, and service offered.

AI and Machine Learning Enhancements: AI and machine learning have been integrated into the supply chain platforms of major tech companies and have significantly enhanced the

supplier selection process. Additionally, AI may be used to anticipate trends, streamline inventory, predict the company's upcoming supplies, and automate supply chains in general. **Advantages of Modern Digital Platforms:** The implementation of an advanced digital platform meaningfully improves the process of supplier selection. These digital tools raise the quality of supplier assessments while at the same time shortening and increasing the depth of the procurement cycle, granting more opportunities to the teams engaged in the decision-making process. Additionally, the use of such platforms increases the level of trust and the quality of the relationships established between the organization and its suppliers. The transparency of the digital platforms leads the suppliers to work closely around the corporate goals, which means that strategies built upon procurement can be better integrated into the business models, leading to the maximum optimization of the efficiency and strategic outcomes of this process. It may be stated that technological integration is becoming increasingly necessary for a business in order to achieve a competitive edge in the current dynamic market.

2.3.2 AI in supplier selection

One of the tendencies that can be highlighted today is the usage of artificial intelligence (AI) in the supplier selection process. In particular, companies nowadays have the capability to analyze vast amounts of complex data. At the same time, the processes of decision-making can also greatly benefit from the use of AI. That is why, today, many AI applications are designed with a focus on the improvement of multi-criteria decision models and predictive analytics to identify the best suppliers. For example, AI can use numerous data sources to predict trends in the market and the preferences of customers. Such predictions can help businesses select their suppliers based on a strategic approach.

The most significant development in this area is the creation of AI or algorithms that can be used for supplier scouting. In the case of this application, the AI is used to select the most appropriate supplier for a company's specific needs. In the course of this process, an AI system evaluates vast arrays of data in order to identify potentially suitable suppliers. Automated evaluation of potential suppliers is crucial for the enhancement of precision and efficiency in decision-making in this area.

Additionally, with the application of AI, it is possible to automate the collection and analysis of data that will subsequently support the selection process. An additional advantage of using an AI-based approach is that it will facilitate risk management by obviating many of the threats of conventional scouting that is supported by manual data collection, and inadequate quality or no up-to-date information will be used to facilitate cost-efficient procurement operations. It can be concluded that the benefits of using AI in the context of supplier scouting are not only the process enhancement but also the contribution to the strategic management of procurement by ensuring that the scouting and identification of new suppliers are conducted with a higher degree of precision and effectiveness (Guida et al., 2023a).

An additional advantage of using an AI-based approach is that it will facilitate risk management by obviating many of the threats of conventional scouting that is supported by manual data collection, and inadequate quality or no up-to-date information will be used to facilitate cost-efficient procurement operations. It can be concluded that the benefits of using AI in the context of supplier scouting are not only the process enhancement but also the contribution to the strategic management of procurement by ensuring that the scouting and identification of new suppliers are conducted with a higher degree of precision and effectiveness.

Furthermore, the use of AI in the supplier selection process contributes to sustainability objectives as it enables more accurate evaluations of suppliers' environmental and social governance. The use of AI in the analysis of data related to suppliers' sustainability practices allows companies to make more informed decisions that align with their own sustainability goals, ensuring that their supply chains contribute positively to environmental and social outcomes. The integration of sustainability criteria into supplier evaluation processes through artificial intelligence represents a significant responsible procurement practice.

2.3.3 The Impact of Artificial Intelligence on Supplier Selection

One of the main trends that make a difference in the supplier selection process is the use of Artificial Intelligence. The capacity to process vast amount of complex data helps companies improve their multi-criteria decision models as well as their predictive analytics. This way, besides better focusing on the most suitable vendors, organizations can also predict market trends and customer needs to perform supplier search more strategically.

AI-Driven Risk Assessment and Management: AI systems are highly effective in detecting and reducing supply chain risks. By examining data trends, AI can predict potential interruptions and risks linked to suppliers hence, companies can proactively handle these obstacles before they disrupt business activities. This is very important for supply chain flexibility and business continuity (Hao & Demir, 2024).

Enhanced Decision-Making through Predictive Analytics: AI uses predictive analytics to aid decision-making on supplier selection. This implies that firms do not only evaluate current supplier performance but also how flexible they are in reacting to changing market conditions or industry requirements so as to achieve long term strategic alignment (Guida et al., 2023b).

Automation of Supplier Evaluation: The automation functionality of AI greatly simplifies the process of evaluating suppliers. It does this by making use of a structured analysis approach where AI reduces the human effort and boosts accuracy and impartiality in selecting the best suitable supplier (Liang et al., 2024).

Strategic Supplier Scouting: AI supports strategic supplier scouting by assisting businesses in identifying suppliers who specifically meet their requirements amongst global available markets helping evaluate such suppliers under the criteria of being innovative, sustainable and financially stable to suit broader business strategy and sustainability approach (Ordoobadi & Wang, 2011).

Case Study: Company A, a global manufacturing firm, decided to start utilizing the power of AI for supplier management. By making use of advanced machine learning algorithms, they were able to analyze and evaluate potential suppliers based on various factors such as quality, cost, and delivery reliability. This not only saved them valuable time but also ensured better decision-making when it came to selecting reliable suppliers (Artificial Intelligence in Procurement: Real-World Case Studies, n.d.).

Integration of Sustainability in Supplier Selection: AI also assists businesses in integrating sustainability criteria into the suppliers' selection process by processing each suppliers' information to evaluate their ESG practices so that the company is ensured that the purchasing from this kind of suppliers is authenticated to be sustainable and contributes to a better social and environmental outcome (Alhasawi et al., 2023).

2.3.4 Data-Driven Supplier Selection

Data-driven supplier selection is one of the most significant trends in procurement. As businesses use more and more analytics and big data today, the use of this information makes it possible to improve procurement processes. Using modern analytical tools and more data, businesses may now analyze supplier capabilities in order to align their procurement activities with the creation of a company plan.

Integration of Advanced Analytics: Machine learning and predictive modeling are two commonly utilized technologies in supplier selection nowadays. With the use of these tools, a wide range of data on subjects like financial stability, legal requirements, and even past performance across numerous data sets may be examined. Procurement managers can utilize predictive analytics to predict supplier performance and analyze risks and possibilities (Chae, 2015).

Practical Implementation: From an operational point of view, data-driven supplier selection requires setting up key performance metrics in line with the company's strategic objectives, such as sustainability and innovation. Data is often acquired from a variety of sources, both internal and external, and evaluated with contemporary tools. It enables the creation of broad and comprehensive supplier profiles, that promotes informed and correct selection decisions based on big amounts of real-time data. This technique is especially useful in the context of international trade and cooperation, where the integration of suppliers from many nations might generate concerns and create risks (Govindan et al., 2015).

Challenges and Solutions: Despite its benefits, the move to data-driven supplier selection cannot be implemented without challenges. Many firms are concerned about data quality and consistency because mistakes can lead to poor decision-making. Businesses frequently use strict data governance to standardize data gathering and processing in order to prevent such issues. Furthermore, the integration of quantitative data with qualitative evaluations remains an issue, with some firms conducting frequent training efforts or even operational reforms to promote such data integration.

Future outlook: The future of supplier selection is likely to become even more data-driven with the evolution of technologies. In particular, the integration of Internet of Things devices and real-time analytics may improve the dynamic capabilities of procurement functions by enabling more agile and responsive supply chain management.

2.3.5 Conclusion and Future Research Directions on AIs impact in Supplier Selection

Artificial Intelligence integration in supplier selection represents one of the most transformative elements in modern procurement and supply chain management. The technology's ability to process vast data sets, predict future trends, and automate the decision-making process has made significantly easier the process of selecting the best supplier while enhancing the strategic aspect of supplier management. The increasing pace of technological development because of AI is likely to continue to influence all aspects of businesses, and the adoption of this technology will reshape how supply chain operations are viewed and managed.

Impact of AI in Supplier Selection: AI technology revolutionized supplier selection by introducing an array of powerful analytical tools and predictive elements in the procurement process. Businesses adopting AI tools can now make informed decisions that support the data-oriented, strategic approach and anticipate future trends on the market. The technology is particularly capable at assessing and predicting the extent of risks associated with each supplier, which allows companies to resolve potential supply chain disruptions before they occur. Another benefit of AI integration is the automation of supplier evaluation processes, which has already significantly reduced the time and cost associated with this process. The technology automatically evaluates how different suppliers meet the parameters which have been specified by the businesses or suggests relevant data if it lacks the information. Unlike the human process, AI does not suffer from personal preferences, making it more accurate and objective in the evaluation of suppliers' capabilities and corporate compliance. According to the above, AI has proven to be an indispensable tool in modern procurement.

Strategic Supplier Scouting and Sustainability: Scouting for the most suitable suppliers acquired strategic importance in recent years, and AI can make this process easier. The technology is capable of searching the web for relevant suppliers and evaluating each of them based on their ability to fulfill the needed criteria, thus objectively selecting the most suitable. Companies prefer to look for smaller suppliers who are relatively less known, but they must still possess some level of stability and an ability to innovate and introduce new products. Finally, the trend of sustainability in business is also likely to continue growing, and AI can assist companies in selecting greener suppliers. Modern AI tools are capable of looking for ESG above merely financially viable partners, which benefits both sides of the deal.

Challenges and Considerations: Although the use of AI has many benefits in the supplier selection field, there are also many challenges and considerations related to it. One of the most important potential disadvantages of AI is that the systems do not currently understand which data is private and should not be used. Transparency also presents a significant challenge because the mechanics of AI can be so complex that even its developers do not understand the decision-making processes. Another important aspect to considering is to keep AI up-to-date, which requires further investment in skills and technology to adapt it to market changes.

Future Research Directions: Due to these considerations, it is evident that there are several areas in which further research is essential for advancing the use of AI in supplier selection. First, to assess the ethical implications related to the use of AI in supplier selection, and secondly to analyze the long-term strategic impact on the company of the use of AI in a supplier selection process. Another possible challenge is to innovate in this regard by matching together AI and another technology, such as blockchain, which could help increasing the level of transparency and trust of supply chains. In conclusion, although AI has a massive impact that should be considered when selecting the supplier, its use also presents many challenges that require further research to maintain the balance.

2.4   Summary of Literature

In this review of supplier selection literature, we focus on the changes from traditional methods towards more modern and more digitalized practices that also involve Environmental, Social, and Governance criteria.

Traditional Supplier Selection: The use of traditional methods such as scorecards or weighted systems, which are focused mainly on price, quality, and delivery reliability, ensures that the necessary operational requirements are met. However, while operational systems are supposedly efficient, they seem not to address the strategic concerns of supplier innovation, sustainability, and flexibility in the constantly changing market.

Modern Approaches: On the other hand, modern big data, artificial intelligence, and machine-learning applications help to forecast supplier performance and manage risks, thereby facilitating more objective and sustainable supplier evaluations. At this time, sustainability has entered the supplier selection process, where organizations evaluate suppliers not only for financial stability but also for their impact on ESG factors.

