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Drivers of Green Practices Adoption in Large Moroccan Enterprises: A TOE Framework Approach Using PLS-SEM

Les déterminants de l'adoption des pratiques vertes au sein des grandes entreprises marocaines : Analyse TOE par PLS-SEM

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Abstract

This research examines the factors influencing the adoption of green logistics practices and their impact on the environmental performance of publicly listed companies in Morocco. Despite a growing awareness among businesses of the importance of sustainable practices, their adoption remains constrained by various organizational and environmental barriers. This study employs a mixed-methods approach, combining a qualitative analysis through in-depth case studies and a quantitative analysis using the PLS-SEM method. The sample includes 98 companies that responded to the survey, out of 120 solicited. The results highlight those external pressures, particularly government regulations, customer expectations, and competitive dynamics, serve as key drivers of green logistics adoption. Furthermore, organizational resources (human, financial, and technical) and stakeholder support play a crucial role in facilitating this transition. The study also confirms a significant positive impact of green logistics practices on environmental performance, reinforcing the strategic relevance of sustainability in logistics for businesses.

Keywords: Green logistics; Environmental performance;Adoption dynamics;TOE model;PLS-SEM method.

Résumé

Cette recherche examine les facteurs influençant l'adoption de pratiques logistiques vertes et leur impact sur la performance environnementale des entreprises cotées en bourse au Maroc. Malgré une prise de conscience croissante de l'importance des pratiques durables au sein des entreprises, leur adoption reste freinée par divers obstacles organisationnels et environnementaux. Cette étude utilise une approche mixte, combinant une analyse qualitative à travers des études de cas approfondies et une analyse quantitative par la méthode PLS-SEM. L'échantillon comprend 98 entreprises ayant répondu à l'enquête, sur les 120 sollicitées. Les résultats mettent en évidence que les pressions externes, notamment la réglementation gouvernementale, les attentes des clients et la dynamique concurrentielle, constituent des moteurs essentiels de l'adoption de la logistique verte. Par ailleurs, les ressources organisationnelles (humaines, financières et techniques) et le soutien des parties prenantes jouent un rôle crucial pour faciliter cette transition. L'étude confirme également un impact positif significatif des pratiques logistiques vertes sur la performance environnementale, renforçant ainsi la pertinence stratégique du développement durable en logistique pour les entreprises.

Mots-clés: Logistique verte ; Performance environnementale ; Dynamique d'adoption ; Modèle TOE ; Méthode PLS-SEM.

INTRODUCTION

Environmental sustainability has become a strategic and operational necessity for companies around the world. This problem stems from a growing awareness of the ecological and social impacts of economic activities, reinforced by the proliferation of environmental regulations, changing societal expectations, and global market pressures. (Delmas and Tofel, 2008; Porter and Lind, 1995). In this regard, organizations aim to incorporate green practices such as emission reduction, sustainable resource management, and energy optimization into their activities to meet current standards while achieving sustainable competitive advantage (Hart, 1995; Sharma & Henriques, 2005).

These practices are no longer based solely on ethical or compliance considerations. They are considered strategic tools to improve overall business performance, enter new markets, attract more environmentally friendly consumers, and mitigate regulatory risks (Miroshnychenko et al., 2017). Adopting environmentally friendly practices is therefore a positive response to pressure from companies, firms and enterprises, and a way to differentiate between increasingly demanding markets.

These policies reflect the government's strong commitment to coordinating economic development with the protection of natural resources. Moroccan companies play an important role in this respect: These are the objectives of the public environment transformation policy and the catalysts of change for other economic operators.

However, despite the favorable environment, the adoption of environmental practices by large Moroccan companies remains uneven and subject to a number of contextual constraints: Regional disparities, limited access to green technologies, complex standards and a lack of expertise. In addition, in a globalized environment, these companies must align their sustainability requirements with those of economic competitiveness, which are characterized by increasingly stringent market requirements for environmental performance. Especially in Europe. Due to this complexity, the developed model TOE (technology-organization-environment) (Tornatzky et al., 1990) provides an appropriate theoretical framework for the analysis of determinants of green practice adoption. The model is convinced that innovation, in this case sustainability practices, is affected by three main dimensions:

The technical dimension, including elements of compatibility, perceived complexity and comparative advantage of practice;

Organisational dimensions, size and quality of internal resources, culture and human capital;

The environmental dimension, including competition and regulatory pressures and stakeholder expectations.

This dynamic is particularly important for developing countries, especially Morocco. Over the past decade, the Kingdom has launched a series of ambitious sustainable development initiatives, including "Morocco Agricultural Transformation Plan" (2008, a national sustainable development strategy, and commitments made at the 2016 Conference of the Parties (COP22). In Marrakech. This policy reflects the Government's strong commitment to balancing economic development with the protection of natural resources. Large Moroccan companies play a role in this.

Using this framework allows us to better understand the diversity of observed adoption behaviors and identify the business drivers for enhancing corporate environmental commitment. Furthermore, numerous studies have shown that incorporating sustainable practices can have a significant impact on environmental performance, particularly through emissions reductions and improved energy efficiency and waste management (Montabon et al., 2007; Q. Zhu et al., 2005). Therefore, it is essential to assess not only the adoption factors, but also the tangible impacts of these practices on the environmental performance of Moroccan companies.

With this in mind, this research aims to explore the determinants of green practice adoption in large Moroccan companies using a mixed methodologies approach. The first qualitative phase relies on case studies conducted with leading companies in various sectors, allowing us to identify drivers, barriers, and perceptions related to sustainability. The second phase, which is quantitative in nature, uses structural equation analysis (PLS-SEM) on a sample of listed companies to empirically test the relationships between the TOE model dimensions and environmental performance.

In detail theorical applications, an empirical investigation, and practical developments, this ambitious project of contributing to a better comparison of durable dynamics in the Moroccan context, will explore in the international literature. It is necessary to formulate concretization recommendations for so-called enterprises to enable their environmental engagement, as well as for public decision-makers to increase policies to accommodate more efficacies.

