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Customs intelligence and risk management in sustainable supply chain for general customs department logistics

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In this descriptive analytical study conducted within the Jordanian Customs Department, the influence of Customs Intelligence and Risk Management on Sustainable Supply Chain practices and their subsequent effects on Customs Department Logistics were investigated. Data collected through a structured questionnaire distributed to department employees were analyzed using Smart PLS-4. The findings revealed that Customs Intelligence significantly shapes Sustainable Supply Chain practices, emphasizing the importance of data driven decision-making in achieving sustainability goals. Effective Risk Management strategies were found to positively contribute to Sustainable Supply Chain initiatives, highlighting the symbiotic relationship between risk mitigation and sustainability. Sustainable Supply Chain practices, in turn, were demonstrated to enhance the efficiency of Customs Department Logistics. Furthermore, the study unveiled that Sustainable Supply Chain acts as a mediator, enhancing the impact of both Risk Management and Customs Intelligence on Logistics outcomes. These findings collectively underscore the intricate dynamics of these factors in the context of the Jordanian Customs Department, providing valuable insights for optimizing logistics operations, ensuring compliance, and fostering sustainability. This paper contributes valuable insights and empirical evidence to the fields of customs-related logistics, risk management, sustainable supply chain management, and logistics operations within the Jordanian Customs Department. The paper provides recommendations that have the potential to inform and improve logistics practices, benefiting stakeholders in both the public and private sectors and advancing the understanding of these critical dynamics in the broader logistics and supply chain management discipline.

1. Introduction

Modern business relies heavily on the logistics and supply chain sector, which makes international trade in products and services smooth (Gunasekaran et al., 2001; Arvis et al., 2018; Melkonyan et al., 2019). The General Customs Department is a key participant in Jordan's economic growth because of its major role in regulating and supervising international commerce (Koburtay et al., 2020; Senthilkumar et al., 2020). The need for sustainable supply chain strategies is becoming more and more obvious as global commerce develops and intensifies (Mangla et al., 2018.). In the context of supply chain management, sustainability covers a wide range of factors, such as social justice, environmental responsibility, and economic viability (Kannan, 2018; Rehacek, 2017; Kumar, 2020; Al-Hattami et al., 2021; Hamour et al., 2023). Sustainability constitutes both a moral duty and a strategic requirement for logistics service providers working under the supervision of the Jordanian General Customs Department.

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The management of hazards related to international commerce is one of the main difficulties encountered by logistics providers in Jordan, as it is in many other nations. These dangers might include everything from shifting economic conditions and geopolitical unrest to supply chain interruptions and legislative changes. For the business to remain stable and for deliveries to be made on schedule, it must be able to properly reduce these risks. Additionally, customs laws and procedures are essential to the functioning of international trade. For logistics providers looking to improve their operations, cut costs, and assure compliance with changing trade rules, customs intelligence the gathering and analysis of data relating to customs processes and compliance has become an essential tool. In addition, growing in importance within the Jordanian General Customs Department is the convergence of risk management and customs intelligence in the context of sustainable supply chain operations (Al-Zaqeba et al., 2023). It offers a chance for logistics service providers to become more competitive, less environmentally damaging, and more helpful to Jordan's overall sustainability goals (Noor et al., 2017; Ghernaout et al., 2018; Abas et al., 2019; Khan and Altayar, 2021). In the current global trade economy, the logistics service providers working under the Jordanian General Customs Department encounter a variety of difficulties. As they work to keep their supply chains operating effectively, follow changing customs laws, and lessen their environmental impact. A thorough analysis of the interactions between risk management, customs intelligence, sustainability, compliance, and competitiveness within the unique context of logistical operations under the Jordanian General Customs Department is also necessary to answer this study topic. In order to improve the integration of these crucial factors for the benefit of both logistics providers and Jordan's larger economic landscape, it entails identifying best practices, evaluating the impact of regulatory changes, investigating technological innovations, and proposing strategic recommendations. However, this article aims to explore the complex interrelationships between risk management, customs intelligence, and ethical supply chain practices in the context of Jordanian logistics.

2. Literature Review and Hypothesis Development

2.1 Direct Effect

2.1.1 Customs Intelligence and Sustainable Supply Chain

The key to lowering the environmental effect of commercial activities is improving transportation efficiency. Customs, border agencies, traders, and logistics providers must digitize their procedures and exchange pertinent data if they are to see substantial improvements (Julian Stephens, 2020). However, these initiatives won't be successful unless they are combined with the usage of computers, which can take use of huge datasets because of cutting-edge algorithms. In addition, through the movement of products, trade processes cause greenhouse gas emissions. The performance of the logistics system has a significant influence on the environmental impact of goods movement, maybe even more so than the mode of transportation and the distance traveled (Hussin et al., 2013; Shahbaz et al., 2019; Nagapan et al., 2021; Al-Zaqeba et al., 2022). Therefore, it is crucial to improve logistical flows to lower costs for businesses as well as the environmental effect of trade.

