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Enhancing Cross-Border Third-Party Logistics Performance: The Role of Supply Chain Visibility and Transparency

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ABSTRACT

This study investigates key supply chain visibility and transparency factors influencing cross-border third-party logistics (3PL) performance. A two-step approach was used: first, a comprehensive literature review identified critical visibility and transparency factors; second, the Grey-DEMATEL method was applied to assess their relative importance and interrelationships. The findings reveal that key issues—such as audit cyclicality, predictive metrics, standardized policies, supply network status, and information sharing—are closely linked to communication gaps, logistical inefficiencies, long delivery cycles, elevated costs, lack of standardization, and ineffective work agreements. These findings underscore the critical role of supply chain visibility and transparency in effectively managing cross-border third-party logistics services utilized by e-commerce platforms. However, challenges such as restricted access to real-time data, information-sharing limitations, regulatory complexities, and security risks remain persistent barriers. The current research emphasizes that enhancing visibility and transparency within the supply chain is essential for improving the operational efficiency and service quality of cross-border third-party logistics in the context of global e-commerce.

Keywords: *3PL, grey-DEMATEL, supply chain transparency, supply chain visibility*

1. INTRODUCTION

Having visibility throughout the supply chain is vital for efficiently managing interactions with suppliers and customers to enhance the value of products in the market while decreasing total expenses. Consumers interpret the information available on an online retailer's website as indicators of the seller and product quality, and trustworthiness. These factors are particularly important in the context of online retail, as buyers and sellers are often unfamiliar with each other, and the quality of a product can only be determined after it has been received (Peinkofer & Jin, 2022). Further, visibility encompasses a wider capability that involves tracking the flow of materials, funds, and information, making the supply chain more transparent in real-time (Dubey *et al.*, 2020). Inadequate visibility can lead to delays, penalties from clients for tardiness, unnecessary shipments due to customer requests, and inventory reduction (Urciuoli & Hintsa, 2018). For many years, freight industry has been striving to establish a real-time flow of information about location of cargo. Currently, the data provided by carriers is out-of-date and incorrect, and it is only made available when the cargo reaches certain key points. The basis of freight visibility depends on carrier-dependent, milestone-based information, leaving shippers exposed in logistics. During these key points, organizations lack visibility into their inventory, cannot verify if carriers are meeting the agreed service levels, and cannot identify where supply chain inefficiencies and bottlenecks are occurring (Hunaid *et al.*, 2022). Thus, transparency is essential for fostering trust among partners, which leads to better

coordination and resource sharing for improved performance.

Supply Chain Transparency (SCT) serves as a key indicator, conveying a positive integrity signal. To connect manufacturers and consumers and communicate the invisible quality of goods, manufacturers can take the initiative to share information about the sustainability of their supply chain, for example, on their company's website (Connelly *et al.*, 2011), manufacturers can voluntarily reveal information about the sustainability of their supply chain (e.g. on the company's website). Consumers can use the available information to infer the quality of a product (Mollenkopf *et al.*, 2022). Supply Chain Transparency (SCT) strategies, which are driven by visibility and traceability, help organizations determine the appropriate level of information sharing, increase oversight both internally and externally, and advance the perception of openness among stakeholders (Montecchi *et al.*, 2021). While many large companies have moved away from using the traditional methods of product's tracking such as physical records, excel sheets, and emails, to IT-based technologies like EDI and ERP systems, the real challenge of ensuring a seamless flow of goods and having transparency into products at every stage is still unresolved (Kapkaeva *et al.*, 2021).

The issue with these technologies also originates from the absence of inter-connectivity and visibility of data among all supply chain participants. For example, the increase in number of intermediaries between the manufacturer and consumer, and globalization has resulted in a more extended supply chain network which led to limited visibility into product origins and shipment information (Raja Santhi & Muthuswamy, 2022). Conventionally, logistics is characterized as the oversight and coordination of the execution and monitoring of all material, component, and product flows, as well as the information required to traverse the entire value-added chain, both internally and across the network. This understanding of logistics remains valid, but logistics performance is becoming increasingly dependent on technological advancements (Windt & Hülsmann, 2007). Our research focuses on the impact of both internal and external information on logistics performance, as previous studies have not considered both scenarios. Real-time visibility is essential for improved predictability and decision-making, but through Supply Chain Visibility (SCV), organizations can achieve a better comprehension of customer demand and offer enhanced services. Additionally, SCV results in more efficient resource utilization and higher productivity, leading to increased profitability and cost savings (Agrawal *et al.*, 2022). Theoretical developments in Supply Chain Transparency (SCT) are emerging, but there are several areas in the literature that require further attention. It's important to differentiate between SCT, visibility, and traceability. The first step in implementing SCT is visibility which involves collecting information about upstream and downstream operations within a company's supply chain (Gligor *et al.*, 2022).

It raises the following key question to be investigated. What are the sub-factors or dimensions of SC Transparency and SC Visibility that can contribute to the cross border 3PL efficiency? How do they interact with each other while improving the CB-3PL? The above two questions set out the key objectives of the study. First, to identify all the related dimensions of SCT and SCV that can contribute to the CB-3PL by adopting a comprehensive approach. Second, to develop a framework demonstrating the interdependencies and impacts of identified dimensions of SCT and SCV on CB-3PL. Third, validation of the developed framework through input from experts. In order to obtain the above objectives, the study follows multi-stage approach. In the first stage, SCT and SCV dimensions are identified. In the second stage, Grey DEMATEL is applied to investigate the interrelationship and probable impact of identified dimensions on CB-3PL.

2. LITERATURE REVIEW

This section exposes the basic definitions and dimensions of key variables, concluding the simplified framework of the study. Whereas dimensions of SCV and SCT have been explored in the subsequent section.

2.1 Supply Chain Visibility

Supply Chain Visibility (SCV) is defined as the extent to which different participants within a supply chain have access to or share information that they consider essential or advantageous to their operations, which they believe will be mutually beneficial (Agrawal *et al.*, 2024; Mirzaei, 2025). Supply chain visibility entails, at its core, ensuring that the organization has access to accurate and up-to-date data regarding internal and external processes within the supply chain (Moshood *et al.*, 2021). Supply chain visibility is based on shared data and information, and according to Brandon-Jones at al. (2014), information sharing and supply chain connectivity are the key factors that precede supply chain visibility (Dubey *et al.*, 2020). The perspectives of inventory and operation indicate how the lack of visibility across both upstream and downstream operations affects the effectiveness of the supply chain's progress (Ahmed *et al.*, 2021). There are several advantages to visibility, including cost savings, enhanced inventory turnover, increased customer satisfaction, reduced risk, improved compliance, streamlined transportation, and the ability to be more agile and flexible (Hunaid *et al.*, 2022).

Supply chain partners can achieve greater market agility and mitigate the risk of disruptions to the flow of materials and goods through the implementation of End-to-end Supply Chain Visibility (SCV), which encompasses first-tier suppliers to final customers (Somapa *et al.*, 2018). There are four main processes that allow a company to align its supply chain with both internal and external needs. These processes are learning visibility, sensing visibility, integrating visibility, and coordinating visibility (Moshood *et al.*, 2021). Having visibility of both internal and external operations in the extended supply chain is crucial for efficient decision making. However, it can be difficult to attain in reality, making supply chain visibility a major concern for companies (Agrawal *et al.*, 2022). The Internet of Things (IoT) has a significant impact on how supply chains integrate internally and with suppliers and customers. The data produced by IoT devices can greatly improve visibility throughout all phases of the supply chain by effectively collecting, analyzing and turning that data into useful information, which can help identify internal and external issues that need to be addressed early on (Ahmed *et al.*, 2021).