Categories of Suppliers and Their Strategic Implications: In this section, we examined the strategic categorization of suppliers into strategic, tactical, niche, commodity, transactional, and local versus global suppliers. Each category is an essential part of procurement strategies and supply chain dynamics. Strategic suppliers are crucial for core operations and long-term success. Tactical and commodity suppliers are valuable for their focus on cost-effectiveness and working to make regular businesses smoother. Niche suppliers provide specific products or services for a special purpose. Transactional suppliers are for immediate, one-off needs. Whether local or global, each categorization of a supplier can help the business' strategy, management of risk, efficiency, and innovation.

ESG Practices in Supplier Selection: The incorporation of ESG criteria into the supplier selection process is becoming crucial as businesses aim to align the operations of their supply chains with sustainability goals. Environmental value is supported by more rigorous sustainable standards applied to supplier selection, which improves the company's reputation and operational resilience. Social values are enhanced through better understanding and monitoring of suppliers by labor practices while improving the supplier's reputation. Governance and ethical procurement are also relevant as they ensure more transparent, accountable, and morally acceptable long-term relations with suppliers.

Technology in Supplier Selection: There is a significant trend in technology in supplier selection that has emerged with the development of digital platforms and AI. These changes tend to increase the strategic capacity, productivity, and transparency of procurement activity. Additionally, these technological tools provide data analysis and decision-making in real time, which leads to improvements in quality and speed in procurement processes. Furthermore, AI technologies increase the precision of the evaluation of suppliers' ESG practices as well as risk management.

To conclude, the literature highlights that there is a trend towards an integrated approach that includes both traditional metrics, modern technologies, and ESG criteria. Such an approach is beneficial for improving operational competencies and strategic compatibility and assists in achieving business goals that are related to sustainability and innovation. Such a comprehensive approach to supplier selection is necessary for establishing more resilient, competitive, and sustainable supply chains.

2.5 Impact of Digital Transformation on Supplier Relationship Management

Introduction to Digital Transformation in Supply Chain Management:

The digital transformation in supply chain management prompted a new era of overall operational efficiency and strategic enhancement. Technologies like the Internet of Things, blockchain, and advanced analytics are not just supplementing the existing procedures and methodologies; they are transforming them as they enable companies to interact with

suppliers fundamentally better. These technologies drive automation of operations, more efficient data flow, and new decision-making models that in previous years were impractical (Queiroz et al., 2020).

Key technologies and their roles

- **Blockchain:** The technology allows making transactions with the highest level of transparency and security. Organizations can use this technology to improve compliance and reduce the risk of fraud in the supply chain. Firms are increasingly adopting Blockchain's approach.

- **Internet of Things:** The technology allows continuously monitoring goods and services at various points of the supply chain. As a result, firms can track the movement of goods, how they are stored, and when they are even managed as a part of the inventory (Ghadge et al., 2020). With the ability to track specific parameters such as packaging, organizations have significantly optimized their overall logistics processes and reduced waste.
- **Advanced Analytics:** Big data has made advanced analytics a vital tool in making predictive insights. This has enabled companies to predict and determine when supply chains will be disrupted or demand will increase so that they make more informed decisions (Ghadge et al., 2020).

Case Studies:

- Automotive Industry: One of the world's leading automotive manufacturers is using the Internet of Things to monitor the quality of the parts it is receiving in real time. The Internet of Things has seen the defects of parts fall drastically and has reduced inefficiencies in operations as it has become easier to detect any defect on the supply chain (Bi et al., 2014).

Research Gaps: There is limited empirical research on the long-term effects of blockchain in supplier relations in less digitalized sectors such as agriculture and construction. This could be explored in future research.

Impact on Supplier Selection: Digital tools such as blockchain facilitate better supplier selection as they enhance the tools and capabilities available to address supplier risks, compliance issues, and performance measures. Thus, they can improve decision-making about which suppliers to use.

2.6   Challenges and Opportunities in ESG Integration into Supplier Selection

Overview of ESG Importance: Environmental, Social, and Governance Criteria have become important aspects of supplier selection. Driven by a combination of regulations, customer expectations, and understanding of the benefits of sustainability, businesses are expected to ensure that their supply chains meet these criteria (Goebel et al., 2012).

Challenges in ESG Integration

- **Data Inconsistency:** Current data on supplier ESG practices is often unreliable. As a result, companies may experience difficulties measuring and comparing suppliers ESG performance (Philip Beske, 2015).
- **Lack of Standardization:** The absence of standard ESG metrics also affects evaluation. Due to the variation in industry requirements and differences across regions, it is difficult to develop generalized and consistent standards and expectations.

Role of Policy and Regulation: Finally, growing common and regional regulations, such as the EU Green Deal and Sustainable Finance Disclosure Regulation, force companies to comply with ESG to a major extent. The policies also encourage companies to have a wider view and make changes beyond compliance that would facilitate ESG across their operations (EU Commission, n.d.).

Future Directions: In the future, one significant development in the ESG incorporation of selecting suppliers would be the combination of AI and ESG. As such, current AI technologies could be combined with ESG, allowing for easier incorporation of complex data and consistent comparisons, streamlining the ESG integration process.

It is evident that the role of environmental sustainability considerations, as well as environmental protection in selection and recruitment practices, have gained increased attention in today's business environments. While there are numerous challenges and opportunities facing decision-makers in integrating the ESG criteria into supplier selection, the findings show that the importance of sustainability is increasing, and consequently, the integration of ESG criteria is becoming a strategic imperative for businesses. Companies that successfully integrate ESG criteria in the selection of suppliers will be in a position to manage related risks, meet regulatory requirements, and achieve a competitive advantage in the market.

3   Chapter 3: Methodology

3.1   Research Design

For the purpose of the study, a quantitative approach was utilized, and a structured questionnaire was developed to gather extensive data from experts in various fields. The objective of the research was to measure and analyze the impact of ESG factors and digital technologies on the current practices of selecting suppliers.

Questionnaire Design and Implementation: The design of the questionnaire was chosen in order to collect a wide range of information on supplier selection practices. The form included different types of questions, a Likert scale, a set of options with multiple answers, and a ranking scale. The questionnaire allowed consideration of the importance of various criteria while choosing a supplier, the implementation of new technologies, and the place of ESG methodologies in the procurement process. To ensure the questionnaire captured diverse perspectives, it also included demographic questions that sorted responses by industry, role, and experience level.

Advantages of the method and the choice of a tool: The fact that the questionnaire was developed in electronic form allowed for the timely receipt of results given to the participants. The questionnaire also included demographic questions that allow sorting by industry, role, and experience. The questionnaire was distributed via email that was sent with a brief explanation of the aims of this research. Furthermore, considering the questionnaire was digital, no printing costs were incurred.

Ethical Considerations: Throughout the entire research, ethical standards were strictly followed. Before taking part in the research, the respondents were informed about the research's purpose and gave their consent to participate. In such a way, ethical considerations were considered, and all respondents' data were protected. All the data that was collected through this questionnaire was anonymized and securely stored to protect the privacy of the participants.

Advantages of the Questionnaire Approach

Standardization: Data were consistently collected through the use of a structured format, which made it simpler to compare replies from various participants.

Measurability: Using this method made it possible to analyze statistical data in depth by precisely quantifying trends and patterns in supplier selection.

Broad reach: The questionnaire was distributed electronically to achieve a global reach and to capture, without regard to geography, a snapshot of supplier selection procedures worldwide.

Using this quantitative questionnaire method offered a solid framework for investigating how firms incorporate ESG criteria and technology into their supplier selection processes. It provided important information to the field of supply chain management by highlighting changing trends across industries and providing insights into the state of procurement strategies today.

3.2   Population and Sample

Population Definition

The population sample approached in this questionnaire were professionals with direct experience and involvement in supplier selection processes. This encompasses a particularly specialized and informative transfer of responses for this questionnaire, as the responses are relevant and informed.

Sample Description and Selection

The study was conducted in two distinct phases: the pilot phase and the main study phase.

Pilot Phase: In the pilot phase, the questionnaire was distributed to a small group of five professionals. These individuals were selected based on their expertise in procurement/purchasing to ensure they were relevant to the questionnaire's subject. Their feedback was crucial for the revision of the questionnaire to better address the research questions concerning ESG factors and technology in supplier selection.

Main Study Phase: Following the successful pilot phase, the revised questionnaire was distributed to a larger group of professionals within the target population. The main phase resulted in 71 complete answers, providing a decent amount of data for analysis. Respondents

in this phase were selected to represent a diverse cross-section of industries and geographical locations to improve the general findings of this research.

Data Collection Method

The questionnaire was distributed electronically through professional networks and variant industries to reach a wide audience efficiently.

Sample Size Justification

The sample size of 71 respondents for the main study phase was determined to be adequate for initial explorations into the integration of ESG practices and technological advancements in supplier selection. This sample size allows for a variety of insights while also supporting meaningful analysis through statistical methods.

Statistical Considerations

Given the sample size and the data collected, the study primarily focused on descriptive statistics to outline trends and inferential statistics to identify significant patterns and relationships within the data. The findings from this robust sample provide a solid foundation for understanding current practices and may suggest directions for future research.

3.3 Data Collection

3.3.1 Design of Questionnaire

The purpose of the questionnaire's design was to delve deeply into the ways that digital technologies and ESG considerations are integrated into supplier selection procedures in a range of industries. The objective was to develop an extensive survey that would elicit considered and in-depth answers from experts engaged in supplier selection and/or procurement procedures.

Structure and Content: In order to determine the background of each respondent's professional experience, the demographic questions were the first ones in the questionnaire. The topics of these inquiries included years of experience in procurement as well as gender, age group, department, and job within the organization. Demographic data of this type is essential because it makes it possible to analyze how various professional backgrounds affect attitudes and supplier selection habits.

The questionnaire proceeded on to additional specific inquiries using an array of forms to collect an extensive amount of data following the demographic section:

- **Likert Scale Questions**: Respondents were asked to rate the importance of various supplier selection criteria on a Likert scale from 1 (least important) to 5 (most important). This format works particularly well for assessing targets and attitudes, as well as offering insights into what professionals think is important to know when choosing a supplier.

- **Multiple-Choice Questions (Single and Multiple Answers)**: These questions have been developed to examine operational practices such as how companies evaluate supplier performance, the factors influencing decisions to switch suppliers, and the

methods used to ensure suppliers meet company standards. By allowing respondents to choose from a variety of options, the complexity of supplier management—where decisions frequently take into account many factors—is acknowledged.

- **Open-Ended Question**: To capture personal insights and predictive analyses on the impact of artificial intelligence on supplier selection, an open-ended question was included at the end of the questionnaire. This provided respondents with the opportunity to express their views freely, offering qualitative data that might unveil innovative ideas and personal predictions beyond what structured questions could capture.