The enormous volume of containers that arrive at ports presents a challenge for customs. It is possible for organized crime to infiltrate with this enormous freight movement. Customs administrations and private businesses now place a high focus on risk management and supply chain security (Pourakbar and Zuidwijk, 2018). According to Dao et al. (2018), since IS may benefit a business, its partners, and clients, they are crucial and vital support tools for any sustainable supply chain. According to Manavalan and Jayakrishna (2019), the use of IoT technology in the emerging Industry 4.0 technologies would help SSCM, particularly in the environmental and social pillar. Additionally, the study, which was carried out by Bag et al. (2020), showed that the BDA might boost the social effect in the workplace. Additionally, BT adoption can lower all transaction costs while enhancing financial outcomes (Schmidt and Wagner, 2019). Although the writers concur on these particular issues, it would have been better to mix these three technologies because they will all be crucial in the near future as supply chains undergo a digital transformation. To determine the extent of each person's contribution to SSCM (Shakir and Mohammed, 2013; Karia and Soliman, 2017; Shahbaz et al., 2018; Ramingwong and Manopiniwes, 2019; Sundarakani et al., 2021)

Julian Stephens (2020) indicates that both the application of AI and the digitization of processes are necessary for this. In fact, if gathering high-quality, dematerialized information is essential, there is a risk that workers may get overloaded with data from an operational standpoint. Therefore, logistics operators must employ AI technologies to maximize business. AI systems provide access to enforcement agencies by facilitating and facilitating the recording and exchange of electronic data on transactions. These agencies might use the systems to monitor operations and receive warnings when unusual or suspicious occurrences are discovered. In addition, Sharma et al. (2021) claim that SSCM projects, which may optimize economic outcomes, reduce environmental effect, and contribute to social impact, can be developed with the support of new technology. First and foremost, digital transformation may support the environmental pillar of sustainability by enabling emission monitoring and control, as well as recall and rework. Second, as it improves data accuracy and gives groups of stakeholder’s access to real-time information, providing transparency and traceability throughout the supply chain, digital transformation may support the social pillar of SCM. Thirdly, by promoting operational efficiency, resulting in cost savings, and improving the visual representation of financial flows, digital transformation may also have an impact on the economic pillar of sustainability.

According to Stroumpoulis and Kopanaki (2022), the application of these technologies (BT, BDA, and IoT), along with supply chain sustainable development practices, can enhance a company's financial performance as well as its social and

environmental footprints. These factors will all result in improved business success. As a result, Industry 4.0's sustainable supply chains should concentrate on digital transformation to help sustainability principles (2020). As new technologies are accessible to all businesses, it is crucial to remember that the installation of IT alone will not give a company a competitive edge (Stroumpoulis et al., 2021). Also, Stroumpoulis and Kopanaki (2022) indicate that a few studies, the three pillars of sustainability are theoretically examined while also investigating the effects of big data analytics, the internet of things, and blockchain technology on the creation of sustainable supply chains. According to Ababneh et al. (2023), technological infrastructure, including blockchain technology, has a positive impact on Jordan's ability to drive sustainable supply chains. Customs port practices also have a positive influence on this ability, underscoring the importance of efficient and dependable customs operations for sustainability. Additionally, blockchain technology is more successful in achieving sustainability goals when environmental standards are followed. The need for strong technology skills in promoting sustainable operations inside customs ports is also highlighted. Digitalization is expected to completely transform supply chain operations by exploiting the technological capabilities of cutting-edge technology applications. Despite the operational advantages associated with the employment of digital technology, due to a lack of empirical data, their overall influence has gone unrecognized. However, Tsolakis et al. (2023) provide an example of the essential roles played by AI and BCT in managing digital supply chains, while influence on sustainability and data monetization is dependent on the parameters and goals established by the system stakeholders engaged. Nevertheless, the confluence of digitization, artificial intelligence, and other digital technologies in the field of customs intelligence, however, holds the possibility of changing supply chains for sustainability. The interaction of these factors can boost productivity, lessen negative environmental effects, increase security, and produce financial gains. To navigate the changing landscape of sustainable supply chain management, it is crucial to embrace these technologies collectively and strategically as supply chains continue to develop. Therefore, it is presumed that the following is true.

H_1: *Customs Intelligence effect Sustainable Supply Chain*

2.1.2 Risk Management and Sustainable Supply Chain

The importance of sustainability problems has mostly been undervalued in supply chain risk management studies (Rostamzadeh et al., 2018). Furthermore, little is known about supply chain management and sustainable risk management, as well as how these factors affect business losses. Identification, analysis, and provision of solutions for accountability, control, and monitoring of the risks in the economic and production cycle are the responsibilities of risk management in the supply chain. By ranking criterion significance using inter-criteria correlation (CRITIC) approaches and ranking criteria similarity to the ideal solution (TOPSIS) (Rostamzadeh et al., 2018). The SSCRM evaluation framework's final set of criteria was constructed using seven major criteria and forty-four sub-criteria. Machines and equipment hazards, key supplier failures, demand variations, risks associated with governmental policy, risks associated with information technology security, economic difficulties, and a lack of effective sewage infiltration were determined to be the most predominate sub-criteria in each category. Nouri complex (A2) was also discovered to be the most effective practitioner.

