

The Evaluation and Development of Thai Logistics Service Providers to Logistics Management Excellence

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Abstract. The objective of this research was twofold: 1) to evaluate Thai logistics service providers towards achieving logistics management excellence, and 2) to investigate the factors influencing their operational potential. A mixed-method approach was employed, involving qualitative data collected through interviews with 12 experts using purposive sampling, and quantitative data collected from 400 samples. Descriptive and inferential statistics were utilized for data analysis. The findings revealed that logistics and supply chain cooperation with external stakeholders, excluding suppliers and customers, was highly prioritized, with an average score of 4.08. The overall evaluation of logistics potentialities indicated an average logistics scorecard rating of 3.92 among entrepreneurs. Hypothesis tests showed that gender, age, educational level, work experience, revenue, types of logistics providers, form of business structure, headquarter location, registered capital, and firm sizes significantly affected the potentialities of logistics scorecard at a significance level of 0.05. The effect of multiple correlation coefficients and multiple exponential coefficients between logistics efficiency and the potentialities of logistics management, as perceived by entrepreneurs, indicated that the best prediction equation with six independent variables—namely, purchasing and procurement (X4), demand forecasting and planning (X2), reverse logistics management (X9), materials handling and packaging (X5), logistics communication and order processing (X3), and customer service and support (X1)—correlated significantly with the logistics scorecard's potentialities. The correlation coefficient between these variables and the potentialities of the logistics scorecard was found to be 0.625.

Keywords: Logistics Service Provider, Logistics Management, Logistics Scorecard

1. Introduction

Every company is subjected to the phenomenon of globalization, as it gradually dominates every area within the company. There is a rapidly growing number of business activities that are affected by the global nature of the world economy. Globalization brings unprecedented new possibilities, including internationalization, cooperation, and constant progress in the development of new technologies, all of which change the function of logistics in a company. The logistics sector brings many positive changes to the businesses operating in the global market (Richnák & Porubanová, 2017). Competitive advantage is generally gained by offering customer service of greater value, with lower prices and superior benefits. Conversely, logistics aims to meet customer demand at the lowest possible cost while facilitating the flow of materials, information, and funds among supply chain partners. From this perspective, logistics can put a company ahead of its competitors by ensuring effective and efficient services, such as delivering the right products faster, on time, to the right place, and at the right price. With the market becoming increasingly demanding and full of uncertainty, there is always a need for firms to be flexible in terms of the above if they are to achieve a competitive advantage (Smart Procurement, 2018). Enhancing competitiveness by developing and improving the logistics management system will increase the potential and reduce operating costs. Moreover, it is one of the solutions to strengthen the country's competitiveness in another way (Fongsamut, 2016).

The Eastern Economic Corridor (EEC) is a vital public initiative aiming to encourage investment, uplift innovation, and advance technology in Thailand. It covers locations within three provinces, namely Rayong, Chonburi, and Chachoengsao. The main goal is to attract and increase the nation's revenue by removing regulations that hinder trade and investment (The Secretariat of the House of Representatives, 2017). This uplifts Thailand's logistics development, especially with the government's encouragement of large companies to invest, leading to high competitiveness. Additionally, there are deployments in technology and reductions in Thailand's logistics costs in the long run, enhancing the competitiveness of Thai products in the global market (WHA Logistics, 2018).

The Third Thailand Logistics Development Plan (2017-2022) aims to continuously reduce logistics management costs. The total logistics cost in 2017 was approximately 1,764.5-billion-baht, accounting for 14.4 percent of the country's gross domestic product (GDP) at annual prices, which is valued at 12,221.4 billion baht (GDP at current prices) as reported by Thailand's logistics management. However, logistics costs in Thailand have remained relatively high compared to other developed countries, where the cost of logistics is no more than 10 percent of GDP. In 2017, the logistics cost structure showed that the cost of freight was the highest proportion of costs, accounting for 51.5 percent of the total logistics costs, followed by the cost of inventory storage with 39.5 percent, and the cost of logistics management with only 9.1 percent.

According to the Third Thailand Logistics Development Plan (2017-2022), the logistics cost in 2019 was targeted to be no more than 12 percent of the country's gross domestic product (Office of the National Economic and Social Development Council, 2017).

According to the logistics report of Thailand, it was found that the overall logistics cost of the country in the year 2019 was valued at 2,232.3-billion-baht, accounting for 13.2 percent of the country's Gross Domestic Product (GDP) at current prices (Nominal GDP). In the year 2020, the logistics cost of Thailand was valued at 2,199.3-billion-baht, accounting for 14.0 percent of the country's GDP at current prices. It was observed that there was a slight decrease in value from the year 2019, representing a 1.2 percent decrease, which was attributed to the overall economic contraction within the country due to the impact of the COVID-19 pandemic. Looking ahead to the year 2021, as the country gradually eases COVID-19 measures and implements economic stimulus measures, the logistics cost of Thailand is estimated to be around 2,238.8-billion-baht, accounting for approximately 13.8 percent of the GDP. Additionally, the value added by the logistics service business is expected to expand, reaching approximately 480.4 billion baht. Therefore, the Office of the National Economic and Social

Development Council has formulated plans to enhance the logistics system in Thailand, focusing on elevating the capabilities of logistics management for logistics service providers to enhance their competitiveness in the business field. (Office of the National Economic and Social Development Council, 2021)

Logistics performance is often assessed by the Logistics Development Index, which serves as a crucial indicator of the level of logistics development (LPI). Low-performance logistics can lead to increased trade costs, hinder the flow of goods, and significantly weaken market competitiveness. The Logistics Performance Index system includes customs clearance efficiency, logistics infrastructure quality, international transportation convenience, logistics service quality, product tracking ability, and goods transit timeliness. A country with lower trade expenses and a stronger position in the global value chain will have a higher LPI score (Pan et al., 2022).

