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ORIGINAL PAPER

DATA ANALYTICS AND GLOBAL LOGISTICS PERFORMANCE: AN EXPLORATORY STUDY OF INFORMATIZATION IN THE LOGISTICS SECTOR

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ABSTRACT: Background: Informatization has enabled global logistics and supply chains (LSC) to capitalize on data-driven analytics to improve logistics performance. At the country level, logistics performance is gauged through the logistics performance index (LPI), where globally 61.25% or 98 countries perform below the mean LPI score. Previous studies focused on logistics informatization in high and moderate LPI rank economies. The paper aims to conduct an exploratory case study in a low LPI performing country to assess the informatization practices of logistics entities and develop a logistics informatization continuum to unlock data analytics for other countries.

Methods: The study implements qualitative methods to develop strategic recommendations to reduce global logistics imbalance. We employ a two-layer methodology consisting of thematic analysis and a novel strategic choice approach (SCA) to involve stakeholders for recommendations on obstruction. For thematic analysis, 16 semi-structured interviews were conducted from logistics companies, also onboard 10 trade associations and government representatives for the SCA analysis.

Results: We observed many obstructions in informatization; low willingness on informatization, fear of information leakage by humans, low-reciprocity for collaboration, the myth of information and communication technologies (ICT) as an expensive tool, self-interest, and opportunistic behavior.

Conclusion: Information-centric and integrated LSC enables data-driven technologies for real-time decision making, vigilance, and data analytics to distinguished the success of a country's logistics performance.

Originality: This study explores the informatization conformity in the logistics sector to connect data analytics. We introduced a novel strategic choice approach in the technology domain for problem structuring. The paper further contributes by suggesting a logistics informatization continuum for low LPI countries to straighten digitalization in the logistics sector.

Keywords: Data analytics, Global logistics performance, Informatization, Logistics performance index (LPI), Thematic analysis, Strategic choice approach (SCA)

INTRODUCTION

Many scholars have attempted to expand logistics competitiveness or performance of countries to brighten the global logistics landscape [Kabak et al., 2020; Kinra et al., 2020; Moldabekova et al., 2021; Önsel Ekici et al., 2019]. Logistics performance is aggregated from logistics entities operating in that economy and is measured by LPI (logistics performance index) scores [Senir, 2021]. The recent integration of industry 4.0 technologies in logistics, particularly data analytics, has enabled to perform event forecasting, risks analysis, optimization of routes, increased visibility, efficient resource allocation, and much more to enhance logistics performance [Altuntaş Vural et al., 2020; Chen et al., 2021; Imam Yudhistyra et al., 2020; Lechler et al., 2019; Liu et al., 2020; Sahal et al., 2020]. However, to reap the benefits of data analytics, the former role of logistics informatization is indispensable [Gunasekaran et

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al., 2017; Önsel Ekici et al., 2019; Ramanathan & Ramanathan, 2021; Xu et al., 2021].

From a holistic view, 'informatization' is how information and communication technologies (ICT) contribute to the formation of information society for socioeconomic development [Rogers, 2000]. Informatization in a business environment is categorized into internal and external assimilation; internal assimilation offers firms the chance to improve productivity and efficiency by utilizing ICT applications at the management and operational levels, whereas how firms interact with their customers, partners, and suppliers related to external assimilation [Hanna & Qiang, 2010]. Srinivasan and Swink [2018] highlighted that regardless of how exhaustive or computerized the data-analytics paradigm becomes in future logistics and supply chains, the strategic effects of data analytics will depend on the ability of organizations to acquire and disseminate information. Kembro et al. [2017] also found that conquering logistics informatization is difficult and vulnerable due to relational, behavioral, and structural problems of logistics entities. However, previous studies reference the growth in informatization through technology factors [Lu et al., 2020], missing the conduct of logistics entities to explore the compliance of informatization in the logistics sector.

In addition, the global LPI statistics (Figure 1) reveal the distress logistics situation in terms of country-wise performance, where 98 out of 160 countries perform below the mean LPI score. Conversely, countries that followed informatization have unlocked data analytics for logistics competence are relishing top positions; for example, Germany [Kapkaeva et al., 2021], Sweden [Mirzabeiki et al., 2016], Indonesia [Kirono et al., (2019]. Despite the proximity of logistics performance in low LPI rank countries, the research context on practices of informatization in the logistics sector is overlooked by scholars. Moreover, Cruz-Jesus et al. [2018] provide evidence of global digital disparity via drivers of digital development. However, they have not included the former impact of an information society. This research filled these gaps by initiating an exploratory case study in the least LPI performing economy to observe informatization in the logistics sector. For this research, we consider a country with an LPI rank of 122nd, indicating that the logistics sector of the selected case performs below par [The World Bank, 2018a].

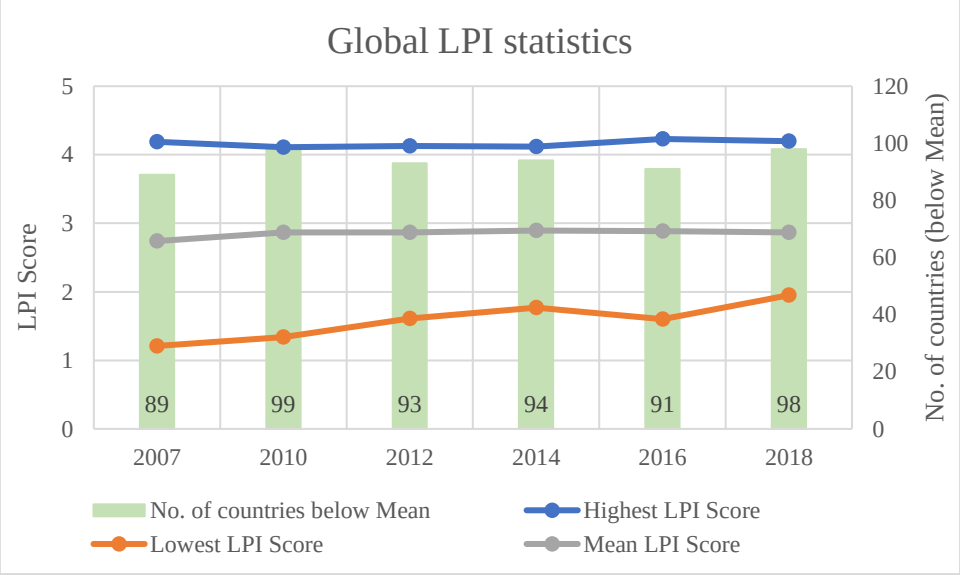

Fig 1. Global LPI statistics (based on country LPI score)

