EFFICIENCY OF LAST MILE DELIVERY OF LOGISTICS SERVICE PROVIDERS (LSPS) IN MALAYSIA: POST-COVID

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Abstract. Several studies have researched on numerous areas about last mile delivery over the past years however, studies focusing on factors influencing efficiency of last mile delivery of logistics service providers (LSPs) is still fragmented and yet to be examined vigorously particularly during post-covid era. To fill the unanswered gaps of last mile delivery efficiency, this research aims to investigate the factors that influence efficiency of last mile delivery of logistics service providers (LSPs) in Malaysia in post-covid era. As a result, this research assists logistics service providers (LSPs) in identifying essential elements and focusing on these aspects in order to successfully improve and execute their last mile delivery services. Perhaps as a consequence, the authors think that this research will guarantee that the hurdles to achieving optimal last-mile delivery are addressed, ensuring the quality of transportation operations and a positive customer experience. This research was conducted in a quantitative approach and the method of data collection was conducted using the physical and online survey questionnaire to obtain responses from major LSPs involved in B2C e-commerce in Malaysia (Pos Malaysia, J&T Express, GDex, Ninjavan) using a non-probability sampling method. A total of 300 respondents participated in the survey from which all of them were taken from around LSPs situated in Malaysia. In accordance with analysis from regression, it is seemed issues from customer side factor seems the stronger influence in the efficiency of last mile delivery during the post covid era, followed by cost of last mile delivery and then by customer expectation. These variables should drive LSPs' strategies and dynamic attempts to enhance last mile delivery efficiency.
Keywords: *last mile delivery, logistics service providers (LSPs), total interpretive structural modeling (TISM), efficiency*

Introduction

Last mile delivery is defined as the last stage of transporting customer's parcels by logistics service providers to the location specified by the customer either to the customer's place of residence or work. The logistics service provider is named as the merchant's representative. Generally, the purpose of last mile delivery/logistics is to get an item to its receiver as soon as possible without the act of negligence on the condition of the product. The outbreak of novel coronavirus changed many traditional practices of humans to a new norm of culture where many workers turn to work from home, while the production disrupted at companies, congestion at ports as the vessels unable to unload the goods at port of destination and air transports are restricted as the world falls under movement control order (MCO). As a result, the whole supply chain from upstream until downstream are affected. This is the period where businesses turn their strategy to utilize the available technologies where e-commerce takes place. In addition, because it involves multiple customer touchpoints as well as the COVID-19 pain areas, the last-mile delivery project has the biggest impact on all sorts of e-commerce companies. On the other hand, when there is movement control, communities in Southeast Asia countries like Singapore, Thailand, Vietnam, Malaysia and Indonesia started to purchase more goods from online platforms.

As a consequence, the demand for 3rd party logistics service providers like courier, express and parcel (CEP) increased among the retailers and other business owners. Recently, generating e-commerce business is quite challenging where the market size keeps on widening from 14.1% to 20% by the year of 2022 based on (Truitt, 2020). Meanwhile the post-covid era is the challenging period for the third-party logistics providers where the competency level keeps on increasing in between one and another competing to win the customers heart by achieving high level of customer services. During the worldwide epidemic of COVID-19, Malaysians have grown used to delivery services and presently it became a norm which means it became a part of their lives. Particularly, the last-mile delivery system, which transports items from distribution hubs to end customers, has been heavily impacted by the growth in e-commerce volumes. As a consequence, prior to ecommerce growth and technological advancement logistics services are more and more getting constantly outsourced to Logistics Service Providers (LSPs), whose major expertise is in the logistics field. LSPs are companies that manage, oversee, and provide logistical services on behalf of its customers. LSPs are used for the intricate shipping procedure. There is always an integration of the 3PL supplier with the customer's system. LSPs in Malaysia are countless in numbers such as GDEX, DHL, POS Malaysia, J&T, KGW Logistics, Ninjavan, LalaMove but differ in logistics services. Customers of LSPs are categorized into two parties which are Business to Business (B2B) and Business to Consumer (B2C). B2B is a way of doing business in which the firms engaged make goods and provide services for the benefit of other companies and organizations.

However, in this research the authors are focusing more on efficiency of logistics service providers performing last mile delivery for B2C business. The practice of selling items and services directly to consumers, who will ultimately be the end-users of such products or services, is referred to as "business-to-consumer" (B2C), which is an abbreviation for "business to consumer" (Kenton, 2022).

Objective of the study

The distribution costs keep on increasing while the profit margin drops in Malaysia among LSP's

Many courier firms are adversely impacted, with poor profit margins and also rapidly losing money as a result of increasing the cost of delivering items to the doorsteps of their customers (Zhe, 2022). The last-mile delivery providers, according to a Bernama (2021) article, have been giving free delivery, notably in the e-commerce market. Many industry participants have been adversely impacted by price dumping since they have been unable to match prices and as a result are incurring losses. Some have even resorted to cutting costs by decreasing employee pay or commissions as a result of their losses. Some industry competitors are attempting to dominate the market by using service dumping tactics, which the CEO of GDex believes should not be permitted in Malaysia. Because of the lack of floor pricing, courier services were compelled to compete with unrealistic pricing, which had a direct impact on the lives of the delivery personnel of the approximately 109 courier service providers in Malaysia, according to the report. Without adequate resources, industry participants would be unable to invest in new technologies and maintain their operations, and as a response, they will be forced to reduce the quality of their services

Customers expect their goods to have their items delivered on time or delivered on same day: Delayed deliveries