Question Development: The questions in the questionnaire were based on themes discovered from contemporary research in the field of supply chain management. The first version of the questionnaire was examined by professionals in the supply chain field. Their feedback was very useful for including questions that could be misunderstood or needed additional response options. Following these five professionals' suggestions, the questionnaire's final version was created and distributed to respondents.

3.3.2 Distribution and Collection of Answers

To ensure that the sample is broad and representative, it was decided to be distributed electronically, taking advantage of digital tools to extend to a wide and diverse group of professionals across multiple industries. This method allowed for a quick process of dissemination and data collection. The steps taken are outlined in the following:

Distribution method: The questionnaire was distributed via email, which included the link to the URL of the questionnaire. This method ensured that the respondents would have access to the survey from their preferred devices at any proposed time, likely following up after thought-through and dedicated responses. The chosen respondents were professionals in different industries and sectors.

Collection method: The responses were automatically collected through the online survey, which, at the end of the questionnaire, also created some early templates for the process analysis. The advantage of this setup is real-time data aggregation, which could also be checked and updated as responses came in. An additional advantage is the decreased potential for error inherent to the manual input of data, which ensures the maximum efficacy of the data collection method.

Data handling and privacy: no databases or recording of information on respondents was kept, the data was anonymous and securely stored.

Response Rate: This was closely monitored through the data collection, with later additional reminders to the potential respondents who had not completed the questionnaire, to improve the overall response rate and ensure a robust data set for analysis.

3.4 Data Analysis

The approach taken for the data analysis is performed with the use of descriptive statistics, which can be instrumental in summarizing the data and providing an impression of trends and patterns in responses. The results will be complemented from certain visualizations and normality tests to ensure a comprehensive understanding of the characteristics of the dataset.

Descriptive Statistics: The initial phase of the analysis will involve descriptive statistics for the data, such as means, medians, modes, ranges, and standard deviations. These results are expected to provide an overview of the essential trends and supplies of the data, such as the average rating of importance of ESG factors for considerations in supplier selection or average frequency of digital tools usage. Additionally, descriptive statistics can assist to identify patterns and tendencies in the data to be transferred into the context of interpretation or anomalies that require further investigation.

Visualizations: Another tool that will be used for further interpretation of the data is various charts of data visualizations. These can be pie charts, bar graphs, histograms, or even scatter plots, to be used for representing the distribution of responses, relationships between variables, and trends. Apart from the fact that it is efficient in making the results of the analysis easily interpretable, it is also crucial for uncovering deep insights in data.

Normality Tests: In order to understand the distribution of the data, we will conduct normality tests. Tests such as the Shapiro-Wilk test or the Kolmogorov-Smirnov test will be used to assess whether the data conforms to a normal distribution.

4 Chapter 4: Analysis of Questionnaire

4.1 Demographic Analysis

The following demographic analysis would provide us with a deep understanding on the profiles of the professionals that participated in the questionnaire on digitalization and ESG factors in supplier selection. The total number of respondents is 71 representing a diverse cross-section of demographics, roles, and industry sectors.

Gender Distribution: The survey showed that a higher rate of males (59,15%) participated compared to females (40,85%). A graphic chart that indicates the number of participants based on the gender is given below.
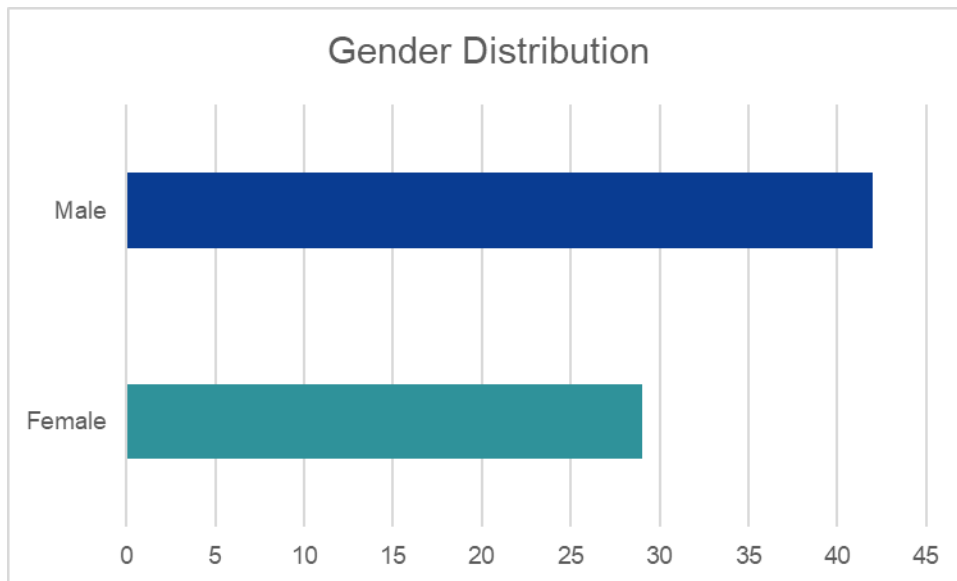
Figure 1: Gender Distribution

Age Range: The majority of the respondents were between the age group of 25-34, a total of 46.48% and 25.35% between the age group of 35-44. These numbers show that there is a generational shift in the procurement roles. The younger professionals in this sector are more involved in roles that require digital applications and environmental, social, and corporate governance. The table for the age groups is provided below.
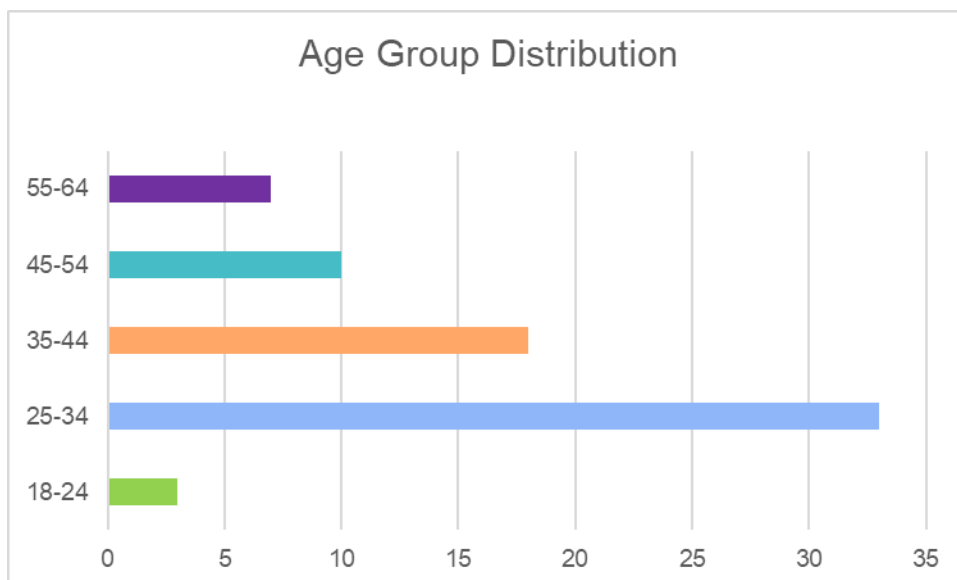

Figure 2: Age Group Distribution

Department Distribution: The majority of the respondents were from Procurement/Purchasing at 29,58%, then Marketing 15,49% and Sales 12,68%. This statistic

indicates that supplier selection process is an important concern across various departments within an organization. The table for the departments is provided below.
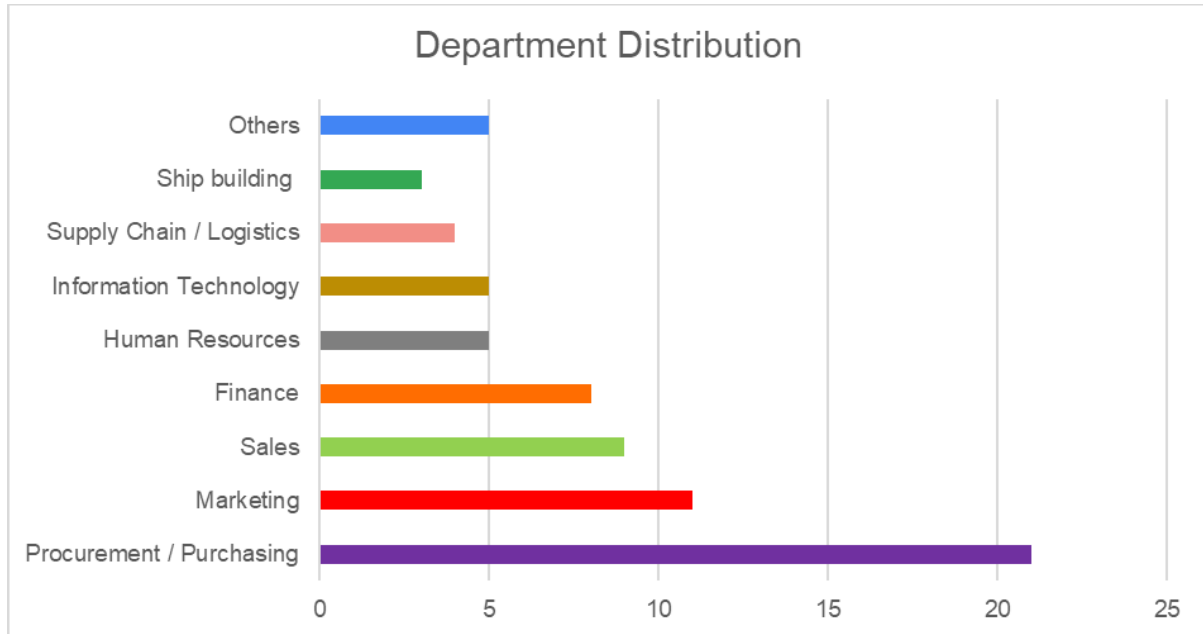
Figure 3: Department Distribution