1. LITERATURE REVIEW

1.1. Green logistics

In the literature, the definition and scope of GSCM ranges from green procurement to integrated green distribution from supplier to customer to supplier to customer.

The literature contains many definitions of green supply chain management. These definitions range from green procurement to closed-loop integrated global supply chains. Wu and Dunn stated that green logistics is not just reverse logistics that seeks to save resources, eliminate waste and minimize the logistics footprint (Wu & Dunn, 1995).

(Srivastava, 2007) defines green supply chain management as the integration of environmental awareness into supply chain management, including the product design phase, material extraction and selection, manufacturing processes, and delivery of the final product to the customer. As well as managing the lifecycle of the final product.

For (Rodrigue et al., 2013), green logistics can be presented as an efficient distribution and transportation system.

(P. R. Murphy et al., 1995) who argue that green logistics impacts logistics systems in thirteen areas: transportation, warehousing, materials handling, packaging, inventory control, order processing, purchasing, demand forecasting, building layout, customer service, production planning, waste recovery and disposal, product returns handling and logistics.(Cosimato & Troisi, 2015).

(Klassen & Johnson, 2004) notes that there are five methods of green supply chain management, Environmental Certification, Pollution Prevention, Reverse Logistics, Life Cycle Analysis and Ecological Design.

Green logistics, as a concept, became a major concern in the late 1980s and early 1990s, when companies began to recognize the importance of the environment in their operations. However, it is difficult to pinpoint the "first" definition of the term, as environmental awareness in logistics developed gradually and several authors contributed to the concept at roughly the same time.

That said, one of the earliest notable works to address the environmental implications of logistics is Murphy's (P. R. Murphy et al., 1995).

As mentioned earlier:(Srivastava, 2007) They define environmental (or green) logistics as "the series of actions taken to make logistics functions or the entire supply and distribution process more environmentally friendly."

1.2. Factors influencing green logistics adoption

(Cooper, 1991)examines how innovations in logistics, such as centralized inventory and 24-hour transport operations, can reduce the environmental impact of transport. The author emphasizes the importance of these innovations in responding to market trends and public

demands for greener freight transport. The study highlights the potential of new logistics approaches to improve both efficiency and sustainability in the transport sector.

(D'souza et al., 1993) analyze individual factors influencing the adoption of sustainable agricultural practices from a survey of West Virginia growers in 1990. They find that human capital characteristics play a significant role, in contrast to structural and institutional characteristics. In particular, awareness of groundwater contamination on their farms had a marked effect on the likelihood of adopting these practices. This highlights a crucial "awareness effect" that can guide policies to promote sustainable agriculture, and suggests a derived demand for sustainable agriculture.

(Rao & Young, 1994) explore the attitudes of shippers and service providers towards the outsourcing of logistics functions within large multinational manufacturing companies. They present a model describing the factors influencing outsourcing decisions, identifying five key factors: the centrality of logistics functions to the company's core competence; risk, responsibility and control ; cost/service trade-offs in operations; information and communication systems; and market relationships. The study highlights the complexities of global supply chains and the strategic considerations behind decisions to outsource logistics functions.

(Germain, 1996) examines how organizational context and structure influence the adoption of logistics innovations, whether radical or incremental. Based on an analysis of manufacturers, the study reveals that company size and environmental uncertainty directly predict the adoption of costly, radical innovations, but not the adoption of low-cost, incremental innovations.

(Florida, 1996) presents the results of a national survey on environmentally friendly manufacturing practices. The article explores how efforts to improve manufacturing processes and increase productivity offer significant opportunities for environmental improvement. Florida argues that the adoption of advanced manufacturing process innovations creates incentives to adopt environmentally friendly manufacturing strategies. It highlights the crucial role of close relationships within the production chain, particularly between end-users and suppliers, in facilitating the adoption of this group of linked industrial and environmental innovations. Companies and plants that invest in R&D and manufacturing innovation have the capacity to improve productivity while reducing costs and environmental risks.

(Premkumar et al., 1997) study the impact of environmental, organizational and technological factors on the adoption of Electronic Data Interchange (EDI) in the transport industry. They develop a research model based on surveys of 950 trucking companies, revealing that company

size, competitive pressure, customer support and top management support are key factors positively influencing EDI adoption.

(Richards & Gladwin, 1999) argue that sustainable development goes beyond mere economic and environmental objectives to include social considerations, forming a "triple bottom line". They describe an evolution towards sustainable development that began over 30 years ago, culminating in the greening of industrial practices. They also present problem-solving techniques developed to achieve both economic and environmental objectives, as well as metrics for measuring environmental performance, underlining the importance of developing new metrics in the context of sustainable development).

(Montiel, 2008) the authors develop a processual model of corporate greening, identifying key dimensions such as political commitment and implementation approach. They emphasize the need for a proactive approach to greening beyond reverse logistics, proposing a typological model to diversify corporate greening strategies. Meanwhile, (Foster & Green, 2000) explores how environmental issues are changing the framework for innovation in UK companies, suggesting that suppliers need to actively integrate green issues to accelerate the development of greener products and services.

Furthermore, (Noci, 1997) discusses the management of green product innovation in small companies, highlighting that despite regulatory and social challenges, green innovations can have significant strategic implications even for SMEs. They propose a framework to help these companies analyze the drivers of green innovation and choose appropriate R&D strategies. Furthermore, (Beard & Rees, 2000) examine the effectiveness of environmental teams in managing change towards sustainability within the Kent Committee Board, revealing how the involvement and motivation of green teams can lead to significant cultural change within large organizations.

In a similar vein, (Beard & Rees, 2000), highlights the effectiveness of environmental teams in managing change towards sustainability within Kent County Council. The authors describe how collective effort and participation can lead to significant cultural change within organizations, while acknowledging the challenges of slow change and organizational resistance.

