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JOINT PRACTICES OF GREEN IT AND QUALITY MANAGEMENT AND THEIR INFLUENCE ON LOGISTICS PERFORMANCE

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Purpose: The paper aims to investigate the joint management practices within green Information Technology (IT) and quality management, and to explore the implications of this amalgamation on the logistics performance of freight transport enterprises. Furthermore, the study examines the mediating influences of logistics customer service performance and environmental management on the relationship between the joint adoption of green IT practices, quality management, and the logistics performance of the companies.
Design/methodology/approach: The research utilized a dataset comprising 278 enterprises operating in the Polish freight transport sector, conducted through a CATI survey employing a structured questionnaire. Initially, a confirmatory factor analysis (CFA) was employed to assess the adequacy of the conceptual model, evaluating whether the constructs in the study adequately represented the observed data. Subsequently, a structural equation modelling (SEM) approach was applied to investigate the hypothesized relationships among the constructs.
Findings: This study investigates the impacts of combined management practices: the integration of green Information Technology practices and quality management practices, on the performance of logistics operations. Within the results of the research, two significant trends are identified: the mediating roles played by logistics customer service performance and environmental management. These factors are found to influence the relationship between the integrated adoption of green IT practices and quality management, and the overall performance of logistics operations within the enterprises.
Originality/value: This research endeavour has undertaken a contribution to enhancing comprehension regarding the determinants that shape the decision-making process for integrating diverse management practices with technological support.

Keywords: management practices, green Information Technology, quality management, logistics customer service, logistics performance.

Category of the paper: Research paper.

1. Introduction

Environmental subjects no longer exclusively command the attention of scientists and international and national regulators. Instead, they have emerged as focal points within the business domain. The implementation of sustainable business practices, particularly the adoption of green Information Technology (IT) practices, seeks to establish a mutually beneficial outcome for both internal and external stakeholders of a company (Gajdzik et al., 2020; Radu, 2016). Consequently, it has become imperative for organizations to integrate the principles of sustainability into their strategies. Furthermore, global competitive paradigms have undergone revisions due to the pervasive influence of environmental management on all aspects of a company's strategic framework (Chen, 2013; Chen et al., 2014).

Green IT practices encompass a range of measures aimed at addressing concerns related to the consumption of material and energy resources, environmental pollution, waste management, recycling, and associated processes. Companies utilize Information Technologies directly or indirectly to realize the economic, environmental, and social advantages of adopting greener practices (Gajdzik, Wolniak, 2022). Extensive research has demonstrated that embracing sustainable business practices yields various benefits for firms, including improved financial value and economic performance resulting from increased revenues and reduced costs, as proved by Christmann (2000). Simultaneously, the adoption of green IT practices enables firms to effectively address normative pressures exerted by diverse stakeholders, including regulatory bodies, customers, competitors, communities, and other interest groups and associations (Epstein, 2008). Consequently, achieving a harmonious balance between economic performance and environmentally friendly practices has become a pivotal strategic concern for companies (Molla et al., 2009). In light of this, leading companies worldwide have increasingly recognized the significance of environmental performance management.

The deliberation regarding the adoption of green IT strategies, policies, and tools poses a significant challenge for organizations. Investing in environmentally sustainable IT solutions holds the potential for future success (Ozurk et al., 2011). There is a noticeable shift among an increasing number of IT vendors and users towards embracing green IT practices, which in turn contributes to the establishment of a sustainable society and economy. Vendors recognize the necessity of enhancing the quality of environmental information and technologies to distinguish themselves from their counterparts in the market.

Lubin and Esty (2010) conducted a comprehensive analysis of managerial megatrends, including quality management, and observed that sustainability is evolving in a similar manner, related to how quality management emerged as a megatrend in the 1980s and 1990s and continues to hold relevance today. Notably, various authors have drawn parallels between environmental and quality programs in terms of their underlying philosophies and practical applications (Karapetrovic, Casadesús, 2009; Klassen, McLaughlin, 1996; Curkovic et al.,

2000; Narasimhan, Schoenherr, 2012). Conceptually, both green and quality practices adopt a proactive managerial approach that emphasizes long-term objectives and the preservation of performance accomplishments. In terms of practical implementation, there exist numerous resemblances, such as the pursuit of zero defects, waste reduction, and employee engagement and training (Sroufe, Curkovic, 2008). Despite extensive exploration of the driving role of quality management, the literature has predominantly overlooked the potential synergistic relationship between green management practices and quality practices in positively reinforcing operational performance improvements within enterprises' activities.

Contemporary enterprises are increasingly inclined to prioritize IT solutions as a means to enhance their logistics and customer service performance. The emergence of Industry 4.0 technologies and digitalization has sparked the need for innovative supply chain arrangements and business models, particularly in the current business activity circumstances characterized by rapid customization and delivery requirements (Anwar et al., 2022; Jelonek, Mesjasz-Lech, 2019; Schönfuß et al., 2021). Information Technologies applied within the transportation sector also present a novel perspective for integrating efficient green practices of high quality. Service providers, particularly those operating in the freight transport sector and adopting a corporate strategic outlook, are poised to emerge as long-term winners. Nevertheless, in order to thrive in this market, it is crucial for organizations to adopt a comprehensive approach that encompasses the inclusion of IT within a broader endeavour to enhance environmental responsibility and quality management, satisfying the comprehensive needs of their customers.

Regardless of the existing literature acknowledging the importance of sustainability, the research area still has much to contribute to the ongoing discourse. The exploration of IT potential in addressing ecological sustainability, fostering green reputation capital, and reinforcing the integration of green strategies with quality management practices remain relatively limited (Curkovic et al., 2000; Molla, Abareshi, 2011). The explicit understanding of the synergistic effects of joint IT practices for promoting environmentally conscious businesses and quality management practices seems to remain lacking among businesses. Thus, it is crucial for scholars to engage in discussions and research endeavours that shed light on how IT can contribute to the sustainable development of high-quality businesses (Trimi, Park, 2012).

