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Smart Logistic Adoption Towards Logistic Performance

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Abstract

In this research, there are three aspect of smart logistic adoption that influence the logistic performance. The aspects are accessibility, reliability, and interoperability of smart logistic system. Technology Acceptance Model (TAM) was used as the framework in assisting the researcher by explaining and forecasting the technology users' behavior. A survey was conducted to 111 respondents who works in an international logistics company located in southern part of West Malaysia. The research sampling design was the convenience sampling due to factor that employee such as delivery men are mobile and at different locations. With that, data was analyzed and interpreted in descriptive analysis to visualize the information gathered. In the end, the result of relationship between aspect of smart logistic adoption and logistic performance are obtained, where accessibility and interoperability of smart logistics have significant relationship with the logistics performance.

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***Keywords*:** Accessibility, Reliability, Interoperability, Smart Logistics, Logistics Performance

1. Introduction

Logistic management firstly began from British Army, they use it to transport and keep their military needs such as troops and weapons during first world war. In 1964, U.S. public starts to implement logistic management in their business and practice it until now. Evolution of logistic is continuously grows as the demand towards logistic is increase. Previously, most of our shipment can only deliver local and inefficiency. Logistic service providers and customers also difficult to track their shipments. Industry's traditional shipping methods such as partial truck load (PTL), truck load (TL), and less-than-truckload (LTL) may cause shipping fee increases and delay of shipment.

In 2020, the demand towards logistic service increase gradually and it had stimulated the evolution of logistic. According to Kaur (2021), Tasco Berhad, a logistic solution company reported their annual profit in year 2021 had hit all new time which is RM41.27mil during pandemic of COVID-19. This is because efficient logistic service to fulfil order become one of the competitive advantages in e-commerce activity during COVID-19 outbreak as people forced to stay home. Due to increase of consumer demand, the importance of information flows in supply chain become significant.However, every country had forced to lockdown during COVID-19 outbreak peak period to prevent the infection of the virus so this action had brings huge impact to logistic industry. The number of shipments to a certain country had limited and many restrictions are set by inbound and outbound country government. The activities of logistic become less and its significant affect the production of manufacturing industry. The interconnecting of logistic system had proven its significant as customers or any parties within the supply chain can check the availability of goods or service through a tracking system. Today, logistic plays a significant role in most of the industry. It is significant to a business or manufacturer as it can optimize the production and profitability. According to Fugate et. al. (2010) better logistic

performance can also offer lower costs, higher customer satisfaction, better supplier relationship, and greater industry reputation.

With that, the concept of smart logistic have been introduced as a solution. The concept of smart logistic is combining the Internet of Things (IoT) and other technology within logistic service to optimize the logistic operation and visualize the information from the supply chain.

2. Literature Review

The examination of the past research literature provides an understanding of the factors affecting adoption of smart logistics in logistics, an understanding of how the accessibility, reliability and interoperability of smart logistics adoption does impact on the effects logistics company performance. Hence, the factors affecting the adoption of smart logistics in logistics company has been discussed.

2.1 Smart Logistic

The word smart logistics is the combination of words 'smart' and 'logistics'. The literal meaning of smart is wise or clever (Dembińska, 2018). It also can be defined as intelligent which is best to describe a high technology product or service. Meanwhile, the word logistics can be defined as the combination of process to acquire, stored, and moved the goods to their destination (Kenton, 2022). According to Wong and Tang (2018), logistics is a way of transporting commodities from producers to consumers, it is the backbone of trade. Logistics is beyond the act of moving the items from one location to another. Bhasin (2021) highlights that main activities of logistics include order processing, materials handling, warehousing, inventory control, transportation, and packaging. Hence, logistic plays important role in every business.

From the separate definitions of smart and logistics, the concept of smart logistic is based on the modern advanced information and communication technology (ICT). It is a contemporary integrated logistics system that are developed intelligently by processing and analyzing information from all parts of logistics in real time (Song et.al , 2021). Ding (2020) mentioned that there are several types of smart logistic available in practice, such as autonomous logistic, smart freight, intelligent transportation system, and customer-oriented intelligent logistic. The expansion of smart logistics types is drawn to the benefits it gets. One of the benefits in using smart logistics is the resiliency of supply chain. This is supported by Kruysen (2020) where by having automated processes are greater resilience to logistics infrastructure will be earned. as the pandemic has proven the needs for supply chain resilience.

2.2 Aspect of Smart Logistic

2.2.1 Accessibility of smart logistic

According to Soegaard (2021), the idea of accessibility refers to whether a product or service is available to everyone. In relation to that, accessible with the presence of technology as in technology that persons with a wide variety of functional abilities can employ successfully. When the technology is high in accessibility, users may interact with the most efficient ways for themselves to carried out the tasks. Greco (2018) mentioned that the initial call for accessibility in contemporary thinking and society may be traced back to the same ferocious argument about human dignity, equality, autonomy, and participation that raged in the opening decades of the twentieth century, between the conclusion of World War 1 and the start of World War 2.

