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EFFECT OF TRANSPORTATION MANAGEMENT PRACTICES ON LOGISTICS MANAGEMENT OUTCOME: A MULTINATIONAL ANALYSIS

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ABSTRACT

Transportation management practices have become increasingly important in explaining logistics management outcomes in a global trade environment shaped by border delays, infrastructure gaps, service inefficiencies, and visibility challenges. Despite growing research on logistics performance, fewer studies have examined transportation management practices as direct predictors of logistics management outcomes using a recent public dataset. This study therefore examined the relationship between transportation management practices and logistics management using the 2023 World Bank Logistics Performance Index dataset. The study adopted a quantitative correlational design based on secondary data for 139 countries. Transportation management practices were operationalized through customs efficiency, infrastructure quality, ease of arranging international shipments, logistics competence, and tracking and tracing capability, while logistics management was measured through timeliness. Data were analyzed using descriptive statistics, diagnostic tests, Pearson correlation, and multiple linear regression. The descriptive results showed that timeliness had the highest mean score ($M = 3.242$, $SD = 0.565$), while customs efficiency had the lowest ($M = 2.800$, $SD = 0.625$). Correlation analysis indicated that all transportation management variables had strong positive and statistically significant relationships with timeliness: customs ($r = .863$, $p < .001$), infrastructure ($r = .863$, $p < .001$), international shipments ($r = .831$, $p < .001$), logistics competence ($r = .898$, $p < .001$), and tracking and tracing ($r = .911$, $p < .001$). Regression results showed that the model was significant, $F(5, 133) = 152.000$, $p <$

.001, explaining 85.1% of the variance in timeliness (R^2 = .851). However, only logistics competence (B = 0.273, p = .012) and tracking and tracing (B = 0.427, p < .001) remained significant predictors. The study concluded that transportation management practices are significantly related to logistics management. It recommends greater investment in logistics competence, digital tracking systems, and coordinated transport reforms to improve shipment timeliness.

KEYWORDS: Customs efficiency, Ease of arranging international shipments, Infrastructure quality, Logistics competence, Logistics management, Timeliness, Tracking and tracing capability, Transportation management.

INTRODUCTION

Global trade now depends on transport systems that are not only available, but efficient, visible, coordinated, and resilient. For that reason, transportation management practices have moved beyond the old concern with moving goods from one place to another and now include customs efficiency, infrastructure quality, shipment arrangement, logistics competence, and tracking capability (United Nations Conference on Trade and Development [UNCTAD], 2024). Arvis et al. (2024) explain that recent logistics assessment frameworks increasingly treat these dimensions as interconnected operational capabilities rather than isolated transport functions. In the same vein, Bayraktar et al. (2025) argue that logistics efficiency after COVID-19 is shaped by how transport systems are managed under uncertainty, not simply by the existence of physical transport assets. This shift is important because it places transportation management at the center of logistics performance and creates a strong basis for examining how transport-related practices influence delivery outcomes in measurable terms. The present study builds directly on that logic.

The broader context of this study is the growing recognition that logistics management has become a strategic driver of trade participation, competitiveness, and supply-chain resilience. Earlier studies established that stronger logistics performance improves trade outcomes across countries. For example, Hausman et al. (2013) found that logistics capability significantly affects trade performance, while Martí et al. (2014) showed that the dimensions of the Logistics Performance Index matter for international trade, though not with equal strength. Gani (2017) also reported that better logistics performance is positively associated with exports and imports. More recently, Sergi et al. (2021) linked competitiveness to logistics performance across major regions, and Koyuncu and Doğaner (2023) showed that

logistics performance mediates the relationship between transport activity, exports, and growth. Taken together, these studies show that logistics management is no longer a background support function but a core performance issue in national and international economic systems.

Within this wider context, transportation management practices deserve closer attention because they shape the operational conditions under which logistics outcomes are produced. Park (2020) argues that high-quality transport infrastructure and logistics can function as a source of comparative advantage, while Şahan (2021) found both short-run and long-run connections between transport infrastructure and trade performance. Yet infrastructure alone is not enough. Tam (2023) shows that customs reform and administrative efficiency remain important drivers of logistics performance, and Helo and Thai (2024) demonstrate that connected tracking and tracing systems improve visibility and decision-making in logistics operations. Similarly, Yang and Lirn (2017) and Zawawi et al. (2017) both emphasize that logistics competence and service capability strongly influence logistics performance. The implication is clear: logistics outcomes depend on a bundle of transport-related practices, not on one variable in isolation, which makes a multidimensional study both necessary and timely.

Despite this growing body of knowledge, an important problem remains. Many countries invest in transport networks and still experience weak logistics outcomes because physical assets do not automatically produce reliable delivery performance. Border delays, weak coordination, low service competence, and poor shipment visibility can undermine otherwise adequate infrastructure. Ardine et al. (2023) found that logistics indicators improve intra-ASEAN trade, but they also warned that the sub-dimensions of logistics performance are strongly interrelated and difficult to interpret when modeled together. This warning matters because it suggests that transport-related variables may all matter, yet their unique effects may not be equally visible in multivariable analysis. A second problem is that much of the literature still treats trade, competitiveness, or growth as the final outcome, even when the more immediate operational issue is whether logistics systems actually deliver goods on time. That analytical distance leaves an important gap in practical logistics knowledge.

The literature gap is therefore twofold. First, while many studies confirm that logistics matters, fewer studies focus directly on transportation management practices as predictors of logistics management outcomes within a single recent, public dataset. Suroso et al. (2022), Zaninović et al. (2021), and Bayraktar et al. (2025) all show that the effects of logistics variables can vary by context, model, and outcome, which means there is still room for

narrower, more operationally focused analysis. Second, the literature often emphasizes the overall logistics index more than the comparative contribution of its sub-dimensions. This study responds to that gap by focusing on customs efficiency, infrastructure quality, ease of arranging international shipments, logistics competence, and tracking and tracing capability as transportation management practices, and by examining their relationship with timeliness, which is the most outcome-oriented indicator in the World Bank (2023) Logistics Performance Index dataset.

Against this background, the aim of the study is to examine the relationship between transportation management practices and logistics management using the 2023 World Bank Logistics Performance Index dataset (world Bank, 2023). More specifically, the study investigates whether customs efficiency, infrastructure quality, ease of arranging international shipments, logistics competence, and tracking and tracing capability are significantly related to shipment timeliness. The main research question is: *What relationship exists between transportation management practices and logistics management as measured by shipment timeliness?* In line with the correlational design, the main null hypothesis states that there is no significant relationship between transportation management practices and logistics management. This formulation is logically consistent with prior evidence, yet it also allows the study to test whether the individual dimensions differ in the strength of their association with timeliness.

LITERATURE REVIEW

Theoretical framework

This study is anchored on General Systems Theory (GST) and the Resource-Based Theory (RBT) because both theories explain, from different but complementary angles, why transportation management practices shape logistics management outcomes. GST is useful for showing that logistics performance emerges from the interaction of connected subsystems such as customs, infrastructure, shipment planning, information flows, and delivery control. RBT, by contrast, explains why some transport and logistics systems perform better than others by emphasizing the quality of strategic resources and capabilities. Together, the two theories provide both a systems explanation and a capability explanation for logistics management. This combined foundation is appropriate because the present study examines how several transportation management dimensions relate to timeliness, which is itself an outcome of coordinated processes and organizational capability.