This paper aims to investigate the joint management practices within green Information Technology and quality management and to explore the implications of this amalgamation on the logistics performance of freight transport enterprises. Furthermore, the study examines the mediating influences of logistics customer service performance and environmental management on the relationship between the joint adoption of green IT practices, quality management, and the logistics performance of the companies.

2. Literature review

Green Information Technology encompasses the development and implementation of information systems that contribute to the establishment of sustainable business practices (Chen et al., 2009). Presently, the pursuit of IT sustainability is a paramount objective, encompassing the economic, environmental, and social impacts of organizations. Molla et al. (2011) provide a conceptualization of green IT from the viewpoint of IT infrastructure and capability. This signifies the need to integrate sustainability considerations into both the technical and human aspects of IT infrastructure, as well as the managerial capabilities, in order to address sustainability challenges, both IT-related and non-IT-related. Consequently, in order to achieve environmental objectives, it is essential for enterprises to align their environmental targets with the encompassing sustainability goals of the organization. As stated by Mann et al. (2009), the concept of green IT can be concisely defined as the strategic utilization of operations and Information Technology to align business-oriented objectives with green practices that promote environmental goals throughout the entire operational activity. Brookes et al. (2010) expand on this definition, encompassing various dimensions of green IT, including power consumption and management, manufacturing practices, data centre design and operations, recycling, the total cost of ownership concerns, micro and macroeconomic implications, system performance and efficiency, as well as environmental, social, and ethical practices associated with acquisition, utilization, and disposal of IT resources. The prevalent definitions of green IT primarily emphasize environmental practices related to sourcing, operations, and allocation of IT infrastructure. However, Molla et al. (2009) incorporate elements of IT management within their conceptualization of green IT. Moreover, the concept of green IT consistently acknowledges the enabling role of information systems (IS) in facilitating environmentally sustainable business and production processes, while its aptitude for greening products and related customer services is less explored. Typically, the term green pertains to technologies and processes that exhibit environmental friendliness, having a reduced negative impact on the natural environment compared to prevailing alternatives. The ecological ramifications of green technologies are directly linked to their comprehensive environmental footprint thoroughout their life cycle (Molla, Abareshi, 2011), and in the context of green processes, the environmental consequences are associated with the diminished demands for resources, mitigated pollution levels, and the reutilization of materials (Albino et al., 2009).

As posited by Loeser (2013), green IT practices encompass a triad of key focal points:

1. Incorporating environmental parameters in the procurement of IT equipment and services.
2. Implementing energy-efficient IT operations within data centres and office settings.
3. Embracing environmentally conscious practices pertaining to the disposal of IT equipment.

The adoption of green IT practices presents advantageous outcomes for both organizations and individuals, encompassing financial and other benefits. Osch and Avital (2010) delve into an extensive list of advantages associated with green IT. Among these benefits, the highest proportions are attributed to the reduction of power consumption and cost, as energy efficiency and cost control imperatives take precedence in most companies' environmental agendas. With regulations and market-driven approaches addressing climate change gaining prominence, businesses are increasingly prioritizing sustainability. To transition their IT practices towards sustainability, organizations must systematically evaluate both internal and external limitations, such as financial constraints, customer demands, and governmental regulations. Once the decision to adopt green IT is made, enterprises ought to formulate a comprehensive green IT policy. This policy should encompass clear objectives, targets, action plans, and timelines, enabling the effective implementation of green IT strategies within the organization (Murugesan, 2008). In the current business landscape characterized by relentless competition and rapidly changing circumstances, companies are confronted with challenging decisions essential for their survival. The complexities are further amplified during economic downturns. Empirical evidence has substantiated the indispensable nature of addressing sustainability concerns, such as embracing green IT practices, for the enduring existence of enterprises (Porter, Kramer, 2006). Moreover, Unruh and Ettenson (2010) conducted a study involving prominent companies like Toyota, GE, Timberland, and Starbucks, revealing that a significant proportion of executives recognize the adoption of green IT initiatives as a potent driver of revenue generation. When considering social performance, the examination encompasses both the internal community (i.e., employees) and external community (i.e., customers) within an organizational context (Gimenez et al., 2012). However, the primary emphasis is placed on the external community, which consists of customers, given that they serve as the primary motivation for organizational operations. The utilization of sustainable technologies, such as green IT, has the potential to enhance customer satisfaction (Chen, 2013), as customers derive satisfaction when processes and products align with environmental sustainability principles. At the organizational level, the adoption of green products is predominantly influenced by available opportunities and resources, as highlighted by Atlas and Florida (1997). While some studies have examined individual or managerial factors driving the adoption of environmental strategies, limited attention has been given to investigating the simultaneous individual-level determinants of green IT practices in conjunction with quality management considerations (Gholami et al., 2013; Ainin et al., 2016).