These studies, covering the early years of the 21st century, show a growing commitment to sustainable development across diverse sectors, highlighting the interactions between policy, education, and business practices in the context of greening. Together, they form a body of research that highlights the complexity and richness of approaches to greener, more responsible management of human activities.

Since 2000, a number of studies have examined green practices and their adoption across various sectors, highlighting the growing importance of sustainability in corporate strategies.

In 2017, (Miroshnychenko et al., 2017) explored the impact of green practices on financial performance, in Their research revealed that internal practices such as pollution prevention and green supply chain management are significant drivers of financial performance, while external practices such as green product development play a secondary role. The authors analyzed data from 3,490 listed companies in 58 countries over a 13-year period, focusing on indices such as pollution prevention, green supply chain management, green product development and ISO 14001 adoption. The results of the study reveal that internal ecological practices, such as pollution prevention and green supply chain management, are the main ecological drivers of financial performance. In contrast, external green practices such as green product development play a secondary role in determining financial performance. Surprisingly, the adoption of ISO 14001 seems to have a negative impact on financial performance.

In 2013, (Lin, 2013) analyzed the factors influencing the adoption of green practices in the Chinese logistics industry, discovering that factors such as regulatory pressure and government support play a significant role. The study highlighted the specific dynamics of the logistics industry in an Asian context.

They identified several determining factors that can be grouped into three main dimensions : technological, organizational and environmental. Among them, the relative advantage and compatibility of green practices, as well as organizational support, the quality of human resources, regulatory pressure and government support, showed a significant positive influence on the adoption of green practices. Conversely, environmental uncertainty and the complexity of green practices had significant negative influences on adoption. Curiously, customer pressure did not appear to have a significant influence on the adoption of green practices by Chinese logistics companies.

These studies, spanning almost two decades, reflect a growing awareness and integration of environmental concerns into business strategies worldwide, illustrating a sustained academic and practical interest in green practices and their effectiveness.

In 2012, (Lai & Wong, 2012) explored green logistics management (GLM) and its impact on the environmental and operational performance of Chinese manufacturing exporters, highlighting the components of GLM and the institutional and operational antecedents that support its adoption. The authors identify four main components of GLM: procedure-based

practices, assessment-based practices, partner-based practices and general environmental management practices.

Their analysis shows that, contrary to popular belief, economic motivations are not a significant determinant of GLM adoption. However, the study reveals that GLM has a positive effect on both the environmental and operational performance of companies. Furthermore, the authors find that environmental regulatory pressure strengthens the relationship between GLM and performance, underlining the importance of the regulatory context in encouraging companies to adopt green logistics practices.Then, in 2017, (Centobelli et al., 2020) developed an innovative taxonomy of green initiatives and studied their diffusion among logistics service providers, using web-based literature review to trace trends in the adoption of these practices.

In 2019, (Chu et al., 2019) examined the influence of customer pressure on green innovation among third-party logistics providers in China, highlighting the moderating role of organizational culture in this relationship.

In 2020, (Ovwigho, s. d.) examined the factors influencing the adoption and infusion of green practices in manufacturing firms in Ogun State, Nigeria. The results reveal that two technological factors, adoption cost and complexity, as well as relative advantage and compatibility, influence the adoption of green practices. Five organizational factors, including regulatory support, organizational support, quality of human resources, environmental factors and customer pressure, also affect the adoption of green practices. The authors conclude that, despite these influences, certain factors such as complexity and customer pressure have no independent significant prediction on the infusion of green practices in companies.

The study by (Satchapappichit et al., 2020) in 2020 analyzes hotel owner-managers' perceptions of the adoption of green practices in southern Thailand. Factors studied include owner-manager attitudes, environmental awareness, perceived benefits, green consumers and competition. It was found that owner-manager attitudes, environmental awareness and competition significantly influenced the adoption of green practices. However, the effect of perceived benefits and green consumers was not significant. This study offers practical implications for encouraging small and medium-sized hotels to adopt more green practices.

(Mohd Shahir et al., 2023) the identification of factors that may influence Politeknik Port Dickson employees to adopt green practices, using Technological, Organizational and Environmental (T-O-E) theory. The study examined the mediating roles of the benefits of green practices between technological (compatibility and complexity), organizational (management support) and environmental (government support and environmental uncertainty) factors. The

results show that the benefits of green practices positively influence the adoption of these practices. In particular, compatibility has a positive impact, while complexity has a negative impact.

Recent studies highlight the crucial importance of management strategies, green entrepreneurial orientation, and employee involvement in the adoption of green practices, each offering valuable insights into different sectors and geographical contexts. Research by (Mustaffa et al., 2023) highlights the significant influence of knowledge management strategies, knowledge creation, acquisition, sharing and application on green innovation practices in the corporate sector.green innovation practices in the Malaysian public sector, demonstrating that knowledge sharing is essential for strengthening environmental innovation.

On the other hand, (Mohd Shahir et al., 2023) analyze how green entrepreneurial orientation influences green innovations and sustainable performance of SMEs in Malaysia, concluding that green innovations significantly affect economic and environmental performance, suggesting that entrepreneurial orientation towards environmental issues is crucial for sustainability. Finally,(Al-Sabi et al., 2023) examine how green management practices impact the sustainable performance of small and medium-sized enterprises in the hospitality sector, highlighting the moderating role of employees' pro-environmental behaviors, and emphasize the importance of employee involvement in green initiatives to improve overall sustainability.

1.3. TOE Model

Since its formulation by (Tornatzky et al., 1990), the Technology-Organization-Environment (TOE) model has served as the foundation for much research into technology adoption within organizations. Their article introduces the Technology-Organization-Environment (TOE) model, which identifies three main areas of influence on the technology adoption process : technological context, organizational context and Environmental context.

Technological context: This includes the company's internal technologies, technologies available on the market, and their maturity, accessibility and compatibility with the organization's existing systems.