The General System Theory

General Systems Theory is most strongly associated with Ludwig von Bertalanffy, who advanced the idea that many phenomena should be understood not as isolated parts but as integrated wholes made up of interacting components. In his 1972 discussion of the history and status of GST, von Bertalanffy argued that systems thinking was developed to identify principles that apply across different fields, especially where relationships among parts are more important than the parts in isolation. Around the same period, Kast and Rosenzweig (1972) extended this logic to organization and management, emphasizing that organizations are open systems that exchange information, energy, and resources with their environments. Their work made GST especially relevant to management research by showing that performance depends on coordination across subsystems rather than on one unit alone.

Historically, GST emerged as a reaction against fragmented and overly reductionist thinking in science and management. Instead of assuming that the study of each component alone could explain the whole, GST proposed that interaction, interdependence, feedback, adaptation, and openness to the environment are central features of real systems. Kast and Rosenzweig (1972) applied this to management by arguing that organizations contain technical, structural, psychosocial, and managerial subsystems that must function together if the organization is to perform effectively. More recent healthcare applications, such as Katrakazas et al. (2020), show that GST still remains useful where outcomes depend on coordination across multiple actors, processes, and technologies. That continuing relevance strengthens its use in this study because transport and logistics systems also involve many linked elements whose combined functioning determines whether deliveries are timely and reliable.

The major propositions of GST fit this study closely. First, a system is made up of interrelated parts, so change in one part affects the others. Second, systems are open to their environments and therefore depend on exchange, adaptation, and feedback. Third, performance is an emergent property, meaning that the whole system can perform well or poorly depending on how well the parts are aligned. Applied to transportation and logistics, these propositions imply that customs, infrastructure, shipment arrangement, logistics competence, and tracking are not independent silos. Rather, they are interconnected dimensions of one logistics system. If customs is slow, infrastructure is weak, or tracking is poor, the effect can spread through the whole chain and reduce timeliness. GST therefore provides a strong conceptual explanation for why the study treats transportation management practices as a multidimensional system influencing logistics management.

Resource Base Theory

The second theory, Resource-Based Theory, is rooted in the broader resource-based view of the firm, especially the influential work of Barney, though the user's listed sources emphasize its later logistics and supply chain applications. RBT argues that organizations achieve superior performance when they possess or develop valuable, rare, difficult-to-imitate, and well-organized resources and capabilities. In logistics and transport studies, this logic has moved beyond physical assets to include information systems, coordination routines, analytics, innovation capabilities, and relationship networks. Yang and Lirn (2017), in particular, revisited the resource-based view in the shipping industry and showed that logistics performance cannot be explained by intrafirm resources alone; interfirm relationships and logistics service capabilities also matter. This makes RBT highly relevant for explaining why some transport systems convert resources into stronger logistics outcomes than others.

The historical development of RBT in logistics reflects a move from asset ownership to capability-based advantage. Early resource-based thinking focused heavily on firm-specific resources, but later studies in supply chain and logistics began to emphasize digital technologies, knowledge, resilience, dynamic capabilities, and interorganizational integration. Nandi et al. (2020) used a resource-based view to explain how blockchain-enabled supply chain systems improve performance through capability development. Nandi et al. (2021) extended this perspective by linking blockchain and circular economy practices to post-COVID supply chain performance through both resource-based and dependence arguments. Related studies by Bag et al. (2020), Herden (2020), Dovbischuk (2022), Sharma et al. (2022), and Khan et al. (2023) further show that innovation capability, analytics, resilience, and green supply chain practices can all be understood as strategic resources that influence logistics and supply chain outcomes.

The core propositions of RBT also fit this study. The theory proposes that performance differences arise not simply from being in the same market, but from differences in strategic resources and the ability to deploy them effectively. In a transport and logistics context, infrastructure quality can be viewed as a physical resource, tracking systems as an information resource, logistics competence as an organizational capability, and shipment coordination as a process capability. Where these resources are strong and effectively combined, firms or countries are more likely to achieve better logistics outcomes. This proposition is visible in the logistics literature on blockchain, logistics 4.0, analytics, and dynamic capabilities, all of which treat technological and managerial capability as central to

performance. For this study, RBT therefore explains why transportation management practices should be positively associated with timeliness.

Application of Theories to the Study

Applied specifically to this study, GST explains how the transport-logistics system works, while RBT explains why stronger transport capabilities should produce better logistics outcomes. GST justifies the inclusion of multiple predictors because customs, infrastructure, international shipments, logistics competence, and tracking and tracing are system components that operate together. RBT justifies treating those same dimensions as strategic capabilities whose quality should influence logistics performance, especially timeliness. In practical terms, the study's dependent variable, logistics management measured through timeliness, can be seen as the emergent output of a coordinated logistics system and as the performance consequence of superior transportation-related resources. This dual-theory framing is especially useful because it avoids reducing logistics management either to physical infrastructure alone or to abstract strategy alone. It keeps both system coordination and resource capability in view.

Overall, the two theories are complementary rather than competing. GST offers a holistic explanation of interdependence, feedback, and system-level performance, which is essential for understanding why weaknesses in one transport dimension can affect overall logistics outcomes. RBT adds the strategic insight that the quality of capabilities and resources determines how effectively that system performs. For a study on transportation management practices and logistics management, this combination is especially powerful because logistics success depends both on connected subsystems and on the strength of the capabilities embedded in them. Accordingly, this research adopts GST to frame transportation management as an integrated system and RBT to explain why differences in that system's capabilities should be reflected in differences in logistics performance across countries. That theoretical pairing provides a clear and defensible foundation for the empirical analysis that follows.

Conceptual framework

Conceptually, this study treats transportation management practices as the independent variable and logistics management as the dependent variable. Transportation management practices are operationalized through five indicators from the 2023 LPI dataset: customs efficiency, infrastructure quality, ease of arranging international shipments, logistics

competence, and tracking and tracing capability (figure 1). Logistics management is operationalized through timeliness, measured by the frequency with which shipments reach the consignee within the expected schedule (figure 1). This structure is appropriate because the five independent dimensions reflect how transport and logistics processes are managed, while timeliness captures the practical outcome of that management. The conceptual logic is therefore directional, with stronger transportation management practices expected to be associated with better logistics management.

The conceptual framework logically explains the study hypotheses: customs efficiency, infrastructure quality, shipment arrangement, logistics competence, and tracking and tracing are expected to influence logistics management as reflected in shipment timeliness. The research believed that efficient customs should reduce border delays, sound infrastructure should reduce congestion and handling inefficiencies, easier shipment arrangement should improve operational flexibility, logistics competence should improve coordination, and tracking and tracing should improve visibility and response speed. The World Bank's (2024) own description of the LPI supports this structure because it frames logistics performance as the ability to create reliable supply chain connections through multiple operational dimensions. Since timeliness is the most outcome-oriented of these indicators, it serves well as the dependent variable in a correlational seminar paper. That framework leads naturally into the empirical studies that have examined related relationships.