Informatization in logistics and supply chains under ICT, information sharing, and collaboration among logistics entities contribute to superior logistics performance [Kirono et al., 2019]. It allows descriptive & diagnostic analytics to examine historical trends and causes, and predictive & prescriptive analytics to forecast future events and suggest situation-specific actions [Maheshwari et al., 2021]. Data analytics brings in many practical implications for logistics performance, such as transport routing decisions [Chen et al., 2021; Liu et al., 2019; Rahimi et al., 2020], resource allocations [Zhang et al., 2020], shipment consolidation [Barreto et al., 2017], real-time tracking and visibility of goods [Dunke & Nickel, 2020] and offer customers with wide-ranging services at low costs [Park & Jeong, 2016]. Despite the imperative role of informatization in enabling data analytics for logistics performance, logistics entities' conduct has not gained much attention from practitioners and researchers. Therefore, an exploratory case study of a low LPI-ranking country is essential to support the disparity in global logistics performance.

This study was initiated with the research goal of exploring informatization practices of logistics entities. The research questions are 1) What is the understanding and willingness of logistics entities on logistics informatization? 2) What are the strengths and obstacles of logistics informatization in the logistics sector? Moreover, 3) How to foster logistics informatization? A two-layer methodology was used to carry out this research, consisting of thematic analysis to find themes for research questions and a strategic choice approach (SCA). SCA involves stakeholders in the decision-making process to develop more effective solutions and expectations [Schmidt et al., 2020]. Finally, we suggest the framework of informatization in the logistics sector as a benchmark for other low-LPI-performing countries. The later sections cover the literature review on data analytics, logistics performance, and informatization. The methodology section outlined the interviews and execution of SCA, followed by results, discussion, and conclusion.

LITERATURE REVIEW

Data Analytics and Global Logistics Performance

Pervasive globalization has raised the profile of global logistics as a determinant of socioeconomic development [Çelebi, 2019; Gani, 2017; Halaszovich & Kinra, 2020; Hausman et al., 2013; Luttermann et al., 2020; Soh et al., 2021]. Global logistics performances are limited to how nations move products or trades with other countries, and their local logistics environment matters [The World Bank, 2018a]. According to Christina Wiederer, Economist at World Bank and co-author of "Connecting to compete 2018", even a minor disturbance in the supply chain of an economy has a propensity to affect the region and other countries.

Data analytics serves as a strategic source [Wang et al., 2016] to improve demand and supply visibility in global logistics and supply chains [Gunasekaran et al., 2017]. The success of logistics function is dependent on how a firm or nation operates at low costs, in-time, and higher service levels. Schoenherr and Speier-Pero [2015] highlighted that to ensure cost and service efficiency, operations and logistics managers must analyze abundant of data to make the right set of decisions. Where transport routing and resource allocation is the biggest challenge for logistics companies because much of the cost is spent on transportation goods in terms of fuel, vehicle rentals, human, and environmental costs [Mangina et al., 2020]. Another challenge that logistics entities and customers face is goods-in-transit deterioration and expiry risks [Chaudhuri et al., 2018]. Hopkins and Hawking [2018] data analysis suggests optimal transports routes to avoid traffic congestion and offers real-time visibility, elevating productivity and service levels [Yan et al., 2019]. Therefore, countries must unlock digitization and data analytics in the logistics sector [Bag et al., 2020; Önsel Ekici et al., 2019].

Informatization in the Logistics Sector

Logistics informatization refers to information and communication technologies and collaboration between logistics entities to make available comprehensive and transparent data for business decisions [Ramanathan & Ramanathan, 2021; Xu et al., 2021]. It significantly influences data analytics adoption, use, and continuation of organizations and supply chains [Gunasekaran et al., 2017]. Many countries have advanced logistics sectors that anchor informatization. Kapkaeva et al. [2021] conducted a case study at the port of Hamburg, Germany (LPI 1st position); informatization as a predecessor allows ports to operate exceptionally through a one-window platform to plan, execute, and monitor logistical activities, for instance, real-time call-in/call-out road and rail actors to pick or release the load. Another study by Mirzabeiki et al. [2016] in Sweden (LPI 2nd position) confirmed that when parties in a logistics system share information, it enables data analytics; to track and trace, speeds up operations, shipment timeliness, resource optimization, and accumulation of an authentic set of information. In Colombia (LPI 58th position), Suarez-Moreno et al. [2019] proposed an intelligent transport load optimization model leveraging shippers' collaboration that reduces vehicle trips by 50% and accumulates a decrease in logistics costs by 37%. Informatization in the logistics environment serves as a soft but significant contributor to performance. Unrestricted flow of information across logistics entities allows logistics professionals to capitalize on information through data analytics to achieve multiple strategic and operational benefits.

Flick on the benefits, good informatization practices is challenged by many constraints that restrict logistics entities to nurture the milieu of an information society. In a highly competitive environment, there would always be a possibility that entities share doubtful or false information [Najjar et al., 2019; Voss et al., 2006] to muscle the benefits of low-cost transactions or other interests [Jarvenpaa & Staples, 2000], another reason can be rational, capable, and trustworthiness issues [Tsai et al., 2020]. In lateral relations, entities perceived risks [Keith et al., 2004] that pose an openness to informatization.