Therefore, the potential development of Thai logistics service providers lies in elevating the level of service in logistics, encompassing both operational efficiency and service reliability. Meeting customer needs and staying competitive by reducing operational costs are essential aspects that Thai entrepreneurs must consistently work on to create competitive advantages in their business. The aims of this research were twofold: 1) to evaluate Thai logistics service providers towards achieving logistics management excellence, and 2) to study the factors influencing the operational potential of Thai logistics service providers.

2. Literature Review

2.1. Logistics Service Provider (LSP)

A logistics service provider is a company that specializes in offering services to help manage the supply chain, including warehouse management, order fulfillment, and shipping orders (Callarman, 2020).

Activities carried out by a logistics service provider (LSP) on behalf of a shipper consist, at least, of the management and execution of transport and storage. Additionally, other activities may be included, such as inventory management, providing activity-related information like tracking and tracing, performing value-added activities such as secondary assembly and product installation, or even engaging in supply chain management (Berglund et al., 1999; Hasna, Mostafa, Zohra, & Smail, 2018).

There are several types of logistics service providers (LSPs), each offering different services and catering to specific logistics requirements of businesses. Some of the most common types of logistics service providers include: 1) 1PLs (First-Party Logistics Providers): these are transportation agencies that distribute the products of the companies that hire them. They represent the first level of subcontracting, where the agency maintains and manages the fleets and drivers. In this scenario, the company has its own warehouses and handling equipment, 2) 2PLs (Second-Party Logistics Providers): in addition to transportation, they also take care of the storage of products. These firms provide standard storage and transportation services, while the contracting company organizes the fleet and manages the material flows. These logistics agents usually operate nationally, 3) 3PLs (Third-Party Logistics Providers): these types of operators are charged with integrating the full logistics service. They not only provide the physical infrastructure but are also responsible for managing and organizing storage and transportation operations. 3PL providers offer services adapted to the needs of the companies that contract them. Hence, they generally enter into long-term agreements, 4) 4PLs (Fourth-Party Logistics Providers): these operators function as agents of supply chain optimization. Normally, 3PLs manage the resources, and 4PLs act as consultants. As a result, they have a very close relationship, 5) 5PLs (Fifth-Party Logistics Providers): these firms integrate the services of 3PLs while also relying on the management and technology expertise of 4PLs. They take on the overall management of the supply chain and are usually highly specialized in optimizing complex operations such as e-commerce flows (Interlake Mecalux, 2020).

2.2. General Information of the Eastern Economic Corridor (EEC)

The development of the Eastern Economic Corridor (EEC) by the Royal Thai Government has laid out a 20-Year Strategy for Thailand to achieve high-income status by 2036. The strategy encompasses a wide range of top-down initiatives, particularly in infrastructure and human resource development, with the goal of transforming Thailand into a nation capable of competing against wealthier, more knowledge-based economies. The government refers to this strategy as "Thailand 4.0," drawing inspiration from the concept of "Industry 4.0," which aims to propel the country into an innovative, value-based industry. The emphasis is placed on 12 key fields, including automation and robotics, aviation and logistics, biofuel and biochemicals, and digital (Eastern Economic Corridor (EEC), 2019).

The Eastern Economic Corridor (EEC) development is at the core of Thailand's 4.0 scheme. It is an area-based development initiative aimed at revitalizing the well-known Eastern Seaboard, which has been a rewarding investment destination for numerous business developers for the past 30 years, resulting in exceptional achievements. Initially, the project focused on three Eastern provinces: Rayong, Chonburi, and Chachoengsao. The EEC development plan envisions a significant transformation in both physical and social development, and it plays a crucial role as a regulatory sandbox to enhance the country's competitiveness. The EEC's 12 targeted S-curve industries include cars, smart electronics, affluent medical and wellness tourism, agriculture and biotechnology, food, robotics for industry, logistics and aviation, biofuels and biochemicals, digital, medical services, defense, and education development (Royal Thai Embassy, Washington D.C., 2021).

2.3. Logistics Performance

Logistics Performance is a multi-dimensional concept that is defined as the degree of efficiency, effectiveness, and differentiation associated with the accomplishment of logistics activities (Fugate et al., 2010; Bobbitt, 2004; Cameron, 1986).

Logistics performance indicators have been developed at the global, national, and organizational levels. For example, the Logistics Performance Index (LPI) by the World Bank is a measure of logistics efficiency, while the Supply Chain Operating Reference Model (SCOR Model) by the Supply Chain Council assesses the capability of supply chains. In Thailand, there is the Industrial Logistics Performance Index (ILPI) developed by the Office of Industrial Logistics, Department of Industrial Works and Mines. The key importance of these indicators at all levels is to establish systems or standards as a starting point for logistics development, leading to cost reduction, time savings, and increased reliability. These indicators can be applied by businesses to evaluate various dimensions of logistics and supply chain management (Department of Industrial Promotion, 2019).

The Industrial Logistics Performance Index (ILPI) is an effective benchmarking tool designed for organizational management. It utilizes a 3D evaluation approach, encompassing nine logistics activities, to assess and analyze organizations at the matrix level in terms of cost, time, and reliability management. The nine logistics performance indices are as follows: (Department of Primary Industries and Mines, 2017).