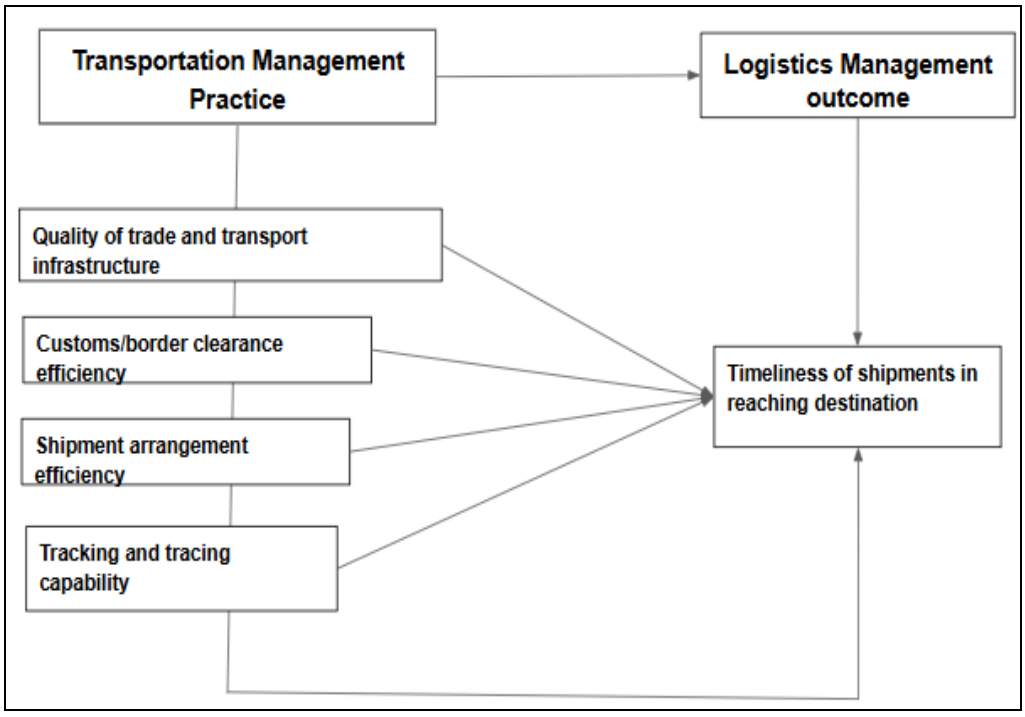

Figure 1: the schematic conceptual framework of the Study.

Transportation management practices

Transportation management practices refer to the organized activities used to plan, coordinate, monitor, and improve the movement of goods across supply chains. Arvis et al. (2024), in explaining the updated Logistics Performance Index, show that transportation management is no longer seen as a narrow routing or dispatch function, but as a broader system involving infrastructure, shipment organization, service quality, and data visibility. In a related way, Bayraktar et al. (2025) argue that post-COVID logistics efficiency depends increasingly on how transport processes are managed under uncertainty rather than on physical transport capacity alone. This reflects a conceptual evolution from traditional transport administration toward an integrated, performance-based management approach. Thus, in this study, transportation management practices mean the set of transport-related operational capabilities that help countries move freight efficiently, reliably, and competitively across logistics networks.

Logistics management

Logistics management refers to the strategic coordination of the flow, storage, and related information of goods from origin to final destination in a way that supports efficiency and customer value. Stević et al. (2024) note that modern logistics management is now understood through measurable performance dimensions rather than through general administrative descriptions alone. Similarly, Tetteh et al. (2025) explain that logistics performance reflects the effectiveness and efficiency of supply chain activities, linking logistics management to broader trade and transport outcomes. Conceptually, the term has evolved from a traditional focus on warehousing and distribution toward a wider concern with resilience, coordination, visibility, and service reliability. This means logistics management in the present study is not treated as a vague background process, but as an outcome-oriented capability reflected in how effectively logistics systems support predictable and timely shipment movement.

Customs efficiency

Customs efficiency refers to the speed, transparency, and procedural ease with which goods are cleared through border agencies for import, export, or transit. Arvis et al. (2024) retain customs as a core logistics dimension because border procedures still affect the reliability of international supply chains. In a more focused regional study, Tam (2023) shows that customs reform, single-window systems, and administrative efficiency remain important

drivers of national logistics performance in ASEAN countries. The concept has therefore evolved from a narrow emphasis on control and revenue collection toward a broader trade-facilitation perspective in which customs is expected to reduce delay and improve supply-chain continuity. In this study, customs efficiency is treated as one of the key transportation management practices because weak border processes can slow cargo movement even when other logistics capabilities are relatively strong.

Infrastructure quality

Infrastructure quality refers to the adequacy, condition, and operational usefulness of transport-related facilities such as roads, railways, ports, airports, and freight-support systems. Park (2020) argues that the quality of transport infrastructure and logistics contributes to comparative advantage, showing that infrastructure is more than a passive support system. In a related empirical analysis, Sénquiz-Díaz (2021) found that transport infrastructure quality and logistics resources positively influence outward orientation and export performance in developing economies. Conceptually, this shows an evolution from seeing infrastructure merely as physical capital to viewing it as a strategic logistics enabler that affects speed, reliability, and trade connectivity. For this study, infrastructure quality represents the structural base of transportation management, because strong logistics outcomes depend not only on movement activity, but also on the quality of the networks and facilities that make efficient movement possible.

Ease of arranging international shipments

Ease of arranging international shipments refers to how readily shippers can secure freight services across borders at competitive rates and with dependable service availability. Arvis et al. (2024) include this dimension in the revised LPI because shipment organization reflects whether a country's logistics market can provide commercially workable transport options. After the pandemic, Bayraktar et al. (2025) also observed that weaknesses in international shipments signaled persistent efficiency problems in global logistics systems. This concept has developed from a simple transactional booking issue into a broader indicator of transport market access, service coordination, and operational flexibility. It now reflects whether businesses can convert logistics demand into actual shipment movement without excessive delay or cost pressure. In this study, the concept is important because transportation management is not only about physical movement, but also about how easily international transport services can be accessed and mobilized.

Logistics competence

Logistics competence refers to the quality, capability, and professionalism of logistics service providers and related actors in organizing and executing freight movement. Yang and Lirn (2017) argue that logistics performance in shipping depends on both intrafirm resources and interfirm service capabilities, showing that competence is not just a technical trait but a strategic one. More recently, Bayraktar et al. (2025) reinforce the importance of operational capability by showing that changes in logistics efficiency after COVID-19 were linked not only to infrastructure and customs issues but also to broader service performance conditions. The concept has therefore evolved from a firm-level operational skill into a wider capability involving coordination, reliability, responsiveness, and problem-solving across logistics systems. In this study, logistics competence is central because it reflects the human and organizational quality needed to translate transport infrastructure and shipment opportunities into real logistics management performance.

Tracking and tracing capability

Tracking and tracing capability refers to the ability to monitor shipment location, status, and movement history across the logistics chain with timely and reliable information. Helo and Thai (2024) show that smart connected tracking and tracing systems now play a major role in digital logistics transformation because they improve visibility and decision-making. In a complementary methodological discussion, Arvis et al. (2024) explain that the updated LPI increasingly incorporates shipment tracking data, indicating how strongly visibility has become part of logistics assessment itself. This reflects the conceptual evolution of tracking and tracing from a simple monitoring tool into a broader capability for agility, control, and exception management. In this study, tracking and tracing is treated as an information-based transportation management practice because it reduces uncertainty, improves coordination, and supports faster response when delays or disruptions occur in the logistics process.

