Journal of Entrepreneurship, Business and Economics
ISSN 2345-4695
2022, 10(2S1), 79–94

ADOPTION AND BENEFIT OF INDUSTRIAL REVOLUTION 4.0 IN LOGISTICS INDUSTRY: A CONCEPTUAL PAPER

Syamaruthadevi Sivan [1], Seyed Mohammadreza Ghadiri [1], Premkumar Rajagopal [1], Atikah Shamsul Bahrin [2], Veera Pandiyan Kaliani Sundram [2]

1 Malaysia University of Science and Technology, Petaling Jaya, Malaysia
2 Faculty of Business and Management, Universiti Teknologi MARA, Selangor, Malaysia
E-mail: veera692@uitm.edu.my

Received June 2022; accepted September 2022

Abstract
The adoption of Industry 4.0 in logistics is a new and critical subject with a need for more research. A few studies have started reviewing the existing works on Industry 4.0; however, they do not focus on its adoption and practices in the logistics sector. This paper presents a conceptual study on Industry 4.0 and its relation to the logistics industry. Current literature on Industry 4.0 in logistics brings out some interesting practices in the adoption of Industry 4.0 in logistics, which will be helpful for the academic and industry, especially top managers. In this paper, some reflections regarding the adequate requirements and issues enabling logistics organizations to be efficient, and fully operational in an industry 4.0 context were discussed. This work identifies several adoption and Industry 4.0 practices in the logistics industry from various selected organizations which are reflected as the highest contributor toward the adoption of a logistics firm in adopting Industry 4.0. Finally, it is evidence that defining a clear organizational vision and strategy is important to help drive logistics business efficiencies which is crucial for future competitive survival.

Research paper

Keywords: Industry 4.0; Logistics; Innovation; Technology; Malaysia

Reference to this paper should be made as follows: Sivan, S., Ghadiri, S. M., Rajagopal, P., Bahrin, A. S., & Sundram, V. P. K. (2022). Adoption and Benefit of Industrial Revolution 4.0 in Logistics Industry: A Conceptual Paper. *Journal of Entrepreneurship, Business and Economics*, *10*(2S1), 79–94.

Copyright © 2013-2022
www.scientificia.com

Introduction

The industrial revolution is the transformation of the manufacturing process involving the features of technological, socioeconomic, and cultural (Stearns, 2020; Sineviciene, 2021). The Industrial Revolution 4.0 (IR 4) was introduced during the Hannover Fair in 2011. It has attracted the attention of different groups of participants, such as the scholars, practitioners, and governmental officers, for its disruptive intelligent manufacturing factories concept, combining the automation and data exchange by the Cyber-Physical System (CPSs), the Internet of Things (IoT), and Cloud Computing (Lee et al., 2015; Kagermann et al., 2013). This was the strategic initiative of the German through the combination of technological development. The key features of IR 4 consist of horizontal integration and vertical integration (Tabim et al., 2021).

Horizontal integration utilizes networks to smoothen the internal operational process within the organization; whereas vertical integration promotes flexibility and adaptability in the manufacturing system across the entire value chain to enable product customization (Lin et al., 2012). For instance, the demand-oriented manufacturing process needs the resources to be well utilized for cost reduction (Evjemo et al., 2014). When IR 4 is matured and established, the manufacturing and logistics systems shall be able to monitor the physical processes of the physical world, making smart decisions through real-time communication and cooperation with each individual, machine sensors, and so on so forth (Berger, 2016).

Background in Logistics Industry

In Malaysia Eleventh Plan, the country aims to be the preferred logistics gateway to Asia and improve its ranking in the World Bank Logistics Performance Index from among the top 25 in 2014 to be among the top 10 by 2020. By 2020, Malaysia aims to achieve annual growth of 8.5% for the transport and storage sub-sector, creating an additional 146,000 jobs, mostly high-skilled in the Eleventh Malaysia Plan (11MP). Efficient and high-performing logistics and trade facilitation are important determinants of a country's competitiveness. The logistics industry is the backbone of the supply chain, and it is recognized as a key to stimulating trade, facilitating business, and spurring economic growth. In cognizance of Malaysia's potential in this industry, Economic Planning Unit (EPU) developed the Logistics and Trade Facilitation Masterplan (Hazwani and Fitri, 2018; Yean, 2018; Intal et al., 2021). The Logistics operations are designed to support the other primary and secondary industry operations regarding the manufacturing, distribution, and customer service (Sundram, Atikah, Hafiz, Azimah, Shahrin, & Thirunavukkarasu, 2017). A robust logistics infrastructure with an advanced IT platform is necessary which relates to Logistics product availability and quick replenishment (Qadeer et al., 2022). Giusti et al., (2019), stated that the ultimate player in this logistics game is logistics efficiency in a real-time environment. The integrated supply chain encompasses all the activities of suppliers, manufacturers, distributors, and retailers.