1) demand forecasting and planning

Demand forecasting and planning is a crucial activity in generating profits or avoiding losses for an organization. Effective customer demand forecasting helps organizations to determine the direction of their operations. In other words, it enables them to plan production and resource utilization efficiently for each process. As a result, the inventory storage quantity can be managed effectively.

2) customer service and support

Customer service and support are activities carried out to provide services and meet the various needs of customers. This is achieved through the coordination of resources from each activity to ensure that customers receive accurate, timely, and complete products and services as agreed upon. Customer satisfaction is a primary focus for marketing and business activities, emphasizing support and management for all customer-related operations. This ensures the proper presentation of products to customers in the right quantity and condition, without any damage, within the specified time and

location, while maintaining the principle of minimizing costs.

3) logistics communication and order processing

Logistics communication and order processing involve the management of purchase orders, including receiving orders from customers, communicating with customers, checking inventory levels, and handling customer details. This activity serves as a crucial link between the organization and its customers, and therefore, it has a direct impact on customer satisfaction levels. It is essential to minimize the time spent in this process and avoid errors to ensure the highest level of customer satisfaction possible.

4) purchasing and procurement

Purchasing and procurement is an activity that involves sourcing and evaluating raw materials and products for purchase, as well as overall supply management. This process includes supplier selection, negotiating prices or quantity terms for orders, and evaluating the quality of goods and materials from suppliers. The aim is to ensure that the organization receives products or materials that meet its requirements and are of high quality. Purchasing and procurement involve acquiring raw materials or services from external sources by the procurement department to support various activities within the company, from production and marketing to sales and logistics.

5) materials handling and packaging

Materials handling and packaging serve different purposes based on marketing principles. Packaging is designed to communicate product details and create awareness about the product. However, in logistics, packaging and handling are primarily aimed at protecting the product from damage and facilitating its movement and storage. Well-designed packaging and handling must be compatible with the transportation equipment and warehouse facilities to help reduce raw material costs. This activity specifically focuses on finished products, starting from the completion of the production process, through packaging, storage, and preparation for delivery to customers.

6) facilities site selection, warehousing and storage

Facilities site selection, warehousing, and storage aim to enhance accessibility and transportation efficiency, ensuring quick response to customer demands. Providing goods and services to customers without significant waiting time is vital in meeting customer expectations. Warehousing decisions have strategic implications that impact transportation costs, customer service levels, and responsiveness to customer demands. This activity specifically focuses on managing warehouses for finished products only.

7) inventory management

Inventory management is an activity that impacts the efficiency of other departments and can also affect the organization's profitability. For instance, having high inventory levels may increase the costs of storage and maintenance, while obsolete inventory can lead to additional expenses. On the other hand, having too low inventory levels might reduce storage costs but could result in higher transportation costs due to more frequent shipments. Therefore, finding the right balance is crucial to optimize overall operations and costs.

8) transportation

Transportation is an activity that involves the movement of raw materials or goods from their origin to points of consumption or within the customer's responsibility. Organizations need to consider the appropriate transportation methods that best suit the nature of the products and also the routes for transportation, such as air, waterways, railways, roads, or pipelines, while adhering to regional regulations.

Ensuring accurate and timely delivery of goods in good condition is crucial to build customer confidence. Organizations must manage transportation efficiently to minimize costs while meeting delivery requirements. It is a vital activity in the supply chain, ensuring the smooth movement of raw

materials and products from production points to consumer points, including storage facilities. Selecting the right transportation mode, whether by air, rail, sea, or road, and finding the optimal routes are essential aspects of transportation management.

9) reversing logistics management

Reversing logistics management refers to the process of managing goods that are returned to a company, either due to non-compliance with customer specifications or standards, damages, or not meeting quality standards. Therefore, organizations need to establish policies to efficiently handle these returned goods to minimize costs effectively.

In the present, the Industrial Logistics Performance Index (ILPI) is being used to evaluate logistics performance management. For example, Sae-sio & Vorarat (2019) published a paper entitled, "Logistics Cost Analysis in Thailand Food Industry." The objective of this research was to study and compare logistics costs in the industrial sector in Thailand. The researchers collected various costs related to logistics activities in 20 small food industrial companies in Thailand and compared logistics costs based on the hypothesis from the CASS Method and the Industrial Logistics Performance Index (ILPI). The results revealed that the logistics activities in the small food industrial companies in Thailand, with a total sales value of 1,688,551,892 THB, had logistics costs amounting to 383,352,671 THB, which accounted for 22.07 percent based on the hypothesis from the CASS Method.

Sartnok et al. (2019) published a paper entitled, "Logistics Performance Measurement: A Case Study of AMET Engineering Company." The objective of this research was to evaluate the efficiency of logistics for AMET Engineering. The survey collected data on performance indicators in the logistics industry using the Industrial Logistics Performance Index (ILPI) to evaluate the management effectiveness of the logistics organization. It was found that the inefficient activities in the company were factory location selection and warehouse management. The researchers proposed improvements to enhance performance and compared the new plant to the current case study in the industry. They considered qualitative factors, and the location of the new plant was determined to be Tambon Tha Phra, Mueang Khon Kaen, which was deemed appropriate as it allowed for increased production rates in response to customer demand and effectively compete within the industry.

2.4. Logistics Scorecard

Logistics Scorecard is an assessment of an organization's logistics potential compared to international standards and similar organizations in Thailand. Its purpose is to allow the organization to evaluate itself, identify its weaknesses and strengths, and use this information to enhance its capabilities and reach higher levels of potential in logistics operations. The Logistics Scorecard comprises 5 elements, which are as follows: (Department of Primary Industries and Mines, 2017)

1) Corporate strategy is a step in developing logistics and supply chain management of an organization. It involves aligning logistics management strategies, policies, and objectives with the overall business strategy. This includes exchanging information between the organization, suppliers, and customers, as well as evaluating customer satisfaction and assessing employee performance for the purpose of improvement and elevating the overall logistics and supply chain management of the organization.