According to van der Vegt et al. (2015), supply chains constitute the foundation of the global economy and have a significant impact on both the social and physical business environment. Additionally, according to Scholten and Fynes (2017), every firm is a part of at least one supply chain. Additionally, supply chains are the pathways that allow materials, services, and information to move from the initial provider to the final customer. Relationships between a company's supply chains and rising globalization have made it easier to conduct global operations, improve communication, and incorporate a wider range of products and more options for customers. According to Koksal and Strahle (2021), there is a power imbalance when it comes to enforcing social standards in multi-layered SSC and that sophisticated global SSC is susceptible to information asymmetries. It is crucial that focus firms in SSC have their risks assessed. A tried-and-true SSCRM tactic is to use risk-sharing agreements and methods between businesses all the way down the SSC. Moreover, demand forecasting in the SSC and green innovation are equally important since projections that drastically differ from reality may cause businesses to place unforeseen orders. The advent of big data analytics and artificial intelligence technologies in recent years has offered hope for accurate demand forecasting (Wang et al., 2022). Green innovation may help businesses improve their public image and lower the risk of SSC brought on by reputational, environmental, and policy risks. Sustainable supply chain management (SSCM) benefits from improved transparency and traceability thanks to blockchain technology. The benefits of using blockchain technology are thoroughly covered. However, little thought has been given to the possible sustainability hazards of integrating blockchain technology into SSCM, such as high energy usage and increased operating training expenses. According to Zhang and Song (2022), the two main risk concerns are rising training prices and resource waste brought on by constant audits and certifications. These findings offer managers management insights on the use of blockchain technology in SSCM.

Blockchain technology holds significant promise for Sustainable Supply Chain Management (SSCM) as demonstrated by research (Saberi et al., 2019). It has the potential to contribute to the sustainability and efficiency of SSCM through several key mechanisms, including enhanced product traceability, improved member transparency, and heightened security and safety measures. These advantages are crucial in ensuring the long-term viability and effectiveness of SSCM initiatives.

However, the full-scale adoption of blockchain technology in SSCM is not without its challenges. Several barriers persist, hampering its widespread implementation. These obstacles include high energy consumption and social hurdles, as evidenced by studies such as those by Crosby et al. (2016), Weng and Khin (2017), Nguyen (2018), Saberi et al. (2019), and Queiroz &

Wamba (2019). These challenges underscore the need for a comprehensive approach to addressing the complexities of integrating blockchain into SSCM effectively.

To comprehensively evaluate SSC's risk factors, prior research has examined this issue from two primary perspectives: the SSC process itself and the triple bottom line concept, which encompasses environmental, social, and economic dimensions (Lüdeke-Freund et al., 2016; Song et al., 2017; Liu et al., 2017; Rostamzadeh et al., 2018; Zhang & Song, 2022). In this context, the concept of "sustainability risk" emerges as a pivotal consideration that may impact the SSC. Sustainability risk pertains to any condition or issue that could jeopardize the sustainability of the supply chain (Hofmann et al., 2014; Tundys & Wiśniewski, 2023).

To delve further into the multifaceted dimensions of SSCM risk, scholars have dissected it into various categories and criteria. For example, Xu et al. (2019) devised a method for assessing supply chain sustainability risk based on the sustainability triple bottom line. This approach considers environmental risk, organizational risk, sustainable supply risk, sustainable production risk, sustainable distribution risk, and sustainable recycling risk. Similarly, Rostamzadeh et al. (2018) presented a framework that encompasses a range of sustainability-related criteria for SSCM risk assessment.

Additionally, Song et al. (2017) categorized risk factors associated with SSCM into four primary categories: operational risk, economic risk, environmental risk, and social hazards. This categorization helps provide a structured understanding of the diverse challenges and threats that SSCM initiatives may encounter. However, the relationship between risk management and sustainable supply chain management is multifaceted and critical to achieving sustainability goals. Effective risk management practices contribute to resilience, ethical standards, environmental responsibility, and economic stability within supply chains. Recognizing and addressing risks proactively is essential for organizations committed to advancing sustainability across the environmental, social, and economic dimensions of their supply chains.

The relationship between risk management and sustainable supply chain management (SSCM) is a complex and multifaceted one, and H2 posits that risk management has a significant impact on SSCM. The literature highlights various dimensions of this relationship, shedding light on how risk management practices influence the sustainability of supply chains. Hince, the following hypothesis can be assumed:

H_2: *Risk Management affects Sustainable Supply Chain.*

2.1.3 Sustainable Supply Chain and Customs Department Logistics

The ideas of sustainability, effective logistics, and expedited customs processes are combining to form the future of supply chain management in the contemporary worldwide corporate environment. A crucial paradigm for businesses looking to combine economic, environmental, and social factors in their supply chain operations is SSCM (Barbosa-Póvoa et al., 2018). In parallel, logistics and customs departments have grown to be crucial parts of this transformational process (Fellenstein and Umaganthan, 2019; Raza et al., 2023). In addition, green practices and renewable energy sources, according to Khan et al. (2018), can lessen the negative effects of logistics operations on environmental sustainability and foster economic activity with promising export possibilities in a region. The intricate relationship between SSCM and customs department logistics has garnered substantial attention in recent research, particularly in the context of economic and environmental indicators (SAR Khan et al., 2017; SAR Khan et al., 2018). This dynamic interplay between SSCM and customs department logistics is essential for understanding its impact on logistics performance, economic growth, and environmental sustainability. According to Morali and Searcy (2013), SSCM requires integrating sustainable practices at every stage of the supply chain, from the procurement of raw materials through the delivery of finished goods and beyond. It aims to reduce negative environmental effects, advance moral labor standards, and increase economic effectiveness (Fritz, 2019). To fulfill customer demand for eco-friendly products, abide by ever-stricter laws, and support global sustainability goals, businesses must now prioritize sustainability in their supply chains (Shahzad et al., 2023). Moreover, customs offices are an important aspect of this complex network of supply chain operations (Kshetri, 2018; Chang et al., 2020). They act as gatekeepers, controlling the flow of products across international borders, ensuring that trade rules and regulations are followed, and bringing in money for the governments. Although customs operations are often linked to trade facilitation and tax collection, their significance in sustainability is growing (Busse, 2021). The effective flow of commodities, the quality of data reporting, and the enforcement of sustainability criteria are all impacted by customs processes. The operations of the customs department must change to accommodate the changing demands of SSCM as supply chains become more global and complicated (Cacho et al., 2020). According to Khan et al. (2018), the amount of fossil fuels and other non-renewable energy sources used in logistics activities has a negative effect on both economic growth and environmental sustainability. Inadequate infrastructure for logistics and transportation-related activities also considerably increases CO2 emissions as well as total greenhouse gas emissions. However, carbon emissions hurt plants and wildlife and impede economic growth.

Numerous studies, such as those conducted by SAR Khan and colleagues (SAR Khan et al., 2017; SAR Khan et al., 2018), have explored how economic and environmental indicators influence logistics performance. The research demonstrates that sustainability practices within supply chains, including green logistics and renewable energy adoption, have the potential to mitigate the adverse effects of logistics operations on environmental sustainability. By aligning economic activities with greater export opportunities and emphasizing environmental responsibility, these studies reveal how logistics operations can

serve as catalysts for both economic growth and environmental sustainability. Moreover, the relationship between green supply chain management and logistics performance has been a focal point in recent research (SAR Khan et al., 2020). SAR Khan's studies (SAR Khan et al., 2020) provide evidence that a commitment to environmental sustainability can enhance logistics performance by minimizing harmful environmental impacts. These studies emphasize that sustainable supply chain practices not only reduce environmental harm but also create opportunities for businesses to expand their export capabilities. In addition to these findings, research explores how environmental, social, and economic growth indicators spur logistics performance (SAR Khan et al., 2019). It highlights the importance of integrating green energy resources and practices to mitigate negative effects on social and environmental sustainability. Furthermore, studies emphasize that green logistics operations and sustainable supply chain practices can lead to fewer export opportunities due to reduced environmental pollution and enhanced sustainability standards.

The nexus between logistics, economic growth, and environmental sustainability is a central theme in these studies (SAR Khan et al., 2021). They illustrate how logistics can either contribute to or alleviate environmental impacts, emphasizing the significance of sustainable practices for both the economic and environmental dimensions of supply chain management. However, recent research has illuminated the interconnectedness of Sustainable Supply Chain Management and customs department logistics with economic and environmental indicators (SAR Khan et al., 2017; SAR Khan et al., 2018). These studies underscore the pivotal role of logistics operations in influencing economic growth and environmental sustainability. By embracing sustainability practices and aligning economic activities with environmental responsibility, organizations can enhance their logistics performance, promote sustainable economic growth, and contribute to a more environmentally friendly future. Understanding this relationship is essential for businesses and policymakers seeking to navigate the evolving landscape of sustainable supply chain management. Hince, the following hypothesis can be assumed:

H_3: *Sustainable supply chain affects customs department logistics.*

2.2 Mediation Effect of Sustainable Supply Chain

The dynamic interplay between risk management and customs department logistics within the realm of international trade and supply chain operations has garnered significant attention in academic literature Veenstra et al., 2012; Alzaqebah et al., 2023). This exploration seeks to shed light on the intricate relationship between these two vital components and the consequential effects on customs department logistics. Customs logistics, as defined in the literature (Jablonskis et al., 2018), encompasses the impact of actions and their influence on the logistics processes associated with customs clearance and trade facilitation. It recognizes the pivotal role of risk management in ensuring the efficient and secure movement of goods across borders. Reliable risk management practices adopted by customs authorities play a vital role in minimizing risks associated with the international trade of goods, ensuring the timely and secure clearance of shipments while causing minimal disruptions (Jablonskis et al., 2018).

A crucial facet of this relationship is the impact of risk management on customs department logistics, particularly in the context of maritime supply chains (Yang, 2011). This research addresses the effects of risk assessment factors on risk levels, emphasizing the importance of employing risk management strategies within the customs domain. The application of risk management principles enables customs offices to collaborate effectively with customs brokers and other stakeholders to achieve reductions in risks, ensuring the security and efficiency of port logistics operations (Yang, 2011). Furthermore, the literature highlights the evolving landscape of customs and logistics activities amid geopolitical and economic changes (Kozenkova et al., 2020). This research underscores the significance of risk management in the customs and logistics sphere, recognizing the intertwined nature of these domains. Effective risk management strategies contribute to the resilience of customs and logistics operations, allowing them to navigate the complexities arising from geopolitical shifts and economic fluctuations (Kozenkova et al., 2020).

