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Research Article

Resilient Infrastructure Of Logistics Industry Towards Industrial Revolution 4.0 In Malaysia

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ABSTRACT

Purpose - The aim of this paper is to investigate the readiness level of resilient infrastructure of Malaysia's logistics industry shifting towards Industry Revolution 4.0 adoption as well as influencing factors integrating financial availability, skills development, economics benefits, perceived benefits, and organization vision and strategy.

Methods - The study employed quantitative research to investigate the logistics industry's readiness shifting towards Industry Revolution 4.0 in Malaysia. Simple linear regression analysis was employed to examine factors influencing the readiness. The study surveyed 234 top managerial personnel in a logistics-related organisation who had decision-making authority.

Findings - Financial capital, skill growth, economic benefits, and perceived benefits, as well as organisational vision and strategy have significant influence on the logistics industry's readiness in the direction of Industrial Revolution 4.0 in Malaysia.

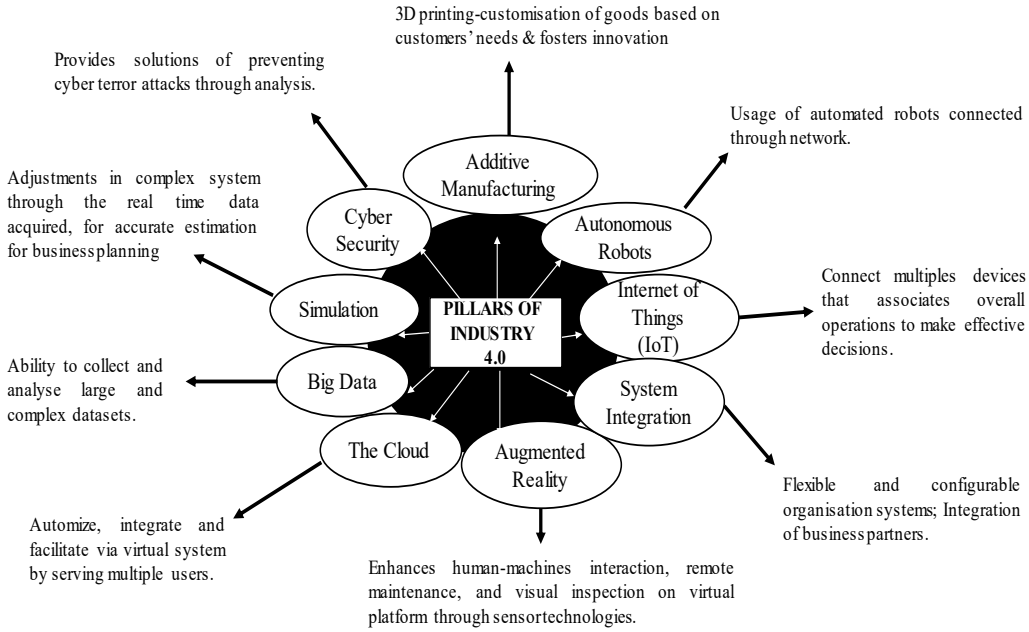
Implications - This study provides essential information about the level of readiness of logistic firms in Malaysia, helping them to recognise areas in their practises that need to be strengthened to effectively introduce Logistic 4.0. Simultaneously, companies in the logistics industry who want to adopt Logistic 4.0 can use the findings of this study to determine their readiness. Managers use this research as a guide to help them make better decisions on what aspects of their operations need to be changed to effectively deploy or maintain the industry.

Originality/value - This study is one of the few that looks at whether Malaysian logistics companies are ready to introduce and maintain the Fourth Industrial Revolution. As a result, this study adds to the limited body of information about Industry 4.0 in the logistics industry.

Keywords: Industrial Revolution 4.0, Logistic, Financial Capital, Skill Growth, Economics, Organisation Vision, Organisation Strategy, Resilient Infrastructure

1. Introduction

The industrial revolution incorporates technological, socioeconomic, and cultural transformation of the manufacturing process. The Industrial Revolution 4.0 (IR4.0) concept, which was introduced at the Hannover Fair in 2011, has piqued the interest of a wide range of people, from academics to government officials. Its intelligent manufacturing concept incorporates a mix of automation and data sharing enabled by technological advancements (Kagermann et al., 2013; Lee et al., 2015; Ibrahim et al., 2015, 2016). The IR4.0 vision is built on nine key pillars that form a solid Industry 4.0 foundation. Figure 1 summarises the characteristics of each pillar.



Adapted from Rubmann *et al.*, (2015).

Figure 1. The Nine Pillars of Industry 4.0 and its Characteristics

Horizontal and vertical integration are two of the most important features of IR4.0. Vertical integration allows for product customization by facilitating flexibility and adaptability across the entire supply chain, while horizontal integration uses networks to smooth out internal operating processes within the business (Lin et al., 2012; Ibrahim et al., 2016, 2020). Manufacturing and logistics systems will be able to track physical processes of the physical world by making smart decisions through real-time communication and cooperation with each person and computer sensors as this revolution matures and establishes (Rolandberger, 2016; Ibrahim et al., 2019, 2021).