2) Planning and execution capability involves ensuring alignment and standardization of operational plans across different organizational units within the organization. It includes establishing effective communication channels between the organization, suppliers, and customers to efficiently meet customer requirements. This entails achieving a balance between resources and demands, as well as developing improvement plans for enhancing logistics and supply chain management processes within the organization.

3) Logistics performance is the process of measuring the efficiency and effectiveness of logistics and supply chain management to achieve better alignment and coordination with customers and suppliers. Organizations should establish performance indicators that align with their logistics and

supply chain strategies, considering dimensions such as cost, time, and reliability. This helps improve overall performance and build stronger relationships with customers and suppliers.

4) IT methods and implementation refer to the steps taken to enhance the efficiency of logistics and supply chain management using information technology as a tool for management and leveraging data to improve business planning and communication both within and between organizations. To effectively utilize information technology, organizations need to have standardized data and processes that facilitate communication within the organization and with customers and suppliers.

5) Inter-organizational alignment is the process of expanding the development of logistics and supply chain management of an organization through collaboration with external entities. This may involve forming business partnerships to leverage resources and shared facilities, collaborating with research and development units, and educational institutions to foster research, value creation, and innovation based on mutual benefits and shared value between both parties.

2.5 Research Review

Research on logistics management, logistics service providers, and logistics entrepreneurship in Thailand is as follows:

Tanachodrungsatis (2014) published a paper entitled "Efficiency and Effectiveness of Thai Rice Transportation Logistics: A Case Study of the Transportation Route from Nakornsawan Province to Foreign Countries." The objectives of this research were as follows: 1) to study the transportation logistics from Nakornsawan Province to foreign countries, 2) to examine the efficiency and effectiveness of Thai rice transportation logistics from the province to foreign countries, 3) to investigate the correlation between transportation logistics and efficiency and effectiveness, and 4) to explore samples of transportation logistics that demonstrate efficiency and effectiveness in the transportation route. The study's conclusions on transportation logistics indicated that both rail and waterway transportation logistics showed a moderate level of correlation. Land transportation logistics showed a high level of correlation. Regarding the efficiency and effectiveness of Thai rice transportation logistics, all three elements, namely transportation cost, lead time, and transportation reliability, exhibited a high level of correlation.

Aussawakornnirangkool (2019) published a paper entitled "Adaptation of Thai Logistics Transportation Service Providers in the Digital Age." The objectives of this article were to study the impact on the services of Thai logistics transportation service providers in the digital age and to present ways for these providers to adapt and be prepared to face the challenges brought about by technology in the digital age. The utilization of technology aims to enhance the competitiveness of logistics service providers by offering benefits such as flexibility, speed, cost-effectiveness, precision, waste reduction, and the elimination of non-value-adding activities. This adaptation will enable them to compete more efficiently on the global stage. Based on the results of this study, it is evident that there are three dimensions to the major changes affecting the services of Thai logistics transportation service providers in the digital age: 1) Dimension 1: the changing technology landscape in Thailand, 2) Dimension 2: the evolving business models in Thailand, and 3) Dimension 3: the shifting trade policies, which indicate how international technological changes can inevitably impact Thai logistics service providers. Entrepreneurs need to take prompt action today by adapting and embracing new ways of thinking to support their growth in an increasingly competitive market and to gain acceptance in the business arena. Therefore, the author recommends that Thai logistics transportation service providers must adapt to survive in the changing digital age, wherein new technologies are replacing existing ones and leading to innovative forms of service. In this regard, Thai logistics transportation service providers should focus on consolidation and creating a network among themselves, following the sharing economy concept. This approach will help reduce costs and create more value for their businesses. Additionally, the adoption of sustainable logistics management and environmentally friendly technologies should be embraced for long-term success.

Muenchu (2019) conducted research on the topic of developing strategies to enhance competitiveness in international freight forwarding businesses. The case study focused on AAA Company Limited, with the aim of improving operational efficiency and defining strategies to increase competitiveness. The study found that the key direction to enhance competitiveness in international freight forwarding businesses is to plan and develop operations continuously, including improving operational efficiency, to increase the competitive edge in the industry.

Sumranhan, Saisuwan, Punthanokoraphat, Saelek, & Chanchamnian (2019) published a paper entitled "A Selection of Warehouse Service Providers for Animal Feed Companies: Case Studies in Samutsakhon." The objective of this research is to study and establish the criteria for choosing a public warehouse for storing feed ingredients in Samutsakhon province. The warehouse selection criteria are based on the efficiency evaluation of logistics activities, consisting of three dimensions: cost dimension, time dimension, and reliability dimension. The importance of decision criteria is prioritized using analytical hierarchy processes. Based on the evaluation of the opinions of three experts, the results of this research showed that the dimension with the highest priority is the cost dimension with a weight of 0.661, followed by the reliability dimension with a weight of 0.272, and the time dimension with a weight value of 0.067. A comparison of two public warehouse providers revealed that each service provider has different advantages and disadvantages. By evaluating the scores using an equation, the service provider with the highest score is Service Provider 2 with an assessment score of 0.437, and the second score is Service Provider 1 with an evaluation score of 0.185. Therefore, this research decided to choose public warehouse service No. 2 to store the feed ingredients of the sample animal feed manufacturer in Samut Sakhon.