Role Distribution: The questionnaire was answered by a range of professional roles from entry level to senior management. The group of Mid-level/Specialist-Expert was the majority of the respondents at 43,66%. Senior-level/Manager-Supervisor roles accounted for 39.44%, showing significant strategic interest in the topic. The table for the role levels is provided below.
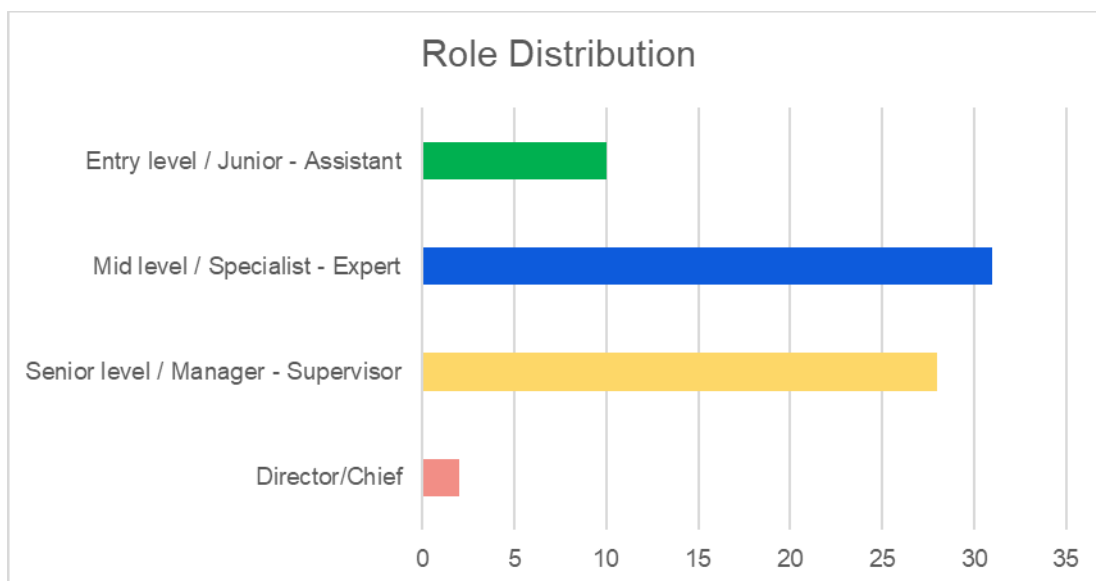

Figure 4: Role Distribution

Experience in Procurement/Supplier Selection: In terms of experience, the largest group of respondents has been involved in procurement or supplier selection processes for more than 5 years (40.85%), indicating that the insights gathered are grounded in extensive industry experience and knowledge.
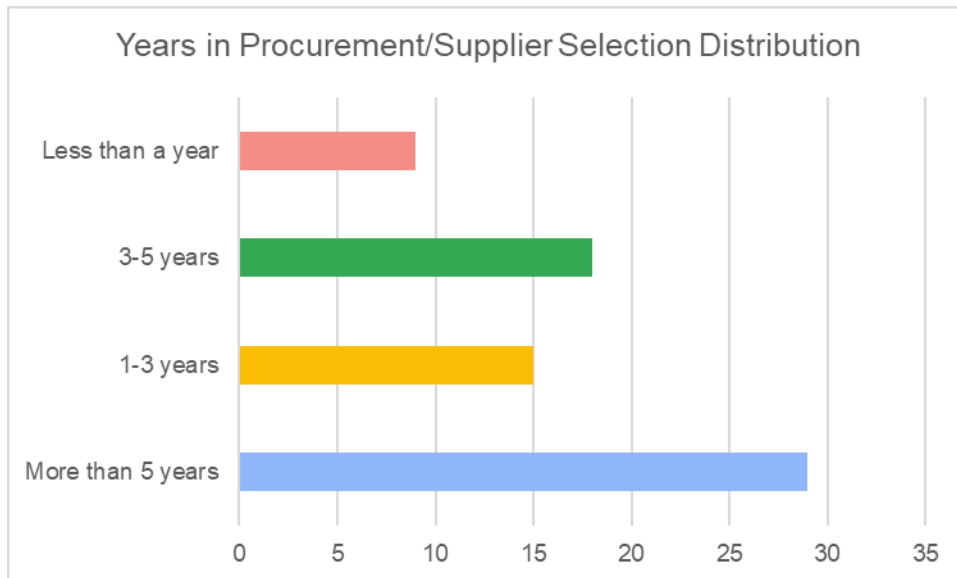
Figure 5: Years in Procurement/Supplier Selection Distribution

Industry Representation: The industry spread was broad, with Retail (23.94%), Technology (26.76%), and Manufacturing (23.94%) being at the top three of the respondents. This variety in industry participation indicates the relevance of digitalization and ESG considerations across different sectors. A graphic chart that indicates the number of participants based on the industry is given below.

Figure 6: Industry Distribution

Additionally, at the table below is given all the relevant data of the demographic analysis including number of participants and percentages in order to provide a clear and precise summary of the population of our study.

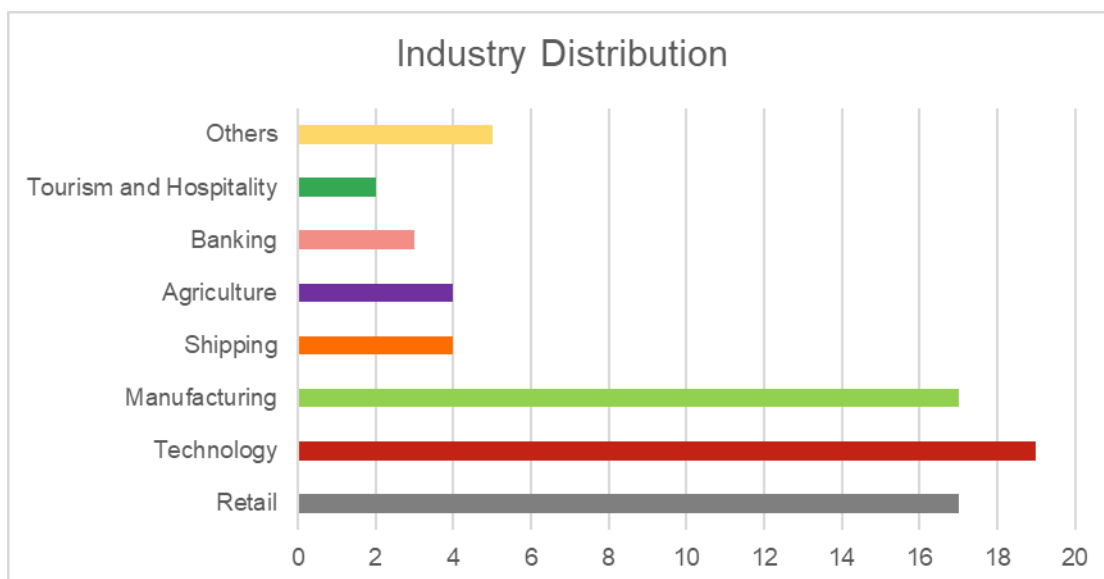| Demographic Category	Count	Percentage (%)
1. Gender		
Female	29	40,85%
Male	42	59,15%
2. Age Group		
18-24	3	4,23%
25-34	33	46,48%
35-44	18	25,35%
45-54	10	14,08%
55-64	7	9,86%
3. Department		
Procurement / Purchasing	21	29,58%
Marketing	11	15,49%
Sales	9	12,68%
Finance	8	11,27%
Human Resources	5	7,04%
Information Technology	5	7,04%
Supply Chain / Logistics	4	5,63%
Ship building	3	4,23%
Others	5	7,04%
4. Role		
Director/Chief	2	2,82%
Senior level / Manager - Supervisor	28	39,44%
Mid level / Specialist - Expert	31	43,66%
Entry level / Junior - Assistant	10	14,08%
5. Years in Procurement/Supplier Selection		
More than 5 years	29	40,85%
1-3 years	15	21,13%
3-5 years	18	25,35%
Less than a year	9	12,68%
6. Industry		
Retail	17	23,94%
Technology	19	26,76%
Manufacturing	17	23,94%
Shipping	4	5,63%
Agriculture	4	5,63%
Banking	3	4,23%
Tourism and Hospitality	2	2,82%
Others	5	7,04%

Table 1: Demographic Analysis

4.2 Analysis of Responses for the importance of criteria

In this section, it is going to be presented how the respondents give priority to various criteria when choosing a supplier. The evaluation is based on a detailed statistical overview, which covers such measures as mean, median, mode, standard deviation, and skewness of responses on a number of criteria, which are Price, Quality, Delivery Time, Ethical Practices, Previous Cooperation, New Technologies, and Experience.

The tables with all the measured referred above are given below.

Price		*Quality*		*Delivery time*	
Mean	3,971830986	Mean	4,352112676	Mean	4
Standard Error	0,107975388	Standard Error	0,098476507	Standard Error	0,096205682
Median	4	Median	4	Median	4
Mode	4	Mode	5	Mode	4
Standard Deviation	0,909816795	Standard Deviation	0,829777794	Standard Deviation	0,810643483
Sample Variance	0,8277666	Sample Variance	0,688531187	Sample Variance	0,657142857
Kurtosis	-0,270990268	Kurtosis	5,814263774	Kurtosis	-0,177505209
Skewness	-0,646101171	Skewness	-1,981457509	Skewness	-0,496699858
Range	3	Range	4	Range	3
Minimum	2	Minimum	1	Minimum	2
Maximum	5	Maximum	5	Maximum	5
Count	71	Count	71	Count	71

Table 2: Price, Quality and Delivery Time

Ethical practices		*Previous Cooperation*		*New technologies*		*Experience*	
Mean	3,408450704	Mean	3,450704	Mean	3,535211268	Mean	3,788732394
Standard Error	0,112726347	Standard Error	0,116606	Standard Error	0,116679385	Standard Error	0,096028779
Median	3	Median	3	Median	4	Median	4
Mode	3	Mode	3	Mode	4	Mode	4
Standard Deviation	0,949849083	Standard Deviation	0,982544	Standard Deviation	0,983157972	Standard Deviation	0,809152872
Sample Variance	0,90221328	Sample Variance	0,965392	Sample Variance	0,966599598	Sample Variance	0,65472837
Kurtosis	0,346096847	Kurtosis	0,136021	Kurtosis	-0,534801804	Kurtosis	1,279587415
Skewness	-0,295468034	Skewness	-0,36996	Skewness	-0,332961768	Skewness	-0,757018581
Range	4	Range	4	Range	4	Range	4
Minimum	1	Minimum	1	Minimum	1	Minimum	1
Maximum	5	Maximum	5	Maximum	5	Maximum	5
Count	71	Count	71	Count	71	Count	71

Table 3:Ethical Practices, Previous Cooperation, New technologies and Experience

Price received a mean rating of 3.97, indicating a high but not supreme importance. This means that while most responses about the importance of price group around a higher value, there's a tail of lower values pulling the mean down. The majority of respondents likely rated price as very important (but not maximally), with a smaller group rating it less important.

Quality is highly valued, with the highest mean of 4.35 and a mode of 5, showing that most respondents consider it crucial in supplier selection. The negative skewness indicates that a large number of respondents consider quality extremely important with very few ratings it lower and that the lower ratings are rare but pull the mean slightly below the mode.

Delivery Time also shows a significant mean of 4, consistent with the importance placed on timely delivery by the respondents. This factor is also left skewed which means that most responses are towards the higher importance but there is a small group of lower importance ratings.

Ethical Practices present a slightly lower mean of 3.41 and skewness level at -0,295 which indicates that the majority of responses are around the median and mean.

Previous Cooperation is moderately important with a mean of 3.45 and skewness at -0,370 which suggests most respondents place previous cooperation quite high.