1.1 Logistics

The digitalization and convergence is are the main key elements of IR4.0, especially in the logistics industry and also referred to as Logistic 4.0. It necessitates a more robust data-driven product range with improved digital technologies and creativity. Industry 4.0 presents tremendous opportunities and is becoming increasingly important to many sectors, including logistics and transportation, resulting in smart data transformation. There are many logistics organisations and international corporations that have successfully implemented Industry 4.0 in their processes and goods as condensed below in Table 1 (DHL, 2015; Geissbauer et al., 2012; Macaulay et al., 2015; Swisslog, 2021; Szlapka & Lubinski, 2017).

Table 1. Organizations that Benefited from using the Industry 4.0 Technology

Organization	Technology Used	Benefits
Port of Hamburg	IoT and System integration	Drone and roadway sensors -Traffic surveillance with autonomous shipping.
Swisslog	IoT and Smart LIFT	Forklifts fitted sensors - Real time information and inventory accuracy.
DHL Smart Sensor	RFID and IoT	Transportation integrity
Postybell42	IoT and Intelligent transport	Proximity sensors trigger instant alert – Effective communication
Maersk Line	Augmented reality	Remote Container Management System - Real-time information.
Volvo	IoT and The Cloud	Greater flexibility for shipping across the world

Nissan	Autonomous robot	Automated supply chain and efficient manufacturing
Decathlon	IoT and RFID	Tag, track, and trace millions of its products across the globe.
Amazon	IoT and Autonomous robot	Wi-Fi connected Kiva Systems - Robot automation for packaging, order or restocking shelves.

Adapted from: Internet of Business (2019)

However, some organizations are hesitating to take up the Logistic 4.0 to fullest and not ready for the implementation. Based on a survey by Baur and Wee (2015) involving over 300 manufacturing leaders in the world in 2015, only 48% of them are ready for the transformation. This finding indicates that almost half of the leaders are still caught off guard by the transition. Also, when different sizes of producers in developed and developing countries are combined as the entire population, a lower percentage is projected. Similarly, findings from a survey of 1,600 C-level executives from 19 countries conducted in 2018 show that only one-third of the executives are comfortably prepared for the transition (Idris et al., 2021; Ismail et al., 2012). Besides, only 14% of them believe their organisations are prepared for any IR4.0 shifts. These findings reveal that the world is still unprepared for IR4.0 adoption in four major areas such as social effects, policy, talent, workforce, and technology (Deloitte Insight, 2018). Furthermore, taking China as an example, despite being one of the leading developing countries, the leaders are encountering obstacles that are slowing the adoption of IR4.0. These reported obstacles-include lack of manufacturing technology, imperfect standard method of industrialization, lack of expertise, and weak digital infrastructure (Feng et al., 2018; Arsat et al., 2023)

As we enter the fourth wave of technological innovation, the emergence of modern digital industrial technology fuelled by technological advancements, sensors, computers, workpieces, and information technology (IT) systems are all interconnected through the internet. These interconnected cyber-physical systems use standard Internet-based protocols to communicate with one another and analyse data to predict failure, configure themselves, and adjust to changes. Industry 4.0 would allow data to be collected and analysed through computers, allowing for quicker, more versatile, and effective processes that result in higher-quality products at lower costs. As a result, logistics productivity will rise, economics will move, industrial growth will accelerate, and the workforce profile will change, inevitably altering logistic companies' competitiveness (Jazdi, 2014; Shrouf et al., 2014; Stock & Seliger, 2016; Wang et al., 2016).

1.2 Malaysia and Logistics 4.0

Malaysia has aimed to be the preferred logistics entryway to Asia since 2018, and to improve its ranking in the World Bank Logistics Performance Index from the top 25 in 2014 to the top 10 by 2020 (Johan et al., 2019; Kasdi et al (2020 Malaysia Plan (11MP), Malaysia also aims to achieve an increase in annual growth for the transport and storage subsector by 2020, generating an additional 146,000 jobs, mainly high-skilled (Malaysian Ministry of Economic Affairs, 2018). According to the Malaysia Productivity Report (2016), the services sector, which includes warehousing and logistics, continues to be the largest contributor to the country's Gross Domestic Product (GDP), employing the most workers. Strengthening the institutional and regulatory system governing other functions such as off-dock depots, warehousing operations, and commercial vehicle registrations is a top priority since the 11MP was outlined, aiming to unleash growth in logistics and boost trade facilitation (Ministry of Transport Malaysia, 2015).

As a result, high-performing logistics and trade facilitation become equally critical for improving supply chain efficiency and spurring economic growth. According to Li (2014), an integrated supply chain includes all activities involving vendors, producers, distributors, and retailers, with logistics performance in a real-time environment serving as the ultimate player. In parallel, as the carbon footprints on goods traded across borders become mandatory, the logistics industry are urged to plan some drastic changes in the way products are treated, processed, and transported. Together with numerous strong global initiatives on sustainability under way, Malaysia's logistics industry should brace for some dramatic changes, as it may not be long before our exports that do not tally up the correct carbon footprints are not permitted to be traded across borders (Northport, 2014).