Curkovic et al. (2000), Rusinko (2005), Simon et al. (2012) have highlighted numerous resemblances between environmental management and quality management practices, particularly concerning managerial tools. In the contemporary business landscape, the concept of quality management has become indispensable for enterprises, encompassing various management measures and strategies aimed at enhancing quality, reducing costs, improving productivity, and enhancing overall corporate performance and competitiveness. Quality

management programs and practices have been the subject of extensive research in the field of operations management and are considered fundamental to the discipline. Within the literature, several commonly identified practices include leadership, people management, planning, information and analysis, process management, supplier management, customer/stakeholder focus, and design. Notably, some of these practices also serve as catalysts for sustainable development and green innovation (Sila, 2007; Molina-Azorín et al., 2015). Certain studies have embraced the view that the realm of quality management is closely intertwined with the advancement of sustainable development at large, including the realm of green innovation (Siva et al., 2016; Zeng et al., 2017). The consensus within the literature indicates that these quality management initiatives yield improvements in customer satisfaction, operational performance, and financial performance (Withers, Ebrahimpour, 2002). Noteworthy connections and resemblances between quality management and environmental management programs and practices have been underscored by various authors. Klassen and McLaughlin (1993) delineated specific parallels between Total Quality Management (TQM) and environmental management. Much like quality management, environmental management also adopts a proactive approach, considering environmental factors holistically across product design, manufacturing processes, marketing, product delivery, customer service, and post-consumer stages (Klassen, McLaughlin, 1996; Sroufe, Curkovic, 2008). These shared conceptual and practical elements imply that the impact of environmental practices on performance can be enhanced by integrating quality practices. In summary, the literature review lends support to the proposition that the operational performance outcomes of environmental management practices are strengthened when combined with quality management practices and programs.

In this regard, certain studies indicate that quality management practices, such as ISO 9001 certification programs and supplier TQM, can facilitate and expedite the adoption of green practices while enhancing their efficacy (Pereira-Moliner et al., 2012; Llanch et al., 2013). Additionally, empirical evidence presented by Wiengarten and Pagell (2012) demonstrates that companies achieve improved performance in terms of cost, flexibility, and delivery when environmental management practices are present, largely attributed to substantial investments in quality management practices.

Equally noteworthy, a multitude of scholars have underscored the incessantly escalating expectations placed on organizations in terms of both quality and environmental aspects (e.g., McGuire, Dilts, 2008; Wiengarten, Pagell, 2012), establishing a connection between the examined interaction and the dynamic capabilities theory's emphasis on a changing environment. In essence, the research delves into the potential complementary outcomes that can arise from the fusion of two capabilities, namely quality management and environmental management, which exhibit apparent overlap within an environment characterized by ever-increasing and evolving demands from numerous stakeholders.

Corroborating this standpoint, several management practices have been scrutinized and revealed to exert a positive influence on firm performance for those that adopt them on average. Nevertheless, given the diversity in the adoption of management practices among enterprises, it becomes crucial to inquire why certain firms opt for practices that are less effective than others (Agarwal et al., 2013). To fully capitalize on the advantages offered by both quality management and environmental sustainability, managers should embrace an integrated, cross-functional, and enterprise-wide approach that encompasses the entire value chain (Rusinko, 2005).

To fulfil this requirement, it may be beneficial for organizations to implement environmental management strategies as a means to mitigate the environmental impact of their activities (Dai et al., 2017; Haden et al., 2009; Liu et al., 2017; Jabbour et al., 2014). By adopting measures that focus on reducing energy consumption, minimizing waste generation, and promoting the use of environmentally friendly and sustainable resources, enterprises can effectively reduce their environmental footprint (Bansal, Roth, 2000). The complexity and varied approaches employed by companies in addressing environmental challenges have led to an increasing number of business leaders and scholars evaluating firms based on their environmental practices (Aragón-Correa, Rubio-López, 2007; Tomomi, 2010). This recognition highlights the diverse nature of environmental management and the need for companies to develop tailored approaches to environmental issues (Kolk, Mauser, 2002; Zhu et al., 2017; Zhu et al., 2008). The examination of environmental management cannot be confined to an organization, as the entire entity influences the supply chain (Seuring, Gold, 2013). Therefore, enterprises are interconnected due to their involvement in the flow of materials and information, spanning from raw material suppliers to end consumers. Environmental management encompasses the development of an organization's environmental policies and the establishment of objectives aimed at safeguarding the environment (Çankaya, Sezen, 2019). This includes activities such as managerial endorsement of environmental practices, interdepartmental collaboration for environmental enhancements, and the implementation of an environmental management system (Zhu et al., 2005). Additionally, it is a response to mounting customer demands for environmentally conscious practices, compelling enterprises to adopt green strategies that mitigate the detrimental environmental effects of their products and services (Ahmed et al., 2019).

Environmental management and the utilization of diverse Information Technology solutions have emerged as critical strategic enablers for organizations aiming to enhance their operational capabilities, seize new market opportunities, or foster customer loyalty (Chen, Tsou, 2007; Evangelista et al., 2012). By empowering enterprises to align supply and demand more effectively, IT solutions enhance the ability to deliver a broader range of offerings and improve responsiveness to customer needs. This, in turn, leads to reduced lead times, costs, and improved logistics efficiency, ultimately enhancing the performance of logistics services provided to customers (Bag et al., 2020; Skowron-Grabowska, 2020). Concurrently,

the implementation of high-quality environmental solutions augments the value of overall logistics processes, further enhancing sustainability and environmental performance (Cichosz et al., 2020).

In accordance with scholarly discourse, logistics effectiveness and efficiency represent the comprehensive evaluation of logistics operations within organizational contexts. This entails the systematic assessment, examination, and administration of diverse performance metrics to gauge the efficacy of logistical processes, functions, and activities (Celebi, 2019; Ciesielski, 2006; Świerczek, 2006). The domain of logistics performance encompasses a broad spectrum of endeavours, encompassing transportation, storage, inventory control, order fulfilment, packaging, and distribution, among other key facets (Blecker et al., 2009; Fawcett, Cooper, 1998; Harrison, 2019; Hausman et al., 2013). The primary objective of logistics performance is to optimize the flow of goods, information, and resources across the supply chain, ensuring alignment with customer requirements while minimizing costs and maximizing service levels (Witkowski, 2006). Within logistics customer service performance, the measurement and evaluation refers to the effectiveness of the organization's needs and expectations of its customers in terms of service quality, responsiveness, and overall customer satisfaction (Ballou, 1998; Daugherty et al., 2019; Kempny, 2001). Extensive scholarly inquiries have consistently evidenced a robust affirmative association between the implementation and utilization of Information Technology and the holistic logistics performance of organizations, particularly with regard to enhancing the efficiency and efficacy of logistics service provision. These research findings have received validation from investigations carried out by various scholars, including Evangelista et al. (2012), Lai et al. (2008), Zawawi and Wahab (2018).