As briefly explained by LalaMove Malaysia, e-commerce consumers still expect to receive their goods instantly or faster as if being handed over the goods from a cashier. In fact, reports have shown that up to 25% of consumers are willing to pay a premium fee to enjoy same-day delivery (Lalamove Malaysia, 2020) since the expectation to receive the goods from an e-commerce store mirrors the experience from regular shopping. During a delivery, customers tend to expect their items to be shipped to them within particular time frame or suggested period of time yet to ship the item within the time frame is still a struggle for many delivery companies and they don't know which customers need a delivery in which time period (Voccia, 2015). Even though COVID-19 has come to be endemic however, it continues to unfold which remains a challenging issue for Pos Malaysia BHD as the volume of parcels to be delivered keeps on surging, unfortunately creating potential delays in parcel deliveries (Keegan, 2020).

Failed deliveries affecting LSPs delivery process

Delivery failure occurs, resulting in needless expenditures for logistics service providers and merchants, consumer discomfort, and an additional environmental load (Rai et al., 2021). LSPs also took initiatives to reduce failed delivery numbers whereby they gave the platform for the customers to choose their preferred shipment time duration which suited one's schedule on weekdays, delivering parcels to different locations apart from the customer's home address. Meanwhile, by doing so the LSPs have a great challenge on parcel consolidation and routing efficiency (Rai et al., 2021). According to terms and conditions provided by one of the LSPs in Malaysia which is JnT Express Malaysia, explained that undeliverable packages will be stored at J&T for a maximum of 7 working days after three failed delivery attempts. Parcels will be returned to the customer at the very same delivery fee model. Each delivery attempt made by the LSPs incurring costs and environmental impacts.

The more technology investments required for last mile delivery adoption as customers demand real-time-delivery status

According to Banoo (2021) report, stated that technology adoption plays a vital role in last mile delivery where smart applications organize the delivery order appropriately and ease the delivery process within a second. The author reported that, in Malaysia many LSP's increase the delivery fare in the name of last mile delivery but customers still experience delay in delivery to their door steps which are considered really unfair and there is no difference between standard delivery performance and last mile delivery efficiency. As parcel volume increases in Malaysia, many LSP's are required to add on their delivery capacity in terms of vehicles and riders or drivers. This situation brings another level of issues where the LSP's consider the parcel safety, costs of wages, and maximization of operation. All of this consideration only will be possible for the LSP's with the adoption of technologies like IoT and software's. However, adopting new technology among LSP's is really challenging since the profit margins keep on affecting low shipping fee or no shipping fee expectations from customers (Dolan, 2022).

Literature review

Theoretical framework

TISM approach model

In view of the constraints of the theory behind last-mile delivery efficiency, the author chose to employ the TISM approach model, which had been used in a prior analysis of last-mile delivery initiatives during the COVID-19 period (Suguna et al., 2022). ISM opened the path for graphical representations of complicated systems. TISM began here. ISM research began in the 1970s. It offers humans the capacity to connect complex variables (Singh et al., 2007). TISM also shows how two variables interact. Example: how A affects C. This TISM model is often used in supply chain operational performance and issues. Based on Suguna et al. (2022), the researcher created the TISM model for COVID-19 last mile delivery variables. TISM was established by the author based on literature and professional advice during the COVID-19 epidemic. The previous research investigated eleven variables that impact last-mile delivery. Previous research found that kinds of items, efficient routing, and timely fulfilment impact last-mile delivery efficiency.

Figure 1 shows the TISM model created by Suguna et al. (2022) to assess last-mile delivery during COVID-19. Based on literature and expert opinion, this TISM model identifies the link between listed elements. After finding the variables, the researchers used the IRM to connect each pair. Strongly influenced factors rated 1 and others 0. For each comparison, 20 respondents are asked for their opinions. The author constructs the Final Reachability Matrix by transit-checking all 0 IRM entries. In IRM, transitivity was only recorded as 1 when absent. MICMAC was used to classify components as dependent, connected, or independent based on their driving force and dependency. Finally, the variables are arranged by their driving power dependence, from first to last (least crucial factors). Only intersection elements were formed as level-1 elements before the process began. Translating direct and transitive links creates the interaction matrix. The digraph uses FRM and level partitions, with level I factoring on top and level III on bottom. TISM is arranged as a methodical digraph with interrelated components.

