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Assessing the Strategic Contributions and Complexity Mitigation by Third-Party Logistics Providers within the Electronic Industry

إعداد

الباحث/ كريم محمد سيد سليمان

مدرس بالأكاديمية العربية للعلوم والتكنولوجيا والنقل البحري بالقاهرة، وجامعة الأعمال والتكنولوجيا بجدة

الباحث/ تامر سعيد سيد

باحث ماجستير بالأكاديمية العربية للعلوم والتكنولوجيا والنقل البحري بالقاهرة

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Abstract

The aim of this study is to provide insight into the significant role that third-party logistics (3PL) play in influencing strategies for electronic companies (e-companies) or electronic shippers (e-shippers) to efficiently address the complexities present in their supply chains (SCs). Thus, this research attempts to fill a major gap that has persisted in the literature, as previous studies shed light on various obstacles faced by e-companies, including price pressures, supply chain (SC) complexity, and worldwide hazards. However, it is worth noting that no subsequent updates or revisions have been studied. This research adopted a quantitative approach, utilizing surveys distributed to the top 100 global e-companies. The objective was to investigate the correlation between the outsourcing of 3PL services and enhancements in SC complexity while exploring further challenges and complexities facing SCs in the e-industry that are in need of enhancement. Furthermore, this research evaluates the present condition of 3PLs and quantifies their achievements in the e-industry.

In conclusion, effective supply chain management (SCM) strategies must be implemented because of the complexity of the electronic industry (e-industry) and the constant challenges caused by risks and disruptions. E-companies are beginning to understand the value of innovative techniques offered by 3PLs and the importance of outsourcing logistical services. They may now focus on their core competencies, which are essential to their survival.

Keywords:

Electronic Industry, Third-Party logistics, Supply chain complexity, Electronic Shippers, and Information Technology

تقييم المساهمات الإستراتيجية وتخفيف التعقيد من قبل مقدمي الخدمات اللوجستية الخارجيين داخل الصناعة الإلكترونية

الملخص

الهدف من هذه الدراسة هو تقديم نظرة ثاقبة للدور الهام الذي تلعبه الخدمات اللوجستية التابعة لجهات خارجية في التأثير على استراتيجيات الشركات الإلكترونية (الشركات الإلكترونية) أو شركات الشحن الإلكترونية لمعالجة التعقيدات الموجودة في سلاسل التوريد الخاصة بها بكفاءة. ومن ثم، يحاول هذا البحث سد فجوة كبيرة ظلت قائمة في الأدبيات، حيث سلطت الدراسات السابقة الضوء على مختلف العقبات التي تواجهها الشركات الإلكترونية، بما في ذلك ضغوط الأسعار، وتعقيد سلسلة التوريد، والمخاطر العالمية. ومع ذلك، تجدر الإشارة إلى أنه لم تتم دراسة أي تحديثات أو مراجعات لاحقة. اعتمد هذا البحث على المنهج الكمي، وذلك باستخدام الدراسات الاستقصائية الموزعة على أفضل 100 شركة إلكترونية عالمية. كان الهدف هو دراسة العلاقة بين الاستعانة بمصادر خارجية لخدمات PL 3والتحسينات في تعقيد SC مع استكشاف المزيد من التحديات والتعقيدات التي تواجه SC في الصناعة الإلكترونية والتي تحتاج إلى تعزيز. علاوة على ذلك، يقوم هذا البحث بتقييم الوضع الحالي لـ PLs 3ويحدد إنجازاتهم في الصناعة الإلكترونية.

وفي الختام، لا بد من تطبيق أساليب فعالة لإدارة سلسلة التوريد بسبب تعقيد القطاع الإلكتروني والتحديات المستمرة الناجمة عن المخاطر والاضطرابات. بدأت الشركات الإلكترونية في فهم قيمة التقنيات المبتكرة التي تقدمها PLs3 وأهمية الاستعانة بمصادر خارجية للخدمات اللوجستية. وقد يركزون الآن على كفاءاتهم الأساسية، والتي تعتبر ضرورية لبقائهم في المنافسة.

الكلمات المفتاحية: الصناعة الإلكترونية، والخدمات اللوجستية للأطراف الثالثة، وتعقيد سلسلة التوريد، وشركات الشحن الإلكترونية، وتكنولوجيا المعلومات

1- Introduction

The concerns surrounding SC vulnerabilities have become increasingly relevant in the current dynamic and unpredictable market environment (Peck, 2006; Soliman, 2017; Sharma et al., 2023). For businesses involved with electronic products (e-products), which exhibit internal and external complexity and are comprised of many components, the challenge is intensified due to their reliance on a complex and globally dispersed SC to bring these products to market (Tansel, 2017; Parajuly et al., 2020). Likewise, the ubiquity of electronics in everyday life has escalated, presenting considerable logistical challenges that stem from a combination of high consumer demand and the rapid rate at which product life cycles progress (Fernandes et al., 2023).

Langley and Capgemini (2012) acknowledged the fleeting nature of popularity for certain electronic items, where today's cutting-edge device may quickly become yesterday's news. Thus, to keep pace with this fast-moving sector, an efficient and flexible SC is essential. However, achieving this efficiency is hindered by several key obstacles:

- The challenges of global manufacturing and procurement
- The complexities of distribution channels and network structures
- The consequences of managing a sophisticated and high-value product range.

In emerging markets, e-companies are increasingly adopting a lean approach, emphasizing asset-light models and outsourcing of production and logistics to third-party entities as a strategic move to curb costs and enhance supplier and material management, with the overarching aim of addressing the dominant challenge of pricing pressures (Langley and Capgemini, 2012; Solakivi et al., 2022). This trend is further exemplified in the electronic manufacturers (e-manufacturers), where manufacturers implement postponement tactics to mitigate the complex challenges posed by their extensive, fragile SCs, such as logistical bottlenecks, supply constraints, distribution intricacies, inventory management, forecasting errors, and additional lead times required for product delivery (Munten et al., 2021; Subramani et al., 2022; Abusaq, 2023).

Combining these issues are the intrinsic challenges associated with high-value e-products, which include protection against theft and counterfeiting, managing the intricacies of long-distance transportation, packaging, and the rapid depreciation of items due to abbreviated life cycles, and the necessity for precise demand forecasting (Khan, 2016). Thus, to maintain a competitive edge and deliver

substantial customer value, companies are compelled to refine operational efficiency, concentrate on primary competencies, and outsource ancillary activities to third-party specialists capable of executing these tasks more swiftly or economically (Govindan et al., 2019; Chen et al., 2021).

Integral to this ecosystem are 3PLs, which perform logistics functions traditionally handled internally by manufacturing firms, encompassing either the entire logistics chain or specific segments thereof. These providers act as conduits, facilitating logistics services between clients and their end customers, taking on the responsibility of logistics execution without assuming product ownership (Barker et al., 2021). Furthermore, the surging need for superior logistics and SC services from electronic businesses (e-business) and various industries has impelled 3PLs to improve and innovate their offerings, while Logistics Service Providers (LSPs) are intensifying their focus on digital technologies, cost reduction strategies, and an expansion of their service portfolios to satisfy and exceed client demands in this rapidly evolving marketplace. (Langley & Infosys, 2020; Barker et al., 2021; Dovbischuk, 2022).

Efficient SCM is predicated on the seamless exchange of information between SC stakeholders, bolstering overall performance and eliminating potential risks (Abdel-Basset et al., 2019). Furthermore, the integral role of IT cannot be overstated, as it facilitates the crucial integration of suppliers, manufacturers, distributors, and end-users. Thus, through adept SCM applications, companies can accumulate actionable data, swiftly adapt to fluctuations in the marketplace, and shape a competitive edge in the marketplace (Chen, 2019; Cahyono et al., 2023)

On the other hand, contemporary enterprises are increasingly weaving IT into their logistical operations to foster cohesion between the systems of logistics providers and their clientele. This technology streamlines processes such as order fulfillment and engenders connectivity among all parties in the SC, including transportation companies, distributors, manufacturers, and retail entities (Prataviera et al., 2021). In the current era, the reliance of logistics-dependent companies on 3PLs is intensifying, primarily to leverage cutting-edge IT solutions that these providers offer (German et al., 2022). Such technological prowess is essential for 3PL companies, enabling the adaptation of complex SC operations and establishing a communicative bridge between customers and logistics users(Tiwari et al., 2023). This trend underlines the growing interdependence between logistics firms and innovative IT systems provided

by 3PLs to ensure synchronized SC functions and seamless interactions among customers and logistics service users (Barker et al., 2021).

Accordingly, the aim of this study is to analyze and understand the complexities within the e-industry and to evaluate how 3PLs contribute to the strategic navigation through these complexities to bolster SC efficiency, particularly addressing the critical issues of pricing pressures, the intricate nature of global SCs, and other challenges that influence crucial delivery metrics like timeliness, completeness of orders, visibility during transit, cost per freight, delivery timeframes, and the overall cycle from order to delivery.

The main research question probes into the ways in which 3PL providers with advanced IT solutions can amplify SC performance and formulate strategies for electronic companies, addressing the overarching question: “How do 3PL providers refine SC performance and shape electronic company strategies?”.

2- Literature Review

In this section, a review of existing research will be conducted to better understand the e-industry's SC challenges and how 3PLs help solve them. Moreover, It will also look at how modern technology influences the strategies of online companies. The review will cover what 3PLs are, what they do, why companies outsource to them, the role of technology, challenges in the e-commerce supply chain, how 3PLs are improving, and what areas need more study.

This section presents a comprehensive review of literature dedicated to the analysis of SC complexities within the e-industry through a critical examination of the pivotal role played by 3PLs in mitigating these complexities and the significant impact of IT on the formulation of strategic approaches in the e-industry. Furthermore, this paper will provide a concise overview of the concept of 3PLs and examine the ways in which technological advancements are influencing and shaping this industry. Furthermore, this research will additionally delineate the particular issues encountered by the e-industry SC, the ongoing enhancements being implemented by 3PLs, and identify areas of research that have still to be explored.

2.1-Understanding 3PLs: Definitions, Services, and Outsourcing Rationale:

The notion of 3PL comprises a diverse array of services, which include contract logistics, integrated logistics, and outsourced logistics. Nevertheless, the concept in question faces a notable challenge due to the absence of a widely acknowledged and agreed-upon delineation. This has resulted in substantial deliberation among scholars and practitioners alike. A 3PL provider is characterized as an independent company that offers logistics services for products it does not own, effectively operating outside the traditional scope of the product provider or the end client, and without holding inventory. These companies are adept at managing logistics functions that manufacturing firms prefer to outsource, thereby positioning themselves as critical intermediaries within the supply chain, facilitating the movement of raw materials, work-in-process inventory, and finished goods. Moreover, They undertake the responsibility of ensuring that the correct items are delivered efficiently and cost-effectively (Tian et al., 2008; Zacharia et al., 2011; Govindan et al., 2019).

The scope of 3PL services is broad and varies in definition as some perspectives outline 3PLs as comprehensive LSPs covering all or part of a company's logistics needs, whether for a producer or a consumer, while others view them through a more focused lens, emphasizing specific logistics tasks such as transportation and storage of goods (Forslund, 2012; Yadav et al., 2020). Nevertheless, literature also distinguishes 3PLs by their strategic role in forming long-term, mutually beneficial partnerships with shippers, offering a diverse array of services. This contrasts with more transactional or single-service definitions and underscores the strategic and integrative role of 3PLs in SCM (Herold et al., 2021). This analytical perspective suggests that the 3PLs' role extends beyond mere service provision into the realm of strategic partnership, implying a deeper integration with their client's business operations and strategic objectives (Delfmann et al., 2022).

Table (1) summarizes the diverse range of services offered by 3PL providers, which include but are not limited to the following categories: logistics, transportation, warehousing, special services, and technology/web services.

Table 1: 3PL services

Logistics Services	Receipt of materials, timely inventory management, financial transaction verification and management, and optimization of processes.
Transportation Services	Parcel delivery, broad-ranging trucking solutions (full truckload and less than truckload), procurement of vehicle fleets, exclusive contract transportation, end-point delivery services, and multimodal transport options (including rail, sea, and air shipping).
Warehousing	Selection and packaging, component assembly, site selection assistance, cargo transfer, centralized distribution hub services, implementation of operational technology like inventory management systems, radio frequency identification, and scanning technologies, transfer of goods through docking points, and completion of customer orders.
Special Services	Home delivery services, store-direct shipments, environmentally responsible logistics practices, return goods management, supply chain security measures, emergency response planning, global market growth strategies, designated areas for duty-free trade, advisory services for transportation and logistics, customs brokerage, international trade services, workforce management, oversight of product life stages, and customer service and sales support.
Technology/Web Services	Digital data interchange capabilities, integrated business process management, predictive analytics, logistics control systems, inventory and warehouse oversight solutions, management of supplier and customer relations, internet-enabled solutions, operational transparency, and mobile communication technologies.

Source: Forslund, 2012; Yang, 2015; Herold et al., 2021.