Sakvanichkul & Jaroenwisan (2020) published a paper entitled "A Study of the Efficiency of Logistic Services in Machine Tools and Metalworking Technology Exhibition." The research aimed to achieve two main objectives: 1) to study the essential components contributing to the efficiency of logistics services in machine tools and metalworking technology exhibitions, and 2) to confirm the identified components related to the efficiency of logistics services in these exhibitions. The results of the study indicated the following: 1) the key drivers for the efficiency of logistics services were found to be logistics strategy, logistic 4.0, and logistics service quality, and 2) the confirmatory model aligned well with the empirical data, suggesting its appropriateness in the overall context. The weights of each factor affecting the efficiency of logistics services were statistically significant at the 0.05 level, indicating their importance and impact on the overall efficiency of logistics services in machine tools and metalworking technology exhibitions.

Kavicha & Suwannasap (2021) published a paper entitled "The Logistics Efficiency of Road Carriers Affecting the Satisfaction of Fruit Exporters in Thailand." The research had three main objectives: 1) to study the characteristics of exporters in Thailand that affect the satisfaction of fruit exporters towards carrier services, 2) to study the characteristics of fruit exporters in Thailand that affect the logistics efficiency of carrier services, and 3) to examine the logistics efficiency of carrier services and its impact on the satisfaction of fruit exporters. The findings showed the following: 1) the different characteristics of exporters in Thailand have no effect on the satisfaction of fruit exporters towards road carriers, 2) the different characteristics of exporters in Thailand have no effect on the logistics efficiency of road carriers. The characteristics studied include the number of trips of shipment per month, product export value per year, size of the company, business model, and the duration of the organization's business operations, and 3) the logistic efficiency of carrier services that most affects the satisfaction of exporters in Thailand includes the efficiency of logistic services, efficiency of accessing services, and efficiency of Information Technology.

3. Methodology

This study employed a mixed-method research approach, collecting qualitative data through interviews with 12 experts. Purposive sampling was utilized to select the participants, including 5 university

professors, 2 logistics association executives, and 5 executives from various Thai logistics service providers. The coverage of the study encompassed transportation services, warehousing services, international freight forwarders, customs brokerage services, as well as postal and courier services. Furthermore, unstructured and in-depth interviews were conducted as the research tool for focus groups to identify factors affecting the efficiency of logistics operations. Additionally, quantitative data was collected from a sample of 400 using the Krejcie and Morgan formula. Stratified random sampling was employed, including transport services, warehouse services, international freight forwarders or customs brokerage services, and third-party logistics services in the Greater Bangkok area and the Eastern Economic Corridor development project region.

The process of creating a quantitative research tool is outlined as follows:

1. Conducting a literature review to study relevant documents, theories, and research works.
2. Collecting qualitative data through expert interviews to analyze and create a questionnaire.

This questionnaire can extract factors for measuring Industrial Logistics Performance Index (ILPI) of companies, which includes a total of 9 main factors and 46 secondary factors. It also extracts factors for evaluating the logistics management potential through Logistics Scorecard (LSC) of companies, which includes 5 main factors and 22 secondary factors.

3. Designing the questionnaire with four sections, including: 1) general information of respondents, such as gender, age, education level, work experience, position, and monthly revenue, 2) general information of the companies, such as logistics service providers, business structure, headquarters location, registered capital, and company size, 3) Industrial Logistics Performance Index of the companies, covering the 9 main factors and 46 secondary factors, and 4) Logistics Scorecard Index of the companies, covering the 5 main factors and 22 secondary factors.

4. The questionnaire was given to three education experts to evaluate its completeness, accuracy, and content validity. After analyzing the experts' evaluations and assessing the congruence index (IOC) between the questionnaire items and the main content issues, the results showed that all questions had congruence index values ranging from 0.60 to 1.00, indicating their appropriateness. For some questions where the experts provided additional suggestions, the researchers made improvements and modifications to ensure the questionnaire's clarity and completeness.

5. After making the necessary improvements, the revised questionnaire was checked for accuracy and completeness. It was then subjected to a Try Out with 30 logistics service providers in the Northeastern region of Thailand, who were not part of the actual research sample. The questionnaire's reliability was assessed using Cronbach's alpha coefficient formula, which yielded a value of 0.736. This level of reliability is within an acceptable range, as shown in Table 1: Range of reliability and its coefficient of Cronbach's alpha (George & Mallery, 2003; Arof et al., 2018).

Table 1: Range of Reliability and Its Coefficient of Cronbach's Alpha

No.	Coefficient of Cronbach's Alpha	Reliability Level
1	More than 0.90	Excellent
2	0.80 – 0.89	Good
3	0.70 – 0.79	Acceptable
4	0.60 – 0.69	Questionable
5	0.50 – 0.59	Poor
6	Less than 0.59	Unacceptable

Note: Reprint from "Contractor's Performance Appraisal System in the Malaysian Construction Industry: Current Practice, Perception, and Understanding," by Arof, K. Z. M., Ismail, S., & Abd Latif Saleh. (2018).

When 400 sets of questionnaires had been collected, the data was analyzed using a statistical program to draw conclusions based on the information obtained. The statistics used for analysis are as follows: 1) descriptive statistics, including percentages, frequencies, means, and standard deviations and 2) inferential statistics, such as the Independent t-test, One-way ANOVA, and Multiple Regression Analysis.

4. Results

4.1. The results of general data analysis of respondents

From the general information of the respondents, the results showed that the majority of the sample were male, representing 66%. Among them, 38.50% fell within the age group of 31-40 years. The level of education for most respondents was a bachelor's degree, accounting for 61 percent. Additionally, 58% of the sample held supervisor positions and had work experience of 11-15 years, amounting to 38.75%. In terms of monthly income, 31% of the respondents had a range of 25,001 to 50,000 baht, as shown in Table 2.