In the quest for attaining superior performance in logistics, the adoption of Information Technology has garnered widespread recognition as a pivotal determinant, as also confirmed by investigations conducted by Anwar et al. (2022). The implementation of IT empowers organizations to optimize their logistics service levels and effectively manage costs, as emphasized in research was undertaken by Barbosa and Musetti (2010) and Kirono et al. (2019). Moreover, logistics enterprises are leveraging IT endeavours to embrace emerging technologies, acquire novel knowledge, and cultivate innovative skills, as evidenced by research conducted by Bag et al. (2020). The utilization of IT in business operations has been observed to exert a transformative influence on the dynamic nature of organizational processes, resulting in enhanced performance in supply chain management, as noted by Li et al. (2009), and demonstrating a significant impact on the performance of contemporary logistics firms, as underscored by Evangelista et al. (2012). Moreover, the integration of cutting-edge IT systems has been shown to have a favourable impact on the efficiency of organizations' operations, their overall productivity, and the level of customer service provided, as demonstrated by studies carried out by Liu et al. (2010). In view of these research findings, it can be concluded, in line with the findings reached by Evangelista et al. (2012), that the implementation of IT plays a pivotal role in shaping the performance outcomes of firms.

Drawing upon an extensive examination of the available scholarly literature, which has not been exhaustively presented in this particular paper but rather alluded to, there exists substantial empirical support suggesting that the incorporation of integrated IT practices and quality management practices within the domain of freight transportation enterprises and their corresponding logistics and customer service performance remains constrained and selectively implemented. Additionally, a critical analysis of the existing body of literature pertaining to logistics and customer service performance, encompassing both the broader management domain and the sphere of information technology, reveals notable gaps and limitations.

Hence, the aforementioned insights gleaned from the existing literature provide the foundation for formulating the following hypotheses:

H1a. Joint practices of green IT and quality management (JGITQM) positively influence logistics customer service performance (LCSP).

H1b. Joint practices of green IT and quality management adoption (JGITQM) positively influences environmental management (EM).

H2a. Logistics customer service performance (LCSP) positively influence logistics performance (LP).

H2b. Environmental management (EM) positively influence logistics performance (LP).

H3a. Logistics customer service performance (LCSP) mediates the relation between joint practices of green IT and quality management (JGITQM) and logistics performance (LP).

H3b. Environmental management (EM) mediates the relation between joint practices of green IT and quality management adoption (JGITQM) and logistics performance (LP).

Figure 1 illustrates a conceptual framework which introduces the proposed relationships.

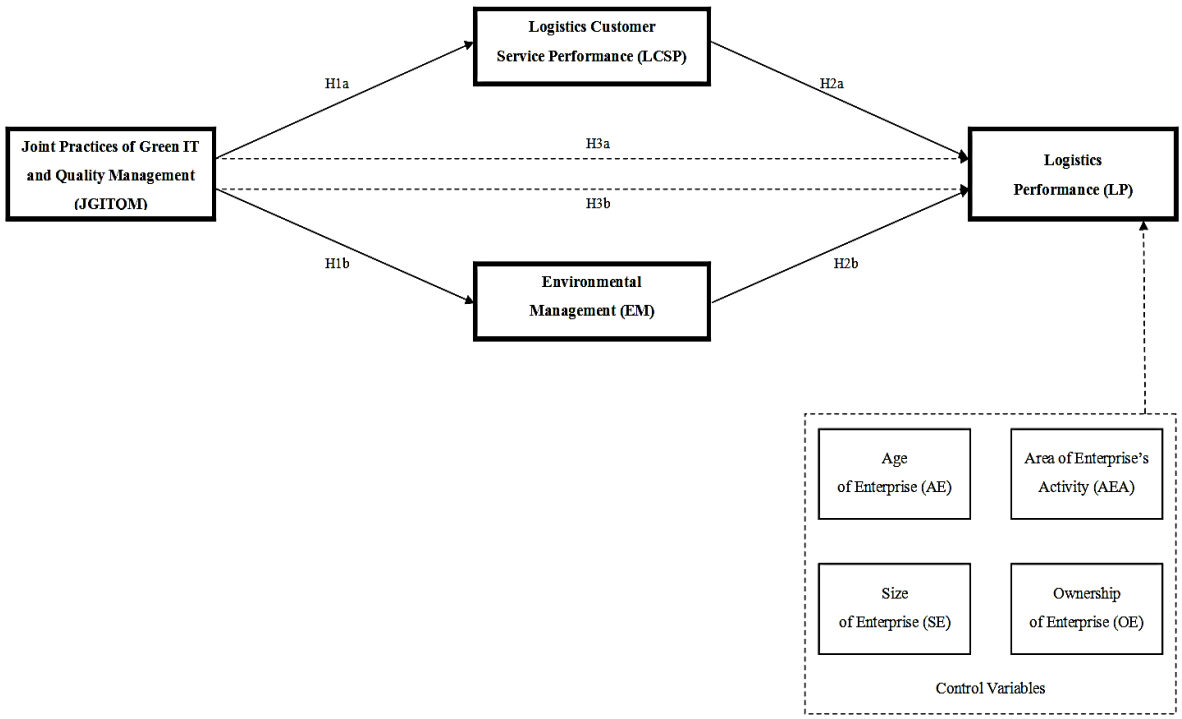

Figure 1. Conceptual model.

Source: Own elaboration.

3. Research materials and methods

The study was intended with the objective of investigating the association between joint practices of green Information Technology and quality management and logistics performance, as well as the mediating effects of logistics customer service performance and environmental management.