The advantages of partnering with 3PLs are manifold, encompassing logistics cost reductions, enhanced customer service, supply chain integration, conflict mitigation, increased operational efficiency, market credibility, capital expenditure avoidance, productivity boosts, risk mitigation, leveraging of resources, augmentation of expertise, creation of competitive advantages, and the trimming of personnel and equipment expenses. Nonetheless, the evident efficiencies and cost savings brought about by 3PLs in warehousing, distribution, and transportation, the selection of an appropriate provider is a decision that hinges on a matrix of factors, including pricing, performance, capability, responsiveness, service diversity, financial stability, cultural acumen, client endorsements, operational flexibility, and commitment fidelity (Zacharia et al., 2011; Yadav et al., 2020; Herold et al., 2021).

2.2- Advanced IT and 3PL:

The integral role of integrating SC networks both upstream and downstream is foundational for achieving organizational objectives. The deployment of IT in SCM has been identified as a catalyst for enhancing quality, diminishing coordination expenses, and ensuring effective management of the information flow within and beyond these networks (De Barros et al., 2015; Attaran, 2020). Moreover, scholars have investigated the synergy between IT and SCM, noting the enriched communication made possible by the internet, and the potential of IT to mitigate SC disturbances, such as the "Bullwhip effect".

The Internet serves not just as a communication medium but also as a transformative platform for evolving business processes, streamlining workflows, and disseminating knowledge. Nevertheless, the strategic application of IT in SCM attempts to streamline cycle times, reduce inventory levels, alleviate the Bullwhip effect, and refine the efficiency of distribution channels (Attaran, 2020).

Minor shifts in retail sales can escalate to significant inventory surpluses across the distribution chain, from distributors to manufacturers and suppliers. Recognizing these challenges, 3PLs are increasingly harnessing technology to scrutinize shipper business practices, aiming to slash transportation costs, optimize resource utilization, and enhance service delivery. The 3PL study conducted by Langley & Infosys (2020) underscores the necessity for 3PLs to extend a suite of IT-based services to their shipping clientele, enriching value delivery. Central to these technologies are tools for enhancing visibility, facilitating electronic data interchange, and managing warehouses/distribution centers and transportation more effectively. Moreover, cutting-edge technologies, such as web portals, cloud computing, network modeling, advanced analytics, and data mining, are also gaining traction (Barker et al.,2021). Additionally, the industry's perspective on blockchain services offered by 3PLs has been reassessed, with findings echoing those from the preceding year's analysis (Di Vaio & Varriale , 2020; Zhang et al., 2023).

2.3-E-Companies Challenges and 3PLs Trends for Improvements

The e-industry exhibits a significant level of SC complexity due to the rapid advancements in technology and the extensive global reach of manufacturing and

distribution networks (Saudi et al., 2019). The aforementioned complexity is additionally heightened by the imperative to consistently enhance product offerings and reduce product lifecycles in order to maintain a competitive edge within a fiercely contested industry. Furthermore, it is imperative for the complex interconnection of suppliers, producers, distributors, and retailers to function in a highly synchronized fashion in order to guarantee the seamless progression of materials from one phase to the subsequent (Pautri & Hudaya, 2021). Nevertheless, the effective coordination of entities is frequently hindered by the geographical dispersion of these entities, the unpredictable fluctuations in consumer demand, and the susceptibility of electronic components to temporal and environmental factors (Mortuza et al., 2023). The complexity of the situation is mostly attributed to the dependence on a wide range of components, which are frequently obtained from many vendors located in different countries. The inclusion of diverse sources is necessary in order to acquire access to specialist technology and cost benefits.

Nevertheless, the implementation of this strategy brings forward potential hazards pertaining to quality control, SC interruptions, and logistical challenges, including delays in customs procedures and transportation. In addition, the e-industry's emphasis on tailoring and individualizing products introduces heightened intricacies to the management of inventory and production procedures, necessitating the implementation of advanced demand prediction techniques and adaptable manufacturing systems (Parajuly et al., 2020). The complexity encompasses not only the physical logistics but also extends to the domain of information flow (Chang & Graham, 2012). Nevertheless, the successful implementation of SCM in the e-industry is contingent upon the utilization of sophisticated information systems that provide real-time monitoring, communication, and data analysis, hence facilitating well-informed decision-making. Therefore, corporations are making substantial investments in technology such as Enterprise Resource Planning (ERP), Advanced Planning and Scheduling (APS), and Customer Relationship Management (CRM) systems. These systems aid in the management of intricacies by offering transparency throughout the SC, promoting improved demand planning, and enabling prompt adaptation to market fluctuations or disturbances (Ivanov et al., 2019; Busse et al., 2021). However, it is imperative to address the environmental and ethical consequences associated with e-manufacturing in order to ensure the sustainability of SCs. The sector is increasingly confronted with the imperative to effectively handle the disposal of electronic waste, guarantee the sourcing of raw materials without any involvement in conflicts, and mitigate the environmental impact of logistics operations by reducing carbon emissions. Achieving sustainability while maintaining efficiency and competitiveness is a multifaceted challenge that

requires innovative solutions in product design, materials sourcing, and end-of-life management (Wang & Lu, 2014; Zhou & Yan, 2021). In conclusion, managing SC complexity in the electronic industry necessitates a holistic approach, embracing technological advancements, strategic planning, and sustainable practices to deliver products that meet the dynamic needs of the market.

The elucidation of challenges linked to e-complexity, as posited in the research question, finds its roots in seminal studies such as the 2012 empirical study conducted by Langley and Capgemini. This study not only laid the groundwork for understanding the intricate dynamics of the electronic manufacturing and sourcing sector but also identified crucial gaps that beckon further exploration.

The nuances of electronic complexity, encompassing challenges arising from retail interactions, inaccurate forecasts, risk tolerance, and penalties associated with vendor compliance programs, were cogently examined in the 2012 study. These challenges, delineated by Langley and Capgemini, serve as the bedrock upon which the industry's intricate landscape is built.

Moreover, the research underscored a conspicuous gap in the utilization of 3PLs for designing cost-efficient infrastructure across SCs. Merely 14% of e-shippers were found to engage 3PLs in this capacity, a statistic that not only reveals a noteworthy underutilization but also signals an untapped potential for enhancements and optimizations in collaboration.

To bridge this gap and usher in transformative improvements, it becomes imperative to leverage the insights gleaned from the 2012 study and couple them with the evolving dynamics of the industry. The 2020 study by Langley and Infosys, building upon the foundational work of the 2012 study, presents an appropriate link to explore contemporary trends and advancements in 3PLs within the e-companies

In essence, the synthesis of these studies provides a compelling narrative that not only articulates the challenges inherent in e-companies complexity but also positions the advancements in 3PL trends as a strategic panacea. This narrative, rooted in empirical research, serves as a persuasive call to action, urging stakeholders to harness the collective wisdom of these studies to drive industry-wide improvements and pave the way for a more efficient, resilient, and collaborative future.

The empirical studies underscore several key challenges and trends in the e-manufacturing and sourcing landscape, emphasizing the complexities within networks and channels. Specifically, the studies illuminate intricate challenges

associated with high-demand, intricate, and high-value e-products. In the subsequent paragraphs, a more in-depth exploration of these highlighted challenges will be presented.

The global e-manufacturing and sourcing industry confronts formidable challenges, necessitating strategic collaboration with 3PL. With e-product lifecycles shortening and margins tightening, the pressure to reduce costs and efficiently manage materials and suppliers is palpable. Several key challenges and trends stand out:

1. Asset Lightness: The prevailing trend is a decline in OEMs managing their own goods, favoring contract manufacturers and external logistics companies. Sony's asset sale in 2010 exemplifies this shift, emphasizing the importance of an asset-light approach.

2. Emerging Markets Sourcing: E-companies increasingly source manufacturing and logistics from developing economies to cut costs. However, challenges like inadequate infrastructure and rising compliance risks persist. 3PLs with market-specific experience are instrumental in developing strategies to expedite freight and maintain pipeline inventories.

3. Global SC Complexity and Risk: The global SC is complex, expensive, and lengthy due to diversified product lines and components sourced from distant locations. Furthermore, 3PLs express slightly more confidence in addressing this challenge than shippers, potentially due to a cost emphasis on products rather than logistics.

4. Postponement Strategies: E-manufacturers adopt a strategy of postponing final configuration until consumption, facilitated by 3PLs. This reduces inventory and offers higher customization options.

5. Price Pressure: E-shippers grapple with the logistical challenge of price pressure to cut operating costs. While they shift away from expensive air freight, 3PLs believe they can assist e-shippers more effectively in overcoming this challenge.

6. Contract Manufacturers as 3PLs: Contract manufacturers in emerging markets blur industry lines by offering 3PL-like services. However, 3PLs remain confident that e-companies will choose them for demanding international logistics requirements.

7. Environmental and Social Sustainability: Concerns about CO2 emissions and fuel consumption drive a focus on sustainability. Businesses and 3PLs explore innovative materials and packaging solutions to address environmental issues.

Additionally, the empirical studies highlighted several complexities in the network and channels, such as:

1. Retail Interactions: E-business complexity arises from diverse supply chains involving component suppliers, contract manufacturers, original design manufacturers, and end-users. Challenges in working with retailers include inaccurate forecasts, risk tolerance, and significant penalties for vendor compliance programs.

2. Cost-Efficient Infrastructure Design: Designing a common, economical infrastructure for supply chains is challenging. While only 14% of e-shippers use 3PLs for this service, there is a need for 3PLs to invest in customer understanding, especially in retail and consumer product experience.

On the other hand, high-demand, intricate, and high-value electronic products introduce challenges, such as:

1. Visibility: Global SC visibility ranks high among e-shippers' concerns, with 74% desiring visibility from 3PLs. This is critical for customers to know inventory availability, order status, and safety during transit.

2. Security: Security is a significant challenge, particularly in emerging markets. E-shippers seek 3PLs to enact security measures, including technologies like engine shutdown and GPS systems.

3. Counterfeiting: Security measures, such as serial number-equipped package seals, are crucial to prevent product counterfeiting. 3PLs play a role in managing component pedigree processes and maintaining supply chain integrity.

4. On-Board Intelligence: E-companies leverage digital supply chains for remote diagnostics and monitoring. 3PLs can act as central depots, handling service messages and dispatching replacement parts.

5. Packaging: E-companies experiment with cost-cutting and environmentally friendly packaging. 3PLs have an opportunity to contribute to innovations that reduce SKUs and enhance shipment integrity.

6. Local Market Customization: Markets vary in electrical needs and regulations, requiring 3PLs to assist e-companies with hardware localization and software downloads, particularly in emerging markets.

7. Short Lifecycles: Short lifecycles lead to inventory obsolescence. E-shippers believe 3PLs can help identify slower-moving items and enhance supply chain velocity.

8. Obsolete Inventory Disposal: E-companies resort to online auctions for obsolete inventory disposal, presenting a value-added service opportunity for 3PLs.

In summary, the trends underscore the intricate challenges in the global electronics manufacturing and sourcing landscape, emphasizing the crucial role of 3PLs in addressing these complexities and fostering innovative, sustainable solutions that require strategic management and innovative solutions, where 3PLs play an increasingly critical role in providing expertise, technology, and infrastructure to navigate these complexities effectively.

2.4-Literature Review Summary and Research Gaps:

The literature underlines the pivotal role of 3PLs in navigating the logistical challenges that face e-manufacturers. Key issues such as cost pressures, transportation, delivery performance, order consolidation, and SC complexity were examined with a specific focus on the 3PL study conducted by Langley & Capgemini in 2012. This study is distinguished as one of the few that delve into the contributions of 3PLs to address the logistical challenges particular to the e-industry comprehensively, unlike subsequent studies that have taken a more generalized approach without zeroing in on a specific industry. In surveying the existing literature, a significant gap is evident as current studies have not provided an updated or thorough examination of the role of 3PLs in mitigating logistics challenges within the e-industry. The 2012 study remains a fundamental reference point. It illuminates the complexities faced by the electronic industry and examines how 3PLs equipped with advanced information technology have developed strategies to surmount these challenges. This comprehensive study also incorporated diverse surveys targeting both electronic shippers (e-shippers) and 3PL providers, gathering a wealth of perspectives on the challenges of e-industry complexity.

In synthesizing this knowledge, it becomes compellingly clear that an updated exploration is required—one that bridges the decade-long research gap and provides current insights into the evolving roles and capabilities of 3PLs in the face of the e-industry's logistical complexities while aligning them with the current dynamics of the e-industry. Such research would not only contribute to the academic discourse but also offer practical guidance for the industry stakeholders navigating an increasingly complex and fast-paced global market.

3- Model Development and Hypothesis

3PL providers play a crucial role in addressing complexity challenges faced by e-shippers, such as price pressures, complexity, and global risks, as well as the areas that still need improvements like order fulfillment and shipment visibility. Figure 1 illustrates the different types of variables (independent, mediator, and dependent variables) and research hypotheses. A mediator variable is the influence of an independent variable on a dependent variable, forming part of the causal pathway and explaining the cause of an effect.