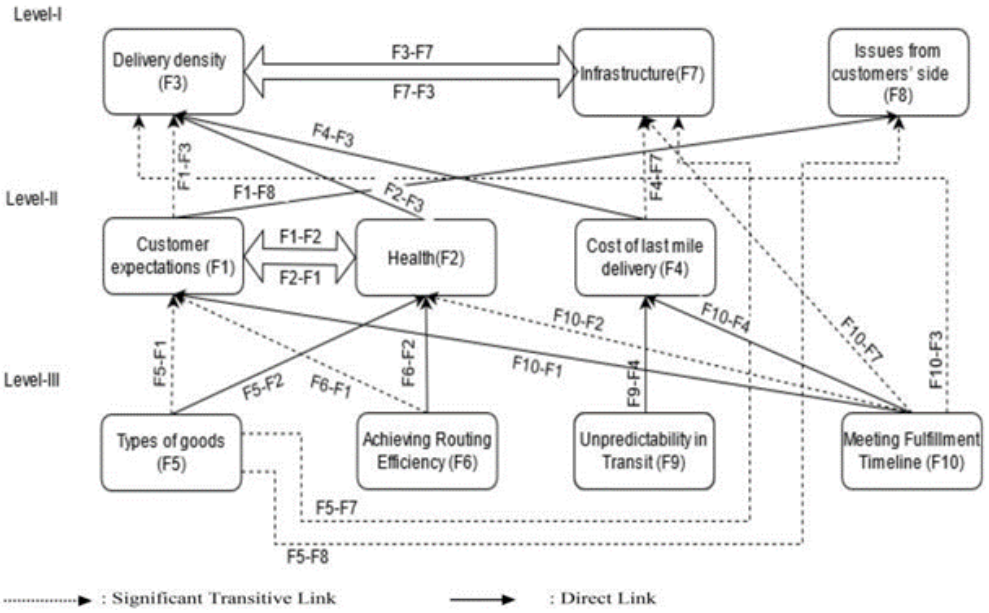

Figure 1. *TISM model.*

Research framework

The independent variable, dependent variable, and theoretical framework were established based on the literature review. In studies, the theoretical framework explains the investigation's challenges. This study incorporated all characteristics from prior studies to analyse last mile delivery among LSPs in Malaysia, especially post-covid-19. This study examined post-covid period elements impacting last mile delivery among LSPs. Previous research revealed that the categories of commodities, attaining routing efficiency, and fulfilment time were the most significant in the COVID-19 era (*Figure 2*).

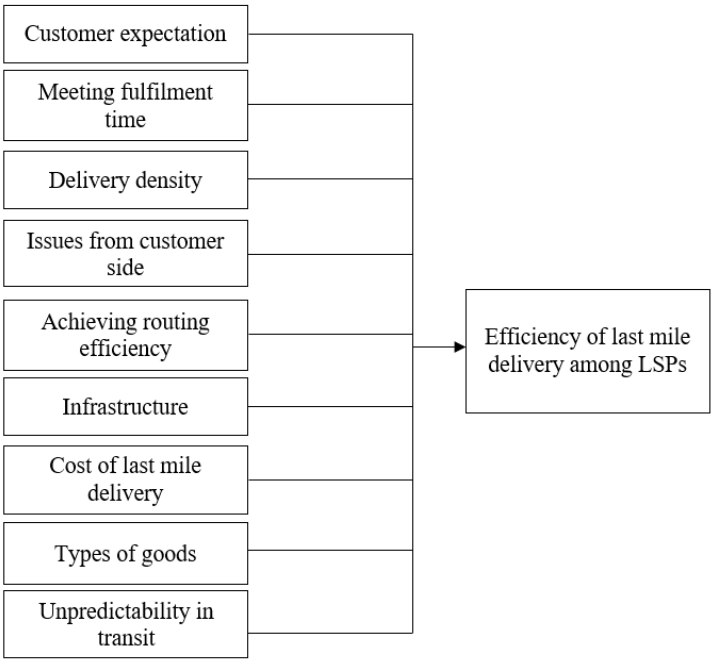

Figure 2. *Research framework.*

Materials and Methods

In this research, the researcher used Quantitative methods were utilized to examine whether or not the independent variables and dependent variables affect the efficiency of last mile delivery in Malaysia. Due to the questionnaire is an effective data collecting approach for hypothesis testing studies, whereby an online survey questionnaire will be utilized to examine factors affecting efficient and effective last mile delivery among major LSP's in Malaysia. This study is a quantitative study, aiming to study the factors which affect efficiencies in last mile delivery of LSPs on post COVID-19. This study uses causal hypothesis testing to establish cause-and-effect relationships among dependent variables and independent variables. The extent of researcher interference in this research is moderate interference with manipulation in a natural setting. Major logistics service providers (LSPs) in Malaysia, such as Pos Malaysia, J&T Express, GD Express, and Skynet Express, specifically the top management, are the unit of analysis in this study.

Moreover, this study is also constrained by a time range when seen from a cross-sectional temporal perspective. Data from individuals who complete the survey form may be acquired fast in cross-sectional research. If the population is well defined, we can have the information regarding on the heights, weights, BMIs, hemoglobin levels, events, and also the outcomes. The population to be examined will be defined by the research topic or study purpose in terms of geographic location, age, gender, or employment. Prior to examining a sample drawn from a study population, it is common practice in descriptive research to identify the study population. Other characteristics of studied populations include employment, religion, and ethnicity (Bhandari, 2020). In this study, we have listed a few logistics service providers located in Malaysia particularly giving services to Business to Consumer (B2C). For this research, a random sample size of 200 respondents will be chosen from Post Malaysia, GD Express, J&T Express and Skynet Express to complete survey questionnaires and provide data for analysis. This study will take place in a natural setting with minimum intervention from the researcher. Finally, the design is noted for being simple, low-cost, and data-collection friendly.

Researchers were able to choose a representative sample from the sampling unit for this experiment by using a questionnaire. The goal of this study is to find relevant causes that affect the efficiency level of last mile delivery among Malaysian LSPs. The questionnaire will be widely used because of its utility as a data collection tool in hypothesis testing research. A Google Forms-based online survey questionnaire will be sent to the target population. Researchers will have an easier job classifying the information gathered since the questionnaire's questions are closed-ended rather than open-ended. Closing-ended questions let survey participants to quickly choose an answer from a pre-selected selection, saving time for all parties involved. Lastly, the SPSS (version 26) application for Windows will be used to analyze the data acquired in this investigation. The data was analyzed using both descriptive and inference statistics which include correlation and multi liner regression.