Strategic Choice Approach (SCA)

The strategic choice approach (SCA) is a novel qualitative operational research approach used for problem structuring in a stressful environment [Friend, 2011]. It originated from IOR (Institute of Operational Research, Tavistock Institute London) in the 1970s [Friend, Norris & Stringer, 1988]. The unique trait of stakeholder involvement (judgments) differentiates it from other decision-making approaches to manipulate uncertainties [Friend, 1992]. It deals with three types of uncertainties; working or market environment, managerial or administrative values, and related choices by performing four processes shaping, designing, comparing, and choosing [Friend, 2011]. Several researchers from different fields used SCA for practical solutions, migration impact assessment [Kourtit & Nijkamp, 2011], architectural design [Todella et al., 2018], water distribution systems [de Sousa & Costa, 2020], but it was rarely applied in the management and business environment.

METHODOLOGY

The present study aims to assess the informatization practices of logistics entities. This paper employed the qualitative research method to examine a situation under natural and real conditions of the subject population or topic [Bryman & Bell, 2009; Creswell, 2009]. Long and Johnson [2000] proposed that a qualitative method would enable the investigator to obtain a greater perspective rather than analyze the external attributes of a theme and the limited focus of the research. The qualitative method allows the evaluation of the topic correctly in contrast to the quantitative method, and there is often an opportunity to gather very useful information [Merriam, 2009].

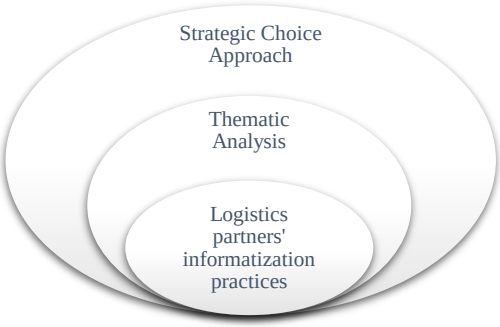

Fig 2. The two-layer research methodology

A two-layer methodology (Figure 2) is used with thematic analysis to study the operations of logistics entities and SCA for decision-making to curb these inadequacies. Semi-structured interviews were conducted with logistics entities, as mentioned in Table 1. The participants are approached on convenience sampling and chosen for this study based on qualifications and industry experience (minimum of 3 years of sitting position experience). The sample size for qualitative studies must meet data saturation [Dworkin, 2012]. Boddy [2016] stated that a minimum sample of 12 is sufficient for data saturation and population homogeneity. In the current research, data saturation is reached in 16 interviews of the participants. The length of each interview ranges from 45 to 75 minutes, considering the participant's interests in the research topic.

Table 1. Participants in the logistics industry

S. No.	Participant ID	Function	Organization type	Position
1	E2E-M1	Logistics service providers (E2E)	MNC	Manager logistics
2	E2E-M2	Logistics service providers (E2E)	MNC	Team lead operations
3	E2E-L1	Logistics service providers (E2E)	Local	Manager logistics
4	E2E-L2	Logistics service providers (E2E)	Local	General manager - International freight
5	E2E-L3	Logistics service providers (E2E)	Local	Director logistics & trade
6	T-L1	Transporter	Local	Manager operations & business development
7	T-L2	Transporter	Local	Business owner
8	T-L3	Transporter	Local	Manager logistics & business development
9	T-L4	Transporter	Local	Business owner
10	T-L5	Transporter	Local	Manager operations
11	T-L6	Transporter	Local	Senior manager operations & Business development
12	CARG-M1	Cargo handling / storage/ packaging services	MNC	Manager procurement
13	CARG-L1	Cargo handling / storage/ packaging services	Local	Branch head operations & cargo
14	PO-M1	Port operators (sea)	MNC	Section head logistics
15	FF-L1	Freight forwarder/clearing	Local	Key accounts manager
16	SL-M1	Shipping line	MNC	Officer operations & import

Thematic analysis is performed in the first stage of the study on the informatization assessment of logistics entities. Qualitative software ATLAS ti 8.4.24 is used. The themes emerging from the thematic analysis become input for the SCA, where the representatives of stakeholders (logistic entities) teamed up for decision-making to devise solutions. The strategic choice approach (SCA) is used to systematically consider practices and their significance in improving logistics performance, creating an environment for the successful adoption of data analytics in logistics. The stakeholders' representatives (Table 2) conduct decision-making analysis to devise progress to elevate the LPI based on the following guidelines:

What is the most important informatization activity of logistics partners?

- Strength – to take advantage
- Weakness – to mitigate or improve

Table 2. Stakeholder representatives in decision-making

Participant ID	Position	Organization type
DMP-1	Senior Logistician - Planning	National logistics (logistics strategic organization)
DMP-2	Member – Executive committee	Freight forwarders association
DMP-3	Member – Executive committee	Freight forwarders association
DMP-4	General Secretary	Transport association - I
DMP-5	Member – Executive committee	Transport association - I
DMP-6	Member – Executive committee	Transport association - II
DMP-7	Member	Supply chain association
DMP-8	Member	Supply chain association
DMP-9	Technology Practitioner - Logistics	IT solution provider for logistics
DMP-10	Member	Fleet operators' association
DMP-11	Convener - Standing Committee	Dry Port/Airport Affairs (Association)

FINDINGS ON INFORMATIZATION PRACTICES OF LOGISTICS SECTOR

All 16 interview participants are located in Karachi, Pakistan, where most economic activities occur due to the two busiest seaports with an annual import and export volume of 104.391 million tons [Ministry of Finance, 2020]. These participants / companies transport the shipment to and from Karachi with destinations all over Pakistan.