2.2 Supply Chain Transparency

Supply chain transparency is, therefore, openness and thoroughness with regard to every single component of either a product or service, including sources as well as the process of manufacturing up to its price and transportation (Montecchi *et al.*, 2021; Cemberci *et al.*, 2024). Supply chain transparency more implies where the requested information reveals transparently without loss, noise, delay or distortion in order that everyone has access to, and also shares common understanding of the product-related accruements (Pant *et al.*, 2015). Creating transparency in a supply chain also helps to gain knowledge about it. In order to ensure fairness in negotiations and to have more information about where products come from, it is essential for all parties involved to have access to the same information (Badzar, 2016). Collaboration within the supply chain often takes the form of partnerships, which are business relationships characterized by trust, transparency, shared risks and rewards, and a focus on achieving a competitive advantage that leads to better overall performance compared to working independently (Gitau, 2022).

Maintaining effective communication throughout the supply chain has become a significant challenge due to the need to manage costs and quality while also accommodating the benefits of mass customization, reducing inventory and dealing with global competition (Ahmed & Omar, 2019). Establishing transparency in the supply chain can be costly and increase operational complexity. However, advancements in technology now allow customers to easily access information from retailers and manufacturers, as well as online reviews, industry reports and watchdog groups (Montecchi *et al.*, 2021). Researchers have identified five key components or actors in food supply chain transparency, which are government food companies, and consumer's standards (including quality and safety), governance, and information systems (ICT). A company is considered transparent when it reveals publicly the identities of its suppliers, the sustainability standards they abide by, and the purchasing policies associated with each of them (Brun *et al.*, 2020). Having access to information is crucial for enhancing relationships within the supply chain, as better coordination of transactions can lead to cost reduction, risk management and overall competitiveness improvement (Badzar, 2016). The flow of information related to transparency relies on the accuracy and authenticity of product, processes, and resources, which must meet established standards and guidelines (Pant *et al.*, 2015).

2.3 Cross Border 3rd Party Logistics

A 3PL is a type of intermediary in the logistics industry that offers various logistics services, such as transportation and distribution (Taha & Reynolds, 2023), to other companies under a contractual agreement (Ying & Dayong, 2005) whereas, Cross-border e-commerce export logistics, in contrast, pertains to the sequence of logistics procedures involved in obtaining goods from sellers engaged in cross-border e-commerce, organizing domestic and international logistics, and shipping the goods to international buyers (Zhao, 2019). Although cross-border e-commerce is thriving globally, there are still barriers that hinder its expansion, including uncertain and prolonged delivery times, complicated and uncertain return procedures, delays at customs, lack of visibility on delivery status, lack of price transparency, and the inability to change delivery times or addresses (Wang *et al.*, 2020). Cross-border e-commerce involves conducting international business transactions through an e-commerce platform for completing payments, transactions, and settlements, as well as using cross-border logistics services for delivery (Wang *et al.*, 2018). The growth and success of cross-border e-commerce is heavily dependent on logistics.

The importance of services cannot be overstated when it comes to cross-border e-commerce. Cross-border e-commerce itself is a complex system which involves a variety of service offerings, including electronic payment, cross-border trade services, logistics services, legal advice services, and customs declaration and inspection services (Wang *et al.*, 2020). Manufacturing materials are initially consolidated in a third-party logistics warehouse before they are transported across the border, thus, it is advisable to outsource the process to attain a higher level of professional service. The warehouse operations which are associated with border inspection mainly comprise of handling paperwork and collecting goods that have been inspected (Lam *et al.*, 2011). Logistics, which includes activities such as warehousing, sorting, packaging, and distribution, is crucial in cross-border e-commerce as it connects sellers and buyers, and it matches supply and demand. Overseas warehouses and bonded warehouses are frequently utilized as primary logistics solutions in cross-border e-commerce. Cross-border e-commerce export logistics is defined by: 1) multiple stages and high complexity; 2) being greatly impacted by political factors such as customs clearance policies at home and abroad; 3) its global nature (Zhao, 2019).

This study focused on finding the relationship of supply chain factors which effects the cross-border logistics operated by third party logistic organization. Hence, conceptual framework is shown in Figure 1.

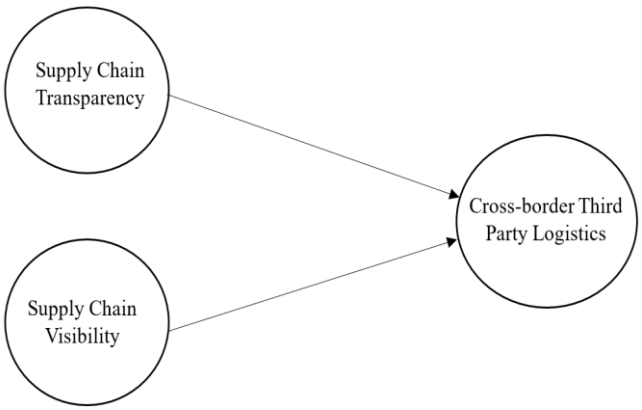

Figure 1 Conceptual framework.

3. METHODOLOGY

In this research, both grey and DEMATEL techniques were utilized to determine the cause-and-effect relationship between supply chain visibility and transparency factors in relation to issues with cross-border third-party logistics. The process followed for application of grey-DEMATEL in this research is shown in figure 2.

Existing Literature review on selected independent and dependent variables was conducted including SCV SCT and CB3PL, 10 relevant factors for each variable were selected as shown in Table 1.

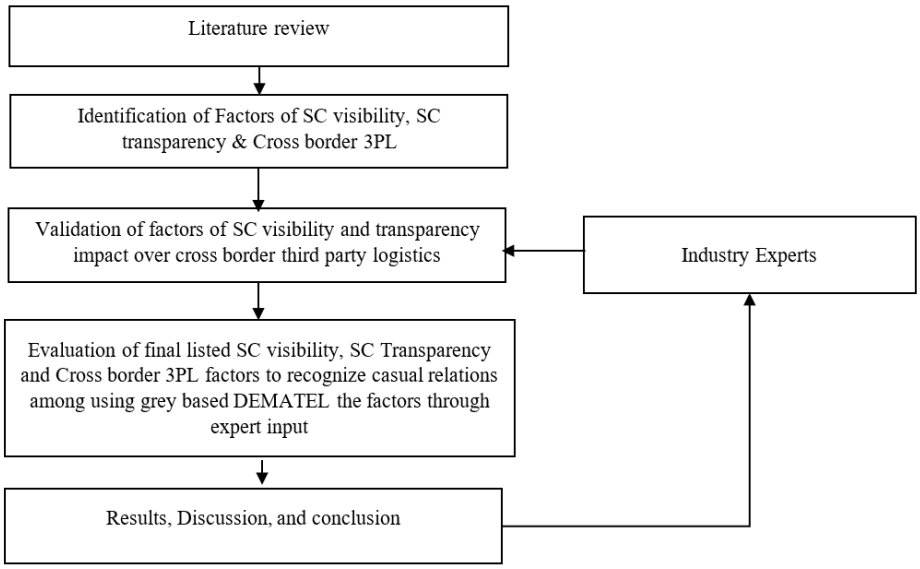

Figure 2 Process flow chart.

Table 1 Factors identified from literature review.