Timeliness

Timeliness refers to the extent to which shipments arrive at the consignee within the expected or scheduled delivery period. Arvis et al. (2024) present timeliness as one of the most outcome-oriented dimensions of the LPI because it reflects what users experience directly when logistics systems function effectively. In a broader logistics-performance study, Tetteh et al. (2025) also emphasize that logistics efficiency is meaningful only when supply-chain activities produce dependable outcomes, not merely strong process scores. The concept has

evolved from a narrow delivery-speed concern into a fuller measure of service reliability, coordination quality, and logistics effectiveness under real operating conditions. For this reason, timeliness is appropriate as the dependent variable in this study. It captures whether transportation management practices are actually translated into practical logistics management outcomes, making it the clearest performance expression of the conceptual framework.

Empirical review and gap in literature

Empirical work has long shown that logistics quality matters for trade and performance, but the findings are not always identical across contexts. Hausman et al. (2013) found that logistics performance significantly affects trade, while Martí et al. (2014) showed that LPI dimensions matter for trade in emerging economies, with some components proving more influential than others. Gani (2017) likewise reported that overall logistics performance is positively and significantly related to exports and imports. These studies are important because they consistently place logistics capability at the center of economic exchange, yet they also imply that the sub-dimensions may not carry equal weight. That variation supports the present study's decision to test each transportation management dimension separately before considering the combined effect.

A second stream of evidence focuses more specifically on transport infrastructure and transport-linked competitiveness. Park (2020) argued that the quality of transport infrastructure and logistics can act as a source of comparative advantage, while Şahan (2021) found short-run and long-run causal linkages between transport infrastructure and trade in Turkey. These findings reinforce the claim that infrastructure is not only a background condition but a strategic driver of trade-related performance. At the same time, infrastructure does not operate in isolation, since the Turkey study explicitly considered ICT as a complement to transport networks. This is important for the present paper because it suggests that infrastructure may matter strongly, but its effect on logistics management is likely to depend on interaction with service coordination and information systems.

A third body of evidence emphasizes customs and trade facilitation. Ardine et al. (2023) found that improvements in logistics indicators are associated with stronger intra-ASEAN trade, but they also warned that estimating all LPI dimensions in one equation can create multicollinearity because the indicators are naturally correlated. Their results further suggested that customs and infrastructure improvements yield substantial export gains, though the magnitudes differ across measures. This is a very useful contrast for the present

study because it shows both why customs remains central and why caution is needed in multivariable models. In other words, customs efficiency is likely to matter for logistics management, but its independent effect may be harder to isolate statistically when it moves together with the rest of the logistics system.

Research on logistics competence and service quality provides another important perspective. Yang and Lirn (2017) empirically showed that logistics service capabilities are closely linked to logistics performance in the shipping industry, while Zawawi et al. (2017) reported a significant positive relationship between logistics capability and logistics performance at the firm level. These studies shift attention away from physical infrastructure alone and toward the competence of the actors coordinating the flow. That shift matters because logistics management is ultimately enacted through planning, scheduling, documentation, exception handling, and inter-organizational coordination. The implication for the present study is that logistics competence should not be treated as secondary; it may in fact be one of the most influential transportation management dimensions when the outcome of interest is timely delivery.

Digital visibility and tracking also appear increasingly decisive in the literature, especially after large-scale supply chain disruptions. Helo and Thai (2024) argued that smart connected tracking and tracing devices support digital transformation in logistics by improving real-time information flow and decision-making. Studies on tracking and tracing challenges likewise show that the technology improves control but also requires organizational capability to be effective. This is significant because tracking is not merely a monitoring tool; it is a management capability that allows delays to be detected early and corrective action to be taken quickly. For a correlational study using the LPI, this makes tracking and tracing a theoretically strong candidate for a high association with timeliness, since visibility should improve the probability of on-time delivery.

Port and maritime studies provide additional support for a transportation-centered explanation of logistics performance. UNCTAD's shipping connectivity work shows that countries with stronger maritime connections generally enjoy lower transport costs, more service options, and better trade integration, while the World Bank's (2023) Container Port Performance Index highlights the role of port efficiency in vessel turnaround and cargo flow. Related empirical studies on port regulation and infrastructure also show that governance and physical capacity affect efficiency outcomes. These findings are relevant because ports are critical interfaces between national transport systems and global supply chains, meaning delays at ports can undermine otherwise strong inland logistics networks. This broader

maritime evidence therefore strengthens the argument that transportation management practices should be visibly linked to logistics outcomes such as timeliness.

The literature also contains contrasting evidence, which is important for balanced interpretation. Suroso et al. (2022) found that all six LPI indicators positively affected palm-oil-related exports from Indonesia and Malaysia, yet some importer-side logistics indicators showed negative effects, suggesting that stronger logistics in destination countries may intensify competition rather than always benefit exporters. Zaninović et al. (2021) likewise showed heterogeneous effects of logistics performance on international trade, and their later work on global value chains also indicated that the strength of logistics effects can vary by trade structure. These contrasts matter because they show that logistics relationships are not uniform across products, regions, and model specifications. Accordingly, the present study expects positive relationships with timeliness but does not assume that every predictor will remain independently significant in a joint regression model.

More recent studies have extended logistics research into competitiveness, sustainability, and post-COVID resilience. Sergi et al. (2021) linked competitiveness dimensions to logistics performance across Africa, Asia, and Europe, while Koyuncu and Doğaner (2023) showed that logistics performance mediates the relationship between transport, exports, and economic growth in emerging upper-middle-income countries. Bayraktar et al. (2025) further examined global logistics efficiency after COVID-19 using LPI-based cross-country analysis. Together these studies show that logistics management is now viewed as a strategic capability influencing resilience, development, and competitiveness. Even so, much of this literature studies trade, growth, or competitiveness as the outcome, leaving a need for narrower work that focuses directly on logistics management itself, especially shipment timeliness.

The main gap in the literature is therefore not the absence of studies on logistics performance, but the relative shortage of focused correlational analyses that treat transportation management dimensions as predictors of logistics management outcomes within one recent public dataset. Many existing studies use gravity models for trade, panel models for growth, or sector-specific designs for ports and shipping. That work is valuable, but it often shifts the dependent variable away from logistics management itself. By contrast, the present study keeps the dependent variable close to operational reality by using shipment timeliness. This makes the study both tighter and more directly aligned with transportation management practice, while still drawing on a recent dataset that captures multiple logistics dimensions.

A second gap lies in the handling of sub-dimensions. Several studies confirm that logistics matters, yet they often emphasize the overall index or trade outcome more than the

comparative strength of individual components. Ardine et al. (2023) explicitly noted multicollinearity challenges when all LPI components are estimated together, which suggests that studies need to report both bivariate associations and multivariable results. The present paper responds to that need by first examining the descriptive and correlational relationships between each transportation management variable and timeliness, and then presenting a regression model with cautious interpretation. This approach allows the study to contribute both evidence on overall association and insight into which dimensions remain most influential once the shared variance among the indicators is considered.

METHODOLOGY

Design

This study adopted a quantitative correlational research design because the purpose was to examine the statistical relationship between transportation management practices and logistics management using measurable variables. Quantitative research is appropriate when variables are expressed numerically and analyzed objectively, while correlational design is used to determine the direction and strength of association between two or more variables without manipulating them (Bloomfield & Fisher, 2019; Curtis et al., 2016). Thomas and Zubkov (2023) similarly explained that correlational studies focus on naturally occurring variables and test whether meaningful relationships exist among them. In this study, the design was suitable because the intention was not to introduce treatment or intervention, but to determine whether transportation management dimensions are significantly associated with logistics management outcomes in the uploaded dataset.