The research utilized a dataset comprising enterprises operating in the Polish freight transport sector. The data collection was conducted in the last quarter of 2022 through a Computer Assisted Telephone Interviewing (CATI) survey employing a structured questionnaire (Czakon, 2015). A thorough examination of the existing literature studies necessitated the inclusion of essential constituents in the questionnaire structure, encompassing four domains: joint practices of green IT and quality management, environmental management, logistics customer service performance and logistics performance. The proposal research tool underwent multiple rounds of piloting to validate the appropriateness of its format and questions' arrangement, while also enhancing its content validity. The revised questionnaire form subsequently was subjected to evaluation by distinct experts from organizations engaged in the fields of transportation, shipping and third-party logistics.

In the survey, 390 participants representing freight transportation enterprises were engaged. Among the gathered data, 112 questionnaires were identified as incomplete or inaccurate, consequently eliminating them from the research sample. Ultimately, 278 interviews were conducted with individuals representing the specific freight transport sector, yielding pivotal research insights.

Table 1 provides a concise overview of the key attributes of the research sample. The sample encompasses mostly small and medium-sized enterprises (over 85% of the total) with international areas of activity (nearly 68% of the total). The average age of the included firms is between seven and ten years, while the dominant type of ownership of the companies is national (more than 76% of the total). The distribution of the research sample, in terms of the type of business activity, is as follows: freight transport enterprises – nearly 71%, shipping companies – 20.5 %, and third-party logistics – 8.6%.

Table 1.
Characteristics of research sample

Features	Responses	Number
Type of economic activity	Freight transport	197
	Shipping	57
	Third-party logistics	24
Size of enterprise	Large enterprise	31
	Medium enterprise	62
	Small enterprise	176
	Micro enterprise	9

Cont. table 1.

Age of enterprise	less than 3 years	46
	3-6 years	98
	7-10 years	76
	11-20 years	31
	more than 20 years	27
Type of ownership	National	212
	Foreign	66
Area of activity	International	189
	Domestic	54
	Regional	35

Source: Own elaboration.

The measurements of the items were conducted utilizing a five-point Likert scale, where a rating of 1 corresponds to "strongly disagree" and a rating of 5 corresponds to "strongly agree" (Kock, 2015). The core component of the survey questionnaire comprised 32 measurement items that were categorically allocated across four pivotal domains explored in the study, presented in Table 2. The proposed constructs were chosen as inferred outcomes of the research, substantiated by the sources in the published literature.

Table 2.
List of measurement items

Variables	Items' acronyms	Constructs	Authors
Joint practices of green IT and quality management (JGICTQMA)	JGITQM1	In our enterprise green IT solutions and quality management attempts act intelligibly to encourage the general goals of the company.	Mann et al., 2009; Karapetrovic, Casadesús, 2009; Radu, 2016; Simon et al., 2012
	JGITQM2	In our enterprise green IT solutions and quality management attempts are launched conjointly in the planning proceeding.	
	JGITQM3	In our enterprise green IT solutions and quality management attempts are launched conjointly while the aims and objectives of the company have been specified.	
	JGITQM4	In our enterprise the practices of green IT and quality management are entirely joint in one distinct system.	
	JGITQM5	In our enterprise the control processes of green IT and quality management are launched conjointly.	
	JGITQM6	In our enterprise the analysis of the results of green IT and quality management are realized conjointly.	
	JGITQM7	In our enterprise the discrepancies in handling of green IT and quality management are launched conjointly.	
	JGITQM8	In our enterprise corrective and preventive activities regarding green IT and quality management are realized conjointly.	
	JGITQM9	In our enterprise processes of resources management regarding green IT and quality management are realized conjointly.	
	JGITQM10	In our enterprise assessment of data possessed from green IT and quality management is realized conjointly.	
	JGITQM11	In our enterprise all employees are in organized constant contact with conjointly realized green IT solutions and quality management attempts.	

Cont. table 2.

Logistics customer service performance (LCSP)	LCSP1	In our enterprise the quality management processes improve the level of excellence of the logistics service provided to customers.	Ballou, 1998; Curkovic et al., 2000; Daugherty et al., 2019; Kempny, 2001
	LCSP2	In our enterprise the quality management processes improve the general effectiveness of the logistics service provided to customers.	
	LCSP3	In our enterprise the quality management processes improve the ability to offer the logistics service of higher standards than competitive companies.	
	LCSP4	Our enterprise assesses pre-, post- and transactional indicators of logistics customer service, among others time of service, flexibility, frequency, accuracy and reliability of services, conveniences of orders, complaints, availability of information, facilitation of order placement, innovativeness of services, environmental friendliness of services, sustainability of services.	
	LCSP5	In our enterprise the quality management processes reduce the cost of quality of logistics customer service.	
	LCSP6	Our enterprise assesses the customer satisfaction of logistics service.	
Environmental management (IEM)	EM1	In our enterprise all top and middle-level managers support environmental management.	Dai et al., 2017; Liu et al., 2017; Zhu et al., 2017; Zhu et al., 2008
	EM2	In our enterprise total quality environmental management is realized.	
	EM3	In our enterprise environmentally-friendly technologies and green solutions are used in all desired domains.	
	EM4	Our enterprise achieves better results in pro-environmental activeness than other companies in our branch.	
	EM5	Our enterprise acquired green compliance and programs.	
	EM6	Our enterprise adopted environmental management systems.	
Logistics performance (LP)	LP1	In our enterprise logistics processes and activities participate in the growth of sales.	Blecker et al., 2009; Fawcett, Cooper, 1998; Harrison, 2019
	LP2	In our enterprise logistics processes and activities participate in the growth of market share.	
	LP3	In our enterprise logistics processes and activities participate in the growth of operational profit.	
	LP4	In our enterprise logistics processes and activities participate in the reduction of costs.	
	LP5	In our enterprise logistics processes and activities participate in the growth of competitive advantage in the branch.	
	LP6	In our enterprise the overall efficiency of logistics processes and activities has improved.	
	LP7	In our enterprise logistics processes and activities participate in the decline of employee turnover.	
	LP8	In our enterprise logistics processes and activities participate in the development of new services for the customers.	
	LP9	In our enterprise logistics processes and activities participate in the increase of advancement of new services for the customers.	