Table 2: The Results of General Data Analysis of Respondents

Information		Number of samples (person)	Percent (%)
Gender	Male	264	66.00
	Female	136	34.00
Age group (Years)	under 20	2	0.50
	20 – 30	47	11.75
	31 – 40	154	38.50
	41 – 50	125	31.25
	51 – 60	71	17.75
	Over 61	1	0.25
Level of education	undergraduate	80	20.00
	Bachelor's degree	244	61.00
	Master's degree	71	17.75
	Ph.D.	5	1.25
position	operator	66	16.50
	chief	232	58.00
	manager	101	25.25
	Business owner	1	0.25
Working experience (years)	Under 1	3	0.75
	1 – 5	38	9.50
	6 – 10	34	8.50
	11 – 15	155	38.75
	16 – 20	97	24.25
	21 years and above	73	18.25
Monthly income	Less than 10,000 baht	2	0.50
	10,000 - 25,000 baht	35	8.75
	25,001 - 50,000 baht	124	31.00
	50,001 - 75,000 baht	106	26.50

Information	Number of samples (person)	Percent (%)
75,001 - 100,000 baht	120	30.00
100,001 baht and above	13	3.25
Total	400	100.00

4.2. The results of general data analysis of entrepreneurs

The general information of entrepreneurs showed that 37.25% were involved in transportation service forwarding. Additionally, 32% of the entrepreneurs operated limited companies as their business structure. Moreover, the registered capital for a significant proportion, 38%, exceeded 20 million baht. This percentage was consistent among limited companies and large companies, as shown in Table 3.

Table. 3: The Results of General Information of Entrepreneurs

Information	Number of samples (person)	Percent (%)
Types of Logistics Service Providers	Transportation Services	37.25
	Warehousing Services	6.50
	International Freight Forwarder	22.00
	Customs Brokerage Services	15.75
	Postal Services and Courier Services	18.50
Forms of Business Structures	Sole Proprietorship	6.75
	Partnership	22.25
	Limited Company	32.00
	Public Company Limited	13.50
	Cooperative	2.00
	State Enterprise	4.25
	International Company	19.00
Registered Capital	Others	0.25
	Less than 1 million baht	20.25
	1 - 10 million baht	31.00
	10.1 - 20 million baht	16.75
Company size	More than 20 million baht	32.00
	Small	26.25
	Medium	35.75
	Large	38.00
Total	400	100.00

4.3. The results of the Industrial Logistics Performance Index (ILPI) analysis for entrepreneurs

The results of the analysis of Industrial Logistics Performance Index (ILPI) data for entrepreneurs revealed that the overall average score for the nine logistics activities was 3.76. When examining each activity individually, entrepreneurs predominantly emphasized procurement management, with an average score of 4.02, followed by order processing and logistics communication with an average score of 4.01, both of which were considered at a good level. The activity with the lowest average score was inventory management, with a score of 3.02, as shown in Table 4. And upon analyzing the Industrial Logistics Performance Index (ILPI) data for entrepreneurs, categorized by logistics service providers,

it was found that all entrepreneurs had an average logistics efficiency measurement of 3.69. Among the different types of logistics service providers, customs brokerage services had the highest logistics efficiency with an average score of 4.19, while warehousing services had the lowest efficiency with an average score of 3.12, as shown in Table 5.

Table 4: The Results of the Industrial Logistics Performance Index (ILPI) Analysis for Entrepreneurs

Information	\bar{x}	S.D.
1. Customer service and support	3.91	0.43
2. Customer demand forecasting	3.85	0.75
3. Order processing and logistics communication	4.01	0.61
4. Procurement management	4.02	0.67
5. Packaging and product movement management	3.85	0.52
6. Warehouse and distribution center location selection	3.61	0.72
7. Inventory management	3.02	1.57
8. Transportation and distribution	3.81	0.73
9. Reverse logistics management	3.75	0.76
Total	3.76	0.50

Table 5: Analysis of Industrial Logistics Performance Index (ILPI) Data for Entrepreneurs, Categorized by Logistics Service Providers.

Industrial Logistics Performance Index (ILPI) of Entrepreneurs	Customer Service and Support	Customer Demand Forecasting	Order Processing and Logistics Communication	Procurement Management	Packaging and Product Movement Management	Warehouse and Distribution Center Location Selection	Inventory Management	Transportation and Distribution	Reverse Logistics Management	Average
Transportation Services	3.81	3.67	3.95	3.93	3.7	3.27	3.11	4.02	3.93	3.71
Warehousing Services	3.58	3.06	3.24	3.27	4.12	4.22	3.75	1.33	1.48	3.12
International Freight Forwarder	3.94	4.15	4.1	4.27	3.83	4.12	3.16	3.88	3.97	3.94
Customs Brokerage Services	4.45	4.43	4.61	4.57	4.41	3.96	2.93	4.3	4.04	4.19
Postal Services and Courier Services	3.72	3.65	3.79	3.83	3.59	3.16	2.49	3.78	3.69	3.52
Average	3.9	3.79	3.94	3.97	3.93	3.75	3.09	3.46	3.42	3.69

4.4. The results of data analysis assessing the potential of logistics scorecard for Entrepreneurs

The potential of logistics scorecard for entrepreneurs showed that the main factors on the evaluation of logistics management paid attention on planning and implementing the development of logistics and supply chain management strategies, with an average score of 4.08, followed by the lowest average score was efficiency measurement of Logistics and Supply chain management, with an average score of 3.88 as shown in Table 6. In addition, the analysis on evaluation of logistics management potential of entrepreneurs found that all entrepreneurs have evaluation of logistics management potential with an average score of 3.92, as shown in Table 7.