The study was also non-experimental because the researcher had no control over the variables and did not alter the study environment. Instead, the research relied on already existing public data from the World Bank Logistics Performance Index dataset uploaded in CSV format. Hodge (2020) noted that correlational research belongs to the wider group of non-experimental quantitative designs that investigate relationships among variables in their natural state. Cook and Cook (2008) added that such designs are useful when the objective is to explain patterns and associations rather than establish causal effects through manipulation. This matches the present study because customs efficiency, infrastructure quality, international shipments, logistics competence, tracking and tracing, and timeliness already existed as country-level indicators. The design therefore suited both the research purpose and the nature of the dataset.

The choice of correlational design was further justified by its wide acceptance in health, education, social science, and policy research where experimental manipulation may be impractical or inappropriate. Devi et al. (2022) observed that correlational designs are especially relevant when experimentation is not feasible, yet the researcher still needs to examine whether variables move together in a statistically meaningful way. Grove (2019) likewise clarified that correlational research is valuable for understanding real-world relationships among variables and can provide strong evidence of association when measurement is clear. However, correlational research has limits. Asamoah (2014) cautioned that correlation does not prove causation because the design does not control all external factors. For that reason, the findings in this study were interpreted as evidence of statistical relationship and prediction, not direct causal effect, which leads to the discussion of the nature of the data used.

Nature and sources of Data

The study used secondary quantitative data from the uploaded World Bank Logistics Performance Index (WB_LPI.csv). Secondary data were appropriate because the relevant indicators had already been measured, standardized, and published numerically by an established international institution. Bloomfield and Fisher (2019) noted that quantitative research depends on structured numerical evidence, while Curtis et al. (2016) emphasized that correlational studies require clearly defined variables measured consistently across cases. These requirements were met in this study because the dataset already contained country-level scores for the logistics dimensions relevant to the research questions. The use of secondary data also made the study transparent and replicable, since other researchers could use the same file and apply the same screening process to obtain comparable results.

Data analysis methods

The analysis focused specifically on the 2023 observations in the uploaded file. After screening for complete cases, the final sample consisted of 139 countries. Transportation management practices served as the independent variable and were represented through five indicators: customs efficiency, infrastructure quality, ease of arranging international shipments, logistics competence, and tracking and tracing capability. Logistics management served as the dependent variable and was measured using timeliness. In addition, a composite transportation management practices score was computed by averaging the five predictor variables. Thomas and Zubkov (2023) explained that correlational studies require variables

that are conceptually distinct but operationally measurable, while Hodge (2020) stressed that quantitative rigor depends on how clearly constructs are translated into observable indicators. The dataset met these standards and therefore provided a strong basis for analysis.

Data collection did not involve questionnaires, interviews, or observation because the information had already been compiled in the uploaded dataset. Instead, data collection in this study involved extracting the relevant 2023 country-level indicators from the file, cleaning the dataset, retaining complete cases, and arranging the variables for analysis. Cook and Cook (2008) argued that existing datasets are often useful in non-experimental quantitative research because they allow researchers to examine broad patterns that would be difficult to capture through primary data collection. Grove (2019) similarly observed that the credibility of such studies depends on the appropriateness of the dataset to the research problem and the clarity of variable selection. In this case, the uploaded World Bank dataset was directly relevant to the study aim and therefore suitable for use.

The data were analyzed using descriptive statistics, diagnostic analysis, Pearson product-moment correlation, and multiple linear regression. Descriptive statistics were first applied to summarize the mean, standard deviation, minimum, maximum, skewness, and kurtosis of each variable. This provided an overview of the central tendency, variability, and distributional pattern of the study variables before inferential testing. Bloomfield and Fisher (2019) explained that descriptive statistics are an essential first step in quantitative analysis because they help the researcher understand how the data behave. Curtis et al. (2016) likewise emphasized that correlational studies should begin with clear descriptive summaries so that the suitability of the variables for further analysis can be assessed. In the present study, the descriptive results showed moderate dispersion and acceptable distributions across the selected indicators.

After the descriptive stage, diagnostic tests were carried out to examine whether the assumptions of regression were reasonably satisfied. Residual normality was assessed using the Jarque–Bera test, homoscedasticity was tested with the Breusch–Pagan test, independence of errors was assessed using the Durbin–Watson statistic, multicollinearity was examined with Variance Inflation Factor values, and influential observations were checked using Cook's Distance. Grove (2019) noted that quantitative correlational studies should not interpret regression results without first testing whether key assumptions hold. Thomas and Zubkov (2023) similarly stressed that statistical conclusions are only defensible when the researcher demonstrates the appropriateness of the analytical model. This stage was therefore

important because it ensured that the regression findings were interpreted within the conditions of the data rather than taken at face value.

The main inferential analyses were Pearson correlation and multiple regression. Pearson correlation was used to test the strength and direction of the bivariate relationship between each transportation management practice variable and logistics management. This was appropriate because the variables were continuous and approximately normally distributed. Curtis et al. (2016) described correlational research as the examination of statistical association between variables, while Steinkamp and Maehr (1983) showed that correlations can provide valuable evidence of meaningful patterns across contexts. Multiple regression was then used to determine the combined predictive effect of customs efficiency, infrastructure quality, international shipments, logistics competence, and tracking and tracing on timeliness. Hodge (2020) observed that regression extends correlational research by showing the relative contribution of several predictors to a single outcome. However, as Asamoah (2014) warned, overlapping predictors can complicate interpretation, so the regression coefficients in this study were discussed cautiously because multicollinearity was high.

Ethical consideration

Although no human participants were involved, ethical consideration remained important. The use of public secondary data meant that informed consent and anonymity procedures were not required in the conventional sense, but ethical research still demanded honesty, transparency, and accurate reporting. Bloomfield and Fisher (2019) and Grove (2019) both emphasized that quantitative research must present methods and findings truthfully and acknowledge limitations clearly. In this study, ethical responsibility was maintained by using the uploaded dataset exactly as provided, reporting the analytical procedures transparently, and avoiding any fabrication or distortion of results. Another key ethical issue was avoiding causal overstatement. Asamoah (2014) and Curtis et al. (2016) both warned that correlational findings should not be presented as proof of cause and effect. Accordingly, this study reported its findings strictly as evidence of association and predictive relationship. Proper citation of all supporting methodological authors also ensured academic integrity and strengthened the credibility of the research process.

RESULTS

Descriptive analysis

The descriptive analysis was conducted to summarize the central tendency, dispersion, and distributional pattern of the study variables before the correlational and regression analyses were performed. The analysis used the complete 2023 cases in the uploaded dataset, giving a final sample of 139 countries with no missing values on the selected variables. The variables examined were customs efficiency, infrastructure quality, ease of arranging international shipments, logistics competence, tracking and tracing capability, timeliness, and the composite transportation management practices score. This stage was important because it provided an overview of how the variables behaved in the dataset and whether they were suitable for further parametric analysis. The results are presented in Table 1, and they provide the first statistical picture of the relationship between transportation management practices and logistics management.