Source: Own elaboration.

The independent variable of the study, denoted as joint practices of green IT and quality management construct, encompasses eleven items that have been adapted from antecedent scholarly investigations by Mann et al. (2009), Karapetrovic and Casadesús (2009), Radu (2016) and Simon et al. (2012). Proposed items of the construct are referred to as conjointly realized green IT solutions and quality management attempts, acting intelligibly to encourage the general goals of the enterprises, launched in the planning proceeding and control processes, analyzed within corrective and preventive activities, in organized constant contact of all employees.

The dependent variable of the research is the logistics performance of the enterprises with nine measurement items selected from recommendations determined by Blecker et al. (2009), Fawcett and Cooper (1998), and Harrison (2019). The postulated components of the construct include logistics processes and activities participation in the growth of sales, market share and competitive advantage in the branch, increase of advancement of new services for the customers, as well as reduction of costs.

Both mediator variables' structures comprise six measurement elements. The construct of the first mediator variable, logistics customer service performance, is based on the literature features offered by Ballou (1998), Curkovic et al. (2000), Daugherty et al. (2019), and Kempny (2001), by assessing customer satisfaction and pre-, post- and transactional indicators of logistics customer service, by considering the quality management processes improving the level of excellence of the logistics service provided to customers, its general effectiveness, the ability to offer the logistics service of higher standards than competitive companies, as well as reducing the cost of quality of logistics. The second mediator variable is environmental management determined by all top and middle-level managers' support, including total quality environmental management, use of environmentally-friendly technologies and green solutions, acquiring green compliance and programs, and adopting environmental management, according to Dai et al. (2017), Liu et al. (2017), Zhu et al. (2017), and Zhu et al. (2008).

Moreover, four control variables were included in the research procedure: size and age of enterprise, type of ownership and area of activity. All data examination was conducted in a two-step process. Initially, a confirmatory factor analysis (CFA) was employed to assess the adequacy of the model for each construct, evaluating whether the constructs in the study adequately represented the observed data. Subsequently, a structural equation modelling (SEM) approach was applied to investigate the hypothesized relationships among the constructs, as depicted in Figure 1 of the conceptual framework.

4. Results of research and discussion

In the first step of the research procedure, in accordance with the guidelines proposed by Johnson and Wichern (2007), one measurement item from the environmental management construct and four measurement items from the logistics performance construct were excluded from the analysis by reason of low factor loadings. The items that remained after the exclusion of the aforementioned ones are presented in Table 3 along with the outcomes of the first-order confirmatory factor analysis (CFA). The evidence implies that the model's fit indices fall within accepted ranges (Field, 2009), signifying a remarkable alignment with the observed data, with chi-square = 1.50, CFI = 0.94, AGFI = 0.82, IFI = 0.94, TLI = 0.94, RMR = 0.052, RMSEA = 0.047. Moreover, Table 3 demonstrates that all items are in significant associations with the majority of their underlying constructs, as evidenced by standardized loadings exceeding 0.60 ($p < 0.001$).

Table 3.
Results of confirmatory factor analysis

Items' acronyms	Standardized loadings*	Average Variances Extracted	Cronbach's Alpha	Composite Reliability
JGITQM		0.75	0.95	0.95
JGITQM1	0.64			
JGITQM2	0.85			
JGITQM3	0.84			
JGITQM4	0.86			
JGITQM5	0.79			
JGITQM6	0.90			
JGITQM7	0.90			
JGITQM8	0.92			
JGITQM9	0.95			
JGITQM10	0.90			
JGITQM11	0.90			
LCSP		0.64	0.91	0.90
LCSP1	0.82			
LCSP2	0.71			
LCSP3	0.84			
LCSP4	0.84			
LCSP5	0.75			
LCSP6	0.80			
EM		0.51	0.85	0.86
EM1	0.60			
EM2	0.59			
EM3	0.70			
EM4	0.83			
EM5	0.80			
EM6	0.72			

Cont. table 3.

LP		0.52	0.89	0.89
LP1	0.61			
LP2	0.69			
LP3	0.65			
LP4	0.62			
LP5	0.73			
LP6	0.84			
LP7	0.66			
LP8	0.67			
LP9	0.73			

* significant value at $p < 0.001$.

Source: Own elaboration.

The internal consistency of all constructs is assessed using Cronbach's Alpha and composite reliability. The results indicated in Table 3 confirm that all constructs surpass the threshold value of 0.70 for both measures, thus demonstrating satisfactory levels of construct reliability (Bagozzi, Yi, 1988). Table 3 also provides insights into the convergent validity of the model through an analysis of the average variance extracted values for the constructs which surpass the established threshold of 0.50 (Fornell, Larcker, 1981), providing empirical support for the robust convergent validity of the constructs. Furthermore, the presence of profoundly considerable standardized regression weights of the variables is considered as strong evidence supporting the convergent validity of the study.

The measurement model's discriminant validity is assessed by evaluating the extent to which each construct converges with its corresponding values. This evaluation involves examining the covariance between pairs of constructs, which demonstrate significant differences from unity. The test results pertaining to the discriminant validity of the model are presented in Table 4. The pairwise comparisons provide robust evidence supporting the criterion of discriminant validity. Further, Table 5 presents descriptive statistics, which include the intercorrelations among the variables, providing a comprehensive overview of the data.