Organizational context: This encompasses internal company characteristics, such as organizational size, governance structure, availability of resources (human, financial and material), and organizational culture, all of which can influence technology adoption decisions.

Environmental context: This aspect examines external influences such as regulation, competitive pressure, market dynamics, and other macroeconomic or sectoral factors that may affect the company's technology adoption decisions.

These findings indicate the usefulness of the proposed research model and theoretical framework for studying the value of e-business, and offer insights for both business managers and policy makers.

More recently, in 2013, (Ramdani et al., 2013) explored its application in the SME context, demonstrating the model's relevance to understanding the factors influencing the adoption of enterprise applications. They explore the factors influencing the adoption of enterprise applications by small and medium-sized enterprises (SMEs) through the framework of the m

1.3.1. Relative advantage and the adoption of green practices

Relative advantage captures the extent to which a future adopter views an innovation as offering an advantage over previous ways of accomplishing the same task. Perceived benefits can be measured in economic or social terms such as performance, satisfaction, reputation and convenience (Rogers et al., 2019)(E. M. Rogers, Singhal, and Quinlan 2019)

Traditionally, the relationship between the economy and the environment has been viewed in terms of a strict trade-off. However, a growing body of empirical research suggests that adopting a green supply chain enables companies to overcome the need for "either/or" decisions (González 2005; Robinson and Stubberud 2013).

1.3.2. Complexity and the adoption of green practices

Complexity is the degree to which an innovation is perceived as relatively difficult to understand and use (E. M. Rogers, Singhal, and Quinlan 2019).(Liu et al. 2010) defined complexity as "whether the innovation could be easily assimilated or not." Studies on green supply chains have reported that reducing complexity related to the adoption of green practices influences companies' adoption intentions(Völlink, Dehue, and McGuckin 2016; Chou, Chen, and Wang 2012).

1.3.3. Compatibility and adoption of green practices

Compatibility is the degree to which an innovation is perceived as consistent with existing values, past experience and the needs of potential adopters (E. M. Rogers, Singhal, and Quinlan 2019). (Liu et al. 2010) have argued that innovation spreads more freely and easily where it appears to match the adopter's existing processes. ("The DeLone and McLean Model of Information Systems Success: A Ten-Year Update" 2003) have suggested that a system's compatibility must be taken into account before the system is implemented in an organization.

At this stage, we can elaborate our first research hypotheses related to technological factors:

H1: Perceived relative advantage is positively correlated with the adoption of green practices by companies.

H2: Perceived complexity is positively correlated with the adoption of green practices in organizations.

H3: The compatibility of green practices with existing values and processes is positively associated with their adoption.

1.3.4. Gouvernement pressure

Coercive pressure, such as threats or legal sanctions, can force companies to adopt specific behaviors. In the environmental context, the role of government pressure is so strong that threats of new environmental regulations or explicit government support for sustainable practices are significant incentives for companies to participate in sustainability initiatives. These official mechanisms take the form of standards, laws, procedures and incentives put in place by regulatory institutions to encourage companies to adopt environmentally-friendly practices.

(Porter and Linde 1995a) have argued that companies adopt green practices as a means of responding to increasingly stringent and global environmental regulation. According to their research, companies are responding creatively, and sometimes re-evaluating their entire operational approach, in order to meet government regulations in a cost-effective manner. These creative responses can lead companies to integrate green practices into planning and manufacturing processes, and to demand that their upstream and downstream partners adopt similar measures.

1.3.5. Clients pression

Institutional theory suggests that normative pressures drive companies to seek legitimacy and reliability (Sarkis, Zhu, and Lai 2011). These pressures come from external stakeholders, including customers who have a vested interest in the company (Vachon and Klassen 2008a). Unlike isolated green initiatives, the green supply chain requires the collaboration of customers. To manage uncertainty, companies adopting green supply chains establish inter-organizational links fostering long-term, mutually beneficial relationships with their customers. A growing body of research shows that consumer pressures are forcing companies to adopt green practices (Hsu and Hu, n.d.; Wolf and Seuring 2010; Nawrocka 2008). The closest links between companies and their customers are often seen in the manufacturing sector, where tighter relationships facilitate cleaner production and are necessary to integrate management strategies such as JIT (just-in-time), continuous improvement and total quality management (Florida 1996). To meet environmental challenges in a cost-effective and sustainable way, a company and its customers can establish partnerships to find solutions to current problems and seek innovations for future benefits(Geffen and Rothenberg 2000).

1.3.6. Pressure from competitors

According to institutional theory, companies seek to acquire prestige by imitating those they consider successful (Perrow, n. d.). This phenomenon, known as mimetic isomorphism, occurs among all competing companies within an industry. Companies may follow or imitate their competitors simply because of the latter's success in operations and production. The logic behind this imitation is simple: by replicating the actions of successful competitors, companies strive for equivalent success (Qinghua Zhu and Sarkis 2007). Some studies have shown that competitive factors play an important role in determining companies' responses to environmental problems (Kagan, Gunningham, and Thornton, n. d.). Companies that observe the environmental success of their competitors often begin to address these issues as well.

1.3.7. The Community

Within the framework of institutional theory, cultural-cognitive isomorphism occurs as a result of a company's rational desire to adopt behaviors it considers valuable. A company may feel a voluntary obligation to society, based on social expectations, norms and codes of conduct (M. T. Jones, n. d.). A company's social community includes environmental organizations, community groups and other special interest groups. In the past, companies were less likely to be influenced by the social community, which they either regarded as an inconvenience or ignored (Henriques and Sadorsky 1996b). However, as public concern about environmental sustainability has grown, companies can no longer ignore the social community, which can directly or indirectly influence their environmental strategies by mobilizing public sentiment in favor of or against corporate environmental approaches (Benn, Dunphy, and Martin 2009). Research has shown that social responsibility plays a significant role in encouraging companies to adopt environmentally-friendly practices (Pavlovich and Akoorie 2010; Guoyou et al. 2013). Companies often adopt these practices as a means of establishing a socially acceptable image, consistent with the obligations and values of the society in which they operate.