The growth of wholesale and logistics trade, which accounted for nearly 18%of Malaysia's GDP in 2014, is currently driving the service sector in Malaysia. Also, the government has set up a dedicated team to promote various logistics to keep Malaysia ahead of the game (NST Business, 2019). Conferring to Star Corporate News (2019a), the Ministry of International Trade and Industry mentioned that National Policy on Industry 4.0 was launched to accelerate digital transformation of Malaysia's manufacturing and logistics services sectors. So far, 300 businesses have completed the online survey. Moving forward, it is important to assess the readiness of Malaysian logistics companies to embrace Industry 4.0. Drone technology has progressed to the point that it can now capture activity from the air. As a result, players in the logistics industry are beginning to use drones as a mode of transportation to expedite shipments. Many start-ups and university researchers are racing to automate this process (Star Corporate News, 2019b).

Nevertheless, Malaysia, as a developing country, is already teetering between Industry 2.0 and Industry 3.0 concepts. Additionally, Malaysia is not a technology-producing country, therefore the transition from evolution 2.0 to 3.0 or 4.0 will take place gradually. Logistic 4.0 is a fairy tale to the developing countries including Malaysia when the nation is ambiguous about an explicit definition for proper understanding and practice in business (Ling et al., 2020). Malaysia’s lack of preparedness was put to the test by lower-cost rivals using

rapidly evolving technologies. As a result, Malaysia has no choice but to accept IR4.0 in the speed of light intending to maintain its global manufacturing competitiveness (MITI, 2018).As a result, this paper aimed to measure Malaysia's logistics industry's readiness for the IR4.0 transition to remain competitive in the global market. In addition, the benefits of IR4.0 was analysed and compared to the perceived benefits of the Malaysian Logistics industry.

2.0 Research Background

This study was further explored in terms of three main areas which are readiness, benefits, and factors:

2.1 Readiness of Logistics Industry

The world is moving at a different speed as it prepares for IR4.0. According to a survey conducted by the University of Warwick in 2017, which included 53 responses from 22 countries, the level of readiness for manufacturing and operations is less than two out of four, suggesting that they are not yet ready to accept IR4.0. The two key principles of the production of IR4.0 are interoperability and consciousness. Self-configuration, self-optimization, self-awareness, decision making, predictive management, real-time roles, customization, flexibility, standardisation, connectivity, and digitalization are sub-concepts of these concepts (Hermann et al., 2016; Qin et al., 2016).

Furthermore, the advancement of technology-enabled manufacturing principles can be divided into three levels of intelligence: (a) power; (b) integration; and (c) intelligence. The power level denotes programmable automation processes; the integration level necessitates collaboration between control systems to exchange useful knowledge ; and the intelligence level denotes big data analysis for decision-making and self-optimization (Shen et al., 2006). As a result, the manufacturing industry is deemed ready for IR4.0 adoption when their manufacturing systems have progressed to the point that they are capable of delivering conscious responses. In terms of skilled labour, capital, and infrastructure, Malaysia outperforms its ASEAN neighbours. Nonetheless, Malaysia's rate of new technology adoption is still low, which has slowed the IR4.0 adoption process. This is supported by MITI's argument that Malaysia is still in the development stage (Ministry of International Trade and Industry, 2018; Tan, 2019).

2.2 The Potential Benefits from Industry 4.0 on Logistics Industries

The first advantage of Logistics 4.0 is that it allows for efficient monitoring and control. Logistics 4.0 introduces contact between humans and machines, as well as parts and products, which can be triggered by sensors mounted in complex machines and devices that are linked in a network. The sensor feedback will be collected as big data, which can be used for equipment tracking, regulation, prediction, planning, and decision-making. The entire process reflects smart factory idea (Iconsortium, 2015; Shafiq et al., 2015; Wang et al., 2016).

Second, Logistics 4.0 encourages cost-cutting. Flexible production methods make use of real-time big data analysis to enhance a company's strategy and operations. Over-processing, which can result in high inventory costs, can be avoided with further planning for the material loading process. In addition, the device would collect data on sales volume and product family to analyse market trends. A successful market analysis and prediction would lead to accurate business planning, which can increase the company's profitability by accurately targeting markets, reducing inventory costs, and lowering unit costs by efficient manufacturing. Otherwise, the business would lose money due to surplus inventory (Carvalho et al., 2012; Schuh et al., 2014).