Results and Discussion

The researcher distributes the questionnaire personally and using Google form. Sample size yielded 345 answers. After eliminating 48 outliers, 300 of 348 were chosen. This study only analyzed 300 respondents' SPSS V26 data. A population outlier has more extreme values than a normal distribution. About 48 responders had very high or low values. SPSS contains data from 48 respondents. The box plot diagram was used to categories outliers and demonstrates that the value is high. Outliers were removed from the data before further analysis. The outlier result shows below (*Table 1*).

Table 1. *Summary of outlier's detections.*

Variables	Total case removed (N=48)	Outliers case number	Upper limit	Lower limit
Efficiency of last mile delivery (DV)	3	42,18,8	2	1
Customer expectatin (IV 1)	4	48,15,20,34	2	2
Meeting fulfillment time (IV 2)	2	43,33	2	-
Delivery density (IV 3)	1	19	-	1
Issues from customer side (IV 4)	2	2,10	1	1
Achieving routing	4	25,38,40,41	1	3

efficiency (IV 5)				
Infrastructure (IV 6)	6	289,88,198,98,76,50	4	2
Cost of last mile delivery (IV 7)	3	242,230,101	3	-
Types of goods (IV 8)	5	299,218,128,111,67	1	4
Unpredictability transit (IV 9)	10	147,269,63,222,234,37,71, 11,164,273	7	3

The normality of the data distribution was also confirmed by looking at the histogram. Histogram shows that the mean of each variable is roughly bell-shaped and symmetric around the mean, and that the data are normally distributed.

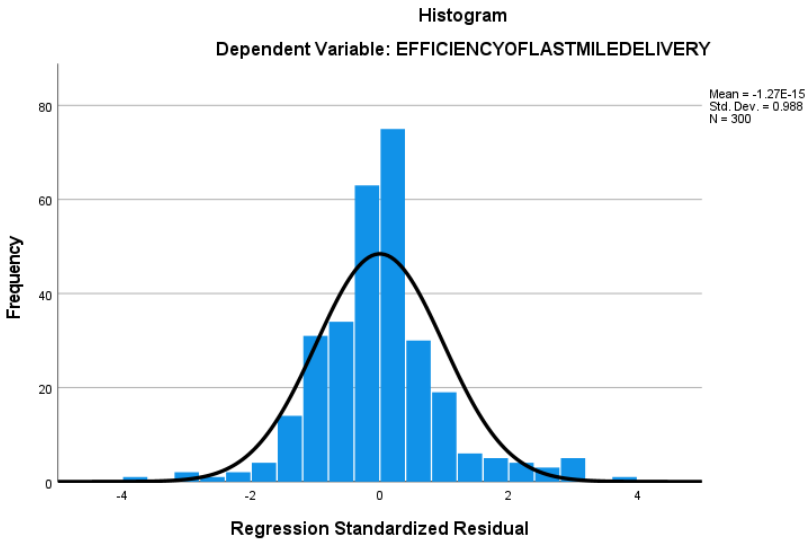

Figure 1. *The efficiency of last mile delivery.*

Goodness of measures using reliability analysis

Table 2 shows the Cronbach's alpha reliability ratings for the ten tested variables from 300 respondents. The Cronbach's alpha for meeting fulfilment time and infrastructure is under the acceptable range of 0.60. The remaining seven independent variables fall inside the acceptable 0.70 range. On the other hand, the dependent variable scored below 0.80, which is also within the acceptable range

Table 2*. Reliability test results of each variable.*

No	Research variable	No. Questions	Reliability	Result
DV	Efficiency of last-mile delivery	5	0.811	Good
IV 1	Customer expectation	5	0.746	Good
IV 2	Meeting fulfilment time	5	0.699	Acceptable
IV 3	Delivery density	5	0.799	Acceptable
IV 4	Issues from customer side	5	0.751	Good
IV 5	Achieving routing efficiency	5	0.836	Good
IV 6	Infrastructure	5	0.655	Acceptable
IV 7	Cost of last mile delivery	5	0.836	Good
IV 8	Types of goods	5	0.783	Good
IV 9	Unpredictbility transit	5	0.783	Good

Descriptive statistic of variables

When the data is regularly distributed, the mean is usually the best approximation of the central tendency to use. The mean value of six variables varies from 3.13 to 3.53, as

shown in *Table 3*. Only two independent variables, customer expectation and infrastructure, had scores ranging from 2.21 to 2.47. The dependent variable, efficiency of last mile delivery, had a score of 3.23. There were 300 respondents in total. The background of respondents was collected based on their gender, ethnic group, job position, years of experience, problem in organization, location of the branch and logistics service provider. *Table 4* shows the summary of the frequency analysis for respondent's background.

***Table 3**. Mean value of each variable.*

Descriptive statistics	N	Mean
Efficiency of last mile delivery	300	3.225
Customer expectation	300	2.214
Meeting fulfilment time	300	3.260
Delivery density	300	3.511
Issues from customer	300	3.330
Achieving routing efficiency	300	3.128
Infrastructure	300	2.468
Types of goods	300	3.529
Cost of last mile deivery	300	3.128
Unpredictability	300	3.529
Valid N (listwise)	300	-