Table 6: The results of the evaluation of logistics management potential (Logistics Scorecard: LSC) for entrepreneurs

List	\bar{x}	S.D.
1. Formulation of logistics and supply chain management strategies	3.93	0.55
2. Planning and implementing the development of logistics and supply chain management strategies	4.01	0.46
3. Efficiency measurement of Logistics and Supply chain management	3.88	0.55
4. Information technology management and logistics and supply chain	3.99	0.65
5. Logistics and supply chain cooperation with third parties (without suppliers and customers	4.08	0.70
total	3.98	0.54

Table 7: The evaluation of logistics management potential assessments data (Logistics Scorecard: LSC) of enterprises classified by type of logistics service provider

Evaluation of logistics management potential (Logistics Scorecard: LSC) of entrepreneurs	Formulation of logistics and supply chain management strategies	Planning and implementing the development of logistics and supply chain management strategies	Efficiency measurement of Logistics and Supply chain management	Information technology management and logistics and supply chain	Logistics and supply chain cooperation with third parties (without suppliers and customers	Mean
Postal services and courier services	3.44	3.51	3.41	3.36	3.48	3.44
Customs Brokerage Services	4.36	4.36	4.35	4.49	4.68	4.45
Transportation Services	4.11	4.16	4.01	4.24	4.38	4.18
Warehousing Services	3.60	3.80	3.86	3.67	3.50	3.68
International Freight Forwarder	3.83	4.00	3.71	3.86	3.81	3.84
Means	3.87	3.97	3.87	3.92	3.97	3.92

4.5. Hypothesis test

The results of the hypothesis testing of the respondents' general information were as follows; gender, age, level of education, work experience, position, monthly revenue and general information of the establishment with potential of logistics management of enterprises. The comparison of the potentialities of logistics management according to personal factors and the characteristics of the enterprises resulted that gender, age, level of education, work experience, position, monthly revenue, logistics service provider, form of business structure, head office location, registered capital, and company size were affected to the potentialities of logistics management of different entrepreneurs at the significance level of 0.05. as shown in Table.8 and Table. 9

Table 8: The comparison of logistics management potential for entrepreneurs classified by gender

Gender	n	\bar{x}	S.D.	t	Sig.
Male	264	4.05	0.57	3.964*	0.000
Female	136	3.84	0.44		

*statistical significance at the .05 level.

Table 9: The comparative results of logistics management potential for entrepreneurs classified by general information of respondents and general information of entrepreneurs

Independent Variables	Dependent Variable (The potential of logistics management for entrepreneurs)					
	Source of Variance	Sum of Squares	df	Mean Square	F	Sig.
Age	Between Groups	31.587	5	6.317	29.482*	0.000
	Within Groups	84.426	394	0.214		
	Total	116.013	399			
Level of education	Between Groups	10.729	3	3.576	13.452*	0.000
	Within Groups	105.284	396	0.266		
	Total	116.013	399			
Work experience	Between Groups	52.032	5	10.406	64.084*	0.000
	Within Groups	69.981	394	0.162		
	Total	116.013	399			
Position	Between Groups	23.606	3	7.869	33.720*	0.000
	Within Groups	92.407	396	0.233		
	Total	116.013	399			
Monthly revenue	Between Groups	43.723	5	8.745	47.661*	0.000
	Within Groups	72.290	394	0.183		
	Total	116.013	399			
Logistics service provider	Between Groups	45.413	4	11.353	63.521*	0.000
	Within Groups	70.600	395	0.179		
	Total	116.013	399			
Form of business structure	Between Groups	16.300	7	2.329	9.154*	0.000
	Within Groups	99.713	392	0.254		
	Total	116.013	399			
Head office location	Between Groups	14.846	8	1.856	7.172*	0.000
	Within Groups	101.167	391	0.259		
	Total	116.013	399			
Registered capital	Between Groups	28.737	3	9.579	43.463*	0.000
	Within Groups	87.276	396	0.220		
	Total	116.013	399			
Company size	Between Groups	22.691	2	11.346	48.266*	0.000
	Within Groups	93.322	397	0.235		
	Total	116.013	399			

*statistical significance at the .05 level.

4.6. The results of correlation analysis between logistics efficiency and logistics management potential for entrepreneurs

The effect of multiple correlation coefficients and multiple exponential coefficients between logistics efficiency and potentialities of logistics management were showed as in Table 10 and 11, It was found that Model 6 was the best predictive equation with 6 independent variables as follows namely: purchasing and procurement (X4), demand forecasting and planning (X2), reverse logistics management (X9), materials handling and packaging (X5), logistics communication and order processing (X3), customer service and support (X1), were correlated with the potentialities of logistics management with a correlation coefficient of 0.625. Additionally, all 6 independent variables were able to explain the variation of the logistics scorecard 38.10 percent.