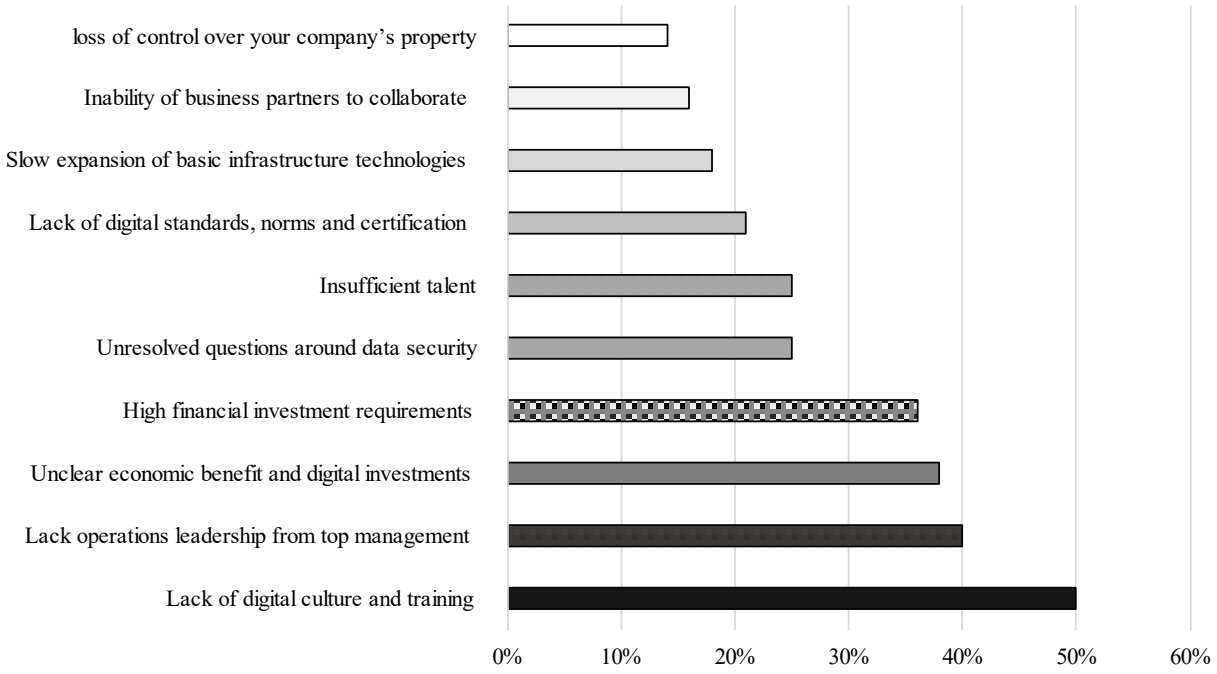
Thirdly, the implementation of IR4.0 encourages the development of business creativity and innovation. The communication between machines and devices offers flexible line, that allow product customisation. Besides that, the additive manufacturing technology allows entity to design together with customers and produce according to customer perceived values. Simulation features in IR4.0 offers an adjustable platform that could help in accurate business prediction, increases the confident level in new business strategy implementation, and fosters innovative creation of ideas. On top of that, as the routine tasks are replaced by machines, the employees can concentrate on innovative and value-addition activities (Brettel et al., 2014; Weller, 2015).

Apart from that, IR4.0 is beneficial to the firms by catalysing many positive business values. Nonetheless, not all the potential benefits are perceived by the real industry of different backgrounds. For example, study involving 2225 companies in Brazil shows that not all the IR4.0 features are positively associated to the expected industrial benefits (Dalenogare et al., 2018). The outcomes explain that Brazil is an emerging country with low average income, therefore lowering price is more significant factor in competitiveness rather than innovativeness (Nakata et al., 2012). Besides that, lack of skilled labours to handle the technology made the big data analysis less perceived by the country (Dalenogare, 2018). Moreover, the high concern about data security at the country has contributed to poor acceptance of the big data concept (Wang, 2016). This shows that not all the benefits are well recognized by the industry with different backgrounds. As such, the benefits driven by the concept of IR4.0 might not be perceived by logistics industry in Malaysia.

2.3 Factors Influencing the Readiness of Industry 4.0

Through the wide range of literature studies, the implementation of IR4.0 would create lots of opportunities. At the same time, the level of adopting IR4.0 is lower than expected. Clearly, challenges exist throughout the revolution process. Research also shows that the process of implementing IR4.0 in developing countries are

different from the developed countries as the adoption of IR4.0 involved the development of advanced technologies that are influenced by many factors (Bogoviz et al., 2019; Kumar et al., 2013). According to the PwC interview reports (2016), there are many challenges that were faced globally in preparing for digital operation capabilities towards IR4.0 as summarised in Figure 2. Among these, the top four were related to digital culture and development, corporate strategy and support, clarity of economic benefits, and financial investment.



Source: Malaysia Productivity Report (2016).

Figure 2. The Challenges Affecting Digital Operations Capabilities

Financial investment is the key resource that contributes to the embracement of IR4.0, as it nurtures the development of IT-infrastructures, technologies development labour culture and skill, that could ease the progress of IR4.0 embracement. Meanwhile, the awareness of the operation vision and support from the top management to adapt the suitable infrastructures, trainings, and new strategical business models are leveraging the readiness of the IR4.0. Moreover, the clarity on the economic benefits would catalyse the readiness of IR4.0 embracement (Muller et al., 2017; Rubmann et al., 2015; Zhou et al., 2015).Malaysia is an emerging country and the logistics industry in Malaysia are mainly multinational companies. Nonetheless, they could experience similar challenges in embracing IR4.0 as reported by PwC and other literature reviews. As such, the factors that contribute to the readiness of IR4.0 could be similar. In the current study, the five main factors influencing readiness of logistics industry in Malaysia shifting towards IR4.0 are as illustrated in Figure 3.