***Table 4**. Summary of the frequency analysis for respondent's background.*

Description	Frequency (N=300)	Percentage (%=100)
Gender		
Male	119	39.7
Female	181	60.3
Ethnic group		
Malay	53	17.7
Chinese	57	19.0
Indian	188	62.7
Others	2	0.6
Job position		
Managing director	35	11.6
Executive	161	53.7
Branch manager/Senior manager/Junior manager	86	28.7
Departmental officers	18	6.0
Years of experience		
<1 year	51	17.0
1-5 years	56	18.7
5-10 years	63	21.0
10-15 years	22	7.3
15-20 years	107	35.7
>20 years	1	0.3
Problem in organization		
Never	17	5.7
Sometimes	41	13.7
Always	112	37.3
Rarely	124	41.3
Often	6	2.0

Location of branch		
Kedah	38	12.7
Johor	27	9.0
Kelantan	91	30.4
Melaka	109	36.3
Negeri Sembilan	3	1.0
Pulau Pinang	13	4.3
Perak	6	2.0
Perlis	5	1.7
Pahang	1	0.3
Selangor	5	1.7
Terengganu	1	0.3
Sabah	1	0.3
Logistics service provider (LSPs)		
Pos Malaysia	14	4.7
J&T	31	10.4
GDEX	109	36.3
Ninjavan	145	48.3
Shopee Express	1	0.3

This research analyzed 300 respondents. 119 women (39.7%) and 181 men (60.3%) responded. In this survey, more men than women responded. Second, based on the data analysis, 53 respondents (17.7%) are Malay, 188 respondents (62.7%) are Indian, 57 respondents (19.0%) are Chinese, and 2 respondents (0.7%) are from another race. Conclusion: More Indians, Chinese, and others responded. This question surveys the respondent's employment history. 161 executives (53.7%) responded, 86 branch managers (28.7%), and 35 managing directors (11.7%). 18 departmental officials (6%) answered our survey. This survey had more executive responders than other jobs. In this study on last-mile delivery efficiency, the researcher analyses respondents' years of experience. 107 responders (35.7%) have 15-20 years' experience. 21% of respondents have 5-10 years' experience. Third, 56 respondents had 1-5 years' experience. 51 replies (17%) have less than 1 year. 22 responses (7.3%) have 10-15 years' experience. 0.3 percent of respondents are above 20 years old. Conclusion: There are more 15-20-year-old responders. In this study, the researcher investigates last-mile delivery issues in the company. 124 respondents said organization problems are unusual. 112 respondents (37.3%) say their firm always has last-mile delivery difficulties, while 41 (13.7%) say they do occasionally. 6 respondents (2%) say they regularly have last-mile delivery problems, while 17 (5.7%) say they never do. In this survey, 109 respondents from Melaka (36.3%) and 91 from Kelantan (30.3%) participated, continue by 38 respondents from Kedah (12.7%) and 27 from Johor (9.0%) are also participated. This include 13 Pulau Pinang respondents (4.3%) and 6 Perak respondents (2%), as well as other responders are from Perlis (1.7%), Negeri Sembilan (1.0%), 5 replies from Selangor (1.7%) and 1 from Pahang, Terengganu, and Sabah (0.3%) respectively. This research identified 5 logistics suppliers. The survey found 145 responders from Ninjavan and 109 from GDEX. 31 respondents (10.3%) used J&T, 14 used Pos Malaysia, and 1 used Shopee Xpress.

Descriptive variable (Descriptive analysis)

According to the *Table 5*, descriptive analysis was used to determine last-mile delivery efficiency among Malaysian logistics providers. The majority of respondents agreed that their consumers say nice things about their delivery service (Mean=3.27, std=1.065). Second, many LSPs argue that their organisation isn't choosy about delivery routing (Mean=2.59, std=1.157). LSPs disagree that they have no social media input (Mean=1.67, std=1.255). Third, LSPs strongly disagree that they have enough trucks to handle all sorts of shipments (mean=1.90, std=1.171) and finally, LSPs dispute that their delivery service often missed delivery time (mean=1.64, std=1.150). Last-mile delivery efficiency is good (Mean=3.225, std=0.701)

Table 5. *Descriptive analysis of dependent variable.*

Efficiency of last mile delivery	N	Minimum	Maximum	Mean	Std. Deviation
Social media evaluations of your last-mile delivery service.	300	1	5	1.67	1.255
Is there a sufficient number of vehicles to handle all types of shipments?	300	1	5	1.90	1.171
Is your company picky about delivery route planning?	300	1	5	2.59	1.157
Do your customers deliver service is good?	300	1	5	3.27*	1.065
Hoe many time your delivery service failed to meet delivery time?	300	1	5	1.64	1.150
Efficiency of last delivery	300	1.20	5	3.225*	0.70119
Valid N (listwise)	300	-	-	-	-

Independent variable (Correlation analysis)

This statistical test used Pearson's correlation coefficient to test the significance of a linear relationship between two variables. To test the independent variables (customer expectation, meeting fulfilment time, delivery density, issues from customer side, achieving routing efficiency, infrastructure, cost of last-mile delivery, types of goods and unpredictability time) on the dependent variable (efficiency of last-mile delivery among logistics service provider), bivariate correlation between two variables is examined. Based on correlation research, significant findings are observed between customer expectation and logistics service provider last mile delivery efficiency (p.000), meeting fulfilment time and last mile delivery efficiency (p >.044), and delivery density and last mile delivery efficiency (p.000). Second, customer issues and last mile delivery efficiency among logistics service providers (p.000), achieving routing efficiency and last mile delivery efficiency among logistics service providers (p.000), infrastructure and last mile delivery efficiency among logistics service providers (p.000), cost of last mile delivery and last mile delivery efficiency among logistics service providers (p.000), types of g Unpredictability transit and last mile delivery are significant (p >.125).