Risk management's impact on customs department logistics extends beyond traditional customs processes to encompass broader supply chain dynamics (Giuffrida et al., 2021). Uncertainty types within cross-border e-commerce logistics, including risks associated with customs clearance checks, are subject to risk management strategies. By adopting effective risk management practices, logistics operations can mitigate uncertainties and their negative effects on service quality and delivery times (Giuffrida et al., 2021). Furthermore, customs certifications at the European level have a profound impact on risk management within third-party logistics (3PL) and supply chains (Houe & Guimaraes, 2012). The Authorized Economic Operator (AEO) program, for example, has the potential to enhance risk management effectiveness within the supply chain. The interplay between customs certifications and risk management practices within 3PL operations illustrates the deep-rooted connection between customs department logistics and risk management (Houe & Guimaraes, 2012).

Building on the extensive literature that explores the interconnectedness of Sustainable Supply Chain Management (SSCM), risk management, customs intelligence, and customs department logistics, we can formulate hypotheses to investigate the mediating role of SSCM in the context of customs department logistics. Hypothesis H4 posits that Sustainable Supply Chain mediates the effect of Risk Management on Customs Department Logistics. This hypothesis is grounded in the recognition that risk management practices significantly impact the efficiency and security of customs operations (Giuffrida et al., 2021), and SSCM has the potential to enhance the resilience and sustainability of logistics processes within supply chains (SAR

Khan et al., 2017). Therefore, we hypothesize that SSCM acts as a mediator, channeling the influence of risk management practices on customs department logistics, ultimately shaping the way goods are moved across borders and how customs operations are conducted. Similarly, Hypothesis H5 suggests that Sustainable Supply Chain mediates the effect of Customs Intelligence on Customs Department Logistics. This hypothesis stems from the understanding that customs intelligence plays a pivotal role in enhancing the visibility and efficiency of customs processes (Stroumpoulis et al., 2022), and SSCM seeks to optimize sustainability across supply chains (Sharma et al., 2021). We posit that SSCM serves as a mediator, translating the impact of customs intelligence into tangible improvements in customs department logistics. Through sustainability initiatives embedded within SSCM, customs intelligence can not only enhance customs operations but also contribute to environmental, social, and economic objectives, thereby mediating its effect on customs logistics. Hince, the following hypothesis can be assumed:

H4: *Sustainable supply chain mediates the effect of risk management on customs department logistics.*
H5: *Sustainable supply chain mediates the effect of customs intelligence on customs department logistics.*

2.3 Research Model

Based on previous studies, to empirically investigate the interplay between Customs Intelligence, Risk Management, Sustainable Supply Chain, and Customs Department Logistics, a comprehensive study model can be developed. Drawing on the existing literature as foundational support for each hypothesis, this study aims to explore these complex relationships in the context of international trade and supply chain operations.

H1 posits that Customs Intelligence has a direct effect on the Sustainable Supply Chain. This hypothesis is informed by research demonstrating the pivotal role of Customs Intelligence in enhancing visibility and control over trade processes (Stroumpoulis et al., 2022) and the potential of Sustainable Supply Chain Management (SSCM) to optimize supply chains with sustainability principles (Sharma et al., 2021). H2 suggests that Risk Management directly influences the Sustainable Supply Chain. This hypothesis is based on the understanding that effective risk management practices can mitigate disruptions within supply chains (Giuffrida et al., 2021) and that SSCM emphasizes sustainability as a core principle (SAR Khan et al., 2017). In addition, H3 proposes that the Sustainable Supply Chain has a direct effect on Customs Department Logistics. This hypothesis aligns with existing research highlighting how SSCM can optimize logistics processes within supply chains (SAR Khan et al., 2017) and the crucial role of sustainability in shaping customs operations (Stroumpoulis et al., 2022).

H4 posits that Sustainable Supply Chain mediates the effect of Risk Management on Customs Department Logistics. This mediation hypothesis builds on the literature suggesting that SSCM acts as a bridge between risk management and logistics processes (Giuffrida et al., 2021) and is informed by the prior hypotheses. In addition, H5 suggests that Sustainable Supply Chain mediates the effect of Customs Intelligence on Customs Department Logistics. This mediation hypothesis is grounded in the recognition that SSCM can translate the impact of customs intelligence into tangible improvements in customs logistics (Stroumpoulis et al., 2022) and is informed by the prior hypotheses. However, the research model presented below in Fig. 1.

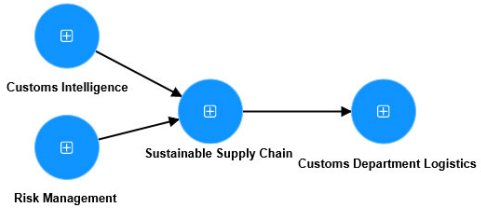

Fig. 1. Research Model

This comprehensive study model encompasses the intricate relationships between these variables and sets the stage for empirical investigation to uncover the nuances of how customs intelligence, risk management, and sustainability principles intersect and influence customs department logistics within the realm of international trade and supply chain operations. Through rigorous empirical analysis, this study aims to provide valuable insights for practitioners, policymakers, and researchers seeking to enhance the efficiency, security, and sustainability of customs operations in a rapidly evolving global trade landscape.