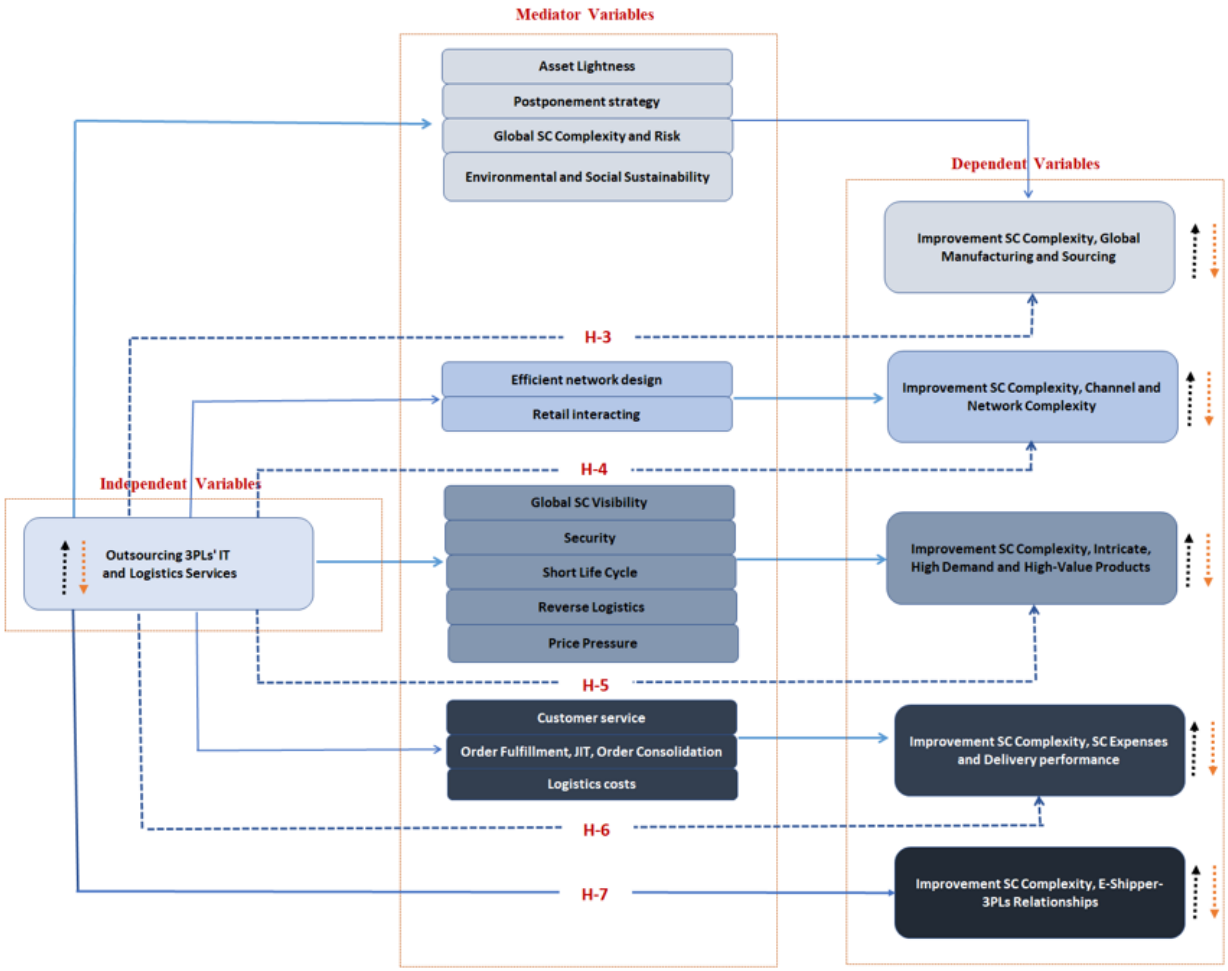


Figure 1: Research model variables and the hypothesis relationship

Source: Authors own (2023)

Table (2) outlines the research model variables, categorizing them as independent, mediators, and dependent, that have been identified from the comprehensive annual 3PL study conducted by Langley & Capgemini in 2012 and subsequently by Langley & Infosys in 2020.

Table (2): Research Model Variables

Type	Variable	Source
Independent	**Outsourcing 3PLs' IT and Logistics Services**	*(Langley & Capgemini, 2012) (Langley & Infosys, 2020)*
Dependent	**Improvement SC Complexity, Global Manufacturing and Sourcing**	
Mediator	Asset Lightness	
Mediator	Postponement strategy	

Mediator	Global SC Complexity and Risk	*(Langley & Capgemini, 2012)*
Mediator	Environmental and Social Sustainability	
Dependent	**Improvement SC Complexity, Channel and Network Complexity**	
Mediator	Efficient network design	
Mediator	Retail interacting	
Dependent	**Improvement SC Complexity, Intricate, High Demand and High-Value Products**	
Mediator	Global SC Visibility	
Mediator	Security	
Mediator	Short Life Cycle	
Mediator	Reverse Logistics	
Mediator	Price Pressure	
Dependent	**Improvement SC Complexity, Delivery performance**	*(Langley & Capgemini, 2012) (Langley & Infosys, 2020)*
Mediator	Customer service	
Mediator	Order fulfillment, JIT, Order consolidation	
Mediator	Logistics costs	
Dependent	**Improvement SC Complexity, E-shipper-3PLs Relationships**	
Mediator	E-shipper-3PLs Relationship	
Mediator	Increasing Outsourced Logistics Services	

Source: Authors own (2023)

The research employs a positive hypothesis, indicating that outsourcing logistics and IT services from 3PLs (independent variable) is directly proportional to improving the SC complexity in the e-industry (main dependent variable). The hypotheses developed in the annual 3PL study conducted by Langley & Capgemini in 2012 and subsequently by Langley & Infosys in 2020 are being validated and updated through authors' surveys with top global e-companies, addressing a gap in the current research.

H-1: SC Complexity in the e-industry which has continuously increased over time leads to the increase of outsourcing and a decrease in the insourcing of the logistics services.

H-2: the majority of challenges that cause the complexity of electronic SC can be grouped into the following main categories:

- Global Manufacturing and Sourcing
- Channel and network complexity
- Intricate, high demand and high-value products

H-3: Outsourcing of logistics services by 3PLs improves global manufacturing and sourcing challenges such as asset lightness and emerging markets sourcing.

H-4: Outsourcing of logistics services by 3PLs improves channel and network complexity challenges of efficient network design and retail interaction.

H-5: Outsourcing of logistics services by 3PLs improves intricate, high-demand, and high-value product challenges such as global SC visibility and security.

H-6: Outsourcing of logistics services by 3PLs improves delivery performance challenges such as customer service, on-time delivery, and complete order fulfillment and consolidations.

H-7: Outsourcing of logistics services by 3PLs improves e-shippers/3PLs relationship.

4- Methodology:

4.1-Data Collection

The research adopted a quantitative methodology to elucidate the strategic role of 3PLs in addressing the SC complexities within e-companies. This methodological approach is inclusive of a comprehensive review of challenges presented in prior literature while placing emphasis on bridging the research gaps from the 2012 study by Langley & Capgemini and the 2020 3PL study by Langley & Infosys. The section will also outline the specific demographic targeted by the research and detail the strategies implemented for the collection and manipulation of data.

The quantitative method within this research applied structured techniques such as surveys to construct a foundation for knowledge acquisition, gathering data through established instruments that produce both statistical and narrative data. The research is framed quantitatively, incorporating survey methodologies and hypothesis testing, with the design of the research methodology and conceptual framework being guided by the hypotheses generated from the literature review, as depicted in Figure (1).

In the pursuit of a robust and representative dataset, the first 500 global e-companies were selected based on a thorough ranking system utilizing market capitalization as of April 1st, 2023. This criterion, facilitated by the esteemed analytics platform Value.Today, ensured a strategic focus on industry leaders,

providing a solid foundation for capturing the diverse dynamics of the electronic business landscape. Market capitalization, a key indicator of a company's financial standing and market influence, served as a judicious basis for selecting the sampling unit, emphasizing the inclusion of influential players.

Regarding the sample profile, the survey responses were garnered from key stakeholders holding pivotal roles in SCM, logistics, procurement, transportation, and warehousing within the selected companies. The respondents, predominantly managers with direct experience and knowledge of the SC logistics process, contributed valuable insights from their vantage points. This deliberate focus on engaging professionals with hands-on expertise in the intricacies of SC operations ensured that the data collection was not only comprehensive but also reflective of the nuanced challenges and trends within the industry.

Furthermore, the survey's deliberate focus on generating precise and quantifiable insights led to the exclusive inclusion of closed-ended questions. This intentional approach was aimed at streamlining responses and facilitating a quantitative analysis of the collected data. Employing a Likert scale with five points of agreement or disagreement (ranging from "Strong Agree" to "Strongly Disagree"), the questionnaire sought to meticulously measure various research variables related to SCM within the e- industry.

In summary, the sampling unit for this study was strategically chosen based on market capitalization, giving precedence to the top 500 global e-commerce companies. The sample profile predominantly consisted of managers in key functional areas related to SCM, providing a targeted and informed perspective on the challenges and improvements within the e-commerce landscape. This structured approach, from survey design to participant selection, underscores the methodological precision employed to glean valuable insights from the e-industry professionals.

The strength of the variables employed in this research is substantiated by their alignment with established theoretical constructs elucidated in the literature Review (Section 2.1) titled "Understanding 3PLs: Definitions, Services, and Basis of Outsourcing Rationale." The majority of these variables, encapsulating the challenges faced by the e-industry, are intricately woven into the fabric of the best services provided 3PLs. This seamless integration not only fortifies the theoretical underpinnings but also enhances the face validity of the research model.

Furthermore, the reliability of the research variables is underscored by their historical application, notably in a 2012 study. The recurrence of these variables in a survey dedicated to understanding the challenges encountered by e-companies and the evolving trends in 3PL improvements attests to their enduring relevance. The consistent utilization of these variables over time contributes to their reliability, painting a comprehensive and reliable picture of the challenges and advancements within the e-commerce domain. In essence, the variables selected for this study are not arbitrary but strategically chosen elements that stand the test of both theoretical alignment and empirical validation.

In exploring the pivotal role of 3PLs in refining the strategies of e-companies and addressing the intricacies of SCM within the electronic industry. The questionnaire comprised 27 questions, organized into five categories split between two sections, A and B:

- **Section A** included two sets of questions providing insights into the roles of 3PLs in enhancing delivery performance and the nature of the relationships and experiences between e-companies and their 3PL providers.
- **Section B** presented three sets of questions elucidating the influence of 3PLs on various supply chain challenges: global electronics manufacturing and sourcing, complex networks and channels, and the challenges associated with high-demand, high-value products.

4.2-Data Analysis

Statistical methods were employed to reflect the role of 3PLs in mitigating SC complexity within the e-industry. This involved assessing various dependent variables that are indicative of SC complexity, influenced by mediator variables as illustrated in the research model shown in Figure (1). The mediator variables in this study serve as crucial pathways through which independent variables exert their influence on dependent variables. These dependent variables, integral to the research, were derived and calculated utilizing SPSS software. The mediator variables, which significantly and directly impact the levels of the dependent variables, were computed through the "Compute Variable" function. Subsequently, the "Mean" function was applied to ascertain the values of the mediator variables.

An illustrative example of this process is evident in the context of the "Improvement SC Complexity, Global Manufacturing, and Sourcing" dependent variable. The mediator variables associated with this dependent variable include:

- Asset Lightness
- Postponement Strategy

- Global SC Complexity and Risk
- Environmental and Social Sustainability

These mediator variables play a pivotal role in mediating the relationship between independent and dependent variables. For clarity, the values for the dependent variable were calculated based on the computed values of these mediator variables, providing a nuanced understanding of the intricate interplay within the research framework. The utilization of these mediator variables is vital for comprehending the mechanisms through which various factors impact the overall improvement in SC complexity, global manufacturing, and sourcing strategies.