Under the Eleventh Malaysia Plan (2016-2020), one of the focus areas is unleashing the growth of logistics and enhancing trade facilitation. This will be met through various strategies; among them is the strengthening of the institutional and regulatory framework through the National Logistics Task

Force (NLTF) and regulating other functions such as off-dock depots, warehousing activities, and commercial vehicle registrations. The Eleventh Malaysia Plan emphasizes creating seamless connectivity for people and goods (Malaysia, 2015). Within the logistics industry, the focus will be given to developing integrated logistics and enhancing trade facilitation mechanisms (Sundram, Rajagopal, Atikah, & Subramaniam, 2018). Strategies that will be undertaken include strengthening institutional and regulatory framework, enhancing trade facilitation mechanisms, building freight infrastructure efficiency and capacity, deploying technology in the logistics chain, and strengthening the capabilities of logistics service providers. According to Malaysia Productivity Report, in 2015, the services sector (warehousing and logistics) remained the largest contributor to the country's GDP at 53.5% to RM569 billion. It was also the largest employer with 8.6 million people. The Services sector is expected to grow at 6.8% per annum and contribute 56.5% to the GDP in 2020 and provide 9.3 million jobs (Hazwani and Fitri, 2018; Rahman et al., 2021). The logistics industry is a crucial determinant of Malaysia's competitiveness. Its importance as an enabler and economic multiplier of the nation's trade-dependent and export-oriented economy cannot be over-emphasized (Sundram, Atika, Akmal, & Zarina, 2017).

Research Aims and Objectives

The study aims to identify the adoption of Industrial 4.0 in the logistics industry perspective and the stage of benefit towards Industrial 4.0 in the Logistics Industry among company's operations in Malaysia This research is initiated to explore and understand the level of readiness of the logistics industry in Malaysia towards to IR 4. Moreover, the perceived interest in the

logistics sector in Malaysia will be studied and compared with the potential benefits that could be obtained from the IR 4 embracement.

Adoption of Industry 4.0 in the Logistics Industry

The concept of Industry 4.0 offers enormous opportunities and become becomes more and more significant to many industries. Accordingly, the logistics and transportation industry have no exception to this smart data transformation. Many organizations and multinational companies in the logistics industry had executed the essentials of Industry 4.0 in their processes and production (Yadav, 2020; Stentoft et al., 2021; Yakubu et al., 2022). Table 1 below shows the organizations that are using the industry 4.0 technology in the business and also, the benefit they enjoy.

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

No.	Organization	Technology Used	Benefits
1	Port of Hamburg	Fitted more than 300 roadway sensors to monitor traffic in the port area and to track wear on bridges. Connected cameras, heat detection sensors, and alarm systems.	The main function of the sensors is to identify recurring underused capacity so it can be used properly. Besides the other sensor are used to prevent theft and provide insight for planning security updates.
2	Swisslog's "SmartLIFT" technology.	Forklifts fitted sensors with directional barcodes put on the roof of the warehouse and WMS information.	This technology provides the forklift driver with accurate location and direction information of pallets. It also delivers a dashboard for managers to observe the real-time speed, location, and productivity of all forklift drivers as well as visibility on inventory accuracy.
3	DHL's SmartSensor,	Smart sensor RFID and Smart sensor gsm are based on mobile phone technology.	This intelligent sensor can monitor temperature and humidity, while also indicating shock and light events, to ensure complete integrity during transportation.

No.	Organization	Technology Used	Benefits
4	Postybell42	Postybell42 has created proximity sensors.	The sensor will detect when mail has been placed in a private mailbox and can also monitor the wetness inside the mailbox. A delivery then triggers an alert to the recipient's phone via GSM.
5	Maersk Line	Remote Container Management System.	This system will transmit vital stats, such as temperature, location, and power supply, via satellite. The information is sent to the cloud and analyzed in a central office. As well as offering real-time information as issues develop, it also increased safety for port staff, as containers now require less manual inspection.
6	Volvo	Cloud-based services and IoT technologies support the logistics side of its supply chain.	It is used in ordering components from different countries to shipping vehicles to suppliers across the world. The company told V3 it was using the cloud because these services give them greater flexibility over on-premise setups.
7	Nissan	Robots, machine-learning techniques, and also automated a large part of its supply chain.	It has dramatically made the manufacturing process much more efficient.
8	Decathlon	Track and trace with IoT elements.	It's using IoT technology, such as radio frequency identification (RFID) from Checkpoint Systems, in more than 400 of its stores, and plans to extend its use of RFID tagging to millions of its products across the globe.
9	Amazon	Wi-Fi-connected Kiva Systems	The AI system assesses which products are to be prioritized for Amazon Prime orders, for example, and the robots do the rest. While this takes place, workers can focus on packaging an order or restocking shelves. It is robots and humans working side by side through IoT.