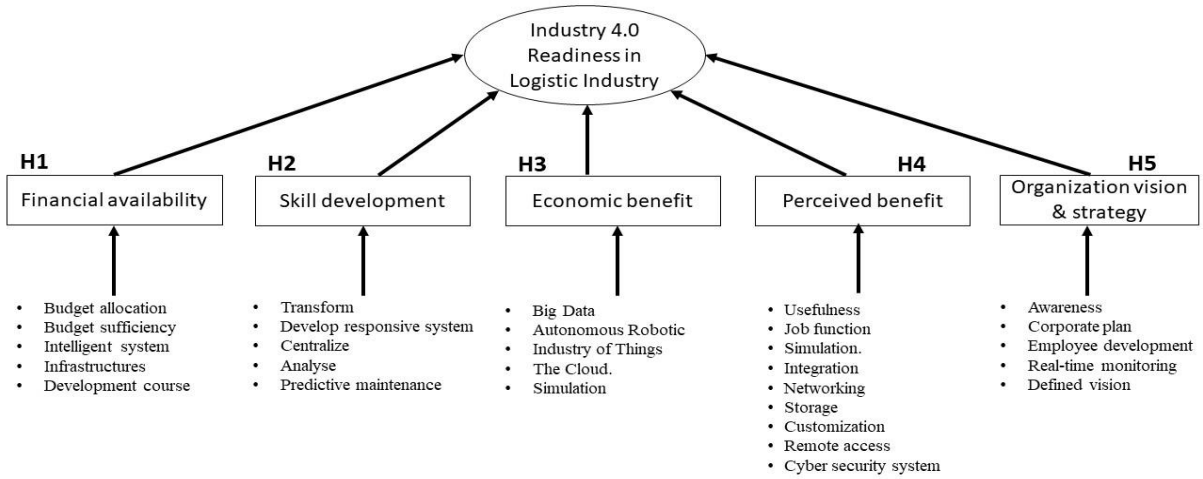


Figure 3. Conceptualization of Factors Influencing Readiness of Logistics Industry in Malaysia Shifting towards IR4.0

2.4 A Review of Supporting Theories

Barney (1991) stated that Resource-Based View (RBV) consist of financial resources (business fund and corporate capital), human resources (experience, knowledge, intelligence, and skill of the individual worker), physical capital resource (firm's plant, technology, and equipment) and organizational asset (firm's planning, structure, and system) that utilized by firms. Most of the firms aim to develop Industry 4.0 but they could not move forward due to lack of financial resources. Industry 4.0 requires some adjustments to the existing installations and new set-up of information technology infrastructures. Developing and introducing the Industry 4.0 technology is very challenging to any firm because it requires large amount of investments in technologies (Jayashree et al., 2019).

One of the important factors leading to the readiness of Industry 4.0 is the skill challenge. According to Racheal (2020), lack of skills in science, technology, engineering, and mathematics (STEM) will cause the employees' poor adaptability to the fast-evolving technology. When Industry 4.0 is adopted worldwide for the workforce training, the employment conditions still need to be inferred in advance. All the labours need to have different set of skills. Perceived benefit on the new technology is where individual willing to accept the new technology. This includes the understanding on its usefulness and ease of application. In line with Industry 4.0 readiness, firm and employee are afraid to use new technology due to the unknown benefit and risk. The IR4.0 allows company to understand human dimension of technology acceptance accurately. This can influence the firm and employee acceptance on Industry 4.0's advanced technology (Ching et al., 2020).

Organization audit should evaluate the employees' performance based on average benchmark related to firm vision and strategy. This analysis should track the company's performance at least three to five years to accurately assess company performance. Such evaluation helps to locate company performance, resources, and capability within these years (Nijssen & Frambach, 2001). Referring to the RBV theory defined by several researchers, RBV theory helps firm to understand their current resources and utilize these strategic resources to create competitive advantage. This included create innovation, adopt advanced technology as well as invest in Research and Development (R&D). IR4.0~~, where~~ requires higher investment in technology, R&D, and expertise to adopt successfully. As a result, RBV theory allows firm to understand their current resources and capacity to innovate. Understanding their status and developing strategies will increase the likelihood of success in adopting Industry 4.0.

3. Methodology

3.1 Research Design and Sampling

With an eye forward to identify the most appropriate key informant, quantitative exploratory research that explores the readiness of the logistics industry in Malaysia on IR4.0 embracement through deductive approach was carried out (Muller et al., 2017). A total of 614 logistics firms engaged with digital transformation in Malaysia was identified through Malaysian Logistics Directory (msialogistics.com) and used as sampling frame. Also, the sampling criteria regarding the level of digital transformation of company was confirmed via phone survey and details of the corresponding employee was obtained together with informed consent. Then, access to the online survey was shared to the respondents. Based on Cochran's (1977) formula, the required sample size was 234. Thus, systematic sampling was carried out to recruit 234 respondents for this survey. The inclusion criteria for selection of respondents was employees with job position of executive level or higher, as they have higher literacy level, and have experience or knowledge related to IR; and are active participants involved in organizational and supply chain oriented decision-making processes.

3.2 Instrumentation

The survey, designed specifically for this study, consisted of
six sections: (a) level of readiness of logistics industry Malaysia towards IR4.0 ; (b) financial availability; (c) skill development; (d) economic benefits; (e) perceived benefits; and (f) organization vision and strategy. All the six sections were measured using symmetric Likert scale ranging from 1 to 7 representing the level of agreement from strongly disagree to strongly agree.

3.3 Validity and Reliability

We examined the appropriateness of the items and the internal structure of the constructs that the instrument measures. For these reasons, an exploratory factor analysis (EFA) was first conducted to evaluate the factor structure of the scale. Second, a reliability analysis was executed to test the reliability of the preliminary questionnaire set.