Table 4.
Results of discriminant validity

Domains of the constructs	Chi-square model	Chi-square unconstrained model	Difference[2]
JGITQM → LCSP	82.1	115.2	33.1
JGITQM → EM	87.5	119.0	31.5
JGITQM → LP	163.1	199.3	36.2
LCSP → EM	54.0	97.1	43.1
LCSP → LP	164.7	202.6	37.9
EM → LP	152.6	182.1	29.5

* significant value at $p < 0.001$.

Source: Own elaboration.

Table 5.
Descriptive statistics and intercorrelations

Variables	Mean	Standard Deviation	LP	JGITQM	LCSP	EM	AE	SE	OE	AEA
LP	3.60	0.78	1							
JGITQM	3.57	1.01	0.44**	1						
LCSP	3.82	0.71	0.75**	0.51**	1					
EM	3.69	0.78	0.65**	0.59**	0.70**	1				
AE	0.55	0.47	0.08	0.01	0.07	0.05	1			
SE	0.37	0.47	0.17*	0.03	0.06	0.11	0.20*	1		
OE	0.18	0.38	0.06	0.07	0.02	0.17**	0.07	0.29**	1	
AEA	0.51	0.49	0.03	-0.01	0.02	-0.02	0.12**	0.01	0.02	1

* significant value at $p < 0.01$.
** significant value at $p < 0.001$.

Source: Own elaboration.

Next three distinct statistical examinations were conducted on the common method bias. Initially, Harman's single-factor test was employed to ascertain if a solitary factor could account for the majority of the variability (Podsakoff et al., 2003). To achieve this, the exploratory factor analysis imposed a constraint on the number of factors by fixing it to one, as opposed to fluctuation based on eigenvalues. The syllogism determining the single-factor approach is that if the fit statistics of the confirmatory factor analysis results are significantly distorted when considering a single factor for the common method bias, it indicates that the method does not exert substantial control over the data. The results of chi-square = 4.30, RM = 0.14, and AGFI = 0.30 suggest that the variations observed cannot be primarily attributed to the common method bias. In the next step of examination, the common latent factor test was employed. The conducted analyses unveiled that the shared variance accounted for a mere 36% and did not represent the predominant part of the variability observed among the variables (Richardson et al., 2009). In the third stage of examination, the zero-constrained test was realized. The findings indicate that there is no significant presence of common method bias in the data, as demonstrated by the statistical comparison between the unconstrained common latent factor model with $\chi 2 = 646.8$, d.f. = 424, and the constrained model with $\chi 2 = 615.1$, d.f. = 402, revealing no substantial variation ($p = 0.49$). The cumulative outcomes unequivocally indicate that the common method bias does not bear significant relevance in the context of this survey (Podsakoff et al., 2003).

Within hypotheses testing for the model's direct associations, a robust statistical significance was denoted for all four hypotheses. For the relations between JGITQM → LCSP (H1a) and JGITQM → EM (H1b), the standardized regression coefficient is respectively 0.64 and 0.54 ($p < 0.001$). Furthermore, the associations between LCSP → LP (H2a) and EM → LP (H2b) obtained the results of the standardized regression coefficient respectively of 0.43 and 0.65 ($p < 0.001$).

According to Hair et al. (2010) in the presence of a mediating effect within a theoretical framework, a formerly statistically significant association between the predictor and outcome variables is expected to lose its significance. Within the confines of the model, in the absence of mediating factors or additional interactive effects, the direct associations between JGITQM and LP, LCSP and LP, as well as EM and LP, all exhibit statistical significance at a level of $p < 0.001$. The corresponding standardized regression weights for these associations are 0.47, 0.82, and 0.70, respectively.

To assess the significance of the mediating effects of LCSP and EM between JGITQM and LP, the conventional Sobel test methodology was initially employed. The Sobel test as a statistical procedure utilized to approximately evaluate the significance of the indirect influence of the independent variable on the dependent variable through the mediator (Baron, Kenny, 1986), in the study allowed for two measurements. Initially, it was found that LCSP acts as a complete mediator in the relationship between JGITQM and LP, with the Sobel test 5.32 ($p < 0.001$). In the subsequent analysis, it was revealed that EM exerts a complete mediating effect in the connection between JGITQM and LP, with the Sobel test 4.09 ($p < 0.001$). Consequently, hypotheses H3a and H3b are upheld, thereby confirming the complete mediation effects of LCSP and EM. These findings affirm that the impact of JGITQM on LP is dependent on the mediating influences of LCSP and EM. Thus, the effectiveness of JGITQM in influencing LP is solely achieved through the indirect effects mediated by LCSP and EM.

The presence of mediation effects was also examined utilizing the bias-corrected bootstrap approach to establish confidence intervals. In accordance with the suggestions of Hayes and Preacher (2014), the bias-corrected bootstrapping technique was employed, creating 6000 resamples to assess the significance of the deviation of the indirect effects from zero. The indirect impacts of JGITQM on LP, mediated by LCSP and EM, were assessed with results of 0.64 and 0.42 ($p < 0.001$), correspondingly, and were determined to be significantly distinct from zero. Hypotheses H3a and H3b, concerning the mediating influences of LCSP and EM, received complete support. Additionally, no statistically significant effects were observed between any of the control variables and the dependent variable, LP.

In the last part of the research procedure, to mitigate potential endogeneity bias, the study employed the two-stage least squares regression method (Liu et al., 2016). To address endogeneity concerns, instrumental variables were first identified for the variable LCSP in the two-stage least squares regression analysis. AE and OE were chosen as instrumental variables for LCSP as their relationships with LP were found to be statistically insignificant (Table 5). To address potential endogeneity, two instrumental variables, SE and the AEA, were selected. These variables were chosen based on their anticipated lack of significant correlation with LP but significant correlation with LCSP, as presented in Table 6.