S. No	Supply Chain Transparency	Supply Chain Visibility	Cross border 3rd Party Logistics
1	Buyer- Supplier Continuous Monitoring	Digital Twins	Communication
2	Periodic Audits	Predictive Metrics	Logistics links, long delivery cycle High Cost
3	Standardized Policies	Information accuracy	Trust
4	Supply Chain Communication	Product complexity	Timely tracking
5	Trust b/w SC Partners	Internal Visibility	Logistics Return and Exchange
6	Integration of SC Partners	External Visibility	Standardization
7	Knowledge sharing	Supply network status	Service Levels
8	Awareness	Cloud Based Information collection	Culture
9	SC Partners Engagements	Inter Organization Collaboration	System compliance
10	Information Processing Capabilities	IOT based tracking	Work agreements

Table 2 Shortlisted factors of supply chain visibility, transparency & cross border 3PL.

Sr. No.	Factors	Description	Reference
		Supply Chain Transparency	
1	Periodic Audits (F1)	Checking policies and working procedures that have been written in documents and followed in day-to-day activities at time intervals defined.	Ahmed and Omar (2019)
2	Standardized Policies (F2)	Standard policies and procedures defined to follow in working procedures to make the working procedures efficient and following all guidelines.	Ahmed and Omar (2019)
3	Supply Chain Communication (F3)	When communication between stakeholders and external suppliers is efficient in the supply chain, it can lead to the introduction of more innovative concepts, thus enhancing the process. The sharing of information and effective communication for each supply chain element is crucial.	Ahmed and Omar (2019)
4	Knowledge sharing (F4)	Through knowledge management, supply chains can progress. It enables access, sharing, and utilization of information pertaining to customer requirements and actions, quality feedback, revenue, and business environment developments or changes for making decisions throughout different parts of the supply chain.	Brun *et al.* (2020)
5	Awareness (F5)	Awareness is the capability of obtaining the necessary information, irrespective of its source, at the precise moment it is needed, to handle exceptions and capitalize on opportunities.	Brun *et al.* (2020)
		Supply Chain Visibility	
6	Predictive Metrics (F6)	Predictive metrics evaluate the actions or activities that advance towards the target.	Moshood *et al.* (2021)
7	Information accuracy (F7)	It refers to the information and data provided are authentic and trusted by sources.	Agrawal *et al.* (2022)
8	Internal Visibility (F8)	Internal visibility entails the gathering, documenting, and dissemination of information within a company's operations. It encompasses all the methods, protocols, and components required to document and distribute data throughout the internal supply chain.	Agrawal *et al.* (2022)

Table 2 Shortlisted factors of supply chain visibility, transparency & cross border 3PL (Cont'd).

Sr. No.	Factors	Description	Reference
9	Supply network status (F9)	A supply chain network illustrates the connections among organizations and how information and materials are transferred among these connections.	Agrawal *et al.* (2022)
10	Inter Organization Collaboration (F10)	Partnering of organizations for betterment and efficient mode of service Defined as 'a mutually beneficial process by which stakeholders or organizations work together towards a common goal'.	Agrawal *et al.* (2022)
		Cross Border Third Party Logistics	
11	Communication (F11)	The exchange of relevant and timely information, both formal and informal, among companies, contributes to an enhancement in performance, particularly in the early stages of partnerships.	Zhao (2019)
12	Logistics links, long delivery cycle High Cost (F12)	Cross-border e-commerce logistics for exports is hindered by various factors such as customs regulations, domestic and foreign logistics protocols, leading to longer logistics processes and higher costs compared to domestic e-commerce logistics. These restrictions notably decrease the satisfaction of foreign customers and impede the expansion of China's export cross-border e-commerce.	Zhao (2019)
13	Timely tracking (F13)	The ability to track logistics information in cross-border logistics is hindered by factors such as disparities in information quality, lack of common information-sharing interfaces, and so on, across different countries.	Zhao (2019)
14	Standardization (F14)	Standardization in logistics covers standardizing product packaging, coding logistics information with bar codes, consolidating goods into containers for loading, unloading, transportation, and storage. Implementing standardization in these processes is an efficient way to reduce logistics costs and improve overall operational efficiency.	Zhao (2019)
15	System compliance (F15)	System compliance allows for operational standardization because the connection between the two systems demonstrates their unification and mutual agreement on work standards and measurements.	Zhao (2019)
16	Work agreements (F16)	In order for a 3PL arrangement to be successful, both parties must have a clear understanding of the logistics involved and have a plan for creating synergies before beginning the partnership.	Zhao (2019)

Table 3 Application of grey-DEMATEL technique in different area**.**

S. No	Researcher (year)	Application Area, Country
1.	Deepu and Ravi (2021)	Assessing the critical success factors for managing business processes in a manufacturing company based in China.
2.	Lai *et al.* (2022)	Examining the critical success factors for managing customer relationships.
3.	Wu and Chang (2015)	Assessment of sustainable supply chain practices within an electronic company based in Taiwan.
4.	Kumar *et al.* (2016)	Assessing the obstacles faced in the European automobile industry regarding the implementation of environmentally friendly products.
5.	Liang *et al.* (2016)	Investigating the key elements for fostering sustainable expansion within the biofuel sector in China.
6.	Rajesh and Ravi (2017)	Assessing the factors that drive supply chain risk within the electronic industry in India.
7.	Luthra *et al.* (2015)	Investigating the essential elements for managing sustainable supply chain in the automobile sector in India.
8.	Han and Trimi (2018)	Assessing the critical success factors for incorporating drones in the logistics sector in India.
9.	Yang *et al.* (2020)	Implementing regulations for the return of vehicles through the adoption of recycling laws in the automobile industry in China.

Table 4 Assessment criteria, grey scale & normal values.

Criteria of Assessment	Respective Grey Scale	Normal values
No Influence (N)	(0.0,0.1)	0
Low Influence (VL)	(0.1, 0.25)	1
Medium effect(M)	(0.25, 0.5)	2
High effect (H)	(0.5, 0.75)	3
Very High Effect (VH)	(0.75, 1.00)	4

Identified factors were listed and sent to experts for validation and 16 factors were finalized as shown in table 2.

To get understanding of grey-DEMATEL analysis technique different research papers were reviewed as depicted in Table 3. Criteria of assessment and respective grey scale & normal values are used as presented in Table 4.

The Grey-Based DEMATEL method applied is described as below.

Step 1 - Construct the primary influenced matrices

Assuming that there are "c" factors identified and "n" experts selected, each expert will assess the effect of x factors on y factors using the evaluation criteria listed in Table 4 for all "c" factors. This will lead to the creation of "n" main influence matrices for each expert.

Step 2 - Develop specific grey matrices

Creating specific grey matrices by converting specific values into corresponding grey scale values as outlined in Appendix 1A (Luthra *et al.*, 2018), i.e.

$$\otimes A_{xy}^{l} = \left(\underline{\otimes} A_{xy}^{l}, \underline{\otimes} A_{xy}^{l}\right) \quad (1)$$

Where $1 \leq l \leq n; 1 \leq x \leq c; 1 \leq y \leq c.$

Step 3 - Calculate the average grey matrix using equation 2

$$\otimes \bar{A}_{xy}^{l} = \sum_{l} \frac{\underline{\otimes A_{xy}^{l}}}{n}, \sum_{l} \frac{\underline{\otimes A_{xy}^{l}}}{n} \quad (2)$$

Step 4 - Transforming the average grey matrix into a clear and defined relationship matrix.

Step 5 - Calculating the normalized direct-relation matrix "N" using equations (3) and (4).