As shown in Table 2, Kaiser–Meyer–Olkin (KMO) test yielded greater adequacy of 0.87 as a qualitative index of the strength of relationship among variables. Bartlett's test of sphericity reports significant degree of intercorrelation ($p<0.001$). A chi-square test of independence was also conducted to examine possible differences in the distribution by samples. Results show that the distribution is significant, x^2 (233) = 10790, $p<0.001$.

Table 2. Kaiser-Meyer-Olkin (KMO) and Bartlett's Test

		Factors
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.87
Bartlett's Test of Sphericity	Approx. Chi-Square	10789.94
	df	233
	Sig.	.000

EFA results are as shown in Table 3. This analysis involved principal component analysis as the extraction method and varimax with Kaiser normalization as the rotation method to gain a better understanding of the underlying structure of the data and to examine factor loadings of all the items measuring the constructs (Pitt & Jeantrout, 1994). Next, the KMO and Bartlett's Test of Sphericity were executed to determine construct validity and appropriateness of the data collected.

Table 3: Exploratory Factor Analysis of Co-creation

	Components					
	1	2	3	4	5	6
IR4-1	0.86					
IR4-2	0.80					
IR4-3	0.87					
IR4-4	0.86					
IR4-5	0.85					
FA-1		0.83				
FA-2		0.66				
FA-3		0.88				
FA-4		0.88				
FA-5		0.76				
SD-1			0.84			
SD-2			0.86			
SD-3			0.73			
SD-4			0.87			
SD-5			0.83			
EB-1				0.88		
EB-2				0.82		
EB-3				0.84		
EB-4				0.79		
EB-5				0.85		
OVS-1					0.88	
OVS-2					0.84	
OVS-3					0.83	
OVS-4					0.86	
OVS-5					0.91	
PB-1						0.80
PB-2						0.81
PB-3						0.87
PB-4						0.86
PB-5						0.87
PB-6						0.86
PB-7						0.67
PB-8						0.87
PB-9						0.88
% of variance	41.53	12.95	9.38	7.09	4.58	4.47
Eigen Value	12.04	3.76	2.72	2.06	1.33	1.29

Note: FA= Financial Availability, SD= Skills Development, EB= Economics Benefits, PB= Perceived Benefits, OVS= Organization Vision and Strategy, IR4= Industry 4.0 Readiness

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization
Factor Loading values <0.3 were suppressed.
Next, the face validity and content validity of each scale was evaluated to assess the presentation and quality of the survey form. The reliability analysis was conducted to test the internal reliability of the measurement items, based on Cronbach's Alpha value as reported in Table 4. Since all Cronbach's Alpha coefficients for scales were above the satisfactory point of 0.70, the scales are deemed acceptable. According to Nunnally and Berstein (1994), an internal consistency greater than 0.70 is reasonably reliable.

Table 4. Cronbach's Alpha Coefficients of the Measurement Scales

Measurements/ Scales	Total Items	Cronbach's Alpha coefficient
Financial Availability	5	0.85
Skills Development	5	0.85
Economics Benefits	5	0.91
Perceived Benefits	9	0.92
Organization Vision and Strategy	5	0.90
Industry 4.0 Readiness	5	0.89

3.3 Data Collection

The study was administered through a self-administered online questionnaire, where the participants complete their own set of response through electronic networking medium (computer or mobile phone). The online survey concept is popular nowadays specifically during the Covid-19 pandemic due to its accessibility and ease of answering, which is the first reason of selecting this method. Besides that, internet access allows greater geographical coverage, where it can be accessed anyway and anytime if internet is available (Lefever et al., 2007).

4.0 Results

4.1 Respondents' Characteristics

A total of 234 respondents participated in this study. Table 5 shows the socio-demographic characteristics of the respondents. The respondents are almost equally distributed between 18 to 49 years old (90.2%) and mostly were males (69.2%). Majority were at least high school certificate holders (65.4%) with working experience below five years (40.2%).

Table 5. Sociodemographic Characteristic of Respondents (n=234)

Demographic Variable	Frequency	Percentage (%)
Gender		
Male	162	69.20
Female	72	30.80
Total	234	100.00
Age		
18 – 29 years	77	32.90
30 – 39 years	75	32.10
40 - 49 years	59	25.20
50 – 59 years	23	9.80
60 and above	00	0.00
Total	234	100.00
Education Qualification		
Secondary School	5	2.10
High School	153	65.40
Degree	60	25.60
Masters	16	6.80
PhD	00	0.00
Total	234	100.00
Experience		
1 – 5 years	94	40.20
6 – 10 years	58	24.80

11 – 15 years	00	0.00
16 – 20 years	34	14.50
20 – 25 years	24	10.30
26 – 30 years	13	5.60
30 years above	11	4.70
Total	234	100.00
Position		
Executive	73	31.20
Senior Executives	37	15.80
Supervisor	33	14.10
Assistant Manager	21	9.00
Manager	70	29.90
Total	234	100.00

4.2 Correlation Analysis The result in the Table 6 demonstrates that compare others relationship between all variables, there is a strong relationship between organization vision and strategy and financial availability (P = < 0.05; r = 0.828); and lowest relationships between organization vision and strategy and skills development (P = < 0.05; r = 0.155).

Regression Analysis

Simple linear regression analysis was used to determine the relationship between the independent variables: financial availability, skills development, economics benefits, perceived benefits and organization vision and strategy and dependent variables: Industry 4.0 readiness in logistics industry. Thus, the variables with significant value (p-value) less than 0.05, concludes that the hypothesis is significant in the study.