3. Research Method and Results

The research employed a quantitative survey methodology to investigate the relationships and mediating effects of the research hypotheses which include 3 hypotheses for direct and 2 hypotheses for indirect effect. However, to analyze the study's data, Smart PLS 4.0 software and Structural Equation Modeling - Partial Least Squares (SEM-PLS) were employed. The research gathered data through the distribution of questionnaires, utilizing a 184-point Likert scale to capture respondents' opinions and insights. The survey involved 184 experts affiliated with Jordan's customs departments, who provided valuable input on

the topics under investigation. Subsequently, the collected data underwent a series of rigorous analyses, including tests for validity, reliability, and significance.

3.1 Path Coefficients and Reliability

Path coefficients are essential in assessing the strength and direction of influence that an independent variable exerts on a dependent variable within a structural model. To delve deeper into this evaluation, the determination coefficient, often denoted as R-Square, plays a crucial role in quantifying the extent to which an exogenous variable impacts an endogenous variable. In this paper, the R-Square value for the endogenous latent variables stands at 0.67 or higher. This value signifies a robust and positive link between the exogenous and endogenous variables under consideration. For a visual representation of these path coefficients and their implications within this research framework on achievement motivation. However, Fig. 2 provides a Measurement Model.

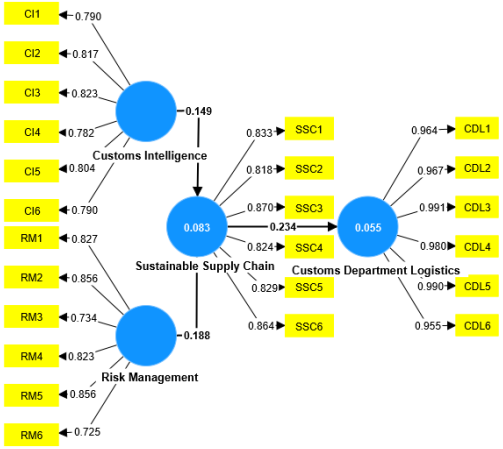

Fig. 2. Finalized Measurement Model

The measurement model's outer loading values play a critical role in evaluating the indicators of our study variables. It is noteworthy that all indicators of several study variables exhibit outer loading values exceeding the conventional threshold of 0.7. However, it is important to acknowledge that a few indicators still fall slightly below this threshold. In line with guidance provided by Mulyono et al. (2020), an outer loading value between 0.5 and 0.6 is considered sufficient to meet the criteria for convergent validity. The significance of this information lies in the fact that none of the variable indicators in our study exhibit outer loading values below 0.5. This observation underscores the suitability of all selected indicators for inclusion in our research, thereby affirming their applicability for further investigation and analysis. The comprehensive evaluation of variable reliability by employing three widely recognized measures: Cronbach's Alpha, composite reliability, and Average Variance Extracted (AVE). These measures are fundamental in assessing the internal consistency, overall reliability, and convergent validity of constructs within the Structural Equation Modeling - Partial Least Squares (SEM-PLS) analysis framework. It is noteworthy that the high coefficients obtained for Cronbach's Alpha, composite reliability (all exceeding the threshold of 0.70), and AVE signify a strong degree of reliability and trustworthiness for all the constructs outlined in Table 1. Essentially, these measures provide robust evidence supporting the reliability, internal consistency, and precision in measuring the intended concepts, ensuring the soundness of our analytical framework within the SEM-PLS analysis context.

Table 1
Reliability and Testing of AVE

	Cronbach's alpha	Composite reliability (rho_a)	(AVE)
Customs Department Logistics	0.989	0.991	0.950
Customs Intelligence	0.890	0.910	0.642
Risk Management	0.891	0.901	0.649
Sustainable Supply Chain	0.917	0.920	0.706

R^2 values, which range from 0.00 to 1.00, are a crucial metric in regression analysis. These values are instrumental in gauging the extent to which independent variables explain the variance in the dependent variable. An R^2 value of 0.00 signifies that the independent variables lack any explanatory power over the dependent variable, while an R^2 value of 1.00 suggests that they comprehensively account for all the variance in the dependent variable. Therefore, higher R^2 values indicate a more robust relationship between the independent and dependent variables, signifying a greater explanatory effect. Conversely, lower R^2 values indicate weaker relationships and smaller effects. The qualitative classification of "weak," "moderate," and "good" is often employed to assess model fit based on the R^2 values. In Table 1, we observe a range of R^2 values for different constructs, providing insights into the varying degrees of explanatory power each independent variable holds within the

research context. These R^2 values, in conjunction with other reliability measures, contribute to a comprehensive assessment of the model's strength and effectiveness in explaining the phenomena under study.

Table 2
R^2 and adjusted R^2values results

	R-square	R-square adjusted
Customs Department Logistics	0.055	0.052
Sustainable Supply Chain	0.083	0.078

Based on Table 2 above, the value of R^2 is 0.055, and 0.083; which means that 05.0%, and 08.3% of the variations or changes in Customs Department Logistics, and Sustainable Supply Chain are influenced by Sustainable Supply Chain; while the remaining 95.0%, and 91.7% are explained by other causes. In addition, it can be said that the R^2 on the variable of Customs Department Logistics, and Sustainable Supply Chain is partially moderate.