The value of each element in "N" ranges from 0 to 1.

$$L = \frac{1}{\max\limits_{1 \leq x \leq c} \sum_{y}^{c} a_{xy}} \quad (3)$$

$$N = L * M \quad (4)$$

Step 6 - Acquire "T" (total relation matrix) using Equation (4)

$$T = N(I - N)^{-1} \quad (5)$$

I represent unit matrix

Step 7 - Determine causal factors

Calculate R (rows sum) and D (columns sum) using equations (6) and (7):

$$R = \left[\sum_{y=1}^{c} a_{xy}\right]_{C \times 1} \quad (6)$$

$$D = \left[\sum_{y=1}^{c} a_{xy}\right]_{1 \times C} \quad (7)$$

Step 8 - Draw diagraph

Average values of set (R + D, R-D) denote cause-effect diagram

3.1 Case Study

As one of the biggest retail platforms, a vast number of products are sold on Amazon, where half of them are listed by third-party sellers. Logistics is a crucial aspect in online retailing, it not only reduces costs in processing, storage, and transportation but also adds value to the transaction and increases the willingness of customers to purchase online. Amazon's advanced logistics system not only benefits its own sales, but it also made available to third-party sellers through the program known as "Fulfillment by Amazon". (Lai *et al.*, 2022). Amazon has about 5 million active sellers in which Drop shipping statistics reveal that about 50% of all units sold on Amazon originate from third-party sellers leading to a total contribution of $95.37 to the ecommerce giant's revenues in 2019. Drop shippers fulfill about 34% of Amazon sales & the market is set to surpass $372.47 billion in 2025. Further stats reveal that Electronics accounted for 30% of the North American drop shipping market which is a positive sign for future business prospects. The electronic industry is a rapidly evolving field due to the constant advancements in technology. It represents 30% of the North American drop shipping market. The industry is facing multiple challenges such as the quick changes in technology, low operating profit margins, short product life cycles, unstable demand and supply, and concerns related to services, warranty, and outsourcing (Deepu & Ravi, 2021).

To address these challenges, a comprehensive model has been proposed focusing on enhancing real-time visibility, leveraging data-driven insights, developing strategic supplier relationships, and integrating technology systems. Supply chain visibility, the ability to track products, materials, and data throughout the supply chain, forms the foundation, allowing sellers to monitor shipment locations and anticipate delivery times. This visibility provides access to all operations and items engaged in the supply chain, offering transparency and real-time knowledge into shipments, inventory levels, transactions, and payments. Meanwhile, supply chain transparency encompasses the approach for disclosing supply chain and source information to stakeholders, characterized by what information you will be open about, who you will be transparent with, and how frequently you will share relevant information.

The implementation of this model promises several benefits for electronics sellers on Amazon: reduced costs through efficient inventory management, improved customer satisfaction with faster and more reliable deliveries, better risk management through enhanced visibility to identify and mitigate potential supply chain disruptions before they affect customers, competitive advantage in the ability to offer reliable international shipping with accurate tracking information, and scalability through access to Amazon's global fulfillment network to expand into new markets without establishing their own international logistics infrastructure. Enhanced supply chain visibility improves coordination between all supply chain participants, while transparency helps demonstrate sustainability efforts and openness to stakeholders. With supply chain visibility, companies can elevate their supply chain maturity level and create cross-functional business processes to improve the quality and speed of decision-making, a critical capability as e-commerce continues to globalize.

3.2 Solution of Methodology

A complete guideline for executing the aforementioned proposed methodology within the context of an electronic retail supply chain to regulate and oversee vulnerability concerns is provided in the following section.

Step 1: The team of experts consisted of domain specialists, as previously mentioned, to evaluate sixteen factors related to supply chain transparency, supply chain visibility, and cross-border third-party logistics (3PL) as listed in Table 2.

The selected domain experts used the evaluation scale given in Table 4 to assess the effect of one factor on the other.

Step 2: Initially, four individual grey relationship matrices were constructed based on the ratings given in Table 3, incorporating each expert's input. By considering the feedback from each expert, a grey relationship matrix is developed as illustrated in the results.

Step 3: All experts have assigned weights according to their understanding to guarantee consistency in decision-making. Then, the average grey matrix $\otimes \bar{A}_{xy}^{l}$ is computed using Equation (2) which is shown through Appendix 1A.

See Appendix 1A Direct Relationship Matrix

Step 4: Build the normalized direct relation matrix (N) using Eqs. (3) and (4) as outlined in Appendix 2A.

See Appendix 2A Normalized Relationship Matrix

Step 5: Create a matrix T by applying equation 5 as outlined in Appendix 3A.

See Appendix 3A Total Relationship Matrix

Step 6: Table 5 demonstrates the construction of matrices (R+ D) and (R-D) for 16 factors. A chart illustrating the causal and effect relationships among all the factors and sets was created (as seen in Fig. 3). The matrix T includes all connections that meet or exceed a certain threshold value. Additionally, the connections among factors are illustrated in Fig. 4.

Table 5 Casual prominence values.

	Factors	R+C	R-C	Rank
F1	Periodic Audits	2.207	-0.267	5
F2	Standardized Policies	2.078	0.15	11
F3	Supply Chain Communication	2.555	-0.263	4
F4	Knowledge sharing	1.884	0.056	13
F5	Awareness	1.881	0.653	14
F6	Predictive Metrics	2.9	-1.292	1
F7	Information accuracy	1.755	0.515	15
F8	Internal Visibility	1.969	0.197	12
F9	Supply network status	2.18	-0.054	8
F10	Inter Organization Collaboration	1.742	-0.06	16
F11	Communication	2.848	-0.326	2
F12	Logistics links, long delivery cycle High Cost	2.184	0.406	7
F13	Timely tracking	2.082	0.624	10
F14	Standardization	2.595	-0.255	3
F15	System compliance	2.16	0.18	9
F16	Work agreements	2.192	-0.264	6

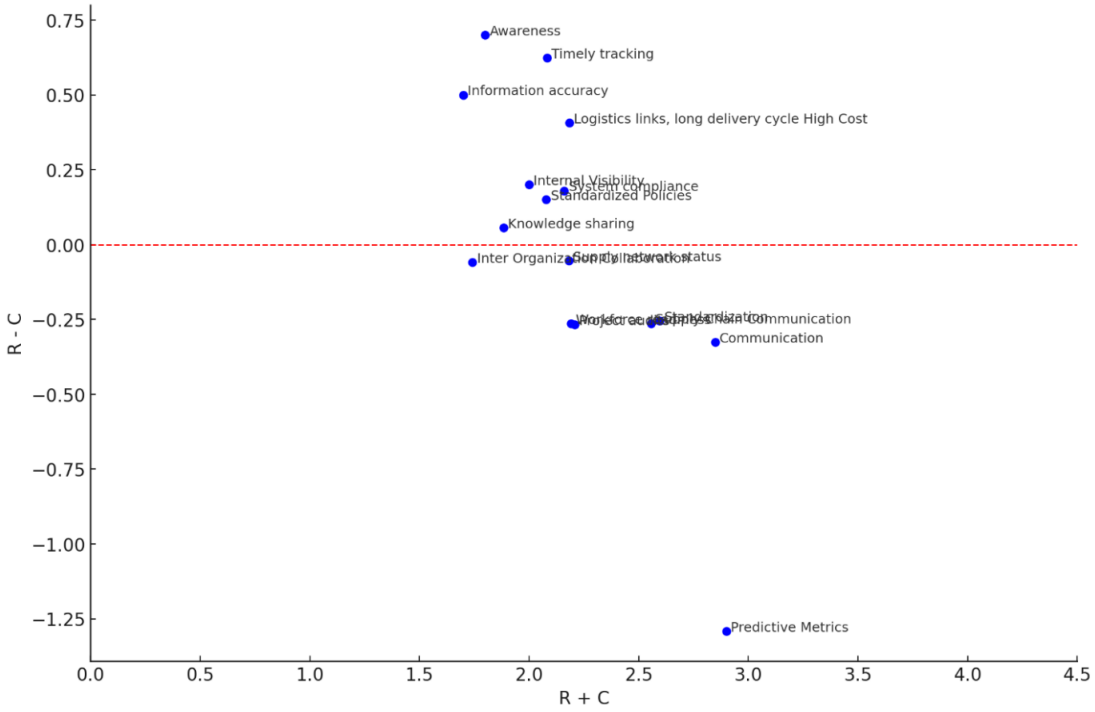

Figure 3 Cause and effect graph.