Strength and direction (Pearson correlation)

Pearson correlation between customer expectation and efficiency of last-mile delivery was found to be definite relationship with statistically significant at (r=-0.379, p=0.00) (*Table 6*). Hence, H1 was not supported. There is definite significant relationship between efficiency of last mile delivery with customer expectations. Pearson correlation between meeting fulfilment time and efficiency of last-mile delivery was found to be negative correlation and non-statistically significant (r=0.116, p=0.044) (*Table 7*). Hence, H2 was not supported. There is no significant relationship between

efficiency of last mile delivery with meeting fulfilment time. Pearson correlation between delivery density and efficiency of last-mile delivery was found to be negative correlation and statistically non-significant (r=0.214, p<0.000) (*Table 8*). Hence, H3 was not supported. There is no significant relationship between efficiency of last mile delivery with delivery density. Pearson correlation between issues from customer side and efficiency of last-mile delivery was found to be high correlation and statistically significant at (r=-0.720, p<0.000) (*Table 9*). Hence, H4 was supported. There is a strong significant relationship between efficiency of last mile delivery with issues from customer side. Pearson correlation between achieving routing efficiency and efficiency of last-mile delivery was found high correlation and statistically significant (r=-0.716, p<0.000) (*Table 10*). Hence, H5 was supported. There is a high significant relationship between efficiency of last mile delivery with achieving routing efficiency. Pearson correlation between infrastructure and efficiency of last-mile delivery was found to be moderately correlated with statistically significant at (r=-0.458, p<0.000) (*Table 11*). Hence, H6 was supported. There is a moderate significant relationship between efficiency of last mile delivery with infrastructure. Pearson correlation between cost of last-mile delivery and efficiency of last-mile delivery was found to be positive correlation and statistically significant at (r=-0.716, p<0.000) (*Table 12*). Hence, H7 was supported. There is a high significant relationship between efficiency of last mile delivery with cost of last-mile delivery. Pearson correlation between cost of last-mile delivery and efficiency of last-mile delivery was found to be negative correlation and statistically non-significant (r=0.089, p>0.125) (*Table 13*). Hence, H8 was not supported. There is a no significant relationship between efficiency of last mile delivery with types of goods delivery. Pearson correlation between unpredictability and efficiency of last-mile delivery was found to be negative correlation and statistically non-significant (r=0.089, p<0.125) (*Table 14*). Hence, H9 was not supported. There is a significant relationship between efficiency of last mile delivery with unpredictability time.

***Table 6**. Relationship between customer expectations and efficiency of last mile delivery.*

Relationship between customer expectation and efficiency of last-mile delivery		Customer expectation	Efficiency of last mile delivery
Custimer expectation	Pearson correlation	1	.379**
	Sig. (2-tailed)	-	.000
	N	300	300
Efficiency of last mile delivery	Pearson correlation	.379**	1
	Sig. (2-tailed)	.000	-
	N	300	300

*Notes: ** means correlation is significant at the 0.01 level (2-tailed).*

***Table 7**. Relationship between meeting fulfilment time and efficiency of last-mile delivery.*

Relationship between fulfilment time and efficiency of last-mile delivery		Efficiency of last mile delivery	Meeting fulfilment time
Efficiency of last mile delivery	Pearson correlation	1	.116*
	Sig. (2-tailed)	-	.044
	N	300	300
Meeting fulfilment time	Pearson correlation	.116*	1
	Sig. (2-tailed)	.044	-
	N	300	300

*Notes: * means correlation is significant at the 0.05 level (2-tailed).*

***Table 8**. Relationship between delivery density and efficiency of last-mile delivery.*

Relationship between delivery density and efficiency of	Efficiency of last	Delivery density

last-mile delivery		mile delivery	
Efficiency of last mile delivery	Pearson correlation	1	.214**
	Sig. (2-tailed)	-	.000
	N	300	300
Delivery density	Pearson correlation	.214**	1
	Sig. (2-tailed)	.000	-
	N	300	300

*Notes: ** means correlation is significant at the 0.01 level (2-tailed).*

***Table 9**. Relationship between issues from customer side and efficiency of last-mile delivery.*

Relationship between issues from customer side and efficiency of last-mile delivery		Efficiency of last mile delivery	Issues from customer
Efficiency of last mile delivery	Pearson correlation	1	.720**
	Sig. (2-tailed)	-	.000
	N	300	300
Issues from custiomer	Pearson correlation	.720**	1
	Sig. (2-tailed)	.000	-
	N	300	300

*Notes: ** means correlation is significant at the 0.01 level (2-tailed).*

***Table 10**. Relationship between achieving routing efficiency and efficiency of last-mile delivery.*

Relationship between achieving routing efficiency and efficiency of last-mile delivery		Efficiency of last mile delivery	Achieving routing efficienmcy
Efficiency of last mile delivery	Pearson correlation	1	.716**
	Sig. (2-tailed)	-	.000
	N	300	300
Achieving routing efficiency	Pearson correlation	.716**	1
	Sig. (2-tailed)	.000	-
	N	300	300

*Notes: ** means correlation is significant at the 0.01 level (2-tailed).*

***Table 11**. Relationship between infrastructure and efficiency of last-mile delivery.*

Relationship between infrastructure and efficiency of last-mile delivery		Efficiency of last mile delivery	Infrastructure
Efficiency of last mile delivery	Pearson correlation	1	.458**
	Sig. (2-tailed)	-	.000
	N	300	300
Infrastructure	Pearson correlation	.458**	1
	Sig. (2-tailed)	.000	-
	N	300	300