Table (3) Calculation of Improvement SC Complexity - Global Manufacturing and Sourcing Value as One of Dependent Variables

Mediator Variable				Dependent Variable
Asset Lightness	**Global SC Complexity and Risk**	**Postponement strategy**	**Environmental and Social Sustainability**	**SC Complexity - Global Manufacturing and Sourcing**
4	5	2	5	4
5	5	5	5	5
5	5	4	5	4.75
4	5	5	4	4.5
5	5	5	5	5
5	5	5	5	5
5	4	4	5	4.5
4	5	4	4	4.25
5	4	4	4	4.25
4	5	5	4	4.5
2	2	2	2	2
2	2	2	3	2.25
2	2	2	2	2
2	2	2	3	2.25
2	2	2	2	2
2	2	2	2	2

Source: Authors own (2023)

The researchers employed SPSS for statistical analysis to compute the following aspects:

- Values for dependent variables were derived based on mediator variables, which are understood to significantly and directly affect the level of the dependent variables as in Table (3).
- The internal correlation between the mediator and each dependent variable was examined to establish the strength of the relationship, denoted by the correlation coefficient (r).
- The relationship between independent and dependent variables was analyzed to ascertain both the strength of the correlation (r) and the significance value (p), affirming the research hypotheses and refuting the null hypotheses.
- Regression analysis and hypothesis testing were conducted to delineate the relationship between independent and dependent variables. This included:
- Descriptive statistics detailing sample size, mean values aligned with the five-point Likert scale, and standard deviations for the variables entered into the regression model.
- The ANOVA test was applied to determine the significance of the regression, aiming to reject the null hypothesis by validating the robust relationship between independent and dependent variables.
- The regression line was plotted to represent the equation and to confirm the presence of a linear and proportionally strong relationship between the variables.
- The regression and correlation coefficients, including unstandardized and standardized coefficients, standard error, Variance Inflation Factor (VIF), and collinearity tolerance, were calculated to ensure a linear regression equation free from multicollinearity.
- Regression charts such as histograms, scatterplots, and normal probability plots were utilized to verify the moderation of residual distribution and the alignment of data around the regression line, conforming to a normal distribution, thereby confirming the validity of the regression analysis.

Moreover, The researchers conducted a descriptive analysis of the questionnaire responses collected from e-companies, drawing comparisons with the findings from the 2012 3PL study conducted by Langley & Capgemini. This analysis highlighted discrepancies, particularly in areas such as pricing pressures and global SC complexity. Moreover, it verified the alignment of these findings with those from the 2020 study conducted by Langley & Infosys, thereby mapping the evolution and persistence of certain challenges within the electronic sector over time.

5- Analysis and Findings

5.1-Statistical Analysis

5.1.1- Correlation and Hypothesis Verification

Correlation is a statistical tool that's used to calculate and examine how closely two or more variables are related. The correlation coefficient is a statistical measure of the strength of a linear relationship between two variables. Symbol (r) represents the simple correlation coefficient and the following displays Pearson's Coefficient scale for of positive linear correlation.

Table (4) Scale of Pearson's Correlation Coefficient

Scale of correlation coefficient	Value
$0 < r \leq 0.19$	Very Low Correlation
$0.2 \leq r \leq 0.39$	Low Correlation
$0.4 \leq r \leq 0.59$	Moderate Correlation
$0.6 \leq r \leq 0.79$	High Correlation
$0.8 \leq r \leq 1.0$	Very High Correlation

Source: Hauke & Kossowski (2011)

Statistical Significance (P Value) involves setting a null Hypothesis and competing alternative hypothesis., the null hypothesis (H0) is a hypothesis of "no difference, no effect, no correlation, no association etc."
The alternative hypothesis (H1) is the competing alternative to the null hypothesis and is usually the research hypothesis set out to investigate. The p-value is a number, calculated from a statistical test, that describes how likely you are to have found a particular set of observations if the null hypothesis were true.

Table (5) Statistical Significance Values (p)

Values of *p*	Inference
$p > 0.10$	No evidence against the null hypothesis.
$0.05 < p < 0.10$	Weak evidence against the null hypothesis
$0.01 < p < 0.05$	Moderate evidence against the null hypothesis
$0.05 < p < 0.001$	Good evidence against null hypothesis.
$0.001 < p < 0.01$	Strong evidence against the null hypothesis
$p < 0.001$	Very strong evidence against the null hypothesis

Source: Andrade (2019)

The correlations between dependent, mediators, and independent variables using the SPSS program.

1. Correlation between the dependent variable (improvement SC Complexity, Global Manufacturing, and Sourcing) and both Mediators and independent variable:

- Table (C-1a) illustrates the correlation level between the dependent variable (Improvement SC Complexity, Global Manufacturing, and Sourcing) and their related mediator variables (Asset Lightness, Postponement strategy, Global SC Complexity, and Risk and Environmental and Social Sustainability), as clear in Table (C-1a) the correlation level (r) mostly exceeds (0.8) that is classified as very high correlation according to Pearson scale.

Table (C-1a) Correlation strength between improvement SC Complexity, Global Manufacturing, and Sourcing as the dependent variable and their mediator variables

Correlations

		Improvement SC Complexity, Global Manufacturing and Sourcing	Asset Lightness	Global Supply Chain Complexity and Risk	Postponement Strategy	Environmental and Social Sustainability
Improvement SC Complexity, Global Manufacturing and Sourcing	Pearson Correlation	1	.913**	.926**	.793**	.898**
	Sig. (2-tailed)		<.001	<.001	<.001	<.001
	N	100	100	100	100	100
Asset Lightness	Pearson Correlation	.913**	1	.861**	.559**	.792**
	Sig. (2-tailed)	<.001		<.001	<.001	<.001
	N	100	100	100	100	100
Global Supply Chain Complexity and Risk	Pearson Correlation	.926**	.861**	1	.613**	.781**
	Sig. (2-tailed)	<.001	<.001		<.001	<.001
	N	100	100	100	100	100
Postponement Strategy	Pearson Correlation	.793**	.559**	.613**	1	.627**
	Sig. (2-tailed)	<.001	<.001	<.001		<.001
	N	100	100	100	100	100
Environmental and Social Sustainability	Pearson Correlation	.898**	.792**	.781**	.627**	1
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	
	N	100	100	100	100	100

**. Correlation is significant at the 0.01 level (2-tailed).

- Table (C-1b) illustrates the correlation level between the dependent variable (Improvement SC Complexity, Global Manufacturing and Sourcing) and independent variable (3PLs outsourcing), the correlation level (r) mostly exceeds (0.8) and is classified as a very high correlation according to Pearson scale.

Table (C-1b) Correlation between the dependent variable (Improvement SC Complexity, Global Manufacturing, and Sourcing) and independent variable (3PLs outsourcing)

Correlations

		Improvement SC Complexity, Global Manufacturing and Sourcing	3PL outsourcing
Improvement SC Complexity, Global Manufacturing and Sourcing	Pearson Correlation	1	.853**
	Sig. (2-tailed)		<.001
	N	100	100
3PL outsourcing	Pearson Correlation	.853**	1
	Sig. (2-tailed)	<.001	
	N	100	100

**. Correlation is significant at the 0.01 level (2-tailed).

- The significance value (p) in table (C-1a) and table (C-1b) is less than 0.001 which confirms the research hypothesis (H-3) and rejects the null hypothesis.

2. Correlation between the dependent variable (Improvement SC Complexity, Channel and Network Complexity) and both Mediators and independent variable:

- Table (C-2a) illustrates the correlation level between the dependent variable (Improvement SC Complexity, Channel and Network Complexity) and their related mediator variables (Efficient network design, Retail interacting), the

correlation level exceeds (0.8) that is classified as a very high correlation according to Pearson scale.

Table (C-2a) Correlation strength between the dependent variable (Improvement SC Complexity, Channel and Network Complexity) and their related mediator variables

Correlations

		Improvement SC Complexity, Channel and Network Complexity	Efficient Network Design	Retail Interacting
Improvement SC Complexity, Channel and Network Complexity	Pearson Correlation	1	.908**	.860**
	Sig. (2-tailed)		<.001	<.001
	N	100	100	100
Efficient Network Design	Pearson Correlation	.908**	1	.567**
	Sig. (2-tailed)	<.001		<.001
	N	100	100	100
Retail Interacting	Pearson Correlation	.860**	.567**	1
	Sig. (2-tailed)	<.001	<.001	
	N	100	100	100

**. Correlation is significant at the 0.01 level (2-tailed).

- Table (C-2b) illustrates the correlation level between the defendant variable (Improvement SC Complexity, Channel and Network Complexity) and independent variable (3PLs outsourcing); the correlation level (r) mostly exceeds (0.6) which is classified as high correlation according to Pearson scale.

Table (C-2b) Correlation strength between the dependent variable (Improvement SC Complexity, Channel and Network Complexity) and independent variable (3PLs outsourcing)

Correlations

		Improvement SC Complexity, Channel and Network Complexity	3PL outsourcing
Improvement SC Complexity, Channel and Network Complexity	Pearson Correlation	1	.691**
	Sig. (2-tailed)		<.001
	N	100	100
3PL outsourcing	Pearson Correlation	.691**	1
	Sig. (2-tailed)	<.001	
	N	100	100

**. Correlation is significant at the 0.01 level (2-tailed).

- The significance value (p) in table (C-2a) and Table (C-2b) is less than 0.001 which confirms the research hypothesis (H-4) and rejects the null hypothesis.

3. Correlation between the dependent variable (Improvement SC Complexity, High Demand, and High-Value Products) and both Mediators and independent variable:

- Table (C-3a) illustrates the correlation level between the dependent variable (Improvement SC Complexity, High Demand, and High-Value Products) and their related mediator variables (Global SC Visibility, Security, Short Life Cycle, Reverse Logistics, Price Pressure); the correlation level exceeds (0.8) for all of them to be classified as very high correlation.

Table (C-3a) Correlation between Improvement SC Complexity, High Demand, and High-Value Products as the dependent variable and their mediator variables

Correlations

		Improvement SC Complexity, Intricate, High Demand and High-Value Products	Global SC Visibility	Security	Short Life Cycle	Reverse logistics	Price Pressure
Improvement SC Complexity, Intricate, High Demand and High-Value Products	Pearson Correlation	1	.900**	.952**	.882**	.903**	.922**
	Sig. (2-tailed)		<.001	<.001	<.001	<.001	<.001
	N	100	100	100	100	100	100
Global SC Visibility	Pearson Correlation	.900**	1	.863**	.670**	.702**	.840**
	Sig. (2-tailed)	<.001		<.001	<.001	<.001	<.001
	N	100	100	100	100	100	100
Security	Pearson Correlation	.952**	.863**	1	.797**	.832**	.846**
	Sig. (2-tailed)	<.001	<.001		<.001	<.001	<.001
	N	100	100	100	100	100	100
Short Life Cycle	Pearson Correlation	.882**	.670**	.797**	1	.838**	.735**
	Sig. (2-tailed)	<.001	<.001	<.001		<.001	<.001
	N	100	100	100	100	100	100
Reverse logistics	Pearson Correlation	.903**	.702**	.832**	.838**	1	.769**
	Sig. (2-tailed)	<.001	<.001	<.001	<.001		<.001
	N	100	100	100	100	100	100
Price Pressure	Pearson Correlation	.922**	.840**	.846**	.735**	.769**	1
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	<.001	
	N	100	100	100	100	100	100

**. Correlation is significant at the 0.01 level (2-tailed).

- Table (C-3b) illustrates the correlation level between the defendant variable (Improvement SC Complexity, High Demand, and High-Value Products) and independent variable (3PLs outsourcing); the correlation level (r) mostly exceeds (0.8) that is classified as very high correlation according to Pearson scale.

Table (C-3b) Correlation strength between the dependent variable (Improvement SC Complexity, High Demand, and High-Value Products) and independent variable (3PLs outsourcing)

Correlations

		Improvement SC Complexity, Intricate, High Demand and High-Value Products	3PL outsourcing
Improvement SC Complexity, Intricate, High Demand and High-Value Products	Pearson Correlation	1	.846**
	Sig. (2-tailed)		<.001
	N	100	100
3PL outsourcing	Pearson Correlation	.846**	1
	Sig. (2-tailed)	<.001	
	N	100	100

**. Correlation is significant at the 0.01 level (2-tailed).

- The significance value (p) in table (C-3a) and Table (C-3b) is less than 0.001 which confirms the research hypothesis (H-5) as found in section (5.3) and rejects the null hypothesis.

4. Correlation between the dependent variable (Improvement SC Complexity, Delivery performance) and both Mediators and independent variable:

- Table (C-4a) illustrates the correlation level between the dependent variable (SC Complexity, Delivery performance) and their related mediator variables (Customer service, JIT and order fulfillment and consolidation, Logistics costs), the correlation level exceeds (0.8) for all of them to be classified as very high correlation.

Table (C-4a) Correlation strength between Improvement SC Complexity, Delivery performance as the dependent variable, and their mediator variables.

Correlations

		Improvement SC Complexity, Delivery Performance	Custome rservice	JIT and Order Fufillment	Logistics costs
Improvement SC Complexity, Delivery Performance	Pearson Correlation	1	.848**	.942**	.950**
	Sig. (2-tailed)		<.001	<.001	<.001
	N	100	100	100	100
Custome rservice	Pearson Correlation	.848**	1	.659**	.681**
	Sig. (2-tailed)	<.001		<.001	<.001
	N	100	100	100	100
JIT and Order Fufillment	Pearson Correlation	.942**	.659**	1	.915**
	Sig. (2-tailed)	<.001	<.001		<.001
	N	100	100	100	100
Logistics costs	Pearson Correlation	.950**	.681**	.915**	1
	Sig. (2-tailed)	<.001	<.001	<.001	
	N	100	100	100	100

**. Correlation is significant at the 0.01 level (2-tailed).

- Table (C-4b) illustrates the correlation level between the defendant variable (Improvement SC Complexity, Delivery performance) and independent variable (3PLs outsourcing); the correlation level (r) mostly exceeds (0.8) which is classified as a very high correlation according to Pearson scale.