Table 10: Multiple correlation coefficients and multiple exponential coefficients between logistics efficiency and potentialities of logistics management

Model	R	R ²	Adjusted R ²	Std. Error of the Estimate
1	0.520 ^a	0.271	0.269	0.461
2	0.542 ^b	0.294	0.291	0.454
3	0.559 ^c	0.313	0.308	0.449

4	0.581 ^d	0.338	0.331	0.441
5	0.599 ^e	0.359	0.351	0.434
6	0.625 ^f	0.391	0.381	0.424

- a. Predictors: (Constant), purchasing and procurement (X₄)
b. Predictors: (Constant), purchasing and procurement (X₄), demand forecasting and planning (X₂)
c. Predictors: (Constant), purchasing and procurement (X₄), demand forecasting and planning (X₂), reverse logistics management (X₉)
d. Predictors: (Constant), purchasing and procurement (X₄), demand forecasting and planning (X₂), reverse logistics management (X₉), materials handling and packaging (X₅)
e. Predictors: (Constant), purchasing and procurement (X₄), demand forecasting and planning (X₂), reverse logistics management (X₉), materials handling and packaging (X₅), logistics communication and order processing (X₃)
f. Predictors: (Constant), purchasing and procurement (X₄), demand forecasting and planning (X₂), reverse logistics management (X₉), materials handling and packaging (X₅), logistics communication and order processing (X₃), customer service and support (X₁)

Table 11: Examination of independent variables that can forecast the potentialities of logistics management

Model		Sum of Squares	df	Mean Square	F	Sig.
6	Regression	45.315	6	7.553	41.984*	0.000
	Residual	70.698	393	0.180		
	Total	116.013	399			

*statistical significance at the .05 level.

- a. Dependent Variable: performance of safety management at work (Y)
b. Predictors: (Constant), commitment and strength in managing safety of executives (X₁), training (X₂), working environment arrangement (X₄), safety education (X₆)

5. Conclusion and Discussion

5.1. Conclusion

1. From the first objective, the results of the analysis of Industrial Logistics Performance Index (ILPI) data for entrepreneurs revealed that when examining each activity individually, entrepreneurs predominantly emphasized procurement management, and the activity with the lowest average score was inventory management. Furthermore, the evaluation of logistics management potential (Logistics Scorecard: LSC) for entrepreneurs resulted that the activity with the most average score was planning and implementing the development of logistics and supply chain management strategies, on the other hand, the lowest average score was efficiency measurement of Logistics and Supply chain management.

2. According from the second objective, the factors affecting on the potential of logistics scorecard for entrepreneurs were gender, age group, level of education, position, working experience, monthly income, types of logistics service providers, form of business structures, registered capital, company size. Those mentioned factors affected on the potential of logistics management at the significance level of 0.05. Moreover, the six logistics efficiency activities were purchasing and procurement, demand forecasting and planning, reverse logistics management, materials handling and packaging, logistics communication and order processing, and customer service and support were correlated with the potentialities of logistics management.

5.2. Discussion

1. The logistics efficiency measurement of entrepreneurs were focused on the main factors of nine logistics activities, accordingly, Kavicha & Suwannasap (2021) and Sakvanichkul & Jaroenwisarn (2020) supported the efficiency of logistics services of entrepreneurs to increase operational efficiency in order to reduce some costs and meet customer needs.

2. Analysis of Logistics Scorecard, classified by types of logistics service providers with international freight forwarders gives the importance to the planning and implementation of the

development of an effective logistics and supply chain management strategies. In order to promote the competitiveness of entrepreneurs corresponding with Muenchu (2019) mentioned to guidelines for developing strategies to enhance the competitiveness of the international freight forwarding business. Additionally, planning and developing other operations, including continuous improvement of operational efficiency to increase the competitiveness of the business sector.

3. Analysis of Logistics Scorecard, classified by type of logistics service providers with warehousing services, focuses on the importance of efficiency measurement of logistics and supply chain management. Measuring logistics and supply chain management efficiency is a measure of the reliability of entrepreneurs that need to constantly improve and develop operational efficiency to meet customer needs, corresponding with Sumranhan, Saisuwan, Punthanokoraphat, Saelek, & Chanchamnian (2019), who indicated to rental public warehouse business. It should build customer credibility by continuously improving efficiency measurements in logistics and supply chain management.

4. Analysis of Logistics Scorecard, classified by type of logistics service providers with postal services and courier services addresses that the importance of the planning and implementation of the development of an effective logistics and supply chain management strategies. In order to promote the competitiveness of the entrepreneurs, corresponding with Suksawat & Jitsoonthornchaikul (2010) mentioned to businesses by the postal company limited, they should speed up the development of logistics operations, in order to increase the competitiveness of the business sector, which is abundant and increased the intensity.

5. Different types of logistics service providers affecting the logistics management capacity of different enterprises, corresponding with Yongvanich, Rungruangwuddikrai, & Girdsaksit (2019), who mentioned about the level of service quality received from different service providers in the same service will have different levels of service quality, because the potential of logistics operators is different.

5.3 Recommendation

From the results of the research on the evaluation and development of Thai logistics service providers to logistics management excellence. The researchers suggest as follows;

Recommendations for logistics service providers

1. Inventory management should be focused by logistics service providers because inventory management is an important cost of overall logistics costs.
2. Warehouse and distribution center location selection should be prioritized at the first place because the location selection will affect on the overall logistics costs, both warehouse costs and inventory costs.
3. Logistics providers prioritized the evaluation of logistics management potential of entrepreneurs because in the present, there are various risky events such as pandemic, the variation of consumers, and new technology. These causes all entrepreneurs to prevent any risky situations by strengthening their businesses. These cause the efficiency measurement of logistics and supply chain management. Therefore, logistics providers should plan the development of logistics and supply chain management strategies under the uncertain situations.

Recommendations for the government

1. The government and related agencies cooperate alongside to develop the infrastructure system, new technology, personnel in the field. The cooperation of government and logistics providers alongside are effectively able to raise the international standard of logistics and supply chain.
2. The government should accelerate the construction of network of logistics operations with logistics providers in order to facilitate the operation, reduction process and time, and operational risk.

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