Expand along time, Campoverde-Molina et.al (2020) talked about online accessibility where they referred it as the web design and development that makes it possible for individuals to see, comprehend, navigate, and engage with the presence of Internet. With the incorporation of internet, the accessibility aspects have expanded into mobile system, which it makes the logistics more feasible as it enables the company to have real time tracking ability with greater accuracy, and when paired with digital maps, providing visual access in the context of a map. It can be explained "accessibility of smart logistic" is the ability for any individual to understand and access the high intelligent logistic system.

H1: There is a significant relationship between accessibility of smart logistic adoption and the logistic performance

2.2.2 Reliability of smart logistic

According to Gillespie (2015) reliability is the chance that a component or system will perform its intended function without error for a certain amount of time under specified operating circumstances. It also can be understood as the chance of a system to complete a designed or intended task within a given time and particular environment (Golnas , 2013). With such definitions, Tatum (2022) accentuate the term into delivery reliability (DR) that refers to a measurement that determines the number of shipments suffer in any type of errors where the shipment starts deliver from origin to its destination in a particular time.

System reliability basically has three arrangements which series system, parallel system, and combined system According to Menčík (2016), series system states that a failure of any part in the system can cause the failure of the entire system. While parallel system states that a failure of any part in the system will not affect the operation of the entire system. Combined system is the combination of series system and parallel system. According to Li and Yi (2014), reliability is the main aspect of logistics service quality that a logistician perceives, and it has a direct impact on the core service benefit of that logistics organization. Hence, reliability in smart logistic can be explained as the probability that error occurs while using high intelligent logistic system.

H2: There is a significant relationship between reliability of smart logistic adoption and the logistic performance

2.2.3 Interoperability of smart logistic

The capacity of separate logistics and supply networks to conduct operations and business with one another in order is known as interoperability Pan et.al (2021). This is to utilize the capability of other networks or to execute activities for others. Santiago et.al (2019) said that through interoperability, an organization's competitive advantage will be driven significantly. The competitive advantage can come in the aspects of cost reduction, response time improvement and broader scope of operations opportunities. It is typically desired in the field of information systems, but its principles have been observed to be applicable to logistics.

According to Hofmann and Rüsch (2017), logistic and supply chain management have a strong emphasis on improving digital interoperability. The main factor is the shift of trends towards logistic system digitalization and data-driven transformation. This is due to the factor of showing the capability to communicate with among the providers efficiently and effectively (Pan et.al (2021). Aside from communication, SSantiago et.al (2019) highlights that this interoperability factor creates interconnection links between processes, information flows, equipment, and systems from different parties. It is considered accomplished if efficient cooperation is carried out at least in the levels of business technologies,

knowledge, information, and communication technologies, as well as considering the semantic factors that supplement the preceding three. As in an example, inventory system which is distributed and interconnected has ability to decrease 35% of total logistic costs. These logistic costs include shipping, inventory cost, and shortage (Yang et al., 2017). Santiago et.al (2019) also emphasis that in order to fully optimize its potential, interoperability in logistics should focus on four basic areas: command and control, information management, transport systems, equipment, and logistics support services. With that, an interoperable system can increase efficiency by reducing logistical expenditure on processes that do not need it such as multi-modal solutions as it provides a centralised command structure among parties involved.

H2: There is a significant relationship between interoperability of smart logistic adoption and the logistic performance

2.3 Logistic performance

According to Brumbrach (1988), performance signifies behaviour and results. The act comes from the doer and translates the performance from abstraction to action. Performance may also be simply described as the achievement of quantifiable goals. In logistics perspective, the aspects that used to measure logistic performance are shipping time, order accuracy, picking accuracy, delivery time, picking and packaging time, equipment utilization rate, transportation cost, warehousing costs, picking, and packaging costs, use of packaging material, number of shipments, inventory accuracy, inventory turnover, and inventory to sales ratio (Chow et.al, 1994). Besides the common performance criteria, Logistics Performance Index (LPI) is normally used to evaluate logistic performance.

3. Methodology and Analysis

This research uses quantitative research design specifically exploratory research. Questionnaires are distributed to the employees in a few branches of international logistics company located in the Southern part of West Malaysia. The research closely examined adoption of smart logistics on the logistics performance.

4. Data Analysis

4.1 Descriptive analysis

Data were collected from 111 respondents. Age, education level, job position are all personal information considered in this study. The age range of the responders is between 18 and 50 years old. 52.3% of the respondents are in the range of age 20-29 years old, while the respondents in their 50 years and above constitute only the 1.8% of the respondents. As for education level, 71.2% of respondents are degree holders, 20.7% are diploma holders, 4.5% are SPM level and 1.8% are STPM and Masters level respectively. Most respondents are in the floor staff position (75.7%).