The first hypothesis (H1) stated that financial availability has significant relationship with the Industry 4.0 Readiness in Logistics Industry. A significant regression equation was found ($F=241.53$, $p<0.001$ with $r = 0.714$ and $R^2= 0.510$ with R^2 is over 0.5, which means that over 50% variation in the readiness of logistic industry is caused by predictors financial availability. In addition to that, the t-value is greater than 1.96; and, thus, the attained value falls into the critical region. Industry 4.0 Readiness in Logistics Industry was increased 0.793 by each unit of financial availability.

The second hypothesis (H2) stated that skills development has significant relationship with the Industry 4.0 Readiness in Logistics Industry. A significant regression equation was found ($F=18.00$, $p<0.001$ with $r = 0.268$ and $R^2= 0.072$. Industry 4.0 Readiness in Logistics Industry was increased 0.281 by each unit of skills development. The third hypothesis (H3) stated that economics benefits have significant relationship with the Industry 4.0 Readiness. A significant regression equation was found ($F=19.76$, $p<0.001$ with $r = 0.289$ and $R^2= 0.078$. Industry 4.0 Readiness was increased 0.301 by each unit of economics benefits.

The fourth hypothesis (H4) stated that perceived benefits have significant relationship with the Industry 4.0 Readiness in Logistics Industry. A significant regression equation was found ($F=13.56$, $p<0.001$ with $r = 0.235$ and $R^2= 0.055$. Industry 4.0 Readiness in Logistics Industry was increased 0.269 by each unit of perceived benefits. The fifth hypothesis (H5) stated that organization vision and strategy have significant relationship with the Industry 4.0 Readiness in Logistics Industry. A significant regression equation was found ($F=52.07$, $p<0.001$ with $r = 0.428$ and $R^2= 0.183$. Industry 4.0 Readiness in Logistics Industry was increased 0.468 by each unit of organization vision and strategy. Thus, we can conclude that all hypothesis was supported in this study. Therefore, there is a statistically significant impact of financial availability, skills development, economics benefits, perceived benefits and organization vision and strategy against readiness of logistic industry. The conducted correlation and regression analysis was shown in Table 7 and Table 8 respectively.

Table 6: Correlation between all the variables.

	Financial Availability	**Skills Development**	**Economics Benefits**	**Perceived Benefits**	**Organization Vision**	**Industry 4.0 Readiness**
Financial Availability	1					
Skills Development	0.238**	1				
Economics Benefits	0.440**	0.430**	1			
Perceived Benefits	0.433**	0.327**	0.764**	1		
Organization Vision and Strategy	0.828**	0.155**	0.437**	0.555**	1	
Industry 4.0 Readiness	0.714**	0.268**	0.289**	0.235**	0.428**	1

***. Correlation is significant at the 0.01 level (2-tailed).*

Table 7: Relationship between attributing factors and readiness of IR 4 embracement for Logistics industry in Malaysia

Coefficients						Model Summary				ANOVA	
Model	**B**	**SE**	**Beta**	**t**	**p-value**	**R**	**R²**	**Adjusted R²**	**SE**	**F**	**p-value**
(Constant)	0.653	0.132		4.97	<0.001						
Financial Availability	0.793	0.051	0.714	15.54	<0.001	0.714	0.510	0.508	0.479	241.53	<0.001
(Constant)	1.923	0.174		11.05	<0.001						
Skills Development	0.281	0.066	0.268	4.24	<0.001	0.268	0.072	0.068	0.660	18.00	<0.001
(Constant)	1.795	0.195		9.23	<0.001						
Economics Benefits	0.301	0.068	0.289	4.45	<0.001	0.289	0.078	0.074	0.658	19.76	<0.001
(Constant)	1.851	0.218		8.48	<0.001						
Perceived Benefits	0.269	0.073	0.235	3.68	<0.001	0.235	0.055	0.051	0.666	13.56	<0.001
(Constant)	1.370	0.180		7.60	<0.001						
Vision & Strategy	0.468	0.065	0.428	7.22	<0.001	0.428	0.183	0.180	0.619	52.07	<0.001

Note: B =Unstandardized Coefficients; SE=Standard error, Beta = Standardized Coefficients
a. Dependent Variable: Industry 4.0 Readiness Logistics Industry

DISCUSSION

The main purpose of this study is to investigate the perspective and stages of preparation of the logistics sector in Malaysia towards the industry 4.0.

Financial availability and Industry 4.0 Readiness in Logistics Industry

Our findings revealed that there is a clear link between a firm's financial availability and its readiness for Industry 4.0 in the logistics field. Munir et al. (2019) found that a firm's financial availability and corporate sustainability promote investment in Industry 4.0, which is consistent with our findings. Furthermore, the availability of infrastructure and advanced technical setups, which necessitate financial availability, serve as foundations for the adoption of Industry 4.0 in developed countries, whereas these same factors serve as missing elements in developing countries (Galati and Bigliardi, 2019; Yadav et al., 2020). Several authors have reported a generalized set of Industry 4.0 technologies' investment that smoothens the pathway to sustainability, but the applicability of these enablers is questionable in certain sector. Financial resources are needed to better understand the opportunities that the digital revolution may present for sustainability and to collaborate more closely to ensure that Industry 4.0 delivers the expected sustainability functions as efficiently, fairly, and as quickly as possible around the world (Ghobakhloo, 2020; Moeuf et al., 2018; Tortorella and Fettermann, 2018).