Table (C-4b) Correlation strength between the dependent variable (Improvement SC Complexity, Delivery performance) and independent variable (3PLs outsourcing)

Correlations

		Improvement SC Complexity, Delivery Performance	3PL outsourcing
Improvement SC Complexity, Delivery Performance	Pearson Correlation	1	.868**
	Sig. (2-tailed)		<.001
	N	100	100
3PL outsourcing	Pearson Correlation	.868**	1
	Sig. (2-tailed)	<.001	
	N	100	100

**. Correlation is significant at the 0.01 level (2-tailed).

- The significance value (p) in table (C-4a) and table (C-4b) is less than 0.001 which confirms the research hypothesis (H-6) as found in section (5.3) and rejects the null hypothesis.

5. Correlation between the dependent variable (Improvement SC Complexity, E-shipper, and 3PLs relationship) and independent variable:

- Table (C-5) illustrates the correlation level between the dependent variable (Improvement SC Complexity, E-shipper, and 3PLs relationship) and independent variable (3PLs outsourcing); the correlation level (r) mostly exceeds (0.7) that is classified as high correlation according to Pearson scale.
- The significance value (p) in the table (C-5) is less than 0.001 which confirms the research hypothesis (H-7) and rejects the null hypothesis.

Table (C-5) Correlation strength between the dependent variable (Improvement SC Complexity, E-shipper, and 3PLs relationship) and independent variable (3PLs outsourcing).

Correlations

		Improvement SC Complexity, E-Shipper-3PLs Relationships	3PL outsourcing
Improvement SC Complexity, E-Shipper-3PLs Relationships	Pearson Correlation	1	.743**
	Sig. (2-tailed)		<.001
	N	100	100
3PL outsourcing	Pearson Correlation	.743**	1
	Sig. (2-tailed)	<.001	
	N	100	100

**. Correlation is significant at the 0.01 level (2-tailed).

5.1.2 Regression and Hypothesis Verification

Linear Single regression studies the relationship between an independent variable and a dependent variable, presenting a linear equation that reflects the dependent variable as a function of the independent variable.

$Y = b_0 + b_1x$ Where b0, b1 $b_1 = \frac{n\sum xy - \sum x \sum y}{n\sum x^2 - (\sum x)^2}$ $b_0 = \bar{y} - b_1\bar{x}$

- (b1) → reflect the slope of the regression line,
- When the b1 sign is positive it means a proportional relationship but if the b1 sign is negative it means a reverse relationship.

The regression results between dependent and independent variables using the SPSS program.

1. Regression between dependent variable (Global Manufacturing and Sourcing) and independent variable (3PLs outsourcing)

- **Descriptive Statistics,** the following table (R-1a) shows the descriptive statistics (sample size - mean values following five-point Likert score - standard deviations) for both dependent and independent variables.

Table (R-1a) Regression descriptive statistics for dependent and independent variables

Descriptive Statistics

	Mean	Std. Deviation	N
Improvement SC Complexity, Global Manufacturing and Sourcing	3.7150	.75463	100
3PL outsourcing	3.81	.775	100

- **ANOVA Test,** the following table (R-1b) shows the results of the ANOVA analysis the value of Sig is (< 0.001) which is less than (0.05), and therefore the

null hypothesis is rejected but the alternative hypothesis is accepted as the regression is significant and the dependent variable could be predicted by examining the impact of the independent variable on it.

Table (R-1b) ANOVA analysis test of dependent variable Improvement SC, Global Manufacturing and Sourcing

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	40.982	1	40.982	260.879	<.001[b]
	Residual	15.395	98	.157		
	Total	56.378	99			

a. Dependent Variable: Improvement SC Complexity, Global Manufacturing and Sourcing
b. Predictors: (Constant), 3PL outsourcing

- **Scattering plot and regression line,** figure (R-1a) illustrates the scattering plot and regression line that is generated using the SPSS program.
The regression equation is **Y= 0.55 + 0.83X** as found in figure (R-1a), in which b0=0.55 and b1=0.83. The conclusion from the regression equation is that each increase in outsourcing logistics by 1% causes an increase of (0.83%) in the overall improvement of SC complexity in global manufacturing and sourcing through the improvement in mediator variables (Asset Lightness, Postponement strategy, Global SC Complexity and Risk, Environmental and Social Sustainability).

The regression equation reflects the existence of the linear and strong proportional relationship between the independent variable (3PLs outsourcing) and the dependent variable (Improvement SC complexity, global manufacturing, and sourcing) that confirms the research hypothesis (H-3).

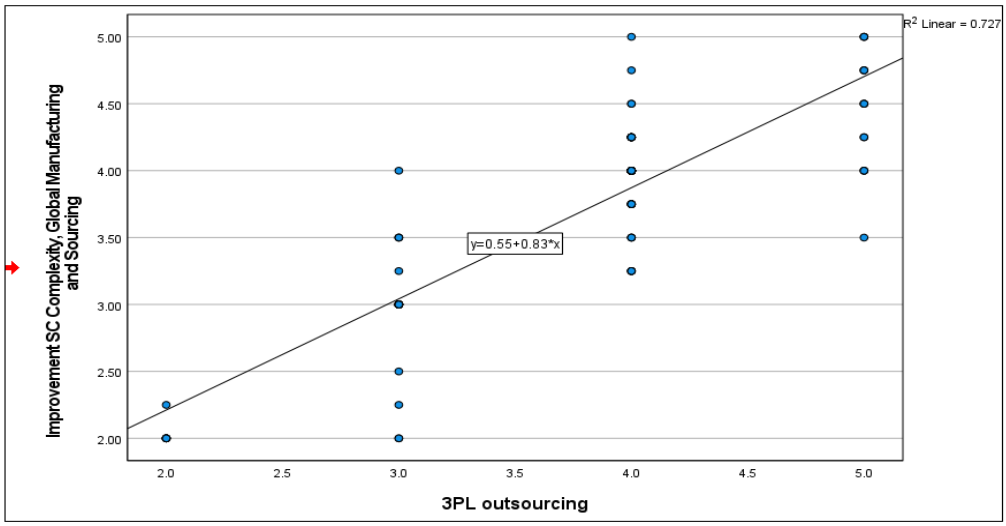


Figure (R-1a) Scattering plot and regression line between dependent and independent variables

- **Regression and correlation coefficients**

Table (R-1c) Regression and correlation coefficients between dependent and independent variables

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Correlations Zero-order	Correlations Partial	Correlations Part	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	.550	.200		2.751	.007					
	3PL outsourcing	.831	.051	.853	16.152	<.001	.853	.853	.853	1.000	1.000

a. Dependent Variable: Improvement SC Complexity, Global Manufacturing and Sourcing

- **Regression Charts,** the following figure (R-1b) shows the moderation of the residual distribution and the existence of data around the straight line. Therefore, the residuals follow the normal distribution, which is one of the conditions for the validity of the regression analysis.

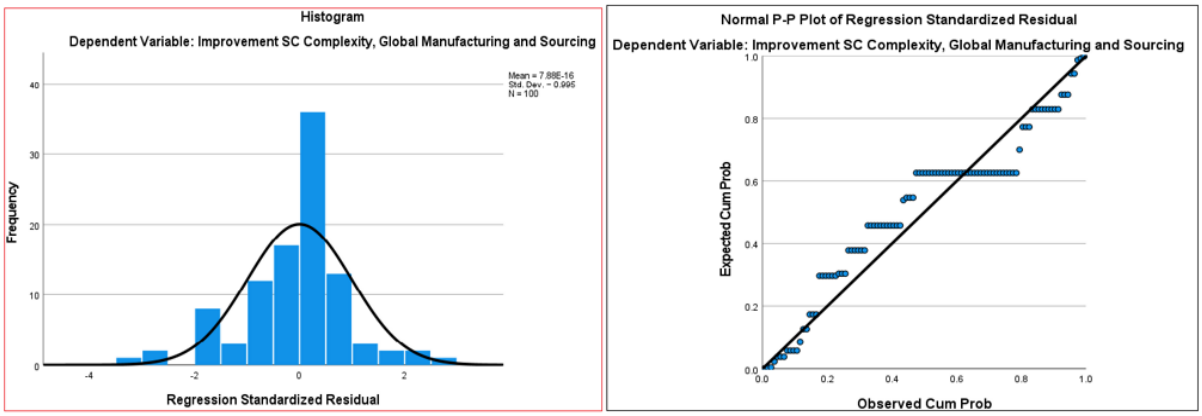


Figure (R-1b) Histogram and Normal probability plot of residuals of dependent variable: Improvement SC complexity, global manufacturing and sourcing

2. Regression between dependent variable (Channel and Network Complexity) and independent variable (3PLs outsourcing)

- **Descriptive Statistics,** the following table (R-2a) shows the descriptive statistics (sample size - mean values following five-point Likert score - standard deviations) for both dependent and independent variables.

Table (R-2a) Regression descriptive statistics for dependent and independent variables

Descriptive Statistics

	Mean	Std. Deviation	N
Improvement SC Complexity, Channel and Network Complexity	3.7400	.63357	100
3PL outsourcing	3.81	.775	100

- **ANOVA Test,** the following table (R-2b) shows the results of ANOVA analysis the value of Sig is (< 0.001) which is less than (0.05), and therefore the null hypothesis is rejected but the alternative hypothesis is accepted also the regression is significant and the dependent variable could be predicted by examining the impact of independent variable on it.

Table (R-2b) ANOVA analysis test of dependent variable Improvement SC, channel and network complexity

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	18.964	1	18.964	89.453	<.001[b]
	Residual	20.776	98	.212		
	Total	39.740	99			

a. Dependent Variable: Improvement SC Complexity, Channel and Network Complexity
b. Predictors: (Constant), 3PL outsourcing

- **Scattering plot and regression line,** Figure (R-2a) illustrates the scattering plot and regression line that is generated using the SPSS program.
The regression equation is **Y= 1.59 + 0.57X** as found in figure(R-2a), in which b0=1.59 and b1=0.57. The conclusion from the regression equation is that each increase in outsourcing logistics by 1% causes an increase of (0.57%) in the overall improvement of SC complexity in channel and network complexity through the improvement in mediator variables (Efficient network design, Retail interacting).

Also, the regression equation reflects the existence of a linear and strong proportional relationship between the independent variable (3PLs outsourcing) and dependent variable (Improvement SC complexity, channel, and network complexity) that confirms the research hypothesis (H-4) as found in section (5.3).

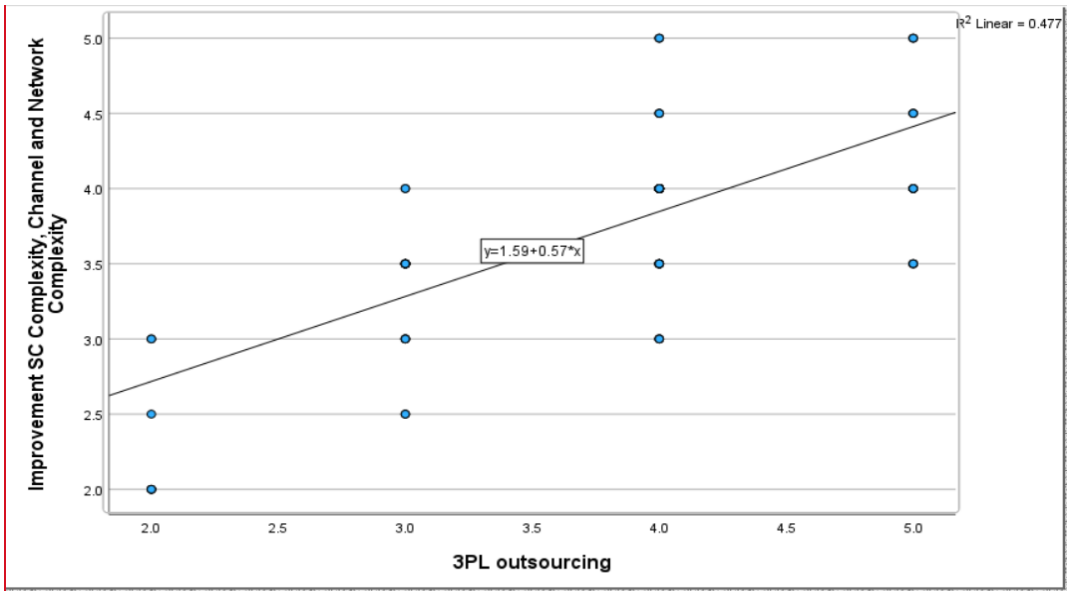


Figure (R-2a) Scattering plot and regression line between dependent and independent variables

- ## Regression and correlation coefficients

Table (R-2c) Regression and correlation coefficients between dependent and independent variables

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Correlations Zero-order	Correlations Partial	Correlations Part	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	1.587	.232		6.834	<.001					
	3PL outsourcing	.565	.060	.691	9.458	<.001	.691	.691	.691	1.000	1.000

a. Dependent Variable: Improvement SC Complexity, Channel and Network Complexity

- **Regression Charts,** the following figure (R-2b) shows the moderation of the residual distribution and the existence of data around the straight line. Therefore, the residuals follow the normal distribution, which is one of the conditions for the validity of the regression analysis.