At this point in our analysis, we are in a position to formulate the research hypotheses concerning technological factors:

H4: Competitive pressure exerts a significant influence on the integration of environmental considerations in decisions to adopt green practices.

H5: Customer pressure plays a decisive role in integrating environmental factors into decisions to adopt green practices.

H6: The influence of government regulations and public policies has a significant impact on decisions to adopt green practices.

1.3.8. Internal stakeholders

According to stakeholder theory (R. E. E. Freeman and McVea 2001), internal stakeholders can be divided into individuals or groups influencing a company's decisions. Internal stakeholders include managers, shareholders and employees. In general, they play a crucial role in the company's environmental policy, and participate extensively in research into environmental issues (Etzion 2007b; Buysse and Verbeke 2003).

Much research demonstrates the positive relationship between a company's internal stakeholders and its environmental activities (S. Lee 2008a; Guoyou et al. 2013). In a study on the adoption of green initiatives, (Yunus et al. 2013) concluded that management support is the main factor for the successful adoption of green practices. Many green practices require the collaboration and coordination of different departments and divisions during the adoption process (Gröschl 2005). To ensure successful adoption, green initiatives are usually approved and encouraged by managers. Managers' main task is to acquire resources and allocate them efficiently so that the company can achieve its environmental objectives (González 2005). In addition, the support of managers can help an organization overcome prejudices, stereotypes and feelings about the environment.

1.3.9. Organizational resources

Organizational resources represent the capabilities an organization holds to respond to future needs or dynamic changes. These resources are linked to the organization's overall infrastructure and its ability to support innovation (Ensminger et al. 2004). In the context of green supply chains, resources dedicated to environmental sustainability are essential, as the entire chain requires specialized types of expertise and capabilities. From an organizational operations point of view, a company's ability to absorb the immediate costs of adopting a green supply chain depends not only on the absolute incremental costs involved, but also on the relative costs, including the cost of the time required to research environmental issues, consult internal and external sources of expertise, and develop options for addressing the problem. Because of the complex technical and legal ramifications of many environmental problems, the expenditure of time and money can be considerable. Among other things, environmental resources include the size of the workforce and sales, R&D spending, and the size of the companies of which they are a part (C.-Y. Lin and Ho 2011b). These resources provide the integrated capacity that enables companies to respond to external stimuli and implement environmental innovations.

1.3.10. The quality of human resources

Human resources play a pivotal role in the adoption of green practices within companies. According to (Renwick, Redman, and Maguire 2013), employee commitment to green initiatives is essential to the success of these practices. These authors point out that employee awareness and training in environmental issues are determining factors that encourage active and sustained participation in green projects. Similarly, (Jabbour and Santos 2008) assert that green human resources management, which integrates sustainability-focused recruitment, retention and development policies, reinforces the adoption of environmental practices by aligning employees' goals with the company's ecological objectives. The study by (Dües, Tan, and Lim 2013) adds that sustainability leadership, demonstrated by visible commitment from top management, is crucial to cultivating a corporate culture that values and prioritizes green actions. In short, human resources, through their ability to influence and implement environmental strategies, are a central pillar for the successful integration of green practices into daily corporate operations.

Based on these theoretical considerations and previous work, we make the following assumptions for our research:

H7: internal stakeholders significantly impact organizational factors in green practice adoption decisions.

H8: organizational resources significantly influence organizational factors in green practice adoption decisions.

H9: the quality of human resources significantly affects organizational factors in decisions to adopt green practices.

2. METHODOLOGY

In view of the results of the literature review and the limited number of recent works specifically focusing on the adoption of green logistics practices in Morocco, this research is justified first by its exploratory nature, allowing to draw an initial portrait of this phenomenon. This exploratory approach is essential for an initial understanding of the factors determining the adoption of green logistics, particularly in a context where few studies have explicitly analyzed these factors. The adoption of the adjusted positivism paradigm, which combines methodological rigor and recognition of the inherent limits to all research, is particularly relevant in this context.

The theories chosen to frame this study, notably stakeholder theory and resource theory, provide a useful conceptual framework, but they do not offer precise methods for dynamically

measuring the interactions between the different concepts. In addition, the literature review revealed several grey areas requiring further investigation, particularly regarding the impact of adopting green logistics practices on companies' environmental performance.

However, sticking to a purely exploratory approach has limitations, including the subjectivity of qualitative interpretations and the difficulty in generalizing the results due to the small sample size (D. Carson et al., 2001).

To overcome these limitations, it is wise to follow Carson's recommendation by combining exploratory and confirmatory research in a two-phase approach. This choice involves a triangulation of qualitative and quantitative methods, allowing cross-validation of results and improvement of the research robustness. This triangulation should not be seen as a simple validation of the results, but rather as a cross-observation that enlightens the research questions in a complementary way and strengthens the credibility of the conclusions

2.1. Sampling

The data collection will be based on a reasoned sampling to ensure adequate representativeness of large companies in Morocco that adopt green logistics practices.

The sample will consist of large companies in Morocco. By doing so, we ensure that the sample reflects the diversity of large companies active in the Moroccan market, while remaining focused on green logistics practices specific to this market segment.

The sample size will be determined based on statistical requirements for advanced analytical methods, such as structural equations (SEM) or partial least squares (PLS). Adequate sample size is essential to obtain reliable and generalizable results, and to test causal relationships with robustness while ensuring the statistical power of analyses (Hair, Ringle, and Sarstedt 2011).

2.2. Data collection

Primary data will be collected through a structured questionnaire, developed specifically for this study to assess green logistics practices and their impact on environmental performance. The questionnaire will be sent to the logistics managers within the selected companies. The questions will be formulated in such a way as to obtain detailed information on the practices implemented, the challenges encountered and the results obtained.