*Notes: ** means correlation is significant at the 0.01 level (2-tailed).*

***Table 12**.Relationship between cost of last mile delivery and efficiency of last mile delivery.*

Relationship between cost of last mile delivery and efficiency of last-mile delivery		Efficiency of last mile delivery	Cost of last mile delivery
Efficiency of last mile delivery	Pearson correlation	1	.716
	Sig. (2-tailed)	-	.000
	N	300	300
Cost of last mile delivery	Pearson correlation	.716**	1
	Sig. (2-tailed)	.000	-
	N	300	300

*Notes: ** means correlation is significant at the 0.01 level (2-tailed).*

***Table 13**. Relationship between types of goods and efficiency of last mile delivery.*

Relationship between types of goods and efficiency of last-mile delivery		Efficiency of last mile delivery	Tyes of goods
Efficiency of last mile delivery	Pearson correlation	1	.089
	Sig. (2-tailed)	-	.125
	N	300	300
Types of goods	Pearson correlation	.089	1
	Sig. (2-tailed)	.125	-

	N	300	300

Table 14. *Relationship between unpredictability timr and efficiency of last mile delivery*.

Relationship between unpredictability time and efficiency of last-mile delivery		Efficiency of last mile delivery	Unpredictability
Efficiency of last mile delivery	Pearson correlation	1	.089
	Sig. (2-tailed)	-	.125
	N	300	300
Unpredictability	Pearson correlation	.089	1
	Sig. (2-tailed)	.125	-
	N	300	300

Multiple linear regression analysis

Salodo Official Portal (2022) states the variance inflation factor identifies regression multicollinearity (VIF). Multicollinearity arises when a model correlates with predictors (independent variables) and the dependent variable affects regression. VIF measures how much model multicollinearity inflates regression coefficient variance. One is not associated, 1 to 5 is moderately, and greater than 5 is significantly linked. Multicollinearity (*Table 15*) shows predictor tolerance levels above 0.1 and VIF values below 10. Multicollinearity is moderately correlated.

Table 15. *Multicollinearity table.*

Collinearity statistics	Tolerance	VIF
Customer expectation	0.417	2.398
Meeting fulfilment time	0.382	2.619
Deivery density	0.353	2.831
Issues from customer side	0.568	1.761
Infrastructure	0.317	3.157
Cost of last mile delivery	0.516	1.936
Unpredictability	0.408	2.448

Table 16 indicates an R-value of .82, indicating a strong association between seven independent factors and the dependent variable. R2=.67. Taken as a set, customer expectation, meeting fulfilment time, delivery density, customer concerns, cost of last mile delivery, meeting fulfilment time, and infrastructure account for 66% of the variation in affecting last mile delivery efficiency. This model explains 66% of the last mile delivery efficiency difference across logistics service providers. 34% of final mile delivery efficiency factors are unknown. The regression model's R square score is 0.672 and is highly significant (*Table 17*).

Table 16. *Model summary*[b].

Model	R	R square	Adjusted R square	Std. Error of the estimate
1	.820[a]	.672	.664	.40634

Notes: a. Predictors: (Constant), Unpredictability; Cost of last mile delivery; Customer expectation; Issues from customer; Meeting fulfillment time; Delivery density; Infrastructure.

Table 17. *ANOVA table.*

Model		Sum of squares	dF	Mean square	F	Sig.
1	Regression	98.794	7	14.113	85.477	.000[b]
	Residual	48.213	292	.165	-	-
	Total	147.007	299	-	-	-

Notes: a. Dependent variable: Efficiency of last mile delivery; b. Predictors: (Constant); Unpredictability; Cost of last mile delivery; Customer expectation; Issues from customer; Meeting fulfilment time; Delivery density; Infrastructure.

F =85.477 p < .000, R2 = .66

The regression analysis's coefficient values are analyzed to determine which of the independent variables are strongly related to the dependent variable. According to *Table 18*, three factors impact the dependent variable. Customer expectations (p.000), customer problems (p.000), and last mile delivery cost (p.000) are significant predictors. Three of nine variables for last mile delivery efficiency indicate significant variances. Last mile delivery efficiency is affected by customer expectations, difficulties, and cost. Three factors explained 66% of variations. However, other variables which is meeting fulfillment time is not sinigicant where it was score (p.288), delivery density also not significant with the (p.079), thridly, infrastructure also not significant where its score (p.018) and lastly unpredictability transit time scored (p.253).

***Table 18**. Coefficient[a] table.*

Model	Unstanderdized coefficient		Standardized coefficient	t	Sig.	95% confidence interval for B		Collinearity statistics	
	B	Std. Error	Beta			Lower bound	Upper bound	Tolerance	VIF
Constant	.226	.202	-	1.115	.266	-.173	.624	-	-
Customer expectation	.211	.045	.246	4.742	.000	.123	.299	.417	2.398
Meeting fulfilment time	-.075	.071	-.058	-1.064	.288	-.215	.064	.382	2.619
Delivery density	.130	.074	.099	1.763	.079	-.01	.276	.353	2.831
Issues from customer	.469	.052	.403	9.065	.000	.367	.571	.568	1.761
Infrasrructure	-.154	.065	-.141	-2.373	.018	-.282	-.026	.317	3.157
Cost of last mile delivery	.454	.044	.481	10.308	.000	.367	.541	.516	1.936
Unpredictability transit	-.080	.069	-.060	-1.146	.253	-.216	.057	.408	2.448