New Technologies show a mean of 3.53, indicating a growth of the role of technological advancements in supplier selection. The amount of skewness of this criterion is similar to the criterion of "Previous Cooperation" suggesting that most values are grouping at the higher end and fewer at the lower end.

Experience shows a mean of 3.79, underscoring the consistent value placed on suppliers' experience in the industry.
Regarding practical application, the skewness results suggest that an emphasis should be placed on enhancing and improving the categories that are consistently agreed on as highly important like quality and delivery time.

4.3   Analysis of Responses for the evaluation of suppliers

In this section, we analyze the findings on how respondents evaluate the current performance of their suppliers, how often they engage in these evaluations, what factors influence their decision to change suppliers, and how they determine their supplier actually meets their company's requirements. The insights obtained from this analysis will offer a comprehensive overview of the current processes and issues in managing suppliers and evaluating their performance.

Current Evaluation Methods:

- **Key Performance Indicators (KPIs)** are the most commonly used method for evaluating suppliers, with 53.52% of respondents are using this method of evaluation. This statistic indicates that most organizations prefer quantifiable metrics to assess supplier performance.

- **Performance Scorecards** are also significant, used by 30.99% of respondents, indicating a more structured approach to supplier assessment that often includes various performance metrics.

- Surprisingly, 32.39% of respondents use regular surveys or questionnaires, highlighting a more qualitative approach.

- A notable 16.90% of respondents do not currently evaluate supplier performance, which may indicate gaps in procurement strategy or smaller company sizes where tactical or formal evaluations are not utilized.

A pie chart that indicates the percentages for the evaluation methods is presented below.
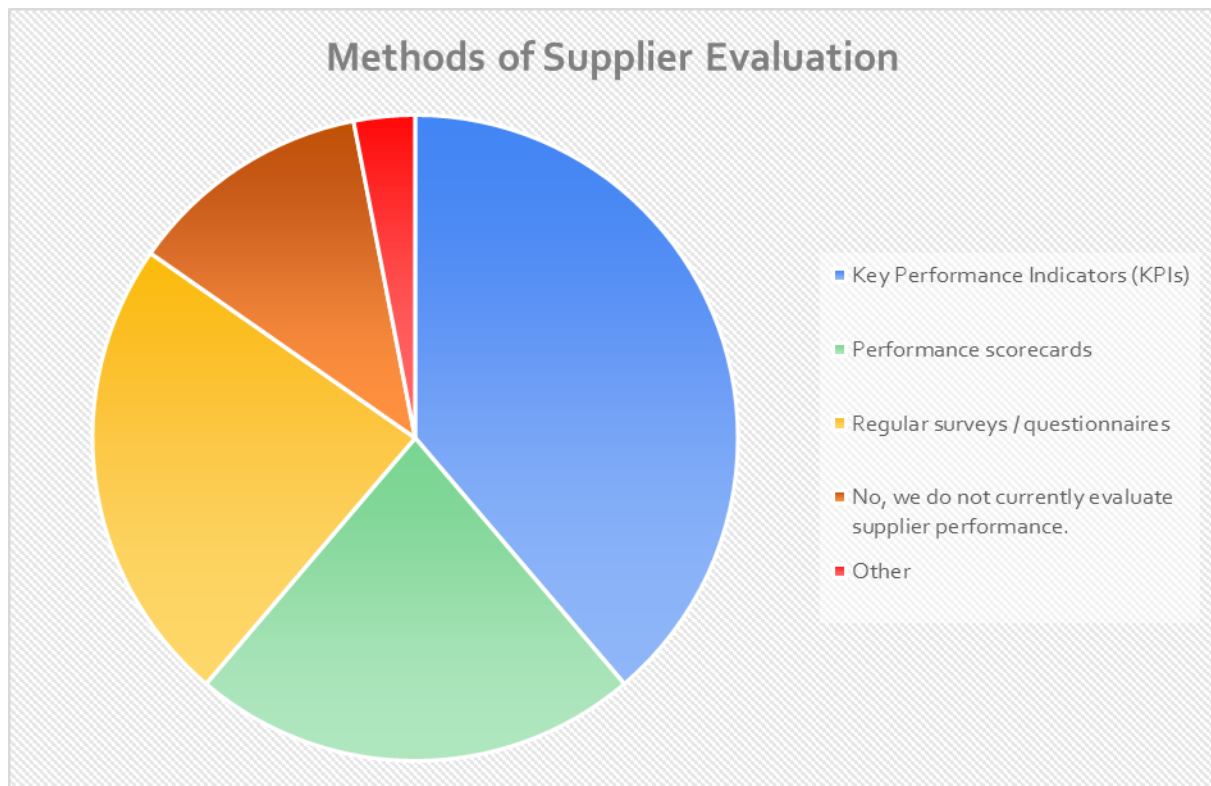

Figure 7: Methods of Supplier Evaluation

Evaluation Frequency:

- Most respondents (46.48%) evaluate supplier performance annually, which indicates a standard cycle in supplier review processes.

- Quarterly evaluations are also fairly common (14.08%), possibly reflecting industries where market conditions change rapidly, requiring more frequent assessment.

- Semiannually and every two years evaluation are less common at 9,86% and 5,63% respectively. These statistics indicate that organizations prefer more frequent monitoring with annual evaluations being the most common.

- The data also shows that a significant portion (16.90%) do not evaluate supplier performance regularly, raising concerns about oversight and risk management.

Factors Influencing Supplier Switch:

- **Quality Issues** (88.73%) and **Price** (76.06%) are the two main factors that impact the decision to switch suppliers, indicating that despite the modern approach of evaluating suppliers according to ESG criteria, quality and price remain critical for most organizations.

- **Delivery Delays** are also a significant concern (60.56%), emphasizing the importance of reliability in supplier performance.

A graphic chart that indicates the percentages of the responses for the factors to switch suppliers is being displayed below.
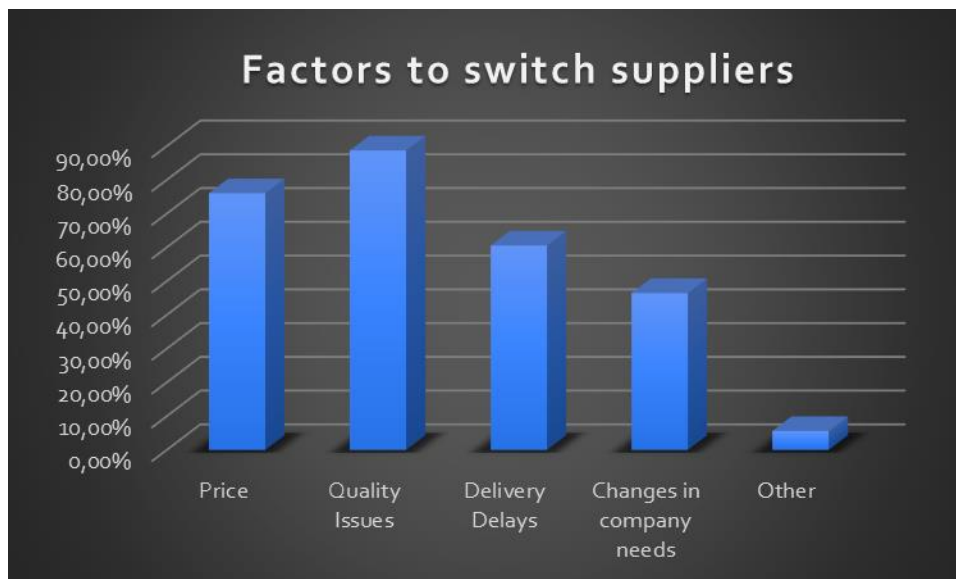

Figure 8: Factors to switch suppliers

Ensuring Supplier meet Company's Requirements:

- The majority of respondents (67.61%) choose **Contractual Agreements** to ensure that their suppliers meet the company's requirements, which indicates the use and the implementation of binding agreements.

- 42.25% of respondents choose regular audits and inspections, which indicates audits and checks are implemented in a proactive way in order to verify supplier compliance and performance.

- Finally, 43.66% of the respondents rely on Performance reviews, which indicates that there is a controlled internal process of evaluation used to confirm the performance of suppliers.

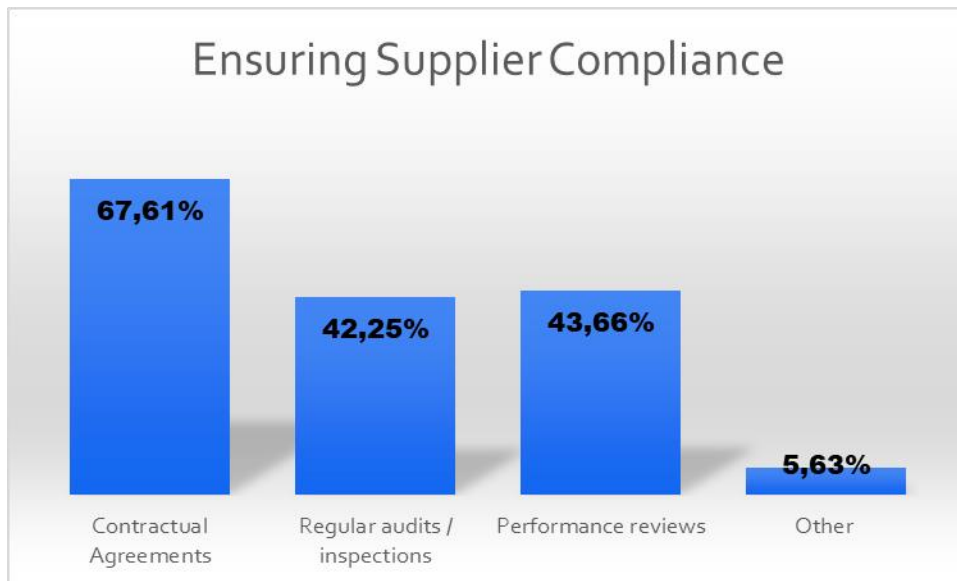On page 41 is the graphic chart indicating the percentages above.

Figure 9: Supplier Compliance

4.4 Analysis of Responses for the ESG criteria

This section will analyze the perceived importance of Environmental, Social, and Governance factors in the supplier selection process. As the rising attention of modern businesses on sustainability and corporate responsibility becomes evident, it is important to evaluate the impact of these factors on the supplier selection process.