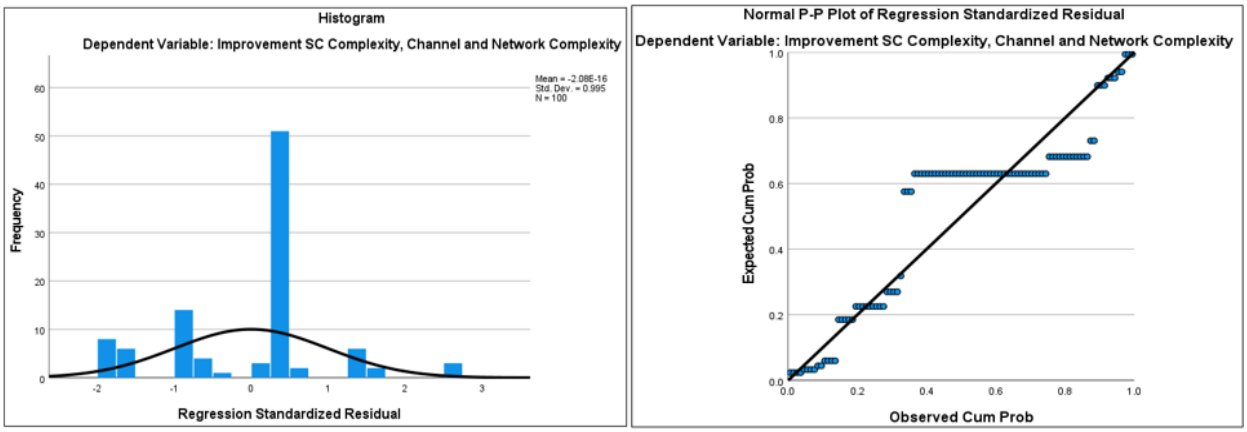


Figure (R-2b) Histogram and Normal probability plot of residuals of dependent variable: Improvement SC complexity, channel and network complexity.

3. Regression between dependent variable (High Demand and High-Value Products) and independent variable (3PLs outsourcing)

- **Descriptive Statistics,** the following table (R-3a) shows the descriptive statistics (sample size - mean values following five-point Likert score - standard deviations) for both dependent and independent variables.

Table (R-3a) Regression descriptive statistics for both dependent and independent variables

Descriptive Statistics

	Mean	Std. Deviation	N
Improvement SC Complexity, Intricate, High Demand and High-Value Products	3.798	.7333	100
3PL outsourcing	3.81	.775	100

- **ANOVA Test,** the following table (R-3b) shows the results of ANOVA analysis the value of Sig is (< 0.001) which is less than (0.05), and therefore the null hypothesis is rejected but the alternative hypothesis is accepted also the regression is significant and the dependent variable could be predicted by examining the impact of the independent variable on it.

Table (R-3b) ANOVA analysis test of dependent variable Improvement SC complexity, High Demand, and High-Value Products

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	38.090	1	38.090	246.389	<.001[b]
	Residual	15.150	98	.155		
	Total	53.240	99			

a. Dependent Variable: Improvement SC Complexity, Intricate, High Demand and High-Value Products

b. Predictors: (Constant), 3PL outsourcing

- **Scattering plot and regression line,** Figure (R-3a) illustrates the scattering plot and regression line that is generated using the SPSS program.
The regression equation is Y= 0.75 + 0.8X as found in figure(R-3a), in which b0=0.75 and b1=0.8. the conclusion from the regression equation is that each increase in outsourcing logistics by 1% causes an increase of (0.8%) in the overall Improvement of SC Complexity, High Demand, and High-Value Products through the improvement in mediator variables (Global SC Visibility, Security, Short Life Cycle, Reverse Logistics, Price Pressure).

  Also, the regression equation reflects the existence of a linear and strong proportional relationship between the independent variable (3PLs outsourcing) and dependent variable (Improvement SC complexity, High Demand, and High-Value Products) that confirms the research hypothesis (H-5).

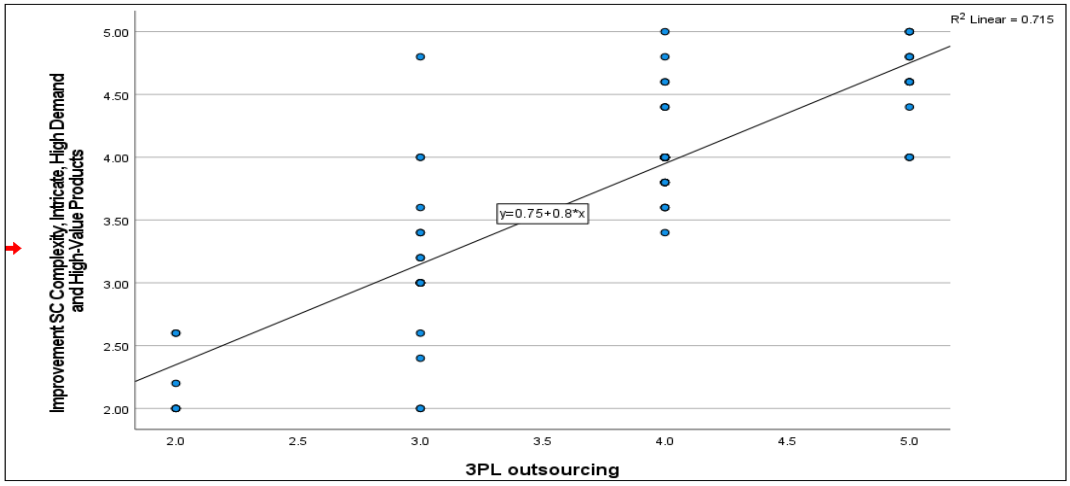


Figure (R-3a) Scattering plot and regression line between dependent and independent variables

- **Regression and correlation coefficients**

Table (R-3c) Regression and correlation coefficients between dependent and independent variables

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Correlations Zero-order	Correlations Partial	Correlations Part	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	.747	.198		3.766	<.001					
	3PL outsourcing	.801	.051	.846	15.697	<.001	.846	.846	.846	1.000	1.000

a. Dependent Variable: Improvement SC Complexity, Intricate, High Demand and High-Value Products

- **Regression Charts,** the following figure (R-3b) shows the moderation of the residual distribution and the existence of data around the straight line. Therefore, the residuals follow the normal distribution, which is one of the conditions for the validity of the regression analysis.

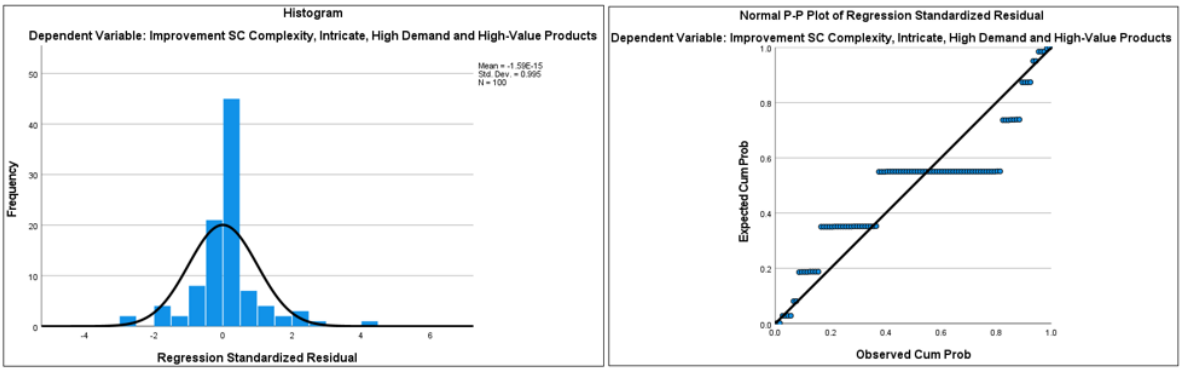


Figure (R-3b) Histogram and Normal probability plot of residuals of dependent variable: Improvement SC complexity, High Demand and High-Value Products.

4. Regression between the defendant variable (Delivery performance) and independent variable (3PLs outsourcing)

- **Descriptive Statistics,** the following table (R-4a) shows the descriptive statistics (sample size - mean values following five-point Likert score - standard deviations) for both dependent and independent variables.

Table (R-4a) Regression descriptive statistics for both dependent and independent variables

Descriptive Statistics

	Mean	Std. Deviation	N
Improvement SC Complexity, Delivery Performance	3.8000	.75953	100
3PL outsourcing	3.81	.775	100

- **ANOVA Test,** the following table (R-4b) shows the results of ANOVA analysis the value of Sig is (< 0.001) which is less than (0.05), and therefore the null hypothesis is rejected but the alternative hypothesis is accepted also the regression is significant and the dependent variable could be predicted by examining the impact of the independent variable on it.

Table (R-4b) ANOVA analysis test of dependent variable Improvement SC complexity, Delivery Performance

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	42.997	1	42.997	298.558	<.001[b]
	Residual	14.114	98	.144		
	Total	57.111	99			

a. Dependent Variable: Improvement SC Complexity, Delivery Performance
b. Predictors: (Constant), 3PL outsourcing

- **Scattering plot and regression line,** Figure (R-4a) illustrates the scattering plot and regression line that is generated using the SPSS program.
The regression equation is Y= 0.56 + 0.85X as found in figure (R-4a), in which b0=0.56 and b1=0.85. The conclusion from the regression equation is that each

increase in outsourcing logistics by 1% causes an increase of (0.85%) in the overall Improvement of SC Complexity, Delivery Performance through the improvement in mediator variables (Customer service, Order fulfillment, JIT, Order Consolidation, Logistics costs).

Also, the regression equation reflects the existence of a linear and strong proportional relationship between the independent variable (3PLs outsourcing) and dependent variable (Improvement SC complexity, Delivery Performance) that confirms the research hypothesis (H-6).

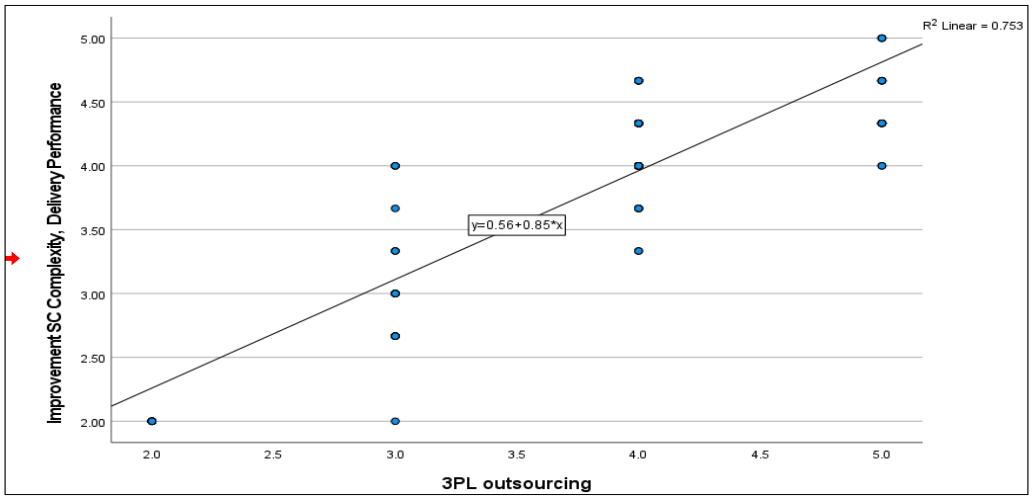


Figure (R-4a) Scattering plot and regression line between dependent and independent variables

- ## Regression and correlation coefficients

Table (R-4c) Regression and correlation coefficients between dependent and independent variables

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Correlations			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.558	.191		2.916	.004					
	3PL outsourcing	.851	.049	.868	17.279	<.001	.868	.868	.868	1.000	1.000

a. Dependent Variable: Improvement SC Complexity, Delivery Performance

- **Regression Charts,** the following figure (R-4b) shows the moderation of the residual distribution and the existence of data around the straight line. Therefore, the residuals follow the normal distribution, which is one of the conditions for the validity of the regression analysis.