Notes: a. Dependent variable: Efficiency of last mile delivery.

$$\hat{y} = 0.22 + 0.211\ (Customer\ Expectation) + 0.469\ (Issues\ from\ customer\ side) + 0.454\ (Cost\ of\ last\ mile\ delivery) + \varepsilon$$

The largest beta coefficient is found in issues from customers side factors (β=0.469) and followed by the cost of last mile delivery factor (β=0.469) and third is the customer expectation factor (β=0.211). It shows that, out of three predictors, an issue from customer side factor seems the stronger influence in the efficiency of last mile delivery. In this research, there are nine objectives that have been proposed to investigate the factors that influence efficiency of last mile delivery of logistics service providers in Malaysia during post-covid 19 (*Table 19*). The results of the analysis of the data demonstrate that there is a substantial link between cost of delivery, infrastructure, issues from customer and achieving routing efficiency which influences the efficiency of last-mile delivery service performed by logistics service providers namely Pos Malaysia, J&T, GDEX, Ninjavan, Shopee Express in Malaysia. Based on the results of the regression analysis, issues from customer side factor seems the stronger influence in the efficiency of last mile delivery during the post covid era, followed by cost of last mile delivery and then by customer expectation.

Table 19. *Hypothesis resut.*

Hypothesis	Result
$H_0$1: There is no relationship between customer experience with the efficiency of last mile delivery	Rejected
H_a1: There is a relationship between customer experience with the efficiency of last mile delivery (D)	
$H_0$2: There is no relationship between customer cost of delivery with efficiency of last mile delivery	Accepted
H_a2: There is a relationship between customer cost of delivery with efficiency of last mile delivery	
$H_0$3: There is no relationship between fulfilment timeliness with the efficiency of last mile delivery	Rejected
H_a3: There is no relationship between fulfilment timeliness with the efficiency of last mile delivery	
$H_0$4: There is no relationship between types of goods with efficiency of last mile delivery	Rejected
H_a4: There is a relationship between types of goods with efficiency of last mile delivery	
$H_0$5: There is no relationship between infrastructures with efficiency of last mile delivery	Accepted
H_a5: There is a relationship between infrastructures with efficiency of last mile delivery	
$H_0$6: There is no relationship between customer issues with efficiency of last mile delivery	Accepted
H_a6: There is a relationship between customer issues with efficiency of last mile delivery	
$H_0$7: There is no relationship between delivery density with efficiency of last mile delivery	Rejected
H_a7: There is a relationship between delivery density with efficiency of last mile delivery	
$H_0$8: There is no relationship between achieving routing efficiency with efficiency of last mile delivery	Accepted
H_a8: There is a relationship between achieving routing efficiency with efficiency of last mile delivery	
$H_0$9: There is no relationship between unpredictability transit with efficiency of last mile delivery	Rejected
H_a9: There is a relationship between unpredictability transit with efficiency of last mile delivery	

Conclusion

In conclusion, the primary emphasis of this research was on the efficiency of last-mile delivery service that was offered by Malaysian logistics service providers during the post-covid era. Hence, the researchers have found a relationship on logistics service providers' service on efficiency of last mile delivery. It was clear that the issues from the customer side were the most influential factor affecting the efficiency of last mile delivery, followed by cost of last mile delivery and then by customer expectation. As a result, other researchers can utilize this information and data to do further study on the matter related to efficiency of last mile delivery among logistics service providers in Malaysia since the studies on this particular matter are yet to be studied vigorously compared to the topics studied related to customers perceptions on last mile delivery by logistics service providers. Therefore, based on this research logistics service providers in Malaysia specifically involved in Shopee delivery may utilize this research to improvise their delivery service which in return will be a win-win situation for both parties which includes the LSPs and as well the end-customer. Thus, based on the variable mentioned, it helps to enhance the process while also resolving various pain points for the last mile delivery logistics service providers and the end-customer.

Based from the analysis and findings, it is clear enough that issues from the customer side were the most and primary factor which affected the efficiency of last mile delivery among logistics service providers in Malaysia especially involved in Shopee delivery. Issues from customers are as such posting negatively about the delivery service on social media, unavailability of customer when performing delivery to their home or customer providing invalid/improper address which caused the last mile delivery process to be disrupted and leads to high delivery cost which has to be bear by the logistics service providers. By placing this issue in mind, the researchers recommend the logistics service providers to leverage on technologies and innovation to detect and hide any unwanted/negative statements given by customers about the LSPs services. Further through technologies which provides real time information will enable LSPs to detect whether the provided address by customer is valid or not hence, will make sure the customer to rechange into proper address.

Another recommendation would be reducing the delivery cost. This can be done by practicing planning the delivery process properly would be the most efficient way of

reducing cost and as well reduce time and energy. Time is money, which means every minute wasted will have an adverse cost to be borne by the LSPs; therefore, faster delivery will have lower cost. Proper planning in terms of stacking on customers parcels one night before shipment which results in quicker parcels leaving the warehouse and delivering the parcels on the right place at the right time and to the right customer will reduce time and cost in terms of fuel and overtime for staff. Meanwhile, LSPs need to ensure once the parcels are out from the warehouse, the routing planning should be efficient as well. If route planning is not done in advance for sure this will result in an increase of fuel cost and possibilities of delayed/incomplete parcel deliveries. Hence, LSPs should partner with professional route and mapping professionals to ease the case of improper route planning issues.

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Conflict of interest

The authors confirmed there is no conflict of interest with any parties or organizations involved in this research study.

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