3.2 Hypotheses Testing

In the process of hypothesis testing in statistical analysis, several key indicators are examined to assess the validity of the hypotheses. These indicators encompass the original value sample estimates (O), t-statistics (T), and p-values (P), each of which offers valuable insights into the nature and significance of relationships between variables.

The original value sample estimate (O) represents a numerical estimate derived from the sample data. A value close to +1 indicates a positive relationship between the variables, while a value close to -1 suggests a negative relationship. This estimation serves as a foundational indicator for understanding the direction of the relationship.

T-statistics (T) play a pivotal role in evaluating the statistical significance of relationships. A t-statistics value exceeding 1.96 (typically at a 95% confidence level) indicates a statistically significant relationship between the variables, signifying the strength of the association.

P-values (P) offer another essential measure for assessing significance. When the p-value falls below the chosen significance level usually <0.05, it signifies that the relationship between variables is statistically significant. However, Fig. 3 and Table 3 below provide a comprehensive presentation of the results obtained for these indicators.

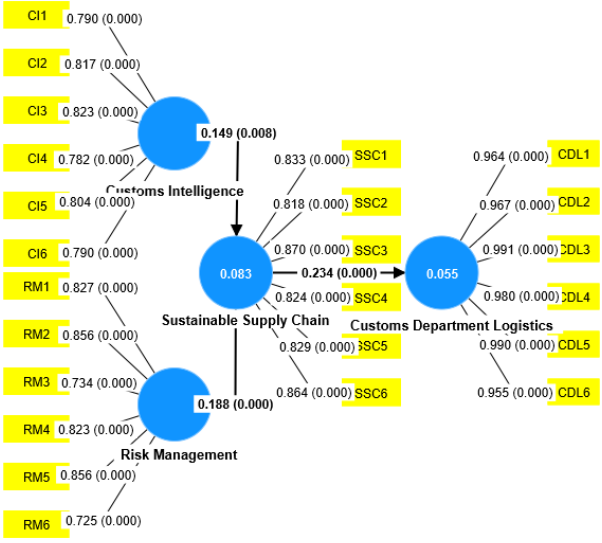

Fig. 3. Hypothesis Testing

The hypothesis testing procedure, which comprises evaluating the research hypotheses, is shown in Fig. 3. For this testing, the previously indicated route coefficients offer critical information. The findings of the hypothesis testing for direct impacts are presented in Table 3 below. This table enables the examination of the hypotheses and offers a thorough description of the correlations between the variables. Researchers can decide if the study hypotheses have been supported or rejected based on the direct effects seen between variables by looking at the data in Table 3. The table is an invaluable resource for comprehending the conclusions reached throughout the hypothesis testing procedure.

Table 3
Results of Hypothesis Testing

Path	β	STDEV	T-values	P-Values
Direct Effect				
Customs Intelligence → Sustainable Supply Chain	0.149	0.056	2.655	0.008
Risk Management → Sustainable Supply Chain	0.188	0.053	3.527	0.000
Sustainable Supply Chain → Customs Department Logistics	0.234	0.050	4.714	0.000
Indirect Effect				
Customs Intelligence → Customs Department Logistics	0.035	0.016	2.190	0.029
Risk Management → Customs Department Logistics	0.044	0.017	2.525	0.012
Mediation Effect				
Risk Management → Sustainable Supply Chain → Customs Department Logistics	0.044	0.047	2.525	0.012
Customs Intelligence → Sustainable Supply Chain → Customs Department Logistics	**0.035**	**0.037**	**2.190**	**0.029**

The analysis is divided into two main sections: direct effects and mediator effects, each providing valuable insights into the relationships between independent and dependent variables. Moreover, in the direct effects, this paper explores the connections between Customs Intelligence, Risk Management, and Sustainable Supply Chain, and their impact on Customs Department Logistics. This examination relies on beta coefficients, t-values, and p-values to unveil the significance and direction of these relationships. For instance, a positive beta coefficient coupled with a low p-value indicates a meaningful and positive relationship between the variables. However, this result aligns with previous research emphasizing the importance of Customs Intelligence and Risk Management in logistics and supply chain operations. For instance, studies by Yang (2011) and Yang (2010) have highlighted the significance of risk management in the context of supply chain security and its impact on logistics. Additionally, research by Khan et al. (2017) and Khan et al. (2018) has underscored the relationship between economic growth, environmental sustainability, and logistics performance, which resonates with the findings regarding Sustainable Supply Chain's role in our study. Moving to the mediator effects section, often represented through interaction terms, such as Customs Intelligence → Customs Department Logistics, and Risk Management → Customs Department Logistics Here, we assess how these interactions influence the dependent variables, employing beta coefficients, t-values, and p-values to provide insights. The results of the mediation testing, as depicted in Table 4, are pivotal. The result reveals that Sustainable Supply Chain as a mediator for the effect both of Customs Intelligence and Risk Management on Sustainable Supply Chain. This conclusion is substantiated by the significance of the indirect effect (Risk Management → Sustainable Supply Chain → Customs Department Logistics) and (Customs Intelligence → Sustainable Supply Chain → Customs Department Logistics). However, H4 and H5 are accepted, but the effect of the mediator is partial. Moreover, the mediation effect of Sustainable Supply Chain identified in this research aligns with the broader literature on supply chain sustainability. This proposition is grounded in previous studies that emphasize the integrative role of SSCM in supply chain operations (SAR Khan et al., 2017). The findings align with existing research that recognizes SSCM as a multifaceted approach capable of enhancing the sustainability, resilience, and efficiency of supply chains (Sharma et al., 2021). However, this study goes further by suggesting that SSCM mediates the effects of risk management and customs intelligence specifically on customs department logistics. This nuanced perspective enriches the literature by highlighting the potential for SSCM to be a transformative force in customs operations.