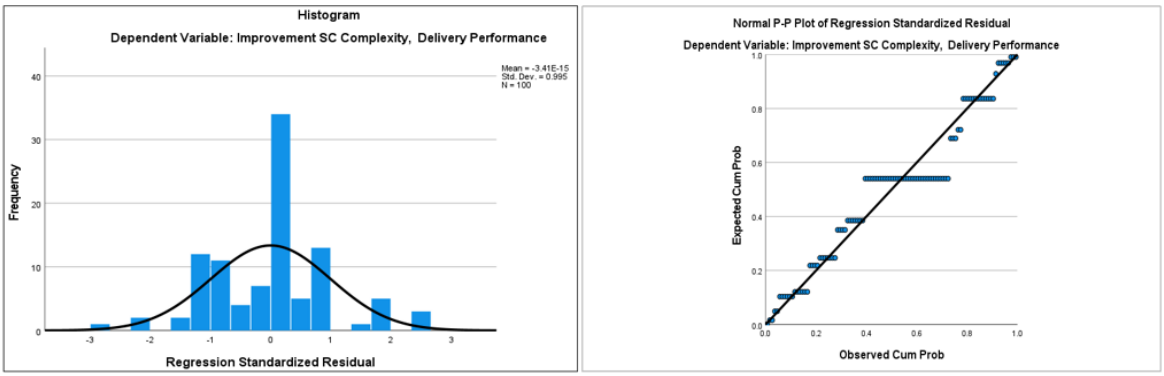


Figure (R-4b) Histogram and Normal probability plot of residuals of dependent variable: Improvement SC complexity, Delivery Performance.

5. Regression between dependent variable (E-shipper and 3PLs relationship) and independent variable (3PLs outsourcing).

- **Descriptive Statistics,** the following table (R-5a) shows the descriptive statistics (sample size - mean values following five-point Likert score - standard deviations) for both dependent and independent variables.

Table (R-5a) Regression descriptive statistics for both dependent and independent variables

Descriptive Statistics

	Mean	Std. Deviation	N
Improvement SC Complexity, E-Shipper-3PLs Relationships	4.0700	.65528	100
3PL outsourcing	3.81	.775	100

- **ANOVA Test,** the following table (R-5b) shows the results of ANOVA analysis the value of Sig is (< 0.001) which is less than (0.05), and therefore the null hypothesis is rejected but the alternative hypothesis is accepted also the regression is significant and the dependent variable could be predicted by examining the impact of independent variable on it.

Table (R-5b) ANOVA analysis test of dependent variable Improvement SC complexity, E-shipper and 3PLs relationship

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	23.464	1	23.464	120.733	<.001[b]
	Residual	19.046	98	.194		
	Total	42.510	99			

a. Dependent Variable: Improvement SC Complexity, E-Shipper-3PLs Relationships
b. Predictors: (Constant), 3PL outsourcing

- **Scattering plot and regression line,** Figure (R-5a) illustrates the scattering plot and regression line that is generated using the SPSS program.
The regression equation is Y= 1.68 + 0.63X as found in figure(R-5a), in which b0=1.68 and b1=0.63. The conclusion from the regression equation is that each

increase in outsourcing logistics by 1% causes an increase of (0.63%) in the overall Improvement of SC Complexity, E-shipper, and 3PLs relationship.

Also, the regression equation reflects the existence of a linear and strong proportional relationship between the independent variable (3PLs outsourcing) and dependent variable (Improvement SC complexity, E-shipper, and 3PLs relationship) that confirms the research hypothesis (H-7).

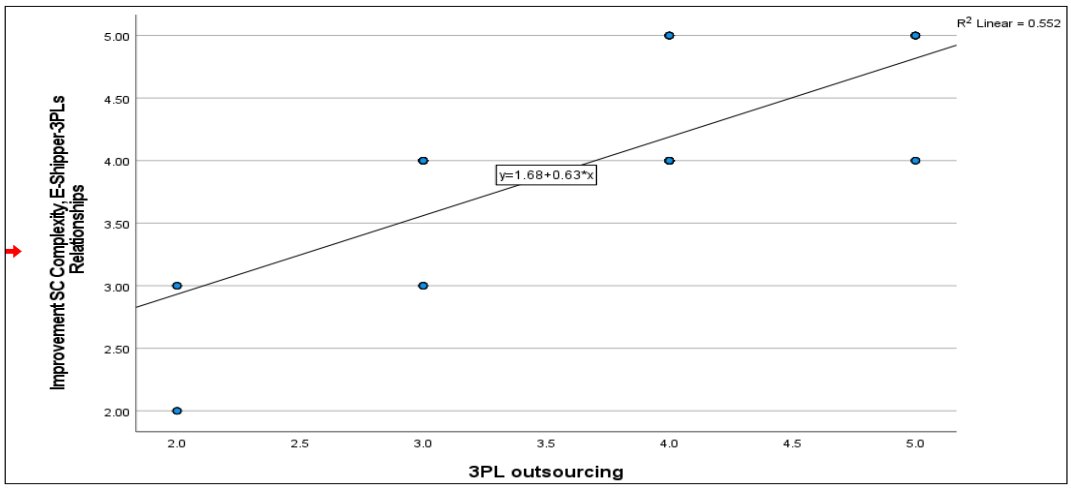


Figure (R-5a) Scattering plot and regression line between dependent and independent variables

- **Regression and correlation coefficients**

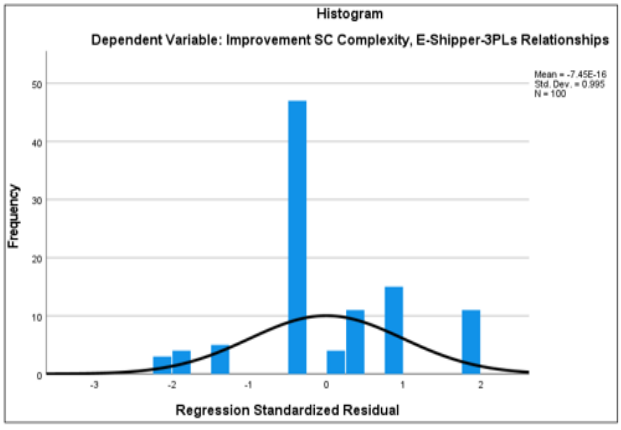
Table (R-5c) Regression and correlation coefficients between dependent and independent variables

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Correlations			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	1.675	.222		7.534	<.001					
	3PL outsourcing	.629	.057	.743	10.988	<.001	.743	.743	.743	1.000	1.000

a. Dependent Variable: Improvement SC Complexity, E-Shipper-3PLs Relationships

- **Regression Charts,** the following figure (R-5b) shows the moderation of the residual distribution and the existence of data around the straight line. Therefore, the residuals follow the normal distribution, which is one of the conditions for the validity of the regression analysis.



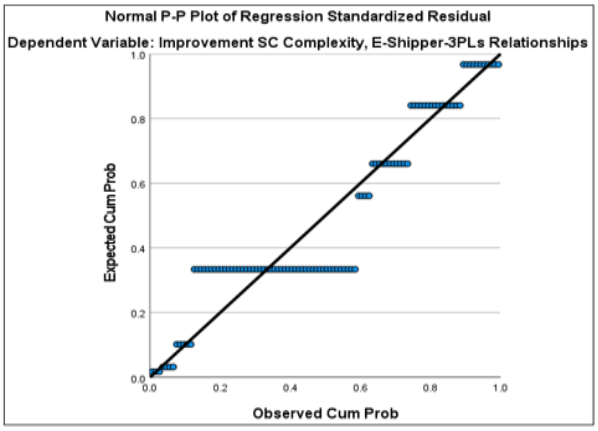


Figure (R-5b) Histogram and Normal probability plot of residuals of dependent variable: Improvement SC complexity, e-shippers and 3PLs relationship.

Statistical analysis shows 3PLs significantly improve SC complexity by calculating correlation relationships between independent, mediators, and dependent variables as found in figure (2), with a high correlation level (r) mostly exceeds (0.8) and significance values below (0.001) that confirm the research hypotheses and reject the null hypotheses.

Regression equations confirm research hypotheses, with linear and strong proportional relationships between variables (independent and dependent variables). Regression charts show moderation and data around the straight line, confirming normal distribution which is one of the conditions for the validity of the regression analysis.

5.1.3- Descriptive Analysis of survey findings

The authors analyze survey results from top global e-companies covering the five sets of questions that display the role of 3PLs in enhancing SC performance and overcoming challenges in electronic SC complexity, survey questions include the buckets of challenges mentioned in the 2012 study conducted by Langley & Capgemini and the 2020 3PL study conducted by Langley & Infosys.

1. **Improvement e-companies SC Complexity → SC Expenses and Delivery performance**

SC expenses and delivery performance is one set of questions that are shared with e-companies through the survey covering the challenges of customer service, information technology, on-time, order fulfillment and consolidation, and Logistics Costs. As shown in Figure (2. a), e-shippers gave high marks to 3PLs' ability to solve their logistics challenges through authors survey:

- 85% of e-shippers believe that 3PLs significantly improve customer service, a high rate compared to the 2012 study and consistent with 2020 studies.
- 80% of e-shippers believe 3PLs can offer value-added IT-based services, a significant increase from the 2012 and 2020 studies.
- 70% of e-shippers believe 3PLs offer innovative ways to enhance delivery performance, including just-in-time (JIT) freight, consolidating orders, promoting flexibility, and enabling perpetual readjustments.
- The study found that 75% of e-shippers believe that the use of 3PLs has significantly reduced their overall logistics costs compared to the 2012 study.

2. **Improvement e-companies SC Complexity → Shipper-3PLs Relationships**

Shipper-3PLs relationship is one set of questions that cover specific questions regarding the relationship and increasing the use of outsourced logistics services. The following is the analysis of survey results as shown in Figure (2. b):

- 84% of e-shippers agreed on increasing the use of outsourcing logistics services for e-business activities which is relatively high compared with the 2012 study and 2020 3PL Studies.
- A higher number (90%) of e-shippers agreed that relationships generally have been successful which is consistent with the 2012 and 2020 3PL Studies.

3. Improvement of e-companies SC Complexity → Global Manufacturing and Sourcing Challenges

Global Manufacturing and Sourcing is one set of questions that cover the challenges of asset lightness, emerging markets sourcing, global SC complexity and risk, postponement strategy, price pressure, and environmental and social sustainability, The following is the analysis of survey results as shown figure (2. c):

- 76% of e-shippers agreed to engage with contract manufacturers or 3PLs for a light asset philosophy through outsourcing both production and logistics (warehousing and transportation), especially in emerging markets.
- 75% of e-shippers agreed that 3PLs with experience in emerging markets could improve challenges in emerging markets sourcing which is relatively high compared with the 2012 study (42%) and 2020 3PL study (59%).
- 70% of e-shippers believe 3PLs can handle complexity and risks in their SCs, which is relatively high compared to 22% in the 2012 study.
- 65% of e-shippers agreed to postpone the final configuration including its packaging and to perform such services by 3PLs vs 32% in the 2012 study that reflects the important role of 3PLs in improving the postponement strategy.
- 75% of e-shippers believe 3PLs can significantly reduce price pressure and lower logistics costs, which is relatively high compared with the 2012 study and is consistent with a 2020 study showing 67% of average shippers agree.
- Regarding environmental and social sustainability, 80% of e-shippers agreed that savvy 3PLs could solve materials and packaging problems such as CO2 emissions, fuel consumption and heavy metal usage such as lead reflects how e-shippers are highly dependent on 3PLs also the survey result is high compared with 2012 study and is consistent with 2020 study.

4. Improvement of e-companies SC Complexity → Complex Networks and Channels

Complex networks and channels are another set of questions that cover the challenges of efficient network design and retail interaction, The following is the analysis of survey results as shown in figure (2.d):

- Regarding efficient network design, e-shippers gave high marks (70%) to 3PLs' ability to provide design of cost-efficient infrastructure across SC which is so high compared with the 2012 study.
- Concerning retail engagement, 80% of e-shippers concurred that 3PLs could aid in the distribution of products and management of demand for e-industry companies, aligning with the 2012 finding where 73% of electronic companies acknowledged that creating their own branded retail outlets is an effective strategy for consumer e-manufacturers to boost revenue.

5. Improvement of e-companies SC Complexity → Intricate, high-demand and high-value products

Intricate, high demand, and high-value products are one set of questions that cover the challenges of global SC visibility, security, counterfeiting, quality, storage conditions, packaging, local market customization, short lifecycles and reverse logistics, The following are the analysis of survey results as shown figure (2. e):

- 72% of e-shippers in the authors' survey vs 24% as found in the 2012 study agree that 3PLs improve the challenge of global SC visibility displays how the role of 3PLs become more effective and how e-shippers become more confident of 3PLs than in the 2012 study.
- 80% of e-shippers according to the authors' survey vs 56% as found in Figure (2. e) and the 2012 study agree that security is considered the significant capability that e-companies search for when they employ 3PLs, especially in emerging markets, which lack some of the protections offered by mature markets. The survey finding reflects how security concerns increased and has become one of the top services that e-shippers seek to get from 3PLs.
- 75% of e-shippers agree that 3PLs could provide SC integrity through the prevention and detection of counterfeiting of goods (component/finished products) using important anticounterfeit measures (package seal with serial number).
- Regarding quality, storage conditions, and packaging, 80% of e-shippers prefer 3PLs for proper packaging using protective materials, compact packaging, and the delay of minor assembly and packaging until the goods reach the target market. as well as proper storage conditions such as temperature and humidity control.
- For local market customization, 65% of e-shippers believe 3PLs can assist e-companies with software downloads and hardware as well as providing expertise on local compliance and knowledge of import/export protocols, especially within growing markets.
- Concerning the issue of rapidly changing product lifecycles, 75% of electronic shippers, a notably higher proportion compared to findings in the 2012 study, are confident that Third-Party Logistics providers can effectively address inventory aging by identifying and cycling out less popular items in favor of new releases. They also trust that 3PLs can implement solutions like intermodal consolidations to expedite the supply chain velocity while avoiding increased transport costs.