Table 6.
Models within endogeneity

Variables	Model 1: ordinary least squares	Model 2: two-stage least squares
	LCSP	**LP**
JGITQM	0.35*	0.10
AE	0.06	
OE	-0.04	
SE	0.06	0.19*
AEA	0.06	
LC	0.15*	
LCSP		0.62*
R^2	0.29	0.59
	F-value = 14.19*	Wald chi-square = 121.82*

* significant value at $p < 0.01$.

Source: Own elaboration.

Before conducting the two-stage least squares regression approach, a regression model was performed to estimate the relationship between LCSP and all the variables in the analysis that are susceptible to endogeneity. The first model, presented in Table 6, employs a one-stage ordinary least squares regression technique. The R-squared value of this regression is 0.29, which is substantially higher than the R-squared value obtained from the regression model containing only the control variables (ΔR-squared = 0.26, Δ F-value = 12.02, $p < 0.01$). This outcome confirms the effectiveness of AE, OE, SE, and AEA as instrumental variables for LCSP in the study.

Due to the outcomes from the first model in Table 6, the anticipated value of the presumed endogenous variable, LCSP, was assessed (Bellamy et al., 2014) to examine the association between LCSP and LP in the second stage. As demonstrated in the second model of Table 5, a positive and statistically significant relationship was observed between LCSP and LP ($\beta = 0.62$, $p < 0.01$).

As remarked by Bernardo et al. (2009), a convergence of multiple discrete management practices with technological support, each with unique objectives, fosters the creation of a cohesive and streamlined system that harnesses existing synergies, resulting in heightened efficiency and effectiveness for the organization. Also according to Molina-Azorin et al. (2009), the integration of green Information Technology practices and quality management practices brings about various advantages, including enhanced organizational efficiency and effectiveness, alignment of aims, objectives, and processes, as well as improved communication throughout the entire organization. Hence, the establishment of capabilities through the implementation of joint green IT and quality management practices is anticipated to amplify firm performance across multiple functional domains. In conjunction with the advantages offered by integrated systems, in consideration of Gianni and Gotzamani (2015), it is imperative to emphasize that the long-term viability of joint management practices with technological support relies on collaborative auditing and performance-driven management approaches. The empirical results of this study provide empirical evidence that establishes a significant and

positive relationship between joint green IT practices and quality management practices, even in the absence of mediating effects. As suggested by Hofmann et al. (2012), embracing advanced technological solutions, demonstrating innovative prowess, and forging partnerships with customers - alongside their established strategic advantages - could equip enterprises with capabilities to effectively address sustainability challenges. These capabilities are also relevant in establishing robust quality management practices that extend beyond a mere management system.

The results additionally confirm that the association between joint green IT practices and quality management practices and logistics performance is completely mediated by logistics customer service performance and environmental management. Despite the apparent simplicity and clarity of this discovery upon initial examination, it harbours significant implications that hold value for both practitioners and managers. Merely implementing joint management practices such as JGITQM does not guarantee enhanced performance. Instead, an organization must convert this integration into a capacity by achieving elevated levels of logistics customer service performance and environmental management. This critical element signifies the organization's aptitude to cultivate a unique competence, which can be accomplished by taking into account specific factors pertinent to the organization.

5. Conclusions

This research endeavour has undertaken a contribution to enhancing comprehension regarding the determinants that shape the decision-making process for integrating diverse management practices with technological support. In pursuit of this objective, a conceptual model has been formulated, primarily grounded in the fundamental principles of the resource-based view theory. It is crucial to recognize that joint management practices have a pivotal role in fostering the development of organizational capabilities aimed at achieving a sustainable competitive advantage. Consequently, implementing integrated management practices is predominantly centred around acquiring capabilities essential for fostering strategic orientation. In light of this, the study explores the effects of integrated management practices, specifically green Information Technology practices and quality management practices, on logistics performance.

The study yields a multitude of managerial implications that arise from the obtained results. Primarily, by highlighting the optimal utilization of particular organizational capabilities to effectively integrate green IT practices and quality management practices, enterprises can achieve favourable outcomes by concurrently attaining high levels of logistics customer service performance and environmental management. Furthermore, upon analyzing the effects of logistics customer service performance and environmental management on the overall logistics

performance, it becomes evident from the findings that distinct capacities can be employed for varying objectives. In accordance with the literature findings discussed earlier, the adoption of state-of-the-art technological solutions, showcasing innovation capabilities, and fostering collaborations with customers - in addition to their recognized strategic benefits - can endow enterprises with the necessary capacities to effectively tackle sustainability challenges. Furthermore, these capabilities hold relevance in establishing resilient quality management practices that surpass the boundaries of a mere management system. It is noteworthy that the interrelationships among joint green IT and quality management practices, logistics performance, logistics customer service performance and environmental management are seemingly more intricate and multifaceted than initially envisioned. The principal managerial implication derived from this study pertains to the necessity of acknowledging intricate interconnections and relationships (such as cumulative impacts or synergies) among management capabilities concerning management practices and the expectations of external stakeholders. Therefore, based on the research findings, it is advised that executives actively explore potential avenues to cultivate and enhance their logistics customer service performance and environmental management with the aim of fostering their overall logistics performance.

Nevertheless, it is important to acknowledge certain limitations when interpreting the results. Firstly, this study has solely investigated the associations between joint green IT and quality management practices and logistics performance within the context of a single emerging country and one branch. Therefore, caution must be exercised in generalizing the findings, as they should be regarded as inquiring in nature. Moreover, relying on perceptual data obtained solely from managers may introduce biases, including measurement errors. Mitigating these biases can be achieved by collecting data from multiple respondents, thereby enhancing the validity and reducing the impact of such limitations. To obtain a comprehensive perspective, future research endeavours could also expand upon the current study by incorporating additional management practices into the integration framework.

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