During the interview, not all, but many, of the participants believe that informatization among logistics entities or clients is beneficial to:

- Save operational time and delays
- Cost benefits
- Help collaborative business partners to provide high-quality services
- Bridge the gap and strengthen execution processes
- To make plans and schedules
- Improves work efficiency
- Ensure accuracy.

Also, according to the participants (Figure 3) the statements of the logistics entities or logistics business partners confirmed that not all information is good to share, so the information that has positive or negative repercussions is extracted in Table 3.

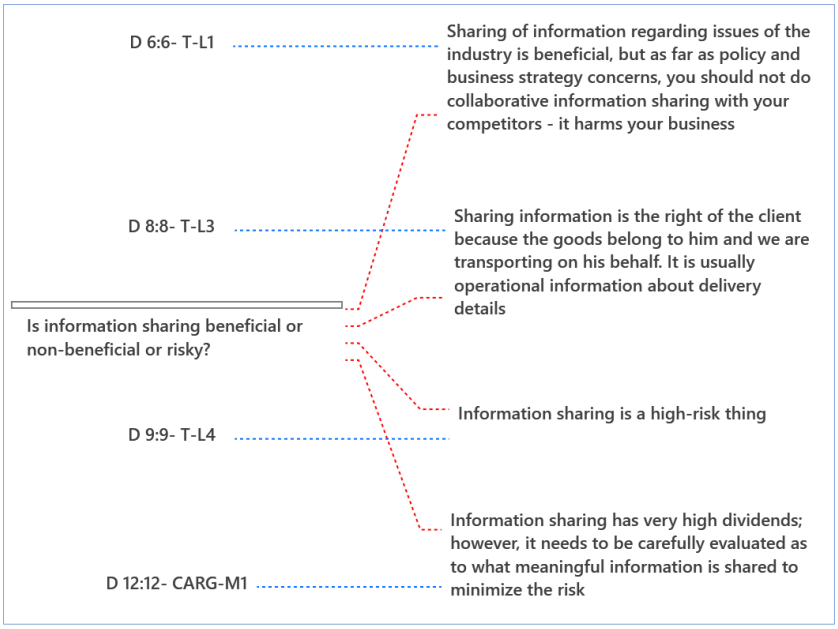

Fig 3. Logistics information sharing

Table 3. Nature of logistics information

Useful or shared information	Risky or harmful information
• Specimen of the shipment (e.g., volume, weight, commodity nature, load pickup time, and location). • Shipment tracking (email, phone call, online portal) • Market road situation • Feasible or allowed hours (time) to move the vehicle in some areas • Optimal routing • Offered services and capabilities • Collective issues (e.g. extra toll or taxes) • Legal information – shipment documents • Scenario-based information (e.g. hurdles, strikes, changes in shipment details)	• Business strategy and policy • Pricing • Cliental information • Legal information – contracts • "Cooperation" - How an entity is handling the shipment of two or more competitor clients

Apart from that, the informatization practices of logistics entities operating in the logistics sector are affected by many factors, as discussed below.

Willingness and Awareness of Informatization

Interviews with logistics companies concluded dissimilarity in willingness and awareness on the level of informatization. The categorization of how these companies perceive and act is presented in Table 4. The asset-owning companies are more concerned with executing the task; what to move, how to move, when to move and at what rates. For example, *"We provide transport service, and just do task execution. From where to pick load and where to release as decided at the time of the deal."* (T-L4). The willingness and understanding of the benefits of brokering companies to share information are moderate and driven by client needs, business volume, and counterparts'

willingness: *"Compare business vs services… the one who is giving large business volumes then we do not hesitate to facilitate beyond our comfort zone."* (T-L3), *"Most of the counterpart transporters are very strong and have the large fleet, but they are not literate. They are more concerned with task execution. Their behavior is not good to update any information..."* (T-L2). Companies providing IT solutions (live asset Podlink) in the logistics sector depend on logistics companies to adopt information technologies for logistics operations. Live asset Polink refers to a free link or application to track and trace cargo/status or cargo or assets (trucks) across logistics and supply chains. For example, DHL and UPS shipment tracking facility. In documentation services, what information to share or not to share depends on the clients' will because they often want to hide information *"In clearing and forwarding processes, customers want to hide their sourcing or export parties, and this constraint will run across the logistics stream"* (FF-L1). Finally, the techno-logistic companies are open to sharing information at the micro-level in real-time basis *"…part of SOP to share information"* (E2E-M2). *"The strong you have willingness on informatization the more clear, visible and efficient task will be"* (E2E-L2).

Table 4. Categorization of Logistics companies

Category	Explanation	Type	Informatization willingness	Informatization Awareness
Asset owning	These companies only own assets such as trucks, warehouses, and other facilities.	Local	Reluctant and stereotype	Low
Brokering	Hire assets and works as middlemen	Local	Varies according to clients' requirement, volume and the willingness of the hired entities	Moderate
Asset live Podlink (technology providers)	Provides technology services, e.g., RFID, vehicle tracking, sensors	Local MNC	The level of information sharing depends on the client (logistics company)	High
Service and documentation	Offer shipment booking, clearance, forwarding services and documentation	Local	Customer-centric	Moderate to High
Techno-logistic	Own assets and equipped with technology.	Local MNC	Open to share	High

The Myth of Informatization as 'Expensive' by Customers and Logistics Companies

The behavior of customers and service partners are not favorable to opt logistics partners offering; real-time shipment information and innovative services. "*Mostly customers failed to trade-off IT-enabled information sharing benefits for businesses and prefer the traditional way of moving goods because of low fares"*, cited participant E2E-M2. Also, the companies are concerned about setup and operational costs and resources to implement and operate collaborative information systems, resulting in slightly higher fares. The cost perceptions of the studied population are varied for the supply and demand sides and are presented in Table 5.