General Consideration of ESG Factors:

A significant majority of the respondents (78,87%) declare that they consider ESG criteria when selecting suppliers. This high percentage emphasizes the increasing importance of ethical, environmental, and social responsibility in corporate procurement practices. Additionally, the change towards sustainable business practices is becoming mandatory and not just optional.
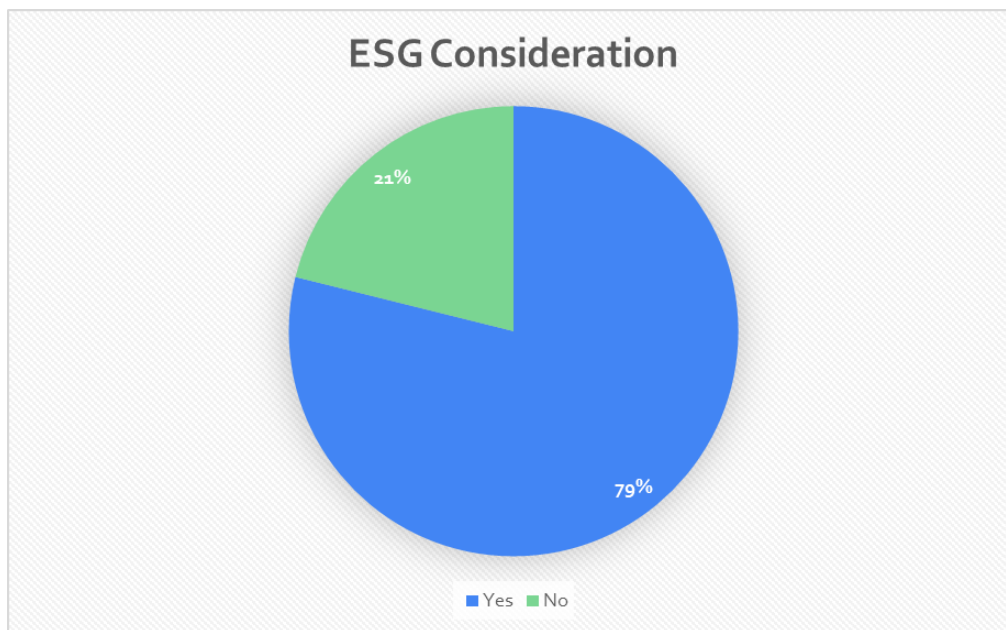
Figure 10: ESG Consideration

Importance of ESG factors:

Very Important: Slightly over the half of the respondents (50.70%) consider ESG factors as very important in the supplier selection process. There is a significant recognition of the need for sustainability and ethical consideration in the process of supply chain and procurement.

Somewhat important: Another 42.25% believe that ESG is somewhat important. Thus, while it may be true that there is a growing level of recognition in the industry, the application and incorporation into existing procurement processes may be somewhat varied.

Not important: Only a small percentage of the respondents (7.04%) consider these factors not important. The reason for this may be the industry-specific requirements.
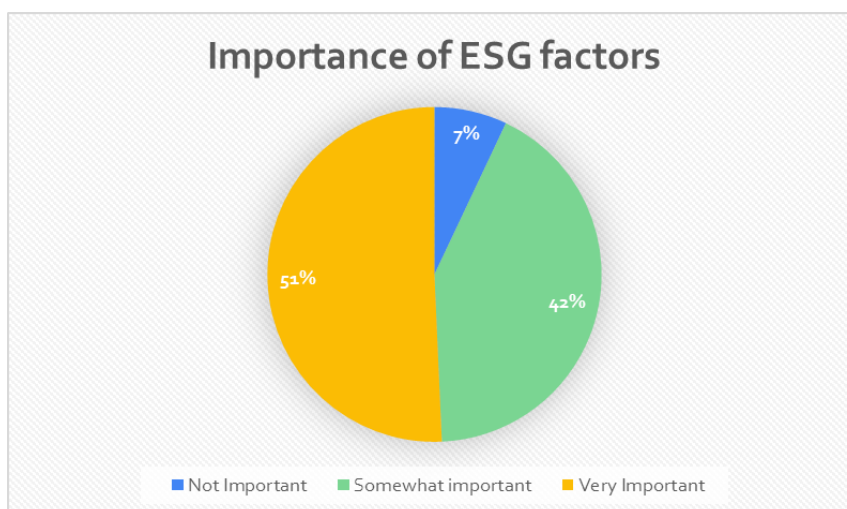

Figure 11: Importance of ESG factors

Specific ESG Factors Considered:

Environmental: Based on the responses, the environmental factors are given the highest attention, considering that 71.83% of the respondents call it the most important. Therefore, the key priority of the organizations is the reduction of the negative environmental impact and the shift to a more sustainable model of operation. This is becoming an increasingly vital component of the organization's viability in the long-term perspective, and it will likely continue to receive high attention.

Governance: Governance factors are also highly valued at 69.01%, emphasizing the need for ethical business practices, transparency, and compliance with laws and regulations.

Social: The social criteria, which include labor aspects, community issues, and human rights, are considered as crucial by the 66.20% of the respondents. This percentage indicates a possible commitment of organizations to social responsibility but it is slightly less prioritized compared to environmental and governance issues.
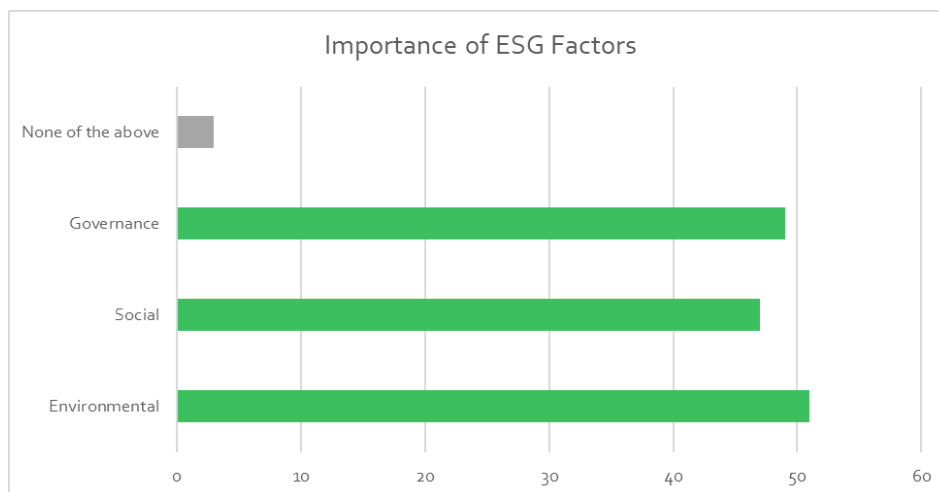

Figure 12: ESG Factors consideration

4.5 Analysis of Responses for the digitalization in supplier selection

This section focuses on how digital technologies are used in supplier selection process, their perceived effects, and future intentions regarding further implementation. The findings can be informative for understanding how digitization can affect procurement functions and improve their efficiency and strategic value.

Current Utilization of Digital Technology:

- **Adoption Rates**: Approximately 49.30% of the respondents indicate that digital technology is fully utilized in their organization's supplier selection processes, demonstrating a significant integration of technology in procurement. However, 18.31% have not adopted these tools at all, and 32.39% report only partial integration, suggesting varying levels of digital maturity across different organizations.

- **Partial Utilization**: The relatively high percentage of partial indicates that organizations may face various challenges towards the transition to digital procurement systems, indicating this area need further development and research.

Impacts of Digitalization:

- **Efficiency Gains**: A notable 60.34% of respondents who utilize digital technologies report reduced time for supplier evaluation and selection, which indicates efficiency as a primary benefit of digitalization in supplier selection processes.

- **Access to Suppliers**: Enhanced access to a wider pool of suppliers was chosen by 46.55% of the participants, illustrating how digital tools can improve sourcing and maybe advance sourcing into a core strategy for an organization.

- **Cost-Effectiveness**: Half of the respondents (50.00%) state that digitalization has made the supplier selection process more cost-effective, highlighting financial benefits along with operational improvements.

- **Risk Management**: Additionally, 53.45% state that digital tools have improved their ability to identify and mitigate risks with suppliers, enhancing the overall security and reliability of the supply chain.

- Only 5,17% of the respondents stated that they did not observe any significant impact on supplier selection process through digitalization.

We must state that 13 out of 71 respondents stated that digitalization is not currently utilized in their organization supplier selection process. These 13 respondents did not answer on the question about how has digitalization impacted the efficiency and effectiveness of supplier selection.

Future Intentions:

- **Plans for Further Digitalization**: 57.75% of respondents plan to further digitalize or automate their supplier selection processes. This indicates a strong trend to the adoption of digital solutions within supplier selection process and procurement.

- **Uncertainty About Future Plans**: However, 29.58% remain unsure, possibly reflecting concerns about the costs, complexity, or uncertainty about the return on investment of new technologies.

- There is also a significant 12.68% percentage of the respondents which do not plan to further digitalize the supplier selection process.
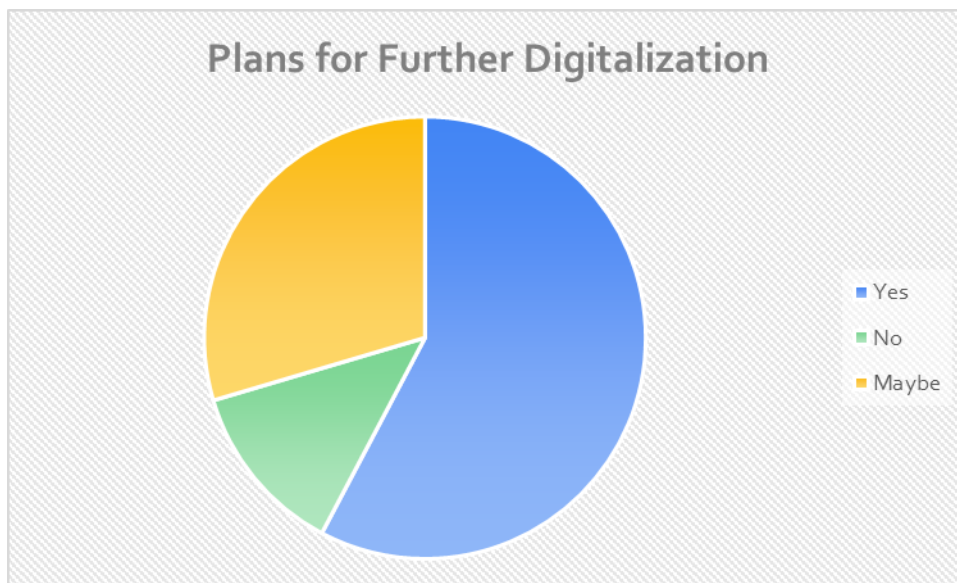
Figure 13: Plans for further Digitalization

Artificial Intelligence:

- **Impact of AI:** There is a high proportion of about 70.42% of the respondents which is highly confident that AI will impact supplier selection processes. This percentage in-dicates a recognition of AI's potential to transform supplier selection and evaluation processes.

- **Skepticism and Caution:** Unlike for the confidence of the majority of the respond-ents, nearly 30% of the respondents are doubtful about the impact of AI, which may arise from a lack of understanding, fear of change, or uncertainty about the practical implementation of AI technologies.