The use of Likert scales will measure perceptions and intensity of practices in a nuanced way, thus offering a detailed view of practices and their impact (Dillman, Smyth, and Christian 2014). Questionnaires will be pre-tested to ensure clarity and relevance before dissemination to the target sample.

In addition, secondary data will be collected from annual company reports, financial databases, and sector publications. These sources will provide additional information on environmental performance and environmental indicators of companies, such as CO2 emissions, energy consumption and waste reduction initiatives. Secondary data will triangulate the information obtained through questionnaires and verify their consistency with quantitative data available in financial and environmental reports (Saunders, Lewis, and Thornhill 2019). Triangulation of sources will strengthen the validity of results and provide a more complete view of green logistics practices and their impacts.

2.3. Data analysis

After data collection, a cleaning phase will be essential to ensure the quality and accuracy of the data. Data will be examined for errors, outliers and missing data. Outliers will be identified and addressed to avoid disproportionately influencing the analysis results (Little and Rubin 2020). Missing data will be addressed through techniques such as multiple imputation or exclusion, depending on the volume and nature of the missing data.

Data encoding will be done using 'Jamovi'statistical software. The questionnaire responses will be systematically coded to facilitate quantitative analysis. The data will then be entered into the software and prepared for statistical analysis. Processing data will also include normalization of variables if necessary, in order to ensure the comparability of the results (Hair, Ringle, and Sarstedt 2011). This careful preparation of data is crucial for ensuring the integrity of analyses and the robustness of study conclusions.

2.4. The Measurement Model

The validation of the relationships between indicators and their latent variables will be carried out using PLS analysis to verify measurement quality and convergent validity

2.4.1. Development of the Items

Write questions or items that accurately measure the dimensions of latent variables. The items must be clear, relevant and able to capture the different aspects of each construct (Dillman, Smyth, and Christian 2014).

2.4.2. Convergent Validity

Convergent validity assesses whether the items in a given construct are strongly correlated with each other, indicating that they measure the underlying concept well. (Fornell and Larcker 1981) recommend examining the factor load of the items on their latent variables to evaluate this validity. Factor loads greater than 0.70 are generally considered good, indicating that the items effectively capture the latent concept (Hair, Ringle, and Sarstedt 2011).

2.4.3. Discriminant Validity

The discriminant validity checks if latent variables are distinct from each other. It is measured by comparing the variance shared between the latent variables with the total variance of each variable (Fornell and Larcker 1981). The discriminant validity is satisfactory if the square root of the extracted mean variance (AVE) of a construct is greater than the correlations between that construct and the others constructed (Fornell and Larcker 1981).

2.4.4. Composite Reliability

Composite reliability assesses the internal consistency of indicators in a construct. It is considered a more robust alternative to Cronbach's alpha, especially in the context of multi-factor models (Hair, Ringle, and Sarstedt 2011).

Composite reliability greater than 0.70 is considered acceptable, indicating that the construct items reliably measure latent concept (Bagozzi and Yi 1988).

2.4.5. Factor Load

Checks that the factor charges of items on their latent variables are high and significant. High factor loads suggest that the items effectively measure latent construct (Hair, Ringle, and Sarstedt 2011).

2.5. The structural model

The structural model, central component of analyses by structural equations (SEM) or the Partial Least Squares (PLS) method, allows testing the hypothetical relationships between latent variables. Once the measurement model is validated, the structural model examines the causal relationships between the different constructs. The associated methodology has several steps, each of which plays a crucial role in interpreting the results.

The first step is to specify the hypothetical relationships between latent variables. These relationships are often based on theories or previous research. (Hair, Ringle, and Sarstedt 2011). The specification of the structural model guides the research hypotheses. The quality of this specification determines the relevance of the conclusions drawn from the analysis.

The model must then be identified to allow parameter estimation. In SEM, this involves ensuring that there is enough information to estimate all the specified relationships. In PLS, this step is more flexible, as the method does not rely on strict assumptions regarding the distribution of data (Hair, Ringle, and Sarstedt 2011). The estimation of the structural model is done through the evaluation of regression coefficients that connect the latent variables to each other. In the PLS framework, iterative algorithms are used to maximize the explained variance of dependent variables.

Regression coefficients are interpreted as the weights of relationships between variables. A high and significant coefficient indicates a strong relationship between the latent variables, which supports the research hypothesis. For example, if the coefficient between green logistics practices and environmental performance is high and significant, this would confirm the expected positive impact.

2.5.1. Evaluation of the structural model

The evaluation of the structural model is based on several criteria. In SEM, global adjustment indices such as the Chi-square or the Comparative Fit Index (CFI) are used. These indices make it possible to verify if the structural model corresponds well to the observed data (Hu and Bentler 1999). In PLS, we focus more on the R2 values of dependent variables, which indicate the proportion of variance explained by independent variables (Hair, Ringle, and Sarstedt 2011).

A high R2 in PLS signals that the structural model explains a substantial proportion of the variance of dependent variables.

2.5.2. Testing of hypotheses

Once the model is evaluated, the research hypotheses can be tested. Each relationship between latent variables corresponds to a hypothesis, and statistical tests determine whether these relationships are significant (Kline 2015). In SEM, this involves checking the p-values associated with the regression coefficients. In PLS, emphasis is placed on path coefficients and confidence intervals to test the meaning of relationships.

• P-value < 0.05 in SEM suggests that the research hypothesis is supported by the data, confirming a significant relationship between variables.

•Significant path coefficients in PLS also indicate the hypothetical relations are valid. For example, a significant path coefficient between green logistics practices and environmental performance would reinforce the conclusion that the adoption of these practices positively influences the environmental outcomes of companies

3. RESULTS

3.1. Descriptive statistics analysis

The survey targeted managers from 120 Moroccan companies. The questionnaire, divided into several sections, was distributed between November 2023 and May 2024. The companies were selected based on HCP publications. Of the 120 companies contacted, 97 provided complete responses, representing a response rate of 80%. The interviews involved 97 managers, including 65 men and 32 women, with varied profiles, educational backgrounds, and ages.