Table 5. Customer-supplier cost perception on IT-enabled information sharing

Supplier side (logistics company) side	Customer side
• Low-cost transaction • Cost of IT system acquisition • Cost of hiring staff • System maintenance cost	• Opt for low rates • Only consider upfront service cost (low shipment charges)

Information Leakage: Human vs. Information Systems

Fear of information leakage has a strong effect on the decision of the logistics companies to share information. According to E2E-L1, *"Serving two clients who are competitors as well creates high responsibility in terms of information security… because of client-to-client rates and service variation"*. The participants were asked to compare human and IT systems to determine which is more susceptible to leak information. The majority of participants agreed on the difficulty of controlling intentional or unintentional information breaches by humans.

"…, for IT systems we can use protocols." (E2E-L2, CARG-M1 and CARG-L1)

"Chances of information is leaked and shared with irrelevant persons." (T-L6)

"…you cannot control humans, and chances are someone would reveal the inside story (information)." (T-L1)

"Humans leak information intentionally or unintentionally." (FF-L1)

The unintentional leakage by humans is caused by staff incompetence, training, and development.

"…because of a lack of confidence and education… no personal development of staff to overcome..." (E2E-L3)

Moreover, the participants (E2E-M1, E2E-L2 and T-L5) confirmed that we offer our collaborative logistics partners to sign information confidentiality contracts. Despite this, the human side is uncontrollable *"we cannot control employees moving from company A to company B. When they leave, information will go with them."* Stated by E2E-M1, E2E-L1 and T-L1. As a result, some companies perceived information as their proprietorship asset and were unwilling to even share it with the staff. T-L1 further added *"information proprietorship dilemma has caused many partners to collapse when the owner dies because the strategic business information and knowledge are constrained (withhold) in the head of business owners"*. Also, *"There is not any practice for securing proprietor information security."* (T-L2).

It concludes a lack of laws or compliance to secure owner/company information as intellectual property in the logistics sector. Furthermore, the government seldom takes any legal actions, which has made logistics companies reluctant to collaborate on information sharing.

Use of IT-Enabled Information Sharing System

IT-enabled information sharing systems are inevitable to adopt in the logistics business environment; they offer loads of socioeconomic opportunities; foreign direct investment (FDI) and exports. The interviewed participants asked about the current state of information sharing system utilization. Figure 4 describes the percentages of responses of the logistics companies to this question. 43.75% of companies are using information systems, while 56.25% do not have information system facilities. Those companies that have not yet implemented information systems exhibited a willingness of 44.44% to adopt in the future, the remaining 44.44% are stringent on conventional systems, and 11.11% do not responds.

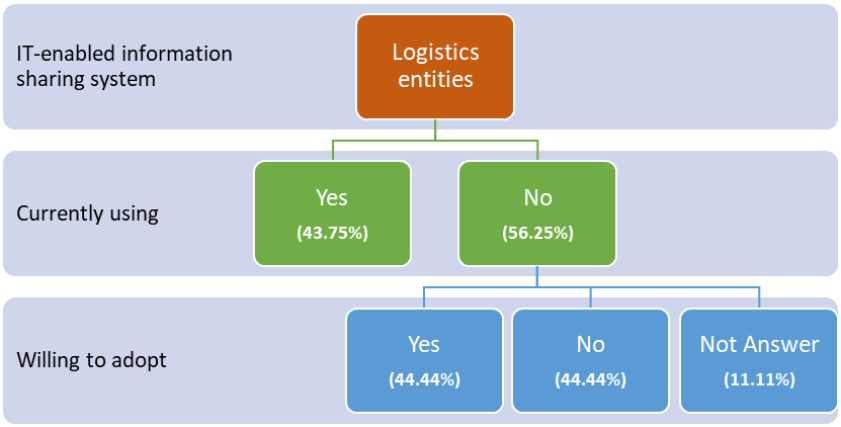

Fig 4. Utilization of an IT-enabled information sharing system

Impact of Cultural and Regional Belongingness

Almost all companies stated that there is no such occurrence of any regional or cultural belongingness obstacles while sharing information, except for language barrier.

"The business environment is like a unipolar thing, so there is no impact of cultural belongingness." (FF-L1)

"Not like that… whoever is giving good business and rates." (T-L3)

Some interviewed logistics entities further added that communication among educated versus non-educated persons or formal versus informal communication creates a reluctance to share information.

"… difference of perception and understanding occurs among educated and non-educated persons." (E2E-M1)

"Language barrier occurs, also the way of communication matters because they (non-educated) do not like formal conversations." (T-L2)

Reciprocity to Collaborate

Reciprocity refers to the collaborative sharing of information between logistics companies to achieve mutual benefits. In theory and practice, the reciprocity norms or rule of reciprocity can be explained as a give-and-take phenomenon or a person doing an action in a good gesture and receiving the same in return. Reciprocity is based on the relational and individual behavior of companies. In comparison, multi-national logistics companies confirmed that sharing information is part of their standard operations for all collaborative logistics partners or clients. For this reason, the transport performance is higher than that of local companies (Gezikol et al., 2020). This practice is rare in local companies except for Techno-logistic companies. The give and take phenomenon is mostly observed among local companies. Surprisingly, few companies are open and enthusiastic about acquiring a business and count on counterparts at the execution level.

"Information sharing is abided by SOPs, rules and regulation of the company." (SL-M1)

"…information is shared on giving and take and more specifically relational behaviors." (T-L2)

"… people take information from you, but in return, they do not share." (T-L1)

The level of altruism of logistics companies to share information with counterparts is very low. In addition, there is an impact of position or power, or the willingness of the dominant party to share or restrict information flow.

Information Quality – Sharing Limited Information, Hiding, or Inaccurate Information

There are positive and negative sides to not sharing all the information. It is optimistic about assessing the absorptive capacity of the recipient

or counterpart to decide how much information is good to share. Another adequate reason is cautionary behavior to avoid leakage of competitive information.