4. RESULTS AND ANALYSIS

The grey-based- DEMATEL method was used to identify the cause-effect relationships among the critical success factors (CSFs). Table 5 shows the net cause-effect values and significance for the factors that influence SCV & SCT on CB3PL. A diagram in Fig. 3 depicts the causal relationship among the factors. The success factors can be divided into two main groups based on the value of net effect (r-c) (Haleem *et al.*, 2019):

Cause group: where the (r-c,) value greater than zero.

This group comprises of following factors F2 (Standardized Policies), F4 (Knowledge sharing), F5 (awareness), F7 (information accuracy), F8 (Internal visibility), F13 (Timely tracking), F15 (System compliance), F12 (logistics links long delivery cycle, High cost),

Effect group: where the (r-c,) value is less than zero.

This group consists of F1 (periodic Audits), F3 (SC Communication), F6 (predictive matrices), F9 (Supply network status), F10 (Inter organization collaboration), F11 (Communication), F14 (Standardization), F16 (work agreements).

Further the importance order of each Factor is derived. The increasing order of the importance of the driver is measured by the increasing value of ‘‘R + C” (please see Table 5). The importance order of the factors based on the ‘upper values of R+C’ is as follows

F6 (Predictive Metrics) >F11 (Communication) >F14 (Standardization) >F3 (Supply Chain Communication) >F1 (Periodic Audits)> F16 (Work agreements) >F12 (Logistics links, long delivery cycle High Cost) >F9 (Supply network status) >F15 (System compliance) >F13 (Timely tracking)

>F2 (Standardized Policies) >F8 (Internal Visibility) >F4 (Knowledge sharing) >F5 (Awareness) >F7 (Information accuracy) >F10 (Inter Organization Collaboration)

In addition, relationships between each factor and its effect over other is correlated as depicted in Figure 4 in which F6 (Predictive matrices) have impact on almost all factors from 1-16 excluding F10 (inter organization collaboration) & F7 (Standardized policies), Followed by F3 (SC Communication), F1 (periodic Audits), F2 (standardization), F4 (Knowledge sharing) & F9 (supply network status) in sequence of having greater influence over multiple factors of dependent variables.

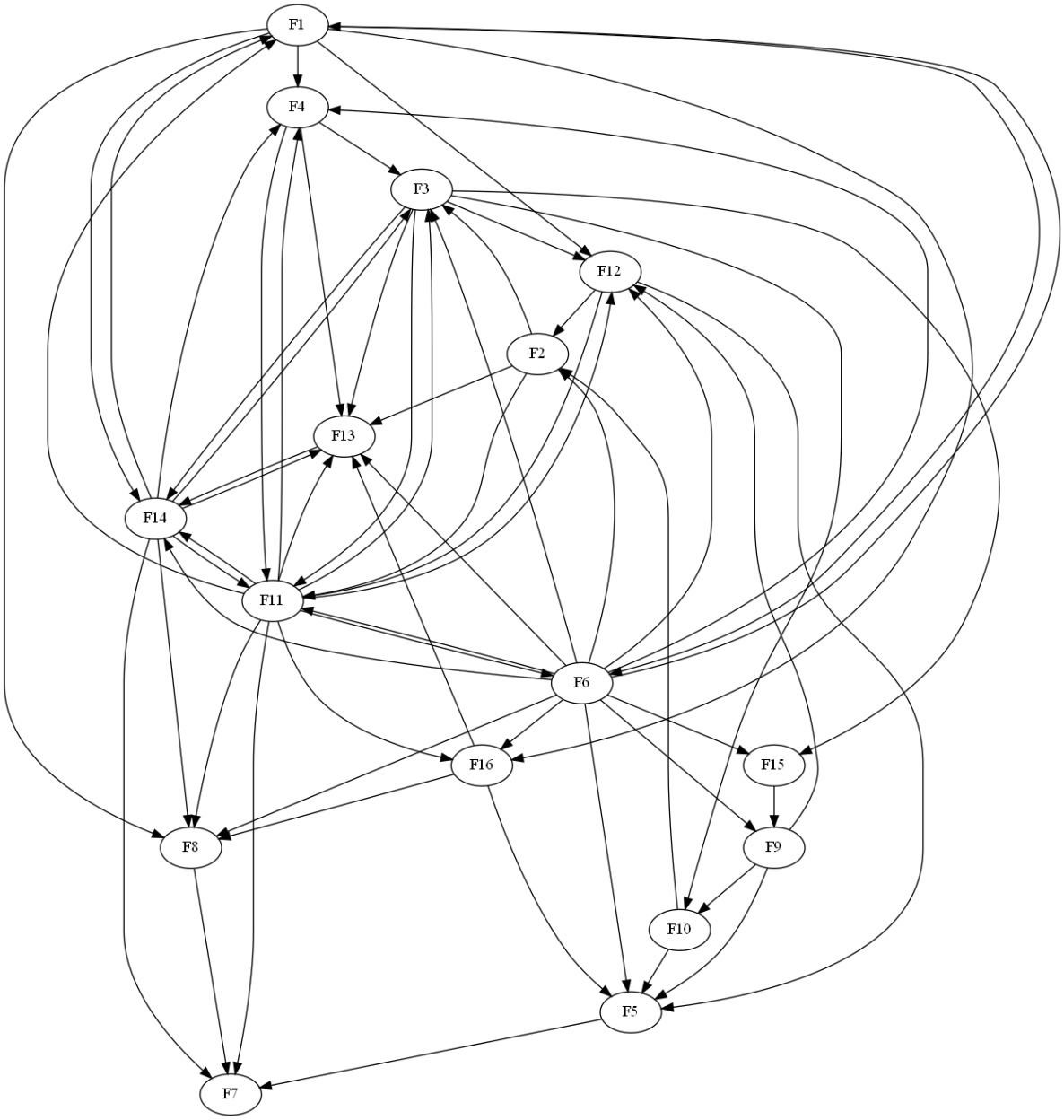

Figure 4 Casual relationship diagram.

5. DISCUSSION

5.1 Supply Chain Transparency Effect on Cross Border 3PL

The findings of the study identify various SCT and SCV dimensions that influence cross-border delivery logistics. Starting from supply chain communication (F3), a major dimension of SCV, demonstrate a strong link with various aspects of CB-3PL like communication (F11), logistics links, long delivery cycles, high costs (F12), timely tracking (F13), standardization (F14), and system compliance (F15). These findings are not only in line with other studies like Li (2022) and Wang *et al.* (2020) but also extend the understanding on the role of SC communication in improving logistics efficiency (CB-3PL). For example, Wang *et al.* (2020) note that information plays a crucial role in fostering connections among stakeholders within a supply chain. By enhancing transaction coordination, it can lead to cost reduction, risk mitigation, and overall enhancement of a supply chain's competitiveness. Our findings show that efficient and transparent communication practices can improve the integration throughout the entire supply chain, which can further promote better planning and performance (Ahmed & Omar, 2019). Likewise, establishing long-term partnerships relies heavily on communication based on

mutual trust. It entails sharing reliable and accurate information on a regular basis and conducting frequent meetings to foster mutual alignment, with decisions being adequately documented (Jazairy *et al.*, 2017b).