Table 1 ***Descriptive statistics of study variables. (N = 139)***

Variable	N	Mean	SD	Min	Max	Skewness	Kurtosis
Customs efficiency	139	2.800	0.625	1.50	4.20	0.367	-0.739
Infrastructure quality	139	2.922	0.721	1.70	4.60	0.427	-0.978
International shipments	139	2.925	0.524	1.70	4.10	0.053	-0.738
Logistics competence	139	3.029	0.646	1.80	4.40	0.297	-1.002
Tracking and tracing	139	3.051	0.675	1.60	4.40	0.186	-0.960
Timeliness	139	3.242	0.565	2.10	4.30	0.076	-0.894
Transportation management practices composite	139	2.945	0.612	1.84	4.32	0.366	-1.008

Table 1 shows that timeliness recorded the highest mean score (M = 3.242, SD = 0.565), indicating that, on average, countries performed better on on-time delivery than on the other logistics dimensions. By contrast, customs efficiency recorded the lowest mean score (M = 2.800, SD = 0.625), suggesting that customs and border clearance processes remain the weakest transportation management dimension within the dataset. Infrastructure quality, international shipments, logistics competence, and tracking and tracing all produced moderate mean scores ranging from 2.922 to 3.051, which indicates relatively similar mid-level performance across countries. This pattern suggests that while countries generally achieve moderate logistics functionality, they still experience notable weaknesses in some of the transport management practices that support effective logistics management.

The standard deviations ranged from 0.524 for international shipments to 0.721 for infrastructure quality, indicating moderate variability among countries. This means the

dataset captured meaningful cross-country differences in transportation management practices and logistics outcomes, which is desirable for correlational analysis. The relatively larger spread observed in infrastructure suggests that countries differ more widely in the quality of their trade- and transport-related physical systems than in their ability to arrange international shipments. In practical terms, this implies that infrastructure gaps may be one of the main areas distinguishing stronger logistics-performing countries from weaker ones. That variability is useful because it creates the statistical conditions needed to test whether such differences are linked to logistics management performance.

The distributional properties of the variables were also acceptable for parametric testing. All skewness values were close to zero, ranging from 0.053 to 0.427, which indicates that none of the variables was severely skewed. Likewise, all kurtosis values were negative but moderate, ranging from -1.008 to -0.738, which suggests relatively flat but acceptable distributions. Since the values fell within commonly accepted practical limits for normality screening, the variables were considered suitable for Pearson correlation and multiple regression analysis. This descriptive evidence therefore established that the dataset was well behaved enough for inferential testing, which leads directly to the diagnostic evaluation of the regression assumptions.

Diagnostic analysis

Diagnostic analysis was carried out to determine whether the assumptions underlying the multiple regression model were reasonably satisfied. This was necessary because regression results are only meaningful when the residuals behave appropriately and when the predictor structure does not distort the model excessively. The diagnostics assessed residual normality, homoscedasticity, independence of errors, multicollinearity, and the presence of influential observations. These checks were conducted after estimating the regression model with timeliness as the dependent variable and the five transportation management practice dimensions as predictors. The outcome of these tests is important because it determines how confidently the model coefficients can be interpreted and how cautiously the findings should be discussed.

The normality of the residuals (table 2), was assessed using the Jarque–Bera statistic, which produced a value of 5.233 with a corresponding p value of .073. Since the probability value was greater than the .05 significance level, the null hypothesis of normal residuals was not rejected. This indicates that the regression residuals did not significantly depart from a normal distribution. In practical terms, the model satisfied the normality assumption well

enough for conventional inferential interpretation. This result supports the use of ordinary least squares regression and suggests that the estimates and significance tests are not being distorted by a serious residual distribution problem.

The homoscedasticity assumption (table 2) was tested using the Breusch–Pagan test, which returned a statistic of 2.800 and a p value of .731. Because the p value was well above .05, there was no statistically significant evidence of heteroscedasticity. This means the residual variance was reasonably constant across the fitted values of the model. Constant error variance is important because unequal variance can weaken the reliability of standard errors and significance tests. In this case, the result indicates that the regression model did not suffer from any major heteroscedasticity problem, which strengthens confidence in the overall fit of the model and prepares the basis for examining the remaining diagnostic conditions.

The independence of errors (table 2) was assessed using the Durbin–Watson statistic, which produced a value of 1.710. A value close to 2.0 is commonly interpreted as evidence that the residuals are not seriously autocorrelated. Since the obtained result was reasonably close to that benchmark, the model did not show any major problem of serial dependence in the residuals. This was expected because the data are cross-sectional country observations rather than time-series observations. Even so, reporting the statistic remains useful because it confirms that the residual pattern did not show an obvious dependence problem that could weaken the validity of the regression results. This means the model met another important diagnostic condition.

Table 2: Diagnostic Tests for Regression Assumptions.

Test	Statistic	p_value
Jarque-Bera	5.233146405	0.07305277144
Breusch-Pagan	2.800403358	0.7307245129
Durbin-Watson	1.710354335	

The most important diagnostic concern in the study was multicollinearity. Variance Inflation Factor values were calculated for each of the five predictors, and the results were extremely high: customs efficiency (VIF = 239.359), infrastructure quality (VIF = 220.986), international shipments (VIF = 102.531), logistics competence (VIF = 298.578), and tracking and tracing (VIF = 206.568). These values clearly exceed conventional thresholds and indicate serious overlap among the independent variables. This is not surprising because all five predictors are dimensions of the same Logistics Performance Index framework and are conceptually interrelated. The implication is that while the overall model can still be

significant, the individual regression coefficients must be interpreted with caution because the predictors share a large amount of common variance.

Table 3: Variance Inflation Factor values.

Predictor	VIF
customs	239.3585253
infrastructure	220.9861436
international_shipments	102.5311495
logistics_competence	298.5776551
tracking_tracing	206.5678538

Finally, the histogram of residuals (figure 2) shows that the residuals are fairly centered around zero and do not display an obvious extreme distortion, which supports the normality result from the Jarque–Bera test. The Q-Q plot (figure 3) shows that most residual points fall reasonably close to the reference line, with only mild deviations at the tails, again suggesting that normality is acceptable for the model. The residuals versus fitted plot (figure 4) does not show a strong funnel pattern, which is consistent with the Breusch–Pagan result indicating no major heteroscedasticity problem. The Cook's distance plot (figure 5) shows that a small number of cases have relatively stronger influence than others, so the model is statistically strong but should still be interpreted with some caution because a few country observations exert more leverage on the fitted line. Influential observations were further assessed using Cook's Distance (figure 2). The maximum Cook's Distance value was 0.108, while the common screening threshold of 4/n was 0.0288. A total of 10 cases exceeded this threshold, indicating that a limited number of countries had relatively stronger influence on the fitted regression model. This does not automatically invalidate the analysis, but it does suggest that some observations had more leverage on the regression estimates than others. As a result, the model should be interpreted as statistically strong but somewhat sensitive to influential cases and overlapping predictors. Taken together, the diagnostics show that the regression assumptions of normality, homoscedasticity, and independence were reasonably satisfied, but that multicollinearity was severe and remains the key caution in interpreting the regression findings.