"Share information according to person, like absorption capacity (educated vs non-educated and decision-making position in the company)." (E2E-M1 and CARG-L1)

"Situation matters, few things/information if we share with partner or client then they panic and worry because they do not have the vision of backdoor activities (process complexities)." (E2E-L3)

The practice to manipulate or hiding information is very common for personal gain, either to operate at a low cost or to make more money. Another pain point is misled or incorrectly shared information to hide internal efficiency by logistics companies. With such malpractices in the logistics sector, it is difficult for companies to trust their counterparts. On the one hand, self-interest or opportunistic behavior benefits individuals, but reduces logistics performance at the collective or national level. The quality of information has strong implications on decision making and execution to improve logistics operations, efficiency, cost control, customer services, and much more.

"Sometimes, we hide actual/real information with client or logistics partner. For example, we have to give a vehicle to a client and failed to arrange the vehicle, then we never clearly said to the client or former business partner that we failed to arrange, but we give a general statement like we have arranged a vehicle and it will reach principally today. This way, by hiding actual/real information, we gain or cover time lag." (T-L3)

"We do not share information with client or counterpart about any delays or hurdle in operations." (T-L5)

"Occasionally, yes." CARG-M1

Lastly, validation of interpretations is essential to establish the reliability of research outcomes (Sousa, 2014). The member check (participant feedback) validation process is performed to confirm the cohesion and credibility of the explanations (Birt et al., 2016).

APPLICATION OF THE STRATEGIC CHOICE APPROACH (SCA)

Step 1. Shaping the Problem

The weaknesses or problematic elements of the thematic analysis are extracted to form themes or shape the problem and compiled in Figure 5.

Step 2. Designing Alternatives

In the design phase, the issues are shared with the pool of decision-making participants (DMPs), as mentioned in Table 2. In the first step, all DMPs were contacted individually to propose solutions to each issue stated in Figure 5. The participants proposed 45 different solutions, sent back for voting following step 3 of the strategic choice approach.

Step 3. Comparison and Choice of Alternatives

The alternatives were shared with (decision-making participants) DMPs to suggest pragmatic solutions keeping in mind the SMART (specific, measurable, attainable, relevant, time-based) criteria approach. Therefore, quality solutions/goals can be obtained to create efficient and workable strategies [Bexelius et al., 2018].

Table 6 visualizes the responses of the DMPs to select alternatives/solutions that are viable with their agreeableness to streamline information sharing practices across the LSC. The 20 out of 45 alternatives with more than one participant vote are accounted as input for the code-document table analysis. From the analysis, "To adopt and promote information security culture" caught the attention of DMPs with the grounded level of 7 followed by "Contracts and

SOPs on information sharing practices – 5" and "Cost and performance benefits of IT-enabled systems – 5". Also, 4 alternatives obtained 4 votes aiming to suggest unification (national) language and use IT systems (digitalization) to curb language barrier and share information sharing benefits with success stories of industry player to increase the willingness of logistics companies. The remainder received 3 and 2 votes of DMPs.

Based on the feedback and suggestions of the DMPs concerning issues of informatization practices by companies, this study takes a stand to propose a framework of logistics informatization continuum (Figure 6) as a contribution to the existing literature. The framework would foster informatization practices and enable governments, scholars, and policy makers to devise strategies to improve data analytics to increase the level of logistics performance.

DISCUSSION AND IMPLICATIONS

This research envisioned exploring informatization practices in a low LPI-ranking country to elevate the country's logistics performance. Much of the published work is related to improving LPI by global institutions and researchers. The World Bank has contributed tons through periodic reports *"Connecting to compete"* to advise economies performing below par. Logistics infrastructure such as road, rail, warehousing, and transportation facilities are common problems among low-performing countries. However, the flow and quality of information through IT-enabled technologies gain more attention in *"Connecting to compete"* 2018 edition [The World Bank, 2018a]. The importance of information in a contemporary digital and data-driven environment incites authors to evaluate the impact of informatization on logistics performance in low-LPI-performing countries.

Intrinsically, this paper presents an examination of collaborative information practices that have an impact on the LPI ranking. Quite a few strengths or positive practices of logistics companies are identified from the findings; surprisingly, logistics companies perceived a low risk of information breach via IT systems confirmed trust in cyber security practices. First, the finding contradicts [Gunes et al., 2021] that modern logistics has a higher probability of cyber security risks. Furthermore, [Pfleeger & Caputo, 2012] believe that human behaviors can mitigate the pinch points of a cyber-security breach in IT systems. The current finding is advantageous for the adoption of data-driven technologies in the logistics sector. Second, there is no impact of cultural belongingness to share information or collaboration among companies, depicting the logistics market heading is to unipolarity for socioeconomic development. Differently, the literature underpins that cultural barriers exist in human interaction in the business environment [Li et al., 2007; Peltokorpi, 2006; Robertson & Swan, 2003]. This finding has opened new stimuli for practitioner and researcher, does unipolar business environments truly mitigate the impact of cultural belongingness.

The low willingness and awareness of informatization have clogged the process of exchange to obtain mutual benefits. As a result, logistics companies failed to equate costs with the reward of information exchange. The myth of information as an *'expensive'* thing has been established in the industry. According to George Armitage Miller (psychologist), information processing is a cognitive phenomenon [Miller, 1956] that refers to interpretation, evaluation, control, utilization, and storing of information by an individual or organization. The effective or ineffective result of information processing is based on an individual's or organization's capability to process information [Tushman & Nadler, 1978] has confirmed low data capabilities among logistics entities. To curb it, managers should not always rely on informatization as organizational resource (IT-enabled systems and information sharing), but leadership vision and commitment also matter [Gunasekaran et al., 2017].