The gender distribution is as follows: 32 female respondents, representing approximately 32.99% of the total sample, and 65 male respondents, representing approximately 67.01% of the total sample. This table highlights a majority of men compared to women in our sample.

Out of a total sample of 97 companies, 65 are publicly traded, representing approximately 67% of the sample. The remaining 32 companies, or approximately 33%, are not publicly traded. This distinction is crucial to understanding the potential influences of public trading on the strategies and performance of the companies studied.

3.2. Validation of the measurement model:

3.2.1. Item reliability

Assessing item reliability is a crucial step in the process of validating measurement instruments in research, particularly in structural equation modeling (SEM). Reliability refers to the ability of items to produce consistent and reproducible results when measuring a latent construct. In other words, a reliable measurement instrument provides stable scores across different measurement occasions, different forms of the instrument, or different sets of participants.

Table 2: Cronbach alpha

Item	Cronbach alpha
AR	0.809
CCR	0.971
CLT	0.966
COMP	0.831
RF	0.752
CPLX	0.889
GREG	0.884
PERF	0.960
PPI	0.982
PV	0.914
RH	0.701

Source : SMARTPLS4

The Cronbach's alpha results for the 12 variables (Table2) indicate overall satisfactory internal consistency for all variables. Indeed, the majority of variables have values above the acceptable threshold of 0.70, suggesting good measurement reliability. More specifically, the values range from 0.701 to 0.982, with some variables reaching very high levels, such as competitor pressure, accounting, government pressure, internal stakeholder pressure, green practices, and regulatory pressure, which exceed 0.95. These high scores indicate excellent internal consistency, meaning that the items that make up these variables effectively measure the same latent construct. Even the lowest values, such as those for variables such as relative advantage with a value of 0.809,

complexity, and human resource quality (0.701), remain within an acceptable range, showing that the items in these variables are also reliable.

3.2.2. Outer loadings

Loadings represent the correlation between each indicator and the latent construct to which it is linked. High values, generally above 0.6, indicate that the indicator contributes significantly to the measurement of the latent construct. High loadings are essential to ensure the convergent validity of the model, as they show that the indicators share a large part of the variance with the underlying construct. If a loading is low, this may suggest that the indicator does not adequately measure the latent construct, which could require its exclusion or a re-examination of its relevance in the model.

Table 3: Loadings values for items

	Relative advantage	Compatibility	complexity
AR1	0.965		
AR2	0.959		
AR3	0.604		
COMP1		0.932	
COMP2		0.724	
COMP3		0.937	
CPLX1			0.783
CPLX2			0.969
CPLX3			0.958

	Les ressources financières	Le support des parties prenantes	La qualité des ressources humaines
RF1	0.783		
RF2	0.842		
RF3	0.826		
PP1		0.988	
PP2		0.978	
PP3		0.946	
PP4		0.988	
RH 1			0.819
RH 2			0.787
RH 3			0.757
	Clients pression	pressure from competitors	The pressure from the government and regulations
CLT 1	0.982		
CLT2	0.985		
CCR2		0.981	
CCR3		0.986	
GREG1			0.887
GREG2			0.892
GREG3			0.911
GREG4			0.737
GREG5			0.694

Source : SMART PLS 4

The items CCR1, CLT3, RH4, PRF1, PRF2, GREG6 have been removed because they do not meet the reliability criteria.

3.2.3. Convergent validity

Construct	Fiabilty composite	AVE
AR	0.902	0.739
CCR	0.972	0.972
CLT	0.974	0.967
COMP	0.829	0.757
RF	0.752	0.668
CPLX	0.908	0.823
GREG	0.902	0.687
PERF	0.975	0.925
PPI	0.983	0.949
PV	0.915	0.700
RH	0.702	0.621

Source : SMART PLS 4

The results of the convergent reliability analysis indicate that all values exceed the recommended threshold of 0.70. This means that the indicators associated with each latent construct share sufficient variance and are strongly correlated with the construct they are intended to measure.

In other words, each indicator contributes significantly to the measurement of the underlying concept, thereby reinforcing the convergent validity of the model. These results suggest that the latent constructs are well defined and that the items used to measure them are appropriate, reflecting strong internal consistency within each construct.

3.2.4. Discriminant validity

Table 4: HTMT grill

	AR	CCR	CLT	COMP	COUT	CPLX	GREG	PERF	PPI	PV	RH
AR											
CCR	0.094										
CLT	0.086	0.177									
COMP	0.184	0.329	0.332								
COUT	0.420	0.143	0.305	0.478							
CPLX	0.395	0.329	0.335	0.473	0.243						
GREG	0.628	0.280	0.317	0.112	0.178	0.583					
PERF	0.238	0.234	0.462	0.366	0.381	0.499	0.411				
PPI	0.602	0.346	0.217	0.308	0.270	0.568	0.617	0.280			
PV	0.473	0.412	0.583	0.354	0.464	0.598	0.587	0.507	0.604		
RH	0.267	0.514	0.499	0.611	0.703	0.351	0.315	0.382	0.382	0.675	

Source: SMART PLS 4

As shown in Table 4, the square root of the AVE for each variable is greater than all correlation coefficients with other variables. This confirms that the discriminant validity of our model is established.

3.2.5. VIF

Table 5 : VIF values

	VIF
AR -> PV	1.684
CCR -> PV	1.391
CLT -> PV	1.349
COMP -> PV	1.595
COUT -> PV	1.454
CPLX -> PV	1.771
GREG -> PV	2.064
PPI -> PV	2.060
PV -> PERF	1.000
RH -> PV	1.939

Source : SMART PLS 4

The results of the VIF (Variance Inflation Factor) analysis for our model reveal that all values are within acceptable ranges, indicating that there are no significant multicollinearity issues in our analysis. More specifically, the VIF values for all latent variables are well below the critical threshold generally set at 5 or 10, which is a key indicator of the robustness of our model.