Skills development and Industry 4.0 Readiness in Logistics Industry

The findings show that many businesses that are primarily focused on Industry 4.0 are off to a good start. Specifically, logistics companies are taking notice and investing in developing the necessary skill sets for their employees to meet the demands of industry 4.0. Top management recognises the advantages and benefits of investing in human capital. Logistics companies that invest in industry 4.0 skills to achieve strategic goals, according to Machadoa (2019), benefit from digitalization. Implementation of Industry 4.0 brings about a new working environment. Most of the work traditionally done by the workers will now be done by digitalization efforts in the smart factory (Palazzeschi et al., 2018). Therefore, most of the traditional skills valued by the traditional organizations will be redundant. This will force the workers to acquire new skills of higher order nature (Pinzone et al., 2017). The employee who will adapt to these new job requirements will survive. The requirements of logistics workers will be more with the new age skills like IT and critical thinking (Wolf et al., 2018). A skill for lifelong learning will also be very important for the success of logistics employees. From the results it is evidence that the areas of skill development include skills in IT infrastructure, automation technology, data analytics, data security or communications security, development or application of assistance systems, collaboration software, non-technical skills such as systems thinking or process. In addition to the above skills, there are also importance of creativity and critical thinking skills for problem solving and highlighted necessity to develop these skills during professionals training (Rampasso et al., 2020).

Economics benefits and Industry 4.0 Readiness in Logistics Industry

Industry is aimed to provide the following benefits: standardization in development, higher quality, more flexibility, continuous benchmarking and improvement, global competition among strong businesses, creation of appealing jobs at the intersection of mechanical engineering, automation, and IT, new services and business models (Wong et. al., 2023; Gokalp et al, 2017). This is further confirmed from the findings of a study where a strong relationship between economics benefits and Industry 4.0 readiness in logistics firms was seen. Tang and Veelenturf, (2019) mentioned that depending on the level of maturity, digital technologies play an important role in the transition to a more circular economy which will eventually bring about economic benefit

to firms. If IT is sufficiently mature, it can support the implementation of new business models on a large scale and make economics benefit (Nascimento et. al., 2019).

Perceived benefits and Industry 4.0 Readiness in Logistics Industry

In this study, the effects of industry 40 readiness on the perceived benefits are highly related. These findings are similar with previous studies (Hofmann & Rusch, 2017). Managers' lack of perceived benefits for a digitalized logistics practice will eventually become barriers that obstruct development of Industry 4.0 readiness and their application of technologies (Stentoft et al., 2020). The finding of this study supports the significance of perceived benefits (cost, efficiency of resources and responsiveness towards customer) as key drivers of attitudes toward industry 4.0 readiness. Hence, top management and the employees should be well informed of the benefits of Industry 4.0 and the way they indulge their customers facing. This perceived benefit will enhance the employees' attitude toward the readiness on industry 4.0 in logistics.

Organization vision and strategy and Industry 4.0 Readiness in Logistics Industry

The Organization Vision and Strategy in a firm must address the Industry 4.0 and its needs which measures their readiness for Logistic. A paradigm shifts in production industries, which is characterised by a new level of socio-technical interaction. Small, decentralized networks are acting autonomous and can control themselves in response to different situations. The fast-changing environment presents huge challenges for enterprises, and economies. Management of the enterprises must have a clear view of their companies' preparedness for this fourth industrial revolution for making the appropriate decisions to preserve or improve their competitiveness (Rajnai and Kocsis, 2018). These, so called smart factories are embedded in the intercompany value network, which is encompassed by end-to-end engineering, resulting in seamless convergence of the digital and physical world. The results are smart products that are always uniquely identifiable and locatable during the manufacturing process. Smart products are customizable and the incorporation of individual customer- and product specific features into the design and configuration is enabled - at the costs of mass products.

CONCLUSION

In line with the research objective, this study initially conducted an exhaustive literature review to explore the key facilitators for industry 4.0 readiness among logistics firms, its challenges and benefits. A unique set of 5 variables were identified and its detail items were drawn to measure the importance towards industry 4.0 readiness among logistics firms. A framework linking the 5 independent variables towards the readiness were measured and the outcome were statistically tested and reported. The statistical analysis outcome shows that financial availability and organization's vision and strategy have a greater impact toward the industry 4.0 readiness, which is then followed by economic benefits. However, among the variables, perceived benefit had the lowest influence toward industry 4.0 readiness in logistics. Various researchers (Koberg and Longoni, 2019; Shibin et al., 2018) (Azmi et al., 2018; Tanjung, R. F., 2019; Tsekeris, C.,2019; Ra, S. et al., 2019; Shrestha, U., et al., 2019; Dash, D. et al., 2019) have argued that skills development is paramount for getting ready with industry 4.0 and this seems to be of less importance as compared to other variables especially financial availability. This appears to be more meaningful for the fact that funds to support the skills development needs to be first budgeted prior making commitment to enhance skills development in any given organization. Finally, there is room for future research to investigate these variables in a variety of firms and settings.

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