Additionally, a follow-up question was posed to respondents who answered positively re-garding the impact of AI on the supplier selection process, asking them to elaborate on how they believe AI will impact this process.

This table below outlines the key trends identified by respondents regarding the future impact of AI on the supplier selection process. The trends are categorized based on the frequency of mentions, highlighting areas such as performance improvement, data analy-sis, automation, risk management, and decision support.

How do you anticipate AI will impact the supplier selection process in the future?	
Possible trends	Frequency
Trend 1: Performance Improvement	Many responses mention that AI will imprive the efficiency of the supplier selection process.
Trend 2: Data Analysis	Data analysis is a common theme, with many respondents highlighting AI's capability to handle large volumes of data.
Trend 3: Automation and Technology	Automation is frequently mentioned, indicating a trend towards using AI to automate repetitive tasks in supplier selection and evaluation
Trend 4: Risk Management	Risk management is a significant concern, with multiple mentions that AI can act as a proactive factor at supplier evaluation.
Trend 5: Decision Support	Decision support through AI is a notable trend, with several respondents mentioning its analytical and comparative functions.

Table 4: Anticipated Impacts of Artificial Intelligence on Supplier Selection Process

4.6 Possible Trends

In this section, it will be presented some trends which were identified through the questionnaire. These trends indicate differences in the perception of the value of Environmental, Social, and Governance criteria and the impact of Artificial Intelligence among different demographic groups and professional groups.

Influence of Age on ESG and AI Perceptions

- **80.55%** of respondents from the 25-34 and 18-24 age groups consider ESG factors important in supplier selection, indicating a strong environmental and ethical awareness among professionals at younger age.

- **72.22%** of the same age groups believe that AI will significantly impact supplier selection processes, suggesting an acceptance to technological advancements and innovation in younger ages.

Role-Specific Attitudes Towards ESG

- **87%** of respondents who are at the mid-level professional tier recognize the importance of ESG factors. This high percentage within mid-level professionals could indicate their direct involvement into decisions where ESG factors are prioritized.

- **78.87%** of respondents across all professional levels consider ESG factors, which emphasizes a wide-reaching recognition of the importance of sustainability and ethical practices in supplier selection within the professional community.

Correlation Between ESG Importance and AI Impact

- **80%** of respondents who consider ESG criteria as very important also believe that AI will impact supplier selection processes. This correlation suggests that those valuing sustainable and ethical practices also believe the improvements that AI can bring.

Gender Differences in ESG Consideration

- **75.86%** of female respondents consider ESG criteria when selecting suppliers. This significant percentage may reflect a deeper sensitivity towards ethical, environmental, and social governance issues among female professionals.

5 Chapter 5: Conclusion and Recommendations

5.1 Conclusions

From the Literature Review:

The literature review established a theoretical basis for a better understanding of the role of Environmental, Social, and Governance (ESG) factors and digitalization in supplier selection. It highlighted that ESG integration is increasingly seen as mandatory not only for meeting regulatory requirements but also for enhancing corporate reputation and long-term profitability. Similarly, digitalization was noted for its potential to significantly improve efficiency and decision-making accuracy in the organizations process.

From the Empirical Study:

The survey conducted as part of this dissertation confirmed and expanded the findings of the literature review. It indicated that companies who integrate ESG factors typically see improved risk management and alignment with global sustainability standards. The adoption of digital technologies was reported to make more efficient supplier selection, enhance data handling, and facilitate faster decision-making among various professionals.

5.2 Recommendations Future Research

From the Literature Review:

Strategic Integration of ESG: The literature suggests that strategic integration of ESG factors into procurement policies can significantly benefit companies. This involves not only compliance with standards but also proactive engagement in sustainability initiatives.

Leveraging Digital Tools: The literature advises for increased investment in digital technologies to optimize procurement processes, suggesting tools like AI, machine learning, and data analytics as particularly effective.

From the Empirical Study:

Enhanced ESG Training: Based on survey responses, there is a need for enhanced training programs focusing on ESG factors, ensuring that all involved in business teams understand and can implement these considerations effectively.

Progressive Adoption of Advanced Technologies: The study indicates that a gradual adoption strategy for new technologies might be more effective, by allowing companies to integrate new tools without disrupting existing processes too severely.

5.3 Future Research

The review identified a gap in longitudinal studies on the long-term impacts of ESG and digitalization on supplier performance. Further investigation is recommended into how these practices affect supplier relationships over time.

Additionally, from the positive feedback on AI from respondents, further studying on how AI can specifically enhance ESG integration within supplier selection processes could be valuable.

References

- *Achieving sustainable procurement | McKinsey*. (n.d.). Retrieved June 14, 2024, from https://www.mckinsey.com/capabilities/operations/our-insights/buying-into-a-more-sustainable-value-chain

- Alhasawi, E., Hajli, N., & Dennehy, D. (2023). A Review of Artificial Intelligence (AI) and Machine Learning (ML) for Supply Chain Resilience: Preliminary Findings. *International Symposium on Technology and Society, Proceedings*. https://doi.org/10.1109/ISTAS57930.2023.10306041

- Arjan van Weele. (2018). *Purchasing and supply chain management*.

- *Artificial Intelligence in Procurement: Real-World Case Studies*. (n.d.). Retrieved June 13, 2024, from https://oboloo.com/blog/artificial-intelligence-in-procurement-real-world-case-studies/

- Awaysheh, A., & Klassen, R. D. (2010). The impact of supply chain structure on the use of supplier socially responsible practices. *International Journal of Operations and Production Management*, *30*(12), 1246–1268. https://doi.org/10.1108/01443571011094253

- Bai, C., & Sarkis, J. (2010). Integrating sustainability into supplier selection with grey system and rough set methodologies. *International Journal of Production Economics*, *124*(1), 252–264. https://doi.org/10.1016/J.IJPE.2009.11.023

- Beske-Janssen, P., Johnson, M. P., & Schaltegger, S. (2015). 20 years of performance measurement in sustainable supply chain management – what has been achieved? In *Supply Chain Management* (Vol. 20, Issue 6, pp. 664–680). Emerald Group Holdings Ltd. https://doi.org/10.1108/SCM-06-2015-0216

- Bi, Z., Xu, L. Da, & Wang, C. (2014). Internet of things for enterprise systems of modern manufacturing. *IEEE Transactions on Industrial Informatics*, *10*(2), 1537–1546. https://doi.org/10.1109/TII.2014.2300338

- Cao, Z., Kim, D. Y., Mu, Y., & Singhal, V. (2024). Toward suppliers' corporate social responsibility performance: the role of relationship dependence. *International Journal of Operations and Production Management*, *44*(2), 538–561. https://doi.org/10.1108/IJOPM-08-2022-0540

- Carter, C. R., & Rogers, D. S. (2008). A framework of sustainable supply chain management: Moving toward new theory. In *International Journal of Physical*

Distribution and Logistics Management (Vol. 38, Issue 5, pp. 360–387). https://doi.org/10.1108/09600030810882816

- Chae, B. (2015). Insights from hashtag #supplychain and Twitter Analytics: Considering Twitter and Twitter data for supply chain practice and research. *International Journal of Production Economics*, *165*, 247–259. https://doi.org/10.1016/J.IJPE.2014.12.037

- Christopher, M. (n.d.). *LOGISTICS & SUPPLY CHAIN MANAGEMENT*. www.pearson-books.comwww.pearson-books.com

- Dubey, R., Gunasekaran, A., Papadopoulos, T., Childe, S. J., Shibin, K. T., & Wamba, S. F. (2017). Sustainable supply chain management: framework and further research directions. *Journal of Cleaner Production*, *142*, 1119–1130. https://doi.org/10.1016/j.jclepro.2016.03.117

- Erlandsson, G., Ibach, B., Spiller, P., & Bonnemaison Cherel, C. (2021, September). *Buying into a more sustainable value chain*. https://www.mckinsey.com/capabilities/operations/our-insights/buying-into-a-more-sustainable-value-chain#/

- EU Comission. (n.d.). *Sustainable Finance – EU classification system for green investments*.

- Ghadge, A., Er Kara, M., Moradlou, H., & Goswami, M. (2020). The impact of Industry 4.0 implementation on supply chains. *Journal of Manufacturing Technology Management*, *31*(4), 669–686. https://doi.org/10.1108/JMTM-10-2019-0368

- Glock, C. H., & Hochrein, S. (2011). Purchasing Organization and Design: A Literature Review. *Business Research*, *4*(2), 149–191. https://doi.org/10.1007/BF03342754

- Goebel, P., Reuter, C., Pibernik, R., & Sichtmann, C. (2012). The influence of ethical culture on supplier selection in the context of sustainable sourcing. *International Journal of Production Economics*, *140*(1), 7–17. https://doi.org/10.1016/j.ijpe.2012.02.020

- Govindan, K., Kaliyan, M., Kannan, D., & Haq, A. N. (2014). Barriers analysis for green supply chain management implementation in Indian industries using analytic hierarchy process. *International Journal of Production Economics*, *147*(PART B), 555–568. https://doi.org/10.1016/J.IJPE.2013.08.018

- Govindan, K., Rajendran, S., Sarkis, J., & Murugesan, P. (2015). Multi criteria decision making approaches for green supplier evaluation and selection: a literature

review. *Journal of Cleaner Production*, *98*, 66–83. https://doi.org/10.1016/J.JCLEPRO.2013.06.046

- Guida, M., Caniato, F., Moretto, A., & Ronchi, S. (2023a). Artificial intelligence for supplier scouting: an information processing theory approach. *International Journal of Physical Distribution and Logistics Management*, *53*(4), 387–423. https://doi.org/10.1108/IJPDLM-12-2021-0536

- Guida, M., Caniato, F., Moretto, A., & Ronchi, S. (2023b). Artificial intelligence for supplier scouting: an information processing theory approach. *International Journal of Physical Distribution and Logistics Management*, *53*(4), 387–423. https://doi.org/10.1108/IJPDLM-12-2021-0536

- Hao, X., & Demir, E. (2024). Artificial intelligence in supply chain decision-making: an environmental, social, and governance triggering and technological inhibiting protocol. In *Journal of Modelling in Management* (Vol. 19, Issue 2, pp. 605–629). Emerald Publishing. https://doi.org/10.1108/JM2-01-2023-0009

- Heckmann, I., Comes, T., & Nickel, S. (2015). A critical review on supply chain risk - Definition, measure and modeling. In *Omega (United Kingdom)* (Vol. 52, pp. 119–132). Elsevier Ltd. https://doi.org/10.1016/j.omega.2014.10.004

- Klassen, R. D., & Vereecke, A. (2012). Social issues in supply chains: Capabilities link responsibility, risk (opportunity), and performance. *International Journal of Production Economics*, *140*(1), 103–115. https://doi.org/10.1016/J.IJPE.2012.01.021

- krause, D. R., Vachon, S., & Klassen, R. D. (2009). Special topic forum on Sustainable Supply Chain Management: Introduction and reflections on the role of purchasing management. *Journal of Supply Chain Management*, *45*(4), 18–25. https://doi.org/10.1111/j.1745-493X.2009.03173.x

- Liang, D., Cao, W., Zhang, Y., & Xu, Z. (2024). A two-stage classification approach for AI technical service supplier selection based on multi-stakeholder concern. *Information Sciences*, *652*. https://doi.org/10.1016/j.ins.2023.119762

- Matos, P. (2020). *ESG and responsible institutional investing around the world: A critical review*.