This absence of significant multicollinearity reinforces the validity of our analysis and the accuracy of the results obtained. Therefore, we can be confident in the reliability of the relationships identified between the latent variables and the conclusions we draw from these relationships.

3.3. Evaluation of the quality of the structural model

In the context of the PLS (Partial Least Squares) approach, it is crucial to rigorously evaluate the quality of the structural model. This evaluation is carried out in two main stages: the overall quality of the model and the measurement quality for each block of variables.

Table 6 : R2 values

	R-square	R-square adjusted
PERF	0.230	0.222
PV	0.653	0.618

Source : SMART PLS 4

In our case, an R^2 of 0.230 indicates that 23% of the variance in the "Performance" variable is explained by the independent variables in your model. This value suggests that the model explains relatively little of the variance in performance. Meanwhile, 65.3% of the variance in the "Adoption of Green Practices" variable is explained by the independent variables in your model.

This result shows that the model has a good ability to explain the variance in the adoption of practices. A proportion of 65.3% is generally considered high, indicating that the variables included in the model have a substantial impact on the adoption of practices. This suggests that the model is quite effective at capturing the main influences on the adoption of practices and that the independent variables chosen are relevant for explaining this variable.

3.3.1. Test of the hypothesis

TABLE 7: HYPOTHESIS TEST

Hypothesis	T of student	¨p	Decision
H1	1.609	0.108	
H2	1.268	0.205	
H3	2.006	0.045	Accepted
H4	1.779	0.076	
H5	2.407	0.016	Accepted
H6	1.791	0.074	
H7	1.351	0.177	
H8	3.877	0.000	Accepted
H9	0.936	0.350	
H10	6.792	0.000	Accepted

4. DISCUSSION

The statistical analysis aims to test the hypotheses of the theoretical model and verify the relationships between the variables explaining the adoption of green logistics practices and their impact on the environmental performance of large listed Moroccan companies. Two main methods were used: PLS (Partial Least Squares), chosen for its robustness with small samples and multicollinearity, and SEM (Structural Equation Modelling), used to validate the structure of the model and measure the strength of hypothetical relationships.

The results reveal first of all that perceived complexity is a major obstacle to the adoption of green practices, due to technical difficulties, lack of skills and resistance to organisational change. Companies perceive these innovations as costly and uncertain, especially in a regulatory context that is still unclear.

On the other hand, the quality of human resources plays a key role: skilled, committed and trained employees facilitate the integration of green technologies, change management and collaboration with external stakeholders. This internal competence reduces perceived complexity and enhances environmental performance.

Similarly, customer pressure acts as a powerful driver : companies, especially exporters, are adapting to growing sustainability requirements in order to remain competitive and improve their image. However, careful management is needed to avoid greenwashing.

Finally, certain variables such as compatibility, competitive pressure, stakeholder support, and financial and technical resources were not included because they were considered redundant, difficult to measure, or not decisive in the Moroccan context.

Thus, the final model highlights three key drivers for the adoption of green practices: the quality of human resources, customer pressure, and the management of perceived complexity.

5. CONCLUSION

The study highlights that the adoption of green practices by large Moroccan companies is an ethical, regulatory and strategic requirement. It is part of a sustainability approach in which environmental performance becomes a lever for competitiveness. However, this adoption continues to face multiple constraints linked to Morocco's economic, social and institutional context. The country finds itself at a crossroads between economic development and environmental preservation, supported by ambitious public policies such as the Green Morocco Plan and the National Sustainable Development Strategy. These initiatives encourage companies, particularly in the logistics sector, to integrate sustainability principles into their activities.

Despite this momentum, Moroccan companies face various obstacles: limited infrastructure, sometimes unstable regulations and the perception that green practices are complex or costly. To analyse these dynamics, the research adopted a mixed approach combining an exploratory qualitative phase and a confirmatory quantitative phase.

The qualitative phase, based on semi-structured interviews, identified the main drivers and barriers to adoption: the quality of human resources, customer pressure and regulatory constraints. These interviews revealed that skilled, committed and trained human resources are essential for a successful green transition,while pressure from customers, particularly foreign ones, acts as a catalyst for change.

The quantitative phase, based on PLS-SEM analysis, empirically tested the hypotheses derived from the theoretical framework and qualitative results. The results confirm the central role of human resource quality and customer pressure in the adoption of green practices, while perceived complexity represents a more moderate barrier. On the other hand, financial resources, although perceived as important during the interviews, prove to be statistically less decisive, their influence probably being mediated by other internal factors.

The theoretical framework draws on several complementary approaches:

– The TOE (Technology, Organisation, Environment) model, which structures the analysis according to three dimensions: technological (complexity, relative advantage), organisational (resources and skills) and environmental (institutional pressure, customers, regulation).

– The theory of diffusion of innovations (Rogers, 2019), explaining the perception and adoption of green practices according to their characteristics and the innovative capacity of companies.

– The Resource-Based View (RBV) (Barney, 1991), which emphasises the role of scarce and inimitable resources, particularly human skills, as a source of sustainable advantage.

– Neo-institutional theory (DiMaggio & Powell, 1983), highlighting the influence of normative, coercive and mimetic pressures on the adoption of sustainable practices.

The synthesis of the results shows three determining factors:

The quality of human resources, a key internal driver promoting technical expertise and change management.

Customer pressure, an external factor encouraging companies to align their strategies with market expectations.

Perceived complexity, an obstacle to be overcome through training and organisational innovation.

Finally, green practices have a significant positive impact on environmental performance, resulting in a measurable improvement in ecological efficiency. The study thus highlights that sustainability, far from being a mere moral imperative, is a strategic driver of competitiveness for large Moroccan companies in a changing environment.

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