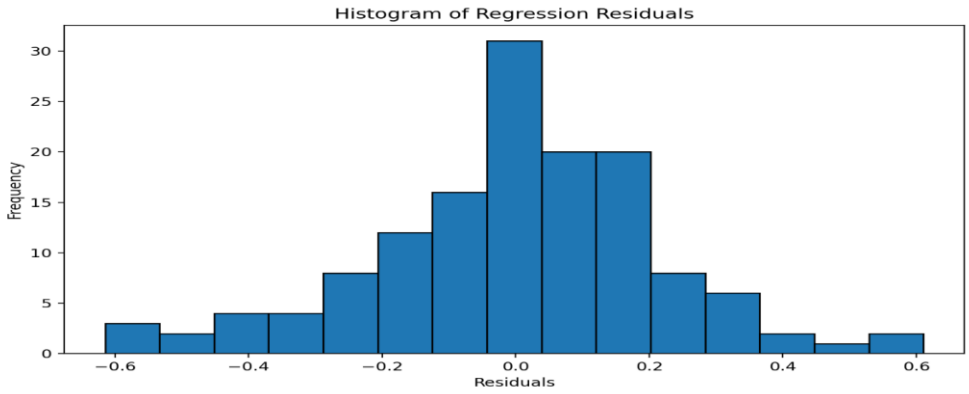

Figure 2: The histogram of the regression residual.

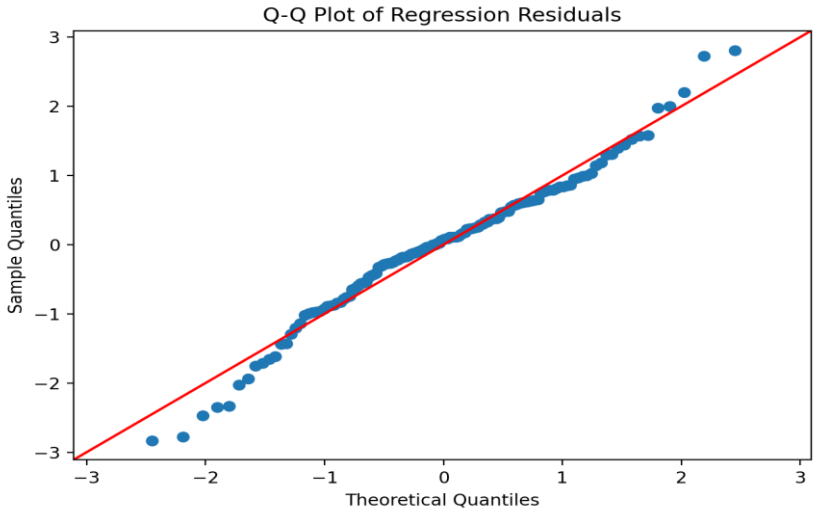

Figure 3: Q-Q plot of the regression residuals.

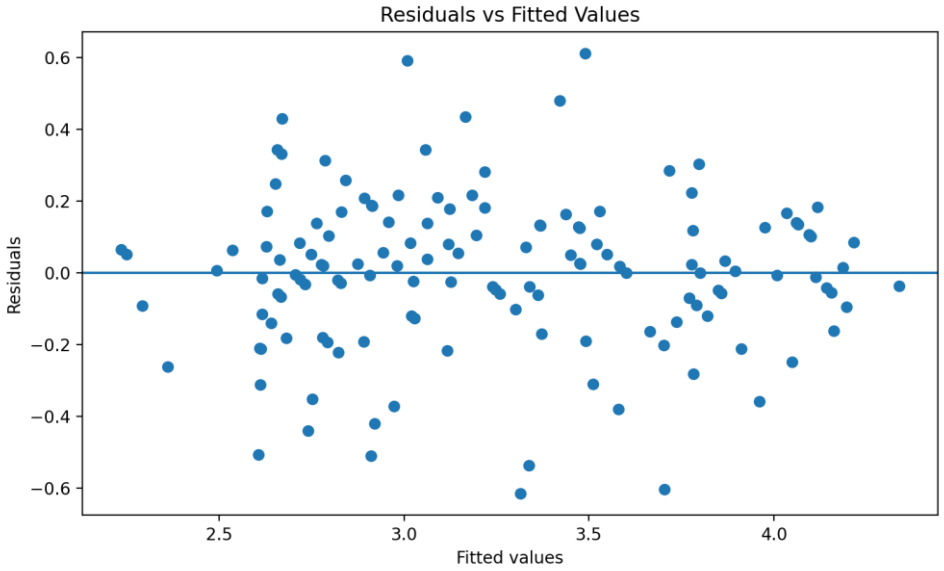

Figure 4: Residual Vs Fitted Values.

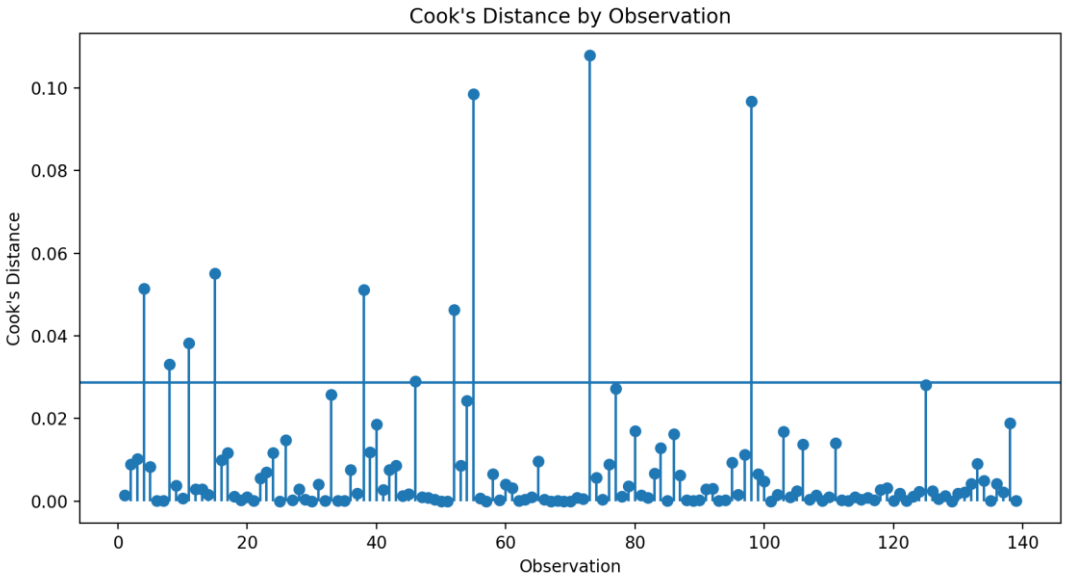

Figure 5: Graph of Cook's Distance

4.3 Correlation analysis

Pearson product-moment correlation was used to test the bivariate relationships between each transportation management practice dimension and logistics management, measured by timeliness. The analysis was appropriate because all variables were continuous and approximately normally distributed. The aim was to determine the strength and direction of the relationship between each predictor and the dependent variable before estimating the regression model. This step was particularly important because it helped establish whether the transportation management practice dimensions were individually associated with logistics management outcomes. The results are presented in Table 2 and provide the clearest initial test of the study hypotheses.