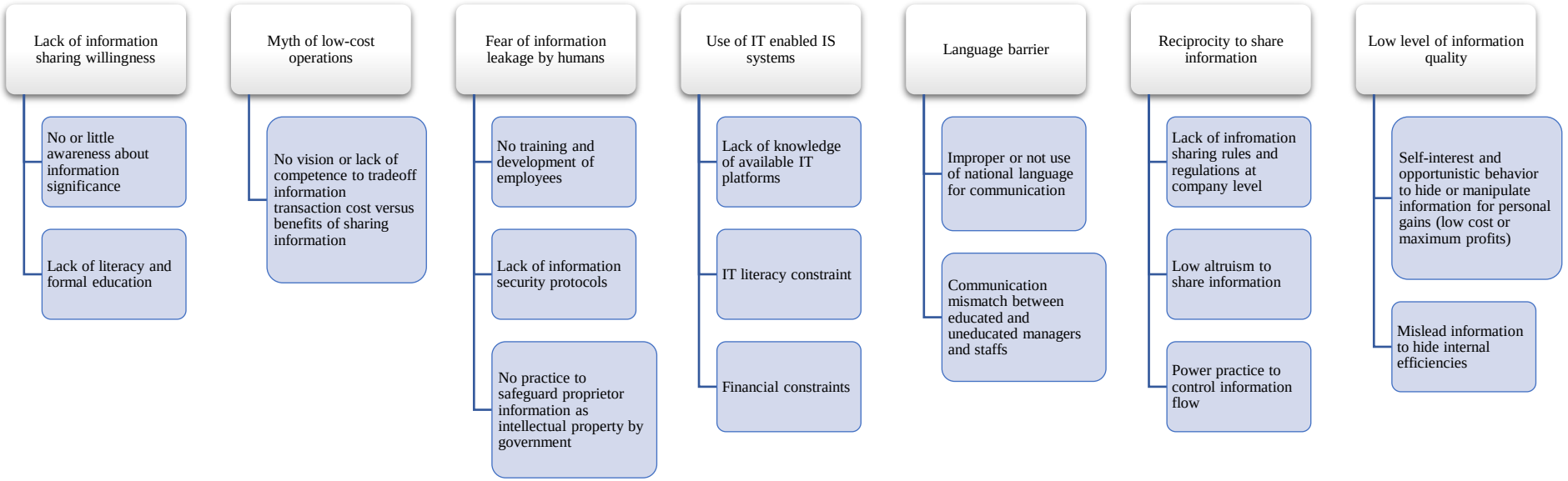

Fig 5. Informatization issues in the logistics sector

Table 6. Selection of solutions by DMPs (code-document table analysis)

Solutions	DMP-1 Gr=6	DMP-2 Gr=14	DMP-3 Gr=10	DMP-4 Gr=8	DMP-5 Gr=9	DMP-6 Gr=4	DMP-7 Gr=8	DMP-8 Gr=2	DMP-9 Gr=11	DMP-10 Gr=6	DMP-11 Gr=11	Totals
Contracts and SOPs on information sharing practices Gr=5	0	0	1	1	1	0	0	0	0	1	1	5
Cost and performance benefits of IT-enabled systems Gr=5	0	0	1	0	0	0	1	1	1	1	0	5
Cost reduction and information withholding by eliminating the role of middlemen via IT systems Gr=3	1	1	0	0	1	0	0	0	0	0	0	3
Employee training and development in information sharing Gr=3	0	1	1	0	0	0	1	0	0	0	0	3
Formation of a committee to deal with information breaches and intellectual property affairs Gr=3	0	1	0	1	0	0	0	0	0	0	1	3
Government supervision and support Gr=3	0	1	0	0	1	0	0	0	0	0	1	3
Government to provide financial assistance to adopt IT-enabled systems Gr=2	0	1	0	0	0	0	0	0	0	0	1	2
Improve business relationships Gr=2	0	0	0	0	0	0	1	1	0	0	0	2
Incentives on information sharing practices Gr=2	0	1	0	0	0	0	0	0	1	0	0	2

Information systems (digitalization) to reduce personal interactions Gr=4	0	1	0	1	1	0	0	0	1	0	0	4
Share real-world information sharing success stories Gr=4	0	1	0	1	1	0	0	0	0	0	1	4
Sharing the benefits of information sharing and utilization Gr=4	0	0	1	1	0	0	0	0	1	1	0	4
Spread awareness of information sharing through training and education Gr=2	1	0	0	0	0	0	1	0	0	0	0	2
To adopt and promote an information security culture Gr=7	0	0	0	1	1	1	1	0	1	1	1	7
Train SMEs on data analytics Gr=2	0	0	0	0	0	0	1	0	0	0	1	2
Train partner / counterpart on information sharing practices Gr=2	0	1	0	0	0	0	0	0	0	0	1	2
Unification of language in the logistics sector Gr=4	0	0	0	0	1	0	0	0	1	1	1	4
Use of blockchain to ensure information quality and automation Gr=3	0	1	0	1	1	0	0	0	0	0	0	3
Use of information sharing services to improve customer satisfaction Gr=3	0	1	1	0	0	0	0	0	0	0	0	2
Totals	2	11	5	7	8	1	6	2	6	5	9	62