4.2 Correlation analysis

The Pearson Correlation test examined the relationship between independent variables (accessibility, reliability and interoperability of smart logistics) and dependent variable (logistics performance). The outcome of the correlations is summarised in Table 1.

Table 1: Correlations

	Accessibility	Reliability	Interoperability	Adoption of Smart

					Logistics
Accessibility	Pearson Correlation	1	.669**	.656**	.705**
	Sig. (2-tailed)		<.001	<.001	<.001
Reliability	Pearson Correlation	.669**	1	.726**	.640**
	Sig. (2-tailed)	<.001		<.001	<.001
Interoperability	Pearson Correlation	.656**	.726**	1	.687**
	Sig. (2-tailed)	<.001	<.001		<.001
Adoption of Smart Logistics	Pearson Correlation	.705**	.640**	.687**	1
	Sig. (2-tailed)	<.001	<.001	<.001	

As shown in Table 1, all variables are significantly linked to the logistics performance. As a result, it indicated that accessibility has the highest correlation value with 0.705 which is significant at 0.01 level (2 tailed). Reliability, on the other hand, has the lowest correlation value of 0.640, which is significant at the 0.01 level.

4.3 Multiple Regression analysis

Multiple regression analysis was utilized in this study to investigate at the impacts of independent variables (accessibility, reliability and interoperability) on dependent variable (logistics performance).

Table 2: Model Summary

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate
1	.770[a]	.593	.581	.48077

The results of multiple regression analysis for adoption of smart logistics are summarised in Table 2. The R-square value was .593, indicating that the three independent variables can explain 59.3 percent of the variance in logistics performance. Other variables not examined in the study influenced the remaining 40.7 percent.

4.4 Empirical Results

Table 3 has shown that all proposed determinants are significantly associated with the logistics performances with coefficient estimation of smart logistics accessibility (Beta=0.438; p<0.001), and interoperability (Beta=0.353; p<0.001). The sign of the regression standardized estimate (Beta) represents the positive or negative impact of the predictors on the dependent variable. Therefore, it can be stated that two determinants (accessibility and interoperability) have positive effect on logistics performance. With reference to Table 3, the regression equation is as follows:

Adoption of Smart Logistics Performance = 0.464 + 0.438 (accessibility) + 0.124 (reliability) + 0.353 (interoperability)

Table 3: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	Constant	.464	.303		1.532	.128
	Accessibility	.438	.096	.401	4.557	<.001
	Reliability	.124	.089	.135	1.400	.164
	Interoperability	.353	.103	.326	3.422	<.001

5. Discussion and Research Implications

This study had explained and proven different relationship between aspects of smart logistic and logistic performance. It proven that accessibility and interoperability bring a significant positive relationship towards logistic performance. Accessibility can offer a better understanding and user-friendly of technology operation in their logistic system. It is good for technology with a lower barrier of entry so every user can operate it smoothly and effectively. In other hand, interoperability can offer better flows of information within the supply chain. Visibility of logistic information is significant to stakeholders as they can observe the logistic activities of their orders. However, there is one variable does not show significant positive relationship between aspect of smart logistic and logistic performance. Respondents of study believe that reliability may not bring significant positive relationship between aspect of smart logistic and logistic performance. It explained that reliability is important for logistic performance but is in the term of measurement. For example, better accessibility and interoperability of technology adoption may increase the reliability in logistic performance.

In this study, accessibility shown its importance in technology adoption in logistic system such as smart logistic. It explained that smart logistic was a high complexity system but it will be better if user can understand, learn, and operate it easily. Hence, this study emphasis accessibility of smart logistic to improve logistic performance. As a conclusion, this study can provide some insights of employee perspective towards adoption of smart logistic with logistic performance. Industry can put more effort on the right path to multiple the effect of output and avoid to put wrong effort on less effective aspect when develop strategy to adopt technology in their logistic system.

These results may lead the logistic service providers such as 3PL and 4PL, even manufacturing industry to understand the important aspects of technology adoption in their logistic system. Industry also can refer to the study and point of views from different degree of understanding. The significant positive relationship between variables of smart logistic adoption such as accessibility and interoperability emphasis the growth of technology in logistic industry. Technology users may become significant factors that could influences the most in logistic performance as they cannot easily access to the technology adopted. Technology required to keep improve so they can optimize their facilities for users. Research and development (R&D) in logistic can focus more on creating higher accessibility and interoperability technology as it had demand in DHL to improve their logistic performance. As a conclusion, logistic service industry need to implement a suitable technology in their company so the efficiency and effectiveness of operation can be optimized.

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