Research consistently demonstrates a positive association between communication trust and improvements in logistics performance. Our findings show that Periodic Audits (F1), a dimension of SCT, has shown effects on Logistics links, long delivery cycle High Cost (F12), Standardization (F14) and Work agreements (F16). Formalization is the procedure of standardizing, harmonizing or aligning buyer-supplier operational information, material, as well as monetary flows to attain better synchronization and transparency. It also helps to evaluate the performance of supplier operations through continuous monitoring by the buyer and periodic audits, which leads to suggesting enhancement programs or assessing partners (Ahmed & Omar, 2019). It is recommended that logistics processes and procedures should be standardized to align with widely accepted international practices and standards which includes normalizing specific measurements of logistics facilities or equipment. It is also mentioned that logistics standardization includes standardizing product packaging, recording logistics information with barcodes, utilizing standardized containers for loading and unloading, transportation, and storage. Standardizing these processes is an efficient method to reduce logistics costs and enhance overall operational efficiency (Jazairy *et al.*, 2017a). Overall auditing will result in developing the habit of following the work agreements and standardized practice and hence creating the better handling of job

Standardized Policies (F2) has effects over Communication (F11) and Timely tracking (F13). The successful implementation of logistics practices like JIT depend on seamless collaboration among supply chain partners and standardization of processes to maintain operational visibility, performance benchmarking, and comparison (Ahmed & Omar, 2019). Collaboration among all levels of the supply chain should be sufficient to detect any discrepancies and take corrective action promptly in order to reduce or eliminate operational and distributional inefficiencies. 3PLs that focus on efficiency tend to provide standardized solutions, achieving high productivity by taking advantage of economies of scale and scope. On the other hand, 3PLs that focus on both efficiency and innovation usually achieve a greater level of "customer adaptation", which entails acquiring specific knowledge for each shipper and strong management commitment.

Knowledge Sharing (F4) shown impact on Communication (F11) and Timely tracking (F13) too. A transparent supply chain network, which positively impacts operational performance, is characterized by the reliability of information systems, the transfer of operational knowledge, and the speed at which information flows through supplier integration (Ahmed & Omar, 2019). Companies should shift their mindset towards open and transparent information sharing, as the ultimate goal of this is to provide the consumers with accurate information. To establish strong supply chain relationships, top management commitment and leadership are essential, and this, in turn, enables the practice of sharing information based on trust (Brun *et al.*, 2020). Transparency provides company differentiation and an edge over its rivals. While transparency provided by a company should decrease the effort required by its competitors to offer similar levels of transparency. If a company makes this information public, its competitors would learn who the company's suppliers are, how the company obtains the disclosed information, and which suppliers could provide the information they need for transparency (Sodhi & Tang, 2019).

5.2 Supply Chain Visibility Effect on Cross Border 3PL

Supply chain visibility has effects on Cross border logistics through various factors. Predictive Metrics (F6) has effect on Communication (F11), Logistics links, long delivery cycle High Cost (F12), Timely tracking (F13), Standardization (F14) System compliance (F15) and Work agreements (F16). By implementing digital tracking, the visibility metrics for sensing (rapidly obtaining information about internal and external processes) and visibility for learning (how quickly the collected data can be analyzed) will significantly enhance, and this accumulated network of information can then be utilized to reorganize internal and external processes more efficiently (Moshood *et al.*, 2021). Supply chain metrics like total inventory stock, average spending per customer, and annual changes in sales are common examples that give historical insights into the company's financial and operational performance (Brintrup *et al.*, 2020). Organizations gain many benefits from Supply Chain Visibility (SCV), but the most highly ranked capabilities were predictive and planning capabilities along with decision-making support. It is acknowledged that forecasting, which is commonly considered as a crucial capability gained by SCV according to literature, is not currently as critical because of high disruptions in the supply chains. Experts argue that even with accurate forecasting and inventory control, production has been disrupted due to weak predictive capabilities. Therefore, real-time visibility for improved predictability and decision-making support is vital. Supply Chain Visibility (SCV) ensures better performance, customer service, and economic sustainability (Dubey *et al.*, 2020). By utilizing SCV, organizations can gain a deeper comprehension of customer demand and offer enhanced services. Additionally, SCV results in more efficient resource utilization and higher productivity, leading to increased profitability and cost savings (Agrawal *et al.*, 2022).

Supply network status (F9) has effect on Logistics links, long delivery cycle High Cost (F12). For external Supply Chain Visibility (SCV) to be effective, it relies on the availability and suitable design of internal visibility within each individual entity (Agrawal *et al.*, 2022). The network status is connected to information sharing and providing quality data to customers, who are then able to track it. Through this connectivity and easy accessibility of information, supply chain can better focus their decision-making processes (Ahmed *et al.*, 2021).

5.3 Practical Implications

When implementing SCT and SCV from 3PL, top management needs to address the shift from large shipments to small consignments and align it with strategic business goals. For example, the implementation of information sharing of the small shipments by using technology like Digital Twins needs involvement of management to employee changes in company strategic policies. A logistics

service integrator must have the ability to differentiate and classify various service levels based on different logistics service costs, so that cross-border e-commerce companies can choose the suitable logistics services based on the value of their goods (Zhao, 2019). Even if intermediaries do not act ethically, there can still be a manipulation of information. Currently, the intermediaries' channel might not be as efficient as multinational stakeholders require, that's why multinationals try to make their supply chain as productive as possible through standardization (Ahmed *et al.*, 2021). This study more focused on perspective of firms needs and want from the shipper, while shipper scenarios and process evaluation is the new world for researcher in this domain of drop shipping industries.

The result of the study has provided several implications for managers to apply in their domain. Many managers view SCV capabilities and performance effects such as the ability to predict, customer service, decision-making support, and flexibility as essential factors that contribute to dynamic capabilities for gaining a competitive edge. By utilizing rich and real-time data from different sources throughout the supply chain, organizations can detect deviations and reallocate resources to fulfill customer demands (Agrawal *et al.*, 2022). Customers can understand and extract data used in their daily process chains with the help of Visibility, a product that provides them with a platform. A database should be implemented for future decision-making and understanding current scenarios, and thus creating KPI's for deliveries. The performance management system can figure out why an exception happened by either comparing it to a set of known underlying indicators or by using data mining and machine learning to look at large amounts of data. Based on the root cause that has been found, the system will automatically take countermeasures, such as sending out a replenishment order or changing settings in the planning systems for things like safety stocks (Hunaid *et al.*, 2022). In the shipping industry, to improve organizational trustworthiness, managers should view SCT as a strategic initiative for developing and managing customer relationships with the company. This initiative may be particularly essential in the case of a supply chain disruption, such as the need to recall items from the market. Companies should be aware that their disclosure efforts may at least partially safeguard their companies from negative customer reactions if they already have sufficient SCV to allow the publication of their sustainable policies (Mollenkopf *et al.*, 2022).