- 80% of e-shippers according to the authors' survey vs 56% according to the 2012 study agree that outsourcing of reverse logistics is continuously increasing which reflects how e-shippers are highly dependent on the outsourcing of reverse logistics in electronics from 3PLs.

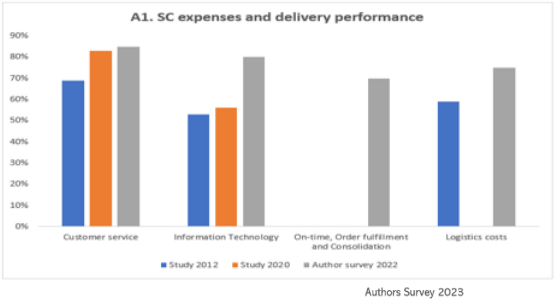


Figure (2. a) e-shippers - 3PLs delivery performance authors survey findings vs 2012 and 2020 studies *(Source: authors own, 2023)*

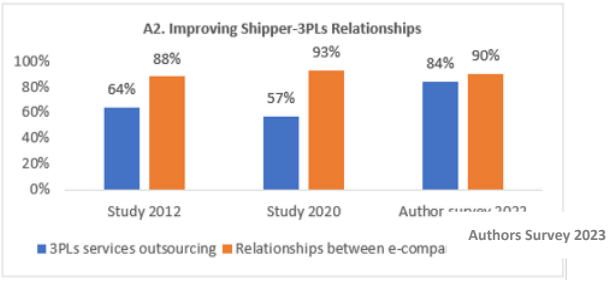


Figure (2.b) e-shippers - 3PLs relationships authors survey findings vs 2012 and 2020 studies *(Source: authors own, 2023)*

Figure (2.c) e-shippers-3PLs Global Manufacturing and Sourcing Challenges of authors survey findings vs 2012 and 2020 studies *(Source: authors own, 2023)*

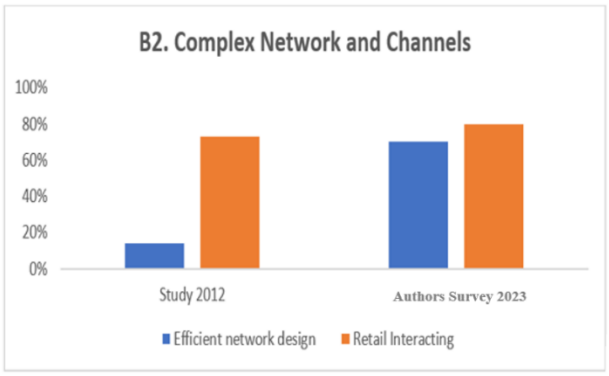


Figure (2.d) e-shippers-3PLs Complex Networks and Channels of authors survey findings vs 2012 and 2020 studies *(Source: authors own, 2023)*

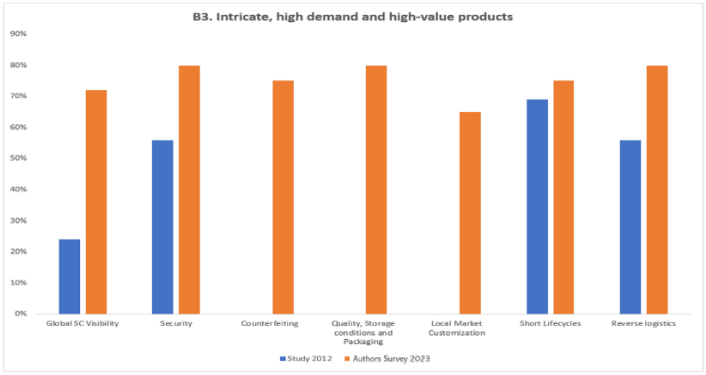


Figure (2. e) e-shippers-3PLs Intricate, high demand and high-value products of authors survey findings vs 2012 and 2020 studies *(Source: authors own, 2023)*

Table 6 presents a consolidated view of the survey results compiled by the authors, summarizing the challenges identified through descriptive analysis and encompassing insights from both the 2012 and 2020 study outcomes.
The survey conducted by the authors yielded particularly high responses regarding challenges like Price Pressure, Efficient Network Design, and Global Supply Chain Visibility. Additionally, areas such as Customer Service and Retail Interaction also registered relatively high concern compared with the 2012 study. These findings underscore the significant role of Third-Party Logistics in improving supply chain performance and addressing a spectrum of challenges.

H-1: the outsourcing of logistics services by 3PLs has increased over time, The survey reading indicates a high reading (84%) compared with the 2012 study (64%).
H-2: The survey's findings support the literature review and a 2012 study that found that the majority of the challenges that contribute to the complexity of electronic SC can be grouped into the following main categories:

- Global Manufacturing and Sourcing
- Channel and network complexity
- Intricate, high demand and high-value products

H-3: increasing the outsourcing of logistics services by 3PLs improves global manufacturing and sourcing challenges which is clear through the significant increase in authors survey readings than survey readings of 2012, especially in the challenges of price pressure and global SC complexity and risk.
H-4: increasing the outsourcing of logistics services by 3PLs improves channel and network complexity challenges which is clear through the significant increase in authors' survey readings to survey readings of the 2012 study, especially in efficient network design challenge and relatively high in retail interacting challenge.
H-5: increasing the outsourcing of logistics services by 3PLs improves intricate, high demand, and high-value product challenges which are clear through the significant increase in authors' survey readings than survey readings of 2012, especially in the Global SC Visibility challenge, and relatively high security, short life cycle and reverse logistics.
H-6: increasing the outsourcing of logistics services by 3PLs improves delivery performance challenges which is clear through the significant increase in authors' survey readings than the 2012 study, especially in logistics costs and IT challenges and relatively high in customer service as authors' survey displays that 70% of respondent agree that 3PLs provide new and innovative ways to improve logistics effectiveness including on-time delivery, complete order fulfillment and consolidations.
H-7: increasing the outsourcing of logistics services by 3PLs improves the e-shippers-3PLs relationship that is clear through the authors' survey reading (90%) which is relatively high compared with the 2012 study (88%).

Table (6): Survey summary matrix

SC Challenge	SC Challenge Details	SC Challenge Category	Study 2012	Study 2020	Author survey 2022	Research Hypothesis
3PLs services outsourcing	Increase outsourcing and decrease insourcing as a result of complexity	Shipper-3PLs Relationships	64%	57%	84%	H1
Asset lightness	E-companies engage with contract manufacturer or 3PLs for light asset philosophy by outsourcing both production and logistics (warehousing and transportation)	Global Manufacturing and Sourcing	-	-	76%	H3
Emerging Markets sourcing	3PLs with experience in emerging markets could improve challenges in emerging markets sourcing	Global Manufacturing and Sourcing	42%*	59%	75%	H3
Global SC Complexity and Risk	3PLs can address the challenges of complexity and risks (many product lines and too many components from faraway places)	Global Manufacturing and Sourcing	22%	-	70%	H3
Postponement Strategy	E-companies prefer to postpone final configuration including its packaging and to perform such services by 3PLs.	Global Manufacturing and Sourcing	32%	-	65%	H3
Price Pressure	3PLs can play a bigger role in meeting the challenges of price pressure and lowering.	Global Manufacturing and Sourcing	28%	67%	75%	H3
Environmental and Social Sustainability	savvy 3PLs could solve materials and packaging problems such as CO2 emissions, fuel consumptions and heavy metal usage such as Lead	Global Manufacturing and Sourcing	29%*	76%	80%	H3
Efficient network design	3PLs' ability to provide design of cost-efficient infrastructure across supply chain.	Complex Network and Channels	14%	-	70%	H4
Retail Interacting	3PLs could help in product distribution and demand management with E-companies	Complex Network and Channels	73%	-	80%	H4
Global SC Visibility	3PLs improve the challenge of SC visibility as the top service of their competency especially inventory availability and order status to customers as well as provide security while in transit.	Intricate, high demand and high-value products	24%	-	72%	H5
Security	security is the most important capability that E-companies look for when they hire 3PLs especially in emerging markets	Intricate, high demand and high-value products	56%		80%	H5
Counterfeiting	3PLs provide SC integrity by prevention and detection counterfeiting of goods (component/finished products) using important anticounterfeit measure (Package seal with serial number).	Intricate, high demand and high-value products	-	-	75%	H5
Quality, Storage conditions and Packaging	E-shippers prefer 3PLs for proper packaging using protective materials, smaller packages and postponement of light assembly and packaging to destination market	Intricate, high demand and high-value products	-	-	80%	H5
Local Market Customization	3PLs help E-companies with software downloads or hardware, such as power supply units.	Intricate, high demand and high-value products	-	-	65%	H5
Short Lifecycles	3PLs can deal with inventory obsolescence especially for make to stock by identifying slower moving items and items that have been replaced with newer releases	Intricate, high demand and high-value products	69%	-	75%	H5
Reverse logistics	E-shippers agree that outsourcing of reverse logistics is continuously increased	Intricate, high demand and high-value products	56%	-	80%	H5
Customer service	3PLs contribute to improving customer service	SC expenses and delivery performance	69%	83%	85%	H6
Information Technology	3PLs could provide a range of IT-based services with value added	SC expenses and delivery performance	53%	56%	80%	H6
On-time, order fulfillment and consolidation	3PLs provide new and innovative ways to improve delivery performance (order fulfillment, JIT, Order consolidation…)	SC expenses and delivery performance	-	-	70%	H6
Logistics costs	3PLs contributed to reducing the overall logistics costs	SC expenses and delivery	28%	67%	75%	H6

		performance				
E-Shipper-3PLs Relationships	Relationships with 3PLs has been generally successful	Shipper-3PLs Relationships	88%	93%	90%	H7

Source: Authors own (2023)

6- Conclusions and Recommendations:

This research probes the complexities of SCM within the e-industry, highlighting the crucial role of 3PLs in addressing the challenges of global manufacturing, intricate channel configurations, and the handling of complex electronic product assortments. The study reveals several insights:

- The e-industry is continuously grappling with complexity and disruptions. The 2012 study on 3PLs extensively explores these challenges, providing a comprehensive understanding of the complexities in the e-industry's SC and the dynamic role of 3PLs within this environment.
- The survey conducted by the researchers contributes fresh insights to the discourse, updating and expanding upon the challenges identified in the 2012 study, such as logistics costs and SC visibility.
- The survey data methodically presented by the authors forms a decisive response to the core research inquiry, illuminating the pivotal role of 3PL in advancing SC performance and molding corporate strategies. The depth of the survey's exploration into the intricate realm of SC challenges, with a specific emphasis on refining delivery performance encompassing "on-time delivery, complete order fulfillment, and consolidations," underscores the profound impact of 3PLs on fundamental SC components.
- Additionally, the strategic unraveling of 3PLs' proactive approach in addressing challenges associated with high-demand and high-value products serves as a notable highlight. The authors draw attention to the enhancements made by 3PLs in overcoming the "Global SC Visibility challenge," strengthening security measures, navigating the complexities of short product life cycles, and adeptly managing logistics costs. This nuanced examination stands as a compelling testament to the multifaceted contributions of 3PLs in shaping and fortifying SC strategies.
- Moreover, this research highlighted the specific ways in which 3PL providers wield their influence, not only to mitigate challenges but also to propel companies toward resilient and adaptive SC strategies. The findings underscore the strategic significance of 3PL partnerships in not only optimizing operational efficiency but also fostering strategic resilience in an ever-evolving business landscape.

To sum up, the e-industry's SC is marked by risks and complexities, particularly due to the brief lifespans of products, which present significant challenges in ensuring security, preventing counterfeiting, and enduring the demands of long-distance

transportation. The study underscores the vital role that 3PLs play in facilitating the logistics process and developing strategies to address supply chain complexities. It also notes a trend: electronics companies are increasingly honing in on their main areas of expertise while entrusting a wider array of logistics services to 3PLs, thus fostering long-standing, multifaceted partnerships.

Nonetheless, the research encountered limitations, such as a low response rate from the e-companies reached out to. The recommendation is for e-companies to focus on their core competencies and to outsource logistics functions to 3PLs to achieve greater efficiency and a competitive edge. The survey conducted by the authors has shown a significant improvement in the role of 3PLs in managing supply chain challenges since 2012. It is suggested that such surveys be conducted annually to continually identify and improve upon challenges, particularly those concerning delivery performance and logistics cost efficiencies.

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