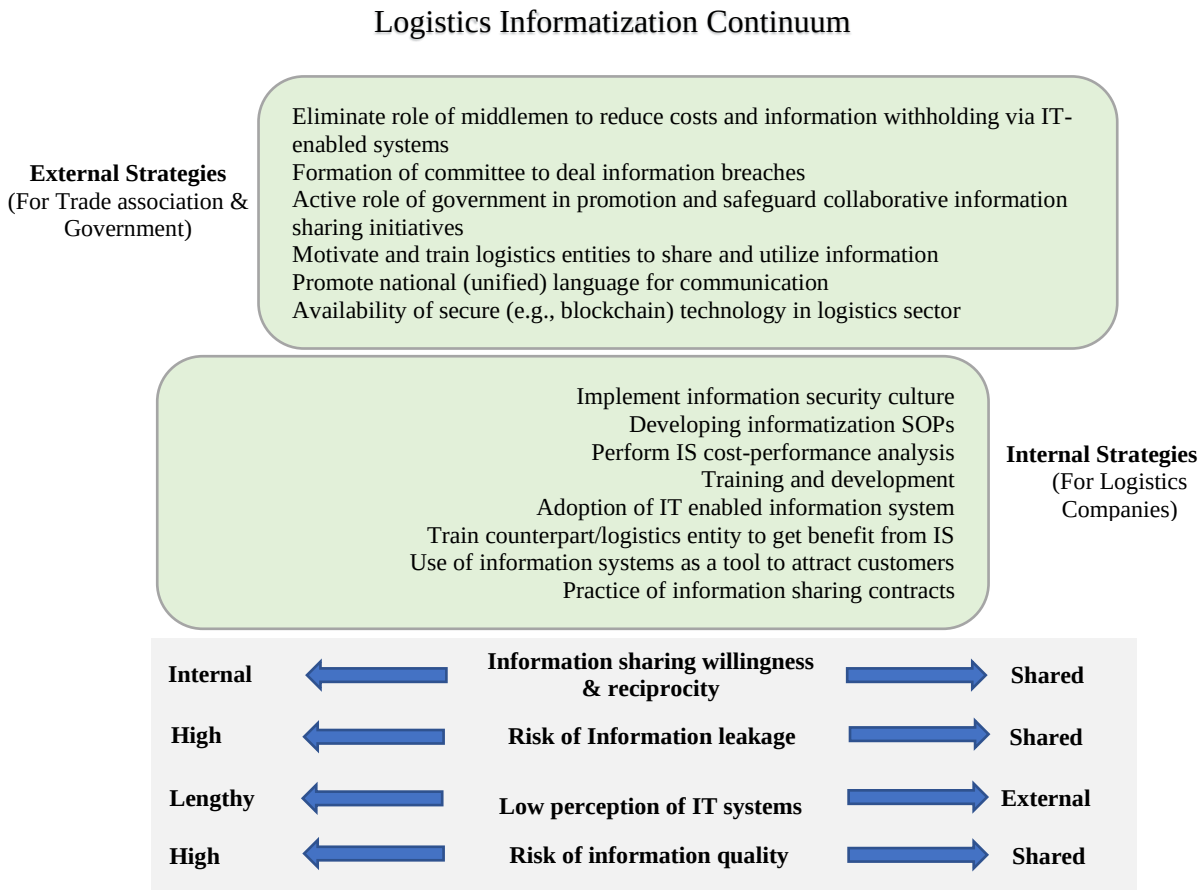

Fig 6. Logistics informatization continuum

The existence of information leakage by humans in interfirm business relations is consistent with prior studies; however, the triggers are different, profit maximization intention of parties [Kong et al., 2012; Liu et al., 2020], market competition [Fang & Ren, 2019; Zhang et al., 2012] inference [Zhang et al., 2011]. While the findings of the current study presented the reasons are human development and lack of information protection protocols and practices. The leakage by humans creates the dilemma of punitive or nonpunitive measures for managers to control information leakages effectively. Companies may opt for the non-punitive 4Cs framework (contain, control, contract, cultivate) posited by Tan, Wong and Chung [2016]. DMPs propose several inline solutions to mitigate the element of fear. They suggest implementing an information security culture (internal strategy) and a platform to report intellectual property breaches (external strategy). The regulatory support evades fears of low trust among the transaction parties [Benamati et al., 2021].

Furthermore, logistics companies' self-interest and opportunistic behavior to share misleading information made the informatization process distrustful for counterparts in using collaborative information in real-time decision-making and operations. The intentions investigated in this study are profit maximization and hiding internal inefficiencies. Many, unlike causes of opportunistic behavior, have been reported in literature from theoretical perspectives of transaction cost and relational exchange; for instance, trust [Zaheer & Trkman, 2017], business governance systems (relational and contractual) [Pomegbe et al., 2021] and asset

specificity [Lui et al., 2009]. The contemporary developments in organizations and economies are data-intensive, so it is crucial to reach data/information justice [Heeks & Renken, 2018]. Also, information quality is essential for the successful adoption and satisfaction of an information system [Rouibah et al., 2020]. To address this, logistics industry suggested using secure technology (e.g., blockchain) to ensure information quality and contracts. Consistent with Wong, Sinnandavar, and Soh [2021], information asymmetry from opportunistic behavior can be treated through the induction of business process platforms.

Finally, managers and practitioners can use the SCA approach by encircling input from stakeholders help to infer practical solutions. Also, the proposed novel and pragmatic framework of the logistics informatization continuum can be generalized to increase the performance of low-LPI performing countries to fill the gap of socioeconomic disparity.

CONCLUSION

The logistics commence by the movement of freight or goods between the point of origin (seller) and the point of consumption (customer). In the middle, there are many logistics entities; for example, transporter, warehousing, freight forwarder, and clearing agent. When the logistics and supply chain is information-centric and integrated, fierce data-driven technologies serve as sources for real-time decision making, vigilance, low costs, productivity, risk mitigation, and customer satisfaction to distinguish the success of a country's logistics performance. Currently, the global LPI is suffering from the low performance of logistics systems. Our research has opened a rational avenue to address the possible inadequacies of the least-LPI performing countries.

The study has some limitations and suggestions for future researchers. The informatization issues may be quantitatively tested on a larger scale to other low LPI countries and confirm generalizability for correlated effects in different regions and income groups. Future researchers can also compare the implications of bridging information and collaboration in logistics and supply chains on the adoption rate of data-intensive technologies and the growth in average and least LPI scores.

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