5.4 Conclusion and Limitations

It is evaluated that the development of supply chain transparency and visibility is seen to have noteworthy impact on the e-commerce platforms utilizing the cross border third-party logistics services (3PL) through Pakistan in European region. Empowering e-commerce platforms with the authority to not only monitor but even track dispatches in real time would enable them to oversee the 3PLs towards yielding better services at ease, with efficiency and at an even lower cost. Further, increased visibility will allow for better managing risks associated with cross border shipments such as customs delays, regulatory compliance, delayed turnaround times and cargo theft etc. In addition, increased visibility also allows E-commerce platforms to optimize their supply chain networks, logistics links and delivery cycles in a manner that will bring enhanced customer service levels. 3PCBL benefits from supply chain transparency and visibility as it is able to take advantage of opportunities that will help to reduce costs, and that will provide an increase in effectiveness, and as well as efficiency. Furthermore, it will enable logistics providers to be proactive in identifying and correcting any supply chain issues before they become problems by being able to track and trace shipments in real-time through better communication, periodic audits, standardized policies, and predictive metrics. Overall, the increased transparency and visibility in the supply chain enable E-commerce platforms to be better armed in the handling of the cross-border logistics operations. Companies should optimize their supply chain networks that reduce costs, delivery cycles, and logistics links while increasing overall business effectiveness through leveraging data-driven insights, attaining timely tracking of shipments, improving to reach Standardization, and system compliance, applying proper communication, and improving work agreements. Supply Chain Transparency and Visibility, therefore, has positive implication on E-commerce platforms using Cross border third-party logistics.

When we look towards limitations and shortcomings the first and foremost is difficulty in sharing information with customers due to language barriers, cultural differences, and varying regulations. Secondly, Limited access to necessary data to effectively track and monitor their supply chains. Further, Complex and ever-changing regulations can lead to confusion and lack of compliance & often subject to security risks due to the nature of their operations. This can result in a lack of transparency and visibility, making it challenging to detect potential issues and inefficiencies. This study comprised of ratings in DEMATEL method employed which were acquired though inputs from field experts managing e-commerce platform and utilizing cross border 3rd party logistics services Further this decision making requires expertise in respective areas and thus selection of experts were done very carefully with relevant e-commerce experience. Thus, this result achieved can be partial or different as it may need involvement from logistic vendors like FedEx etc. which can be part of future research. Literature and research conducted in Cross-border logistics application utilized by FBA model e-Commerce platforms working in European region from Pakistani domain is limited. With increasing models utilizing this channel to function with existing market dynamics and supply chain scenarios further research exploring implications in this sector is fruitful. Future research may consider using other methodologies of MCDM such as TOPSIS, MAUT, ANP, VIKOR, BWM, AHP, and ELECTRE, to analyze the identified factors. Further results obtained from other MCDM methodologies can be compared to our results.

AVAILABILITY OF DATA AND MATERIALS

The data was taken in the form of filled questionnaires and can be submitted on request.

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APPENDIX 1: DIRECT RELATIONSHIP MATRIX

DRM	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16
F1	[0, 0]	[0, 0]	[0.25, 0.5]	[0.5, 0.75]	[0, 0.25]	[0.75, 1]	[0, 0.25]	[0, 0.25]	[0, 0.25]	[0, 0.25]	[0.5, 0.75]	[0, 0.25]	[0, 0.25]	[0.75, 1]	[0.25, 0.5]	[0.25, 0.5]
F2	[0, 0.25]	[0, 0]	[0, 0.25]	[0.25, 0.5]	[0.5, 0.75]	[0.5, 0.75]	[0, 0.25]	[0.5, 0.75]	[0.5, 0.75]	[0.5, 0.75]	[0.25, 0.5]	[0.5, 0.75]	[0, 0]	[0, 0.25]	[0.25, 0.5]	[0, 0]
F3	[0.25, 0.5]	[0.5, 0.75]	[0, 0]	[0.5, 0.75]	[0, 0.25]	[0.75, 1]	[0, 0.25]	[0, 0.25]	[0, 0.25]	[0, 0.25]	[0.5, 0.75]	[0, 0.25]	[0, 0.25]	[0.75, 1]	[0.25, 0.5]	[0.25, 0.5]
F4	[0.5, 0.75]	[0, 0]	[0.25, 0.5]	[0, 0]	[0, 0.25]	[0.75, 1]	[0, 0.25]	[0, 0.25]	[0, 0.25]	[0, 0.25]	[0.5, 0.75]	[0, 0.25]	[0, 0.25]	[0.75, 1]	[0.25, 0.5]	[0.25, 0.5]
F5	[0, 0.25]	[0, 0]	[0, 0.25]	[0.25, 0.5]	[0.5, 0.75]	[0.5, 0.75]	[0, 0.25]	[0.5, 0.75]	[0.5, 0.75]	[0.5, 0.75]	[0.25, 0.5]	[0.5, 0.75]	[0, 0]	[0, 0.25]	[0.25, 0.5]	[0.5, 0.75]
F6	[0.5, 0.75]	[0, 0]	[0.25, 0.5]	[0, 0]	[0, 0.25]	[0, 0]	[0, 0.25]	[0.5, 0.75]	[0, 0]	[0, 0.25]	[0.75, 1]	[0, 0.25]	[0, 0.25]	[0, 0.25]	[0, 0.25]	[0.5, 0.75]
F7	[0, 0.25]	[0.5, 0.75]	[0, 0.25]	[0, 0.25]	[0.75, 1]	[0, 0.25]	[0, 0]	[0.75, 1]	[0, 0.25]	[0, 0.25]	[0.5, 0.75]	[0, 0.25]	[0, 0.25]	[0.75, 1]	[0.25, 0.5]	[0.25, 0.5]
F8	[0.5, 0.75]	[0, 0]	[0.25, 0.5]	[0, 0]	[0, 0.25]	[0.5, 0.75]	[0, 0.25]	[0, 0]	[0.5, 0.75]	[0.25, 0.5]	[0.5, 0.75]	[0, 0]	[0, 0.25]	[0.5, 0.75]	[0.25, 0.5]	[0.5, 0.75]
F9	[0, 0.25]	[0, 0.25]	[0.5, 0.75]	[0, 0.25]	[0, 0.25]	[0.75, 1]	[0.25, 0.5]	[0.25, 0.5]	[0, 0]	[0, 0.25]	[0, 0.25]	[0.5, 0.75]	[0, 0.25]	[0, 0.25]	[0.75, 1]	[0.25, 0.5]
F10	[0, 0]	[0, 0.25]	[0.75, 1]	[0, 0.25]	[0, 0.25]	[0, 0.25]	[0, 0.25]	[0.5, 0.75]	[0.75, 1]	[0, 0]	[0, 0]	[0, 0.25]	[0.75, 1]	[0, 0.25]	[0, 0.25]	[0, 0.25]

APPENDIX 1: DIRECT RELATIONSHIP MATRIX (CONT'D)