- Nasseri, H., Chen, H. K., Huo, K. Z., & Lo, Y. F. (2023). A Hybrid Grey Decision Methodology in Social Sustainable Supplier Selection. *Sustainability (Switzerland)*, *15*(15). https://doi.org/10.3390/su151511777

- Ordoobadi, S. M., & Wang, S. (2011). A multiple perspectives approach to supplier selection. *Industrial Management and Data Systems*, *111*(4), 629–648. https://doi.org/10.1108/02635571111133588

- Philip Beske, M. P. J. S. S. (2015). *20 Years of Performance Measurement in Sustainable Supply Chain Management. What has been achieved?*

- Queiroz, M. M., Telles, R., & Bonilla, S. H. (2020). Blockchain and supply chain management integration: a systematic review of the literature. In *Supply Chain Management* (Vol. 25, Issue 2, pp. 241–254). Emerald Group Holdings Ltd. https://doi.org/10.1108/SCM-03-2018-0143

- Rajeev, A., Pati, R. K., Padhi, S. S., & Govindan, K. (2017). Evolution of sustainability in supply chain management: A literature review. *Journal of Cleaner Production*, *162*, 299–314. https://doi.org/10.1016/J.JCLEPRO.2017.05.026

- *Risk Management Tools*. (n.d.). Retrieved June 25, 2024, from https://marketplace.procurementleaders.com/topics/risk-management-tools

- Sarkis, J., & Dhavale, D. G. (2015). Supplier selection for sustainable operations: A triple-bottom-line approach using a Bayesian framework. *International Journal of Production Economics*, *166*, 177–191. https://doi.org/10.1016/J.IJPE.2014.11.007

- Schaltegger, S., & Burritt, R. (2018). Business cases and corporate engagement with sustainability: Differentiating ethical motivations. *Journal of Business Ethics*, *147*(2), 241–259. https://doi.org/10.1007/s10551-015-2938-0

- Schoenherr, T., & Speier-Pero, C. (2015). Data science, predictive analytics, and big data in supply chain management: Current state and future potential. *Journal of Business Logistics*, *36*(1), 120–132. https://doi.org/10.1111/jbl.12082

- Searcy, C. (2016). Measuring Enterprise Sustainability. *Business Strategy and the Environment*, *25*(2), 120–133. https://doi.org/10.1002/bse.1861

- Sharma, M., & Joshi, S. (2023). Digital supplier selection reinforcing supply chain quality management systems to enhance firm's performance. *TQM Journal*, *35*(1), 102–130. https://doi.org/10.1108/TQM-07-2020-0160

- *Supplier Collaboration Platforms: The Evolution of Supplier Relationship Management*. (n.d.). Retrieved June 14, 2024, from https://www.clovercollab.com/blog/evolution-of-supplier-relationship-management

- *Sustainable Supplier Selection: A Comprehensive Guide*. (n.d.). Retrieved June 14, 2024, from https://www.zunocarbon.com/blog/sustainable-supplier-selection-guide

- Tachizawa, E. M., & Wong, C. Y. (2014). Towards a theory of multi-tier sustainable supply chains: A systematic literature review. *Supply Chain Management*, *19*, 643–653. https://doi.org/10.1108/SCM-02-2014-0070

- Thomas Y. Choi, C. M. A. S. H. (2013). *Toward a Theory of Multi-Tier Supply Chain Management*.

- Toorajipour, R., Sohrabpour, V., Nazarpour, A., Oghazi, P., & Fischl, M. (2021). Artificial intelligence in supply chain management: A systematic literature review. *Journal of Business Research*, *122*, 502–517. https://doi.org/10.1016/J.JBUSRES.2020.09.009

- Unilever. (n.d.). *Unilever Sustainable Living Plan 2010 to 2020*.

- Winter, M., & Knemeyer, A. M. (2013). Exploring the integration of sustainability and supply chain management: Current state and opportunities for future inquiry. *International Journal of Physical Distribution and Logistics Management*, *43*(1), 18–38. https://doi.org/10.1108/09600031311293237

Appendix A: "Research Questionnaire"

Supplier Selection Questionnaire

Your participation in this questionnaire is voluntary. All data collected will be used solely for academic research purposes and will be treated confidentially. By proceeding with this questionnaire, you consent to the use of your responses for academic research purposes only. Your personal data will not be disclosed or used for any other purposes. If you have any concerns about the data collection or processing, please contact the researcher at kon.chatzipavlis@gmail.com. Thank you for your cooperation.

* Υποδεικνύει απαιτούμενη ερώτηση

1. Διεύθυνση ηλεκτρονικού ταχυδρομείου *

_____

Ενότητα χωρίς τίτλο

2. 1. What is your gender? *

Να επισημαίνεται μόνο μία έλλειψη.

○ Male

○ Female

○ Prefer not to say

3. 2. What is your age group? *

Να επισημαίνεται μόνο μία έλλειψη.

○ 18-24

○ 25-34

○ 35-44

○ 45-54

○ 55-64

○ 65 or older

4. 3. What department do you currently work in? *

Να επισημαίνεται μόνο μία έλλειψη.

⬭ Procurement / Purchasing

⬭ Human Resources

⬭ Supply Chain / Logistics

⬭ Finance

⬭ Sales

⬭ Marketing

⬭ Information Technology

⬭ Άλλο: _____

5. 4. What is you current role in the company? *

Να επισημαίνεται μόνο μία έλλειψη.

⬭ Entry level / Assistant

⬭ Mid level / Specialist - Expert

⬭ Senior level / Manager - Supervisor

⬭ Director/Chief

6. 5. How many years have you been involved in procurement/supplier selection? *

Να επισημαίνεται μόνο μία έλλειψη.

⬭ Less than a year

⬭ 1-3 years

⬭ 3-5 years

⬭ More than 5 years

19/6/24, 3:45 μ.μ.   Supplier Selection Questionnaire

7.   6. What industry does your company operate in? *

Να επισημαίνεται μόνο μία έλλειψη.

- Retail
- Manufacturing
- Technology
- Banking
- Shipping
- Άλλο: _____

8.   7. Rank the following criteria in order of importance when selecting a supplier. 1 *
being the least important and 5 being the most important

Να επισημαίνεται μόνο μία έλλειψη ανά σειρά.

	1	2	3	4	5
Price	○	○	○	○	○
Quality	○	○	○	○	○
Delivery time	○	○	○	○	○
Ethical practices	○	○	○	○	○
Previous Cooperation	○	○	○	○	○
New technologies	○	○	○	○	○
Experience	○	○	○	○	○

9. 8. How do you currently evaluate the performance of your suppliers? (Select all *
    that apply)

    Επιλέξτε όλα όσα ισχύουν.

    ☐ Key Performance Indicators (KPIs)
    ☐ Performance scorecards
    ☐ Regular surveys / questionnaires
    ☐ No, we do not currently evaluate supplier performance.
    ☐ Άλλο: _____

10. 9. How frequently do you conduct supplier performance evaluations? *

    Να επισημαίνεται μόνο μία έλλειψη.

    ◯ Quarterly
    ◯ Semi-Annually
    ◯ Annually
    ◯ Every two years
    ◯ Άλλο: _____

11. 10. What factors influence the decision to switch suppliers? (Select all that *
    apply)

    Επιλέξτε όλα όσα ισχύουν.

    ☐ Price
    ☐ Quality issues
    ☐ Delivery delays
    ☐ Changes in company needs
    ☐ Άλλο: _____

19/6/24, 3:45 μ.μ.   Supplier Selection Questionnaire

12.   11. How do you ensure that selected suppliers meet your company's   *
       requirements? (Select all that apply)

       Επιλέξτε όλα όσα ισχύουν.

       ☐ Contractual agreements

       ☐ Regular audits / inspections

       ☐ Performance reviews

       ☐ Άλλο: _____

13.   12. Do you consider Environmental, Social, and Governance (ESG) criteria when *
       selecting suppliers?

       Να επισημαίνεται μόνο μία έλλειψη.

       ◯ Yes

       ◯ No

14.   13. In your opinion, how important are ESG factors in the supplier selection   *
       process?

       Να επισημαίνεται μόνο μία έλλειψη.

       ◯ Very important

       ◯ Somewhat important

       ◯ Not important

15.   14. Which of the following ESG factors are important considerations in your   *
       supplier selection process? (Select all that apply)

       Επιλέξτε όλα όσα ισχύουν.

       ☐ Environmental sustainability practices (e.g., carbon footprint reduction, waste
       management)

       ☐ Social responsibility (e.g., labor practices, diversity and inclusion)

       ☐ Governance and ethical standards (e.g., transparency, anti-corruption measures)

       ☐ None of the above

16.   15. Is digital technology currently utilized in your organization's supplier   *
        selection process?

Να επισημαίνεται μόνο μία έλλειψη.

( ) Yes

( ) No

( ) Partially

17.   16. If positive on the question above, how has digitalization impacted the
        efficiency and effectiveness of your supplier selection? (Select all that apply)

Επιλέξτε όλα όσα ισχύουν.

[ ] Reduced the time needed for supplier evaluation and selection

[ ] Increased access to a wider pool of suppliers

[ ] Made the process more cost-effective

[ ] Enhanced the ability to identify and mitigate risks with suppliers

[ ] No significant impact observed

[ ] Άλλο: _____

18.   17. Do you have plans to further digitalize or automate aspects of the supplier   *
        selection process in the future?

Να επισημαίνεται μόνο μία έλλειψη.

( ) Yes

( ) No

( ) Maybe

19.   18. In your opinion, do you believe that artificial intelligence (AI) will have an   *
        impact on supplier selection processes?

Να επισημαίνεται μόνο μία έλλειψη.

( ) Yes

( ) No

20.   19. If positive on the question above, how do you anticipate AI will impact the supplier selection process in the future?

_____

_____

_____

_____

_____

_____

Αυτό το περιεχόμενο δεν έχει δημιουργηθεί και δεν έχει εγκριθεί από την Google.

Google Φόρμες

Author's Statement:

I hereby expressly declare that, according to the article 8 of Law 1559/1986, this dissertation is solely the product of my personal work, does not infringe any intellectual property, personality and personal data rights of third parties, does not contain works/contributions from third parties for which the permission of the authors/beneficiaries is required, is not the product of partial or total plagiarism, and that the sources used are limited to the literature references alone and meet the rules of scientific citations.