4. Discussion

The results of the mediation testing, a pivotal aspect of our analysis, unveiled the mediating role of Sustainable Supply Chain in the relationships between Customs Intelligence, Risk Management, and Customs Department Logistics. This mediation effect was confirmed by the significance of the indirect pathways (Risk Management → Sustainable Supply Chain → Customs Department Logistics and Customs Intelligence → Sustainable Supply Chain → Customs Department Logistics). However, Sustainable Supply Chain, was found to be partial rather than complete. The study's examination of the direct effects of Customs Intelligence, Risk Management, and Sustainable Supply Chain on Customs Department Logistics aligns with prior research emphasizing the significance of these factors in logistics and supply chain operations. Notably, the positive relationships between Customs Intelligence and Sustainable Supply Chain (H1) and Risk Management and Sustainable Supply Chain (H2) corroborate previous studies that underscore the importance of technology and digitization in logistics efficiency and sustainability (Julian Stephens, 2020). These findings resonate with the broader literature, which recognizes the multifaceted nature of SSCM and its capacity to enhance sustainability, resilience, and efficiency in supply chains (SAR Khan et al., 2017). The study contributes to this understanding by highlighting the specific roles of Customs Intelligence and Risk Management in driving sustainability within customs department logistics. Furthermore, the study's acknowledgment of the environmental impact of trade processes and the crucial role of logistics system performance in mitigating these effects aligns with prior research by Hussin et al. (2013), Shahbaz et al. (2019), Nagapan et al. (2021), and Al-Zaqeba et al. (2022). These studies emphasize the central role of logistics efficiency in addressing environmental challenges associated with goods movement. Therefore, the findings supporting the direct effect of Risk Management on Sustainable Supply Chain (H2) are consistent with existing literature highlighting the environmental aspects of supply chains. The study also recognizes the importance of risk management and supply chain security in the context of massive container movements and the threat of organized crime, consistent with findings by Pourakbar and Zuidwijk (2018). This underscores the critical role of risk management practices in ensuring the security and efficiency of port logistics operations. Consequently, the findings related to the direct effect of Risk Management on Customs Department Logistics (H3) align with prior research highlighting the

significance of risk management in supply chain security. In addition, the mediation testing results reveal that Sustainable Supply Chain serves as a mediator in the relationships between Customs Intelligence, Risk Management, and Customs Department Logistics. This mediation effect is a significant contribution to the broader discussion on the role of technology, including blockchain technology (Ababneh et al., 2023), IoT (Manavalan and Jayakrishna, 2019), and big data analytics (Stroumpoulis & Kopanaki, 2022), in enhancing sustainability within supply chains. The study's findings reinforce the idea that digital transformation and technological infrastructure can have a positive impact on supply chain sustainability and overall performance (Stroumpoulis & Kopanaki, 2022).

The recognition of Sustainable Supply Chain as a partial mediator highlights the nuanced nature of its influence. This partial mediation is consistent with previous research acknowledging that the effects of technology and sustainability initiatives may not always be fully realized but can still significantly contribute to positive outcomes (Julian Stephens, 2020). It underscores the importance of considering the intricate interplay between these variables.

5. Conclusion

This paper provides a comprehensive exploration of the intricate interplay between Customs Intelligence, Risk Management, Sustainable Supply Chain, and their collective impact on Customs Department Logistics. Through quantitative analysis using Smart PLS 4.0 and structural equation modeling, we have uncovered valuable insights into the relationships and mediating effects within this complex ecosystem. This paper revealed that Customs Intelligence, Risk Management, and Sustainable Supply Chain all play pivotal roles in shaping Customs Department Logistics. The presence of positive beta coefficients and low p-values underscores the significance of these variables, emphasizing their importance in optimizing logistics operations within customs departments. Furthermore, the analysis has delved into the mediator effects, highlighting the nuanced interactions between Customs Intelligence, Risk Management, and Customs Department Logistics. These findings provide a deeper understanding of how these factors influence one another and ultimately impact logistics outcomes. Nevertheless, one of the key contributions of this study is the identification of the Sustainable Supply Chain as a crucial mediator in the relationships between Customs Intelligence, Risk Management, and Customs Department Logistics. While the mediation effects were confirmed, it is essential to note that the influence of the Sustainable Supply Chain was found to be partial, suggesting that other factors may also contribute to the observed dynamics. However, this research provides valuable insights for policymakers and practitioners in the customs and logistics domain. Understanding the roles of Customs Intelligence, Risk Management, and Sustainable Supply Chain can help optimize operations, enhance efficiency, and promote sustainability within customs departments. Additionally, recognizing the mediating role of Sustainable Supply Chain underscores the importance of holistic approaches to logistics management.

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