DRM	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16
F11	[0, 0.25]	[0.5, 0.75]	[0.5, 0.75]	[0.5, 0.75]	[0.25, 0.5]	[0.5, 0.75]	[0, 0]	[0, 0.25]	[0.5, 0.75]	[0.25, 0.5]	[0, 0]	[0.5, 0.75]	[0.25, 0.5]	[0.5, 0.75]	[0, 0]	[0, 0.25]
F12	[0.5, 0.75]	[0.25, 0.5]	[0.5, 0.75]	[0, 0.25]	[0, 0.25]	[0.5, 0.75]	[0, 0.25]	[0, 0.25]	[0.75, 1]	[0.25, 0.5]	[0.5, 0.75]	[0, 0]	[0.5, 0.75]	[0.25, 0.5]	[0.5, 0.75]	[0, 0]
F13	[0, 0.25]	[0.5, 0.75]	[0.5, 0.75]	[0.5, 0.75]	[0.25, 0.5]	[0.5, 0.75]	[0, 0]	[0, 0.25]	[0.5, 0.75]	[0.25, 0.5]	[0.5, 0.75]	[0, 0]	[0, 0]	[0.5, 0.75]	[0.25, 0.5]	[0.5, 0.75]
F14	[0.5, 0.75]	[0.25, 0.5]	[0.5, 0.75]	[0, 0]	[0, 0.25]	[0.75, 1]	[0, 0.25]	[0, 0.25]	[0, 0.25]	[0, 0.25]	[0.5, 0.75]	[0, 0]	[0.75, 1]	[0, 0]	[0.5, 0.75]	[0.25, 0.5]
F15	[0, 0.25]	[0, 0.25]	[0.5, 0.75]	[0, 0.25]	[0, 0.25]	[0.75, 1]	[0.25, 0.5]	[0.25, 0.5]	[0.5, 0.75]	[0.5, 0.75]	[0.25, 0.5]	[0.5, 0.75]	[0, 0]	[0.25, 0.5]	[0, 0]	[0, 0.25]
F16	[0.5, 0.75]	[0.25, 0.5]	[0.5, 0.75]	[0, 0]	[0, 0.25]	[0.75, 1]	[0, 0.25]	[0, 0.25]	[0, 0.25]	[0, 0.25]	[0.5, 0.75]	[0, 0]	[0.25, 0.5]	[0.5, 0.75]	[0, 0.25]	[0, 0]

APPENDIX 2A: NORMALIZED RELATIONSHIP MATRIX

X	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16
F9	0.0047	0.0610	0.0047	0.0047	0.0610	0.0000	0.0047	0.0610	0.0000	0.0892	0.0610	0.0892	0.0610	0.0047	0.0610	0.0047
F8	0.0047	0.0610	0.0047	0.0047	0.0610	0.0610	0.0892	0.0000	0.0329	0.0610	0.0047	0.0047	0.0047	0.0047	0.0329	0.0047
F7	0.0141	0.0141	0.0141	0.0141	0.0141	0.0141	0.0000	0.0141	0.0704	0.0141	0.0000	0.0141	0.0000	0.0141	0.0704	0.0141
F6	0.0892	0.0610	0.0892	0.0892	0.0610	0.0000	0.0047	0.0610	0.0892	0.0047	0.0610	0.0610	0.0610	0.0892	0.0892	0.0892
F5	0.0047	0.0610	0.0047	0.0047	0.0610	0.0047	0.0892	0.0047	0.0047	0.0047	0.0329	0.0047	0.0329	0.0047	0.0047	0.0047
F4	0.0775	0.0423	0.0775	0.0000	0.0423	0.0000	0.0070	0.0000	0.0070	0.0070	0.0775	0.0070	0.0775	0.0000	0.0070	0.0000
F3	0.0329	0.0047	0.0000	0.0329	0.0047	0.0329	0.0047	0.0329	0.0610	0.0892	0.0610	0.0610	0.0610	0.0610	0.0610	0.0610
F2	0.0000	0.0000	0.0775	0.0000	0.0000	0.0000	0.0775	0.0000	0.0070	0.0070	0.0775	0.0423	0.0775	0.0423	0.0070	0.0423
F1	0.0000	0.0070	0.0423	0.0775	0.0070	0.0775	0.0070	0.0775	0.0070	0.0000	0.0070	0.0775	0.0070	0.0775	0.0070	0.0775

APPENDIX 2A: NORMALIZED RELATIONSHIP MATRIX (CONT'D)

X	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16
F10	0.0070	0.0775	0.0070	0.0070	0.0775	0.0070	0.0070	0.0423	0.0070	0.0000	0.0423	0.0423	0.0423	0.0070	0.0775	0.0070
F11	0.0610	0.0329	0.0610	0.0610	0.0329	0.0892	0.0610	0.0610	0.0047	0.0000	0.0000	0.0610	0.0610	0.0610	0.0329	0.0610
F12	0.0070	0.0775	0.0070	0.0070	0.0775	0.0070	0.0070	0.0000	0.0775	0.0070	0.0775	0.0000	0.0000	0.0000	0.0775	0.0000
F13	0.0047	0.0000	0.0047	0.0047	0.0000	0.0047	0.0047	0.0047	0.0047	0.0892	0.0329	0.0610	0.0000	0.0892	0.0000	0.0329
F14	0.0892	0.0047	0.0892	0.0892	0.0047	0.0047	0.0892	0.0610	0.0047	0.0047	0.0610	0.0329	0.0610	0.0000	0.0329	0.0610
F15	0.0329	0.0329	0.0329	0.0329	0.0329	0.0047	0.0329	0.0329	0.0892	0.0047	0.0000	0.0610	0.0329	0.0610	0.0000	0.0047
F16	0.0423	0.0000	0.0423	0.0423	0.0775	0.0775	0.0423	0.0775	0.0423	0.0070	0.0070	0.0000	0.0775	0.0423	0.0070	0.0000

APPENDIX 3A: TOTAL RELATIONSHIP MATRIX

TRM	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16
F1	0.045	0.05	0.09	0.117	0.058	0.108	0.051	0.117	0.051	0.03	0.058	0.118	0.061	0.117	0.053	0.113
F2	0.03	0.026	0.107	0.03	0.031	0.027	0.106	0.032	0.04	0.036	0.111	0.08	0.114	0.079	0.043	0.072
F3	0.075	0.055	0.048	0.075	0.063	0.067	0.051	0.082	0.104	0.123	0.113	0.117	0.117	0.109	0.111	0.099
F4	0.101	0.066	0.107	0.029	0.069	0.028	0.037	0.031	0.031	0.034	0.11	0.048	0.113	0.041	0.035	0.034
F5	0.018	0.078	0.024	0.018	0.08	0.017	0.113	0.02	0.023	0.018	0.053	0.026	0.055	0.025	0.025	0.021
F6	0.151	0.125	0.161	0.151	0.137	0.054	0.079	0.131	0.151	0.061	0.14	0.143	0.149	0.162	0.153	0.148
F7	0.03	0.037	0.033	0.03	0.04	0.026	0.02	0.035	0.091	0.032	0.024	0.042	0.026	0.034	0.092	0.028
F8	0.027	0.093	0.034	0.027	0.095	0.075	0.118	0.026	0.064	0.079	0.038	0.039	0.04	0.034	0.068	0.029
F9	0.029	0.104	0.037	0.029	0.107	0.024	0.048	0.089	0.034	0.114	0.102	0.129	0.1	0.041	0.099	0.031
F10	0.028	0.108	0.036	0.028	0.11	0.026	0.046	0.064	0.036	0.021	0.075	0.075	0.076	0.039	0.103	0.03

APPENDIX 3A: TOTAL RELATIONSHIP MATRIX (CONT'D)

TRM	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16
F11	0.111	0.082	0.119	0.111	0.091	0.127	0.112	0.112	0.061	0.04	0.061	0.119	0.123	0.12	0.088	0.11
F12	0.029	0.108	0.038	0.029	0.11	0.026	0.043	0.028	0.102	0.028	0.11	0.039	0.04	0.031	0.104	0.024
F13	0.029	0.027	0.031	0.029	0.031	0.022	0.031	0.031	0.026	0.102	0.062	0.086	0.03	0.109	0.03	0.053
F14	0.131	0.046	0.135	0.131	0.054	0.048	0.13	0.107	0.052	0.044	0.109	0.086	0.115	0.054	0.08	0.103
F15	0.058	0.067	0.064	0.058	0.069	0.024	0.066	0.063	0.117	0.035	0.042	0.1	0.071	0.089	0.036	0.031
F16	0.078	0.042	0.082	0.078	0.122	0.105	0.084	0.115	0.08	0.044	0.053	0.048	0.123	0.086	0.05	0.038

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