Table 2 ***Pearson correlation between transportation management practices and timeliness.***

Predictor	**r**
Customs efficiency	.863
Infrastructure quality	.863
International shipments	.831
Logistics competence	.898
Tracking and tracing	.911
Transportation management practices composite	.912

The results in Table 2 show that all five transportation management practice variables had strong, positive, and statistically significant relationships with timeliness. Customs efficiency and infrastructure quality each recorded a correlation of .863, international shipments

recorded .831, logistics competence recorded .898, and tracking and tracing recorded .911. The composite transportation management practices score showed the strongest overall association with logistics management at .912. These findings indicate that countries with stronger transportation management practices generally also perform better in terms of on-time delivery. The results therefore provide broad support for the study proposition that transportation management practices are significantly related to logistics management, and they lead directly to the regression analysis that examines their combined predictive effect.

4.4 Regression analysis

A multiple linear regression analysis was performed to assess the joint effect of customs efficiency, infrastructure quality, international shipments, logistics competence, and tracking and tracing on logistics management as measured by timeliness. The objective was to determine how much variance in timeliness could be explained collectively by the transportation management practice variables and to identify which predictors retained significant independent effects when entered together in the same model. This analysis was necessary because correlation only examines one predictor at a time, whereas regression evaluates the combined structure of the predictors. The results are presented in Table 3 and are interpreted in light of the earlier diagnostic findings, especially the evidence of severe multicollinearity.

Table 3 ***Multiple regression predicting timeliness from transportation management practices.***

Predictor	**B**	**SE**	**t**	**p**
Constant	0.710	0.114	6.201	< .001
Customs efficiency	0.109	0.103	1.061	.291
Infrastructure quality	-0.072	0.098	-0.736	.463
International shipments	0.106	0.076	1.380	.170
Logistics competence	0.273	0.107	2.557	.012
Tracking and tracing	0.427	0.087	4.901	< .001

Model summary: $R = .923$, $R^2 = .851$, Adjusted $R^2 = .845$, $F(5, 133) = 152.000$, $p < .001$

The regression results show that the model was statistically significant and explained 85.1% of the variance in timeliness. This indicates that the transportation management practice variables, taken together, are very strong predictors of logistics management. However, only logistics competence and tracking and tracing remained statistically significant in the joint model, with tracking and tracing emerging as the strongest unique predictor. Customs efficiency, infrastructure quality, and international shipments did not remain significant when

all predictors were entered simultaneously. Given the very high VIF values, this should not be interpreted as evidence that those factors do not matter, but rather that their effects overlap strongly with the rest of the logistics performance structure. This final result sets up the discussion of findings, where both the strong correlations and the multicollinearity-aware regression interpretation will need to be integrated carefully.

DISCUSSION OF FINDINGS

The findings strongly support the overall proposition that transportation management practices are associated with logistics management. Every transportation management dimension showed a strong and positive bivariate relationship with timeliness, and the composite transportation management score was very highly correlated with the dependent variable. This broad pattern is consistent with Hausman et al. (2013), Martí et al. (2014), and Gani (2017), all of whom found that stronger logistics-related capabilities are associated with better trade-related outcomes. The present study extends that logic by showing the same pattern with a more operational dependent variable, namely shipment timeliness. This matters because it demonstrates that transportation management affects not only trade volumes or competitiveness but also the core logistics outcome of whether goods arrive when expected.

The strongest individual bivariate association was found for tracking and tracing, followed by logistics competence, which is theoretically meaningful. Helo and Thai (2024) argued that connected tracking and tracing technologies improve logistics decision-making, while Yang and Lirn (2017) and related capability studies emphasize the performance role of service quality and coordination. The current results suggest that these arguments also hold at country level. Where visibility is high and logistics actors are more competent, timeliness is more likely to improve because disruptions can be detected quickly and responses can be coordinated more effectively. In this sense, the results imply that digital visibility and service capability may now be the most distinctive practical levers for logistics management, especially in a period marked by supply chain uncertainty and resilience pressures.

The regression findings, however, add an important nuance by showing that not all dimensions remain independently significant once entered together. Customs, infrastructure, and international shipments were strongly correlated with timeliness at the bivariate level, yet they lost significance in the multivariable model. This pattern closely mirrors the warning by Ardine et al. (2023) that LPI components are naturally intercorrelated and may create multicollinearity when analyzed simultaneously. The result therefore should not be misread as evidence that customs or infrastructure do not matter. Rather, it suggests that these factors

are part of a shared logistics capability system whose unique effects are harder to separate statistically. The regression thus reinforces the value of using both correlational and multivariable evidence together in interpreting transportation management.

These findings also help bridge prior literature that emphasized trade, competitiveness, and development rather than logistics management itself. Studies by Park (2020), Sergi et al. (2021), Koyuncu and Doğaner (2023), and Zaninović et al. (2023) all linked logistics or transport performance to broader strategic outcomes, but the current study shows that the same transport capabilities are directly associated with a closer operational outcome. This is a useful contribution because policymakers and logistics managers often need evidence at the level of delivery performance, not only at the level of macroeconomic trade. The results suggest that interventions aimed at improving logistics competence and tracking capability may produce more immediate gains in timeliness, while infrastructure and customs reforms remain essential system enablers that support the wider capability base. That practical implication takes the argument into its final section.

CONCLUSION

This study examined the relationship between transportation management practices and logistics management using publicly available 2023 World Bank Logistics Performance Index data for 139 countries. The results showed that customs efficiency, infrastructure quality, ease of arranging international shipments, logistics competence, and tracking and tracing all had strong positive bivariate relationships with timeliness. The composite transportation management score also showed a very strong relationship with the dependent variable, confirming the central argument that better transportation management practices are associated with better logistics management outcomes. These findings support both the systems view that logistics performance emerges from interdependent capabilities and the resource-based view that strong logistics capabilities function as strategic performance resources.

At the same time, the joint regression model revealed that logistics competence and tracking and tracing were the most distinctive predictors of timeliness once the overlap among the transportation dimensions was taken into account. This suggests that service capability and visibility now occupy a particularly important place in logistics management, even though customs, infrastructure, and shipment arrangement remain foundational components of the wider system. Overall, the study provides a clear, data-based answer to the research problem: transportation management practices and logistics management are strongly related, but the

dimensions do not contribute equally once modeled together. That conclusion offers a defensible foundation for further dissertation-level work using richer panel data or additional transport performance datasets.

RECOMMENDATIONS

Based on the findings,

1. Policymakers should treat transportation management as a systems issue rather than as a narrow infrastructure issue.
2. Governments and logistics agencies should therefore pair infrastructure improvements with digital tracking systems, interoperable logistics information platforms, customs modernization, and capacity building for logistics service providers. This is consistent with both recent World Bank logistics benchmarking and UNCTAD's emphasis on connectivity and data-informed transport management. A practical reform package should therefore target infrastructure, service quality, and information transparency together so that physical assets are translated into dependable delivery performance.
3. For research, future studies should extend the present design in three directions. First, they should use multi-year panel data to test whether improvements in transportation management precede improvements in logistics management over time. Second, they should combine LPI data with other public sources such as UNCTAD connectivity indicators and the World Bank Container Port Performance Index in order to deepen the transport-specific analysis. Third, they should explore regional or income-group differences, since recent LPI and post-COVID studies show that logistics patterns differ substantially across countries. These steps would strengthen causal interpretation, reduce the limitations of a single-year cross-sectional design, and generate a more refined understanding of how transportation management practices shape logistics performance in different contexts.

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