Besides that, based on the report produced by PWC on Industry 4.0: Building the Digital Enterprise Transportation and logistics key findings (2016), it is revealed that globally today, 28% of job functions in this sector have reached digitization and integration level. It is also understood that to enhance their product portfolio with digital functionalities and introduce innovative, data-based services, logistics, and transportation companies are strategically digitizing critical functions within their internal vertical value chain, from procurement through operating activities to customer service, as

well as with their horizontal partners along the supply chain. If the smart logistics vision is to be realized, the critical success element will be a revolution in the traditional logistics remarkably an interconnected upwards and downward system with a highly intelligent, efficient, and responsive logistics ecosystem (Tang & Veelenturf, 2019; Ghobakhloo, 2020; Sundram, Rajagopal, Nur Atiqah, Atikah, & Appasamy, 2018).

Literature Review

Potential Benefits from Industry 4.0 on Logistics Industries

i. Effective Monitoring and Controlling

According to the Industrial Internet Consortium US, IR 4 introduces the communication among human-machine Interaction (HMI), parts, and products, that can be driven by the sensors installed in the complex machinery and devices and are connected to a networking system. The feedback from the sensors will be collected as big data, that could help in equipment monitoring, controlling, predicting, planning, and decision making (Shafiq et al., 2015), (Industrial Internet Consortium). This is also known as the smart factory concept (Wang et al., 2016). For instance, predictive maintenance utilizes the embedded system to trigger maintenance before the machine malfunction; and better resource utilization to reduce material, machine, and time wastage (Dalenogare et al., 2018).

ii. Cost-Effective

Besides, IR 4 introduces a flexible manufacturing process that uses real-time big data analysis to improve the strategy and operation of the business entity (Kagermann et al., 2013; Mohan & Sundram., 2017). For instance,

the system can analyze the amount of work in progress (WIP) for each process step of the manufacturing, to further plan for the material loading to the process, and to avoid over-processing that could generate high inventory costs. Moreover, the information on sales volume and product family will be captured by the system for demand trend analysis, to decide what product family should be manufactured. Good market analysis and prediction contribute to accurate business planning, which could gain the profitability of the company through accurate market targeting, inventory cost-minimizing, and lowering the unit cost through efficient manufacturing (LEAN) (Schuh et al., 2014). Else, the company will experience losses primarily due to excess inventory (Hallie Detrick, 2018).

iii. Encourage Business Innovation

Apart from that, the implementation of IR 4 encourages the development of business creativity and innovation. The communication between machines and devices offers flexible lines, that allow product customization (Brettel et al., 2014; Sundram et al., 2016). Besides, additive manufacturing technology allows an entity to design together with customers, and to produce according to customers' perceived values (Weller, 2015; Dana et al., 2022). Simulation features in IR 4 offers an adjustable platform that could help in accurate business prediction, increases the confidence level in new business strategy implementation, fostering innovative ideas' creation.

On top of that, as the routine tasks are replaced by machines, the employees can concentrate on innovative and value-addition activities (Erol et al., 2016; Mkumbo et al., 2019).

iv. The Potential versus The Perceived

Through literature reviews, IR 4 is beneficial to the firms by catalyzing many positive business values, nonetheless, not all the potential benefits are perceived by the real industry of different backgrounds. For example, a study has been carried out on 2225 companies in Brazil to compare the potential benefits of IR 4 with the perceived requirements of the industry. The result shows that not all the IR 4 features are positively associated with the expected industrial benefits (Dalenogare et al., 2018). The outcomes explain that Brazil is an emerging country with a low average income, therefore lowering the price is a more significant factor in competitiveness rather than innovativeness (Nakata and Weidner, 2012). Besides, the lack of skilled labor to handle the technology made the big data analysis less perceived by the country (Dalenogare et al., 2018). Moreover, the high concern about data security in the country has contributed to the less belief in the big data concept (Wang et al., 2016). The above scenarios, clearly show that not all the benefits are well recognized by the industry with different backgrounds. As such, the benefits driven by the concept of IR 4 might not be perceived by the Logistics industry in Malaysia.

Contribution of study

The outcomes would contribute to the logistics industry in Malaysia along the process of embracing IR 4, which could also be selectively adopted by other related industries. The individual industry could measure their level of preparation, and identify the future development requirements towards IR 4 by using the research gap guideline. Besides, the research finding will gain an understanding of the overall benefits of IR 4 in the Logistic industry, and

also the perceived benefits from the industry in Malaysia, which could help in the corporate strategy planning and government policies implementation, for increasing the business competitiveness in the world, towards a better economy.

The known contributing factors could benefit the government, institutions, and individuals. The study provides knowledge, and standard guidelines that could help these parties to develop in four aspects: social, strategy, talents, and technology, to prepare for IR 4. For example, the government would know how to construct relevant infrastructures that are highly needed in IR 4; individuals would know what needs to be enhanced to cope with the revolutionary change that required different skill sets of knowledge. Lastly, the research contributes to the existing body of knowledge in IR 4 from the Malaysian context, which would benefit not just the logistics sector, but also other industries which are highly challenged.

Future research and limitation

The limitations of the study had been identified where the study only focuses on the adoption and benefit of Industrial 4.0 in the logistics industry and the focus is more in Malaysia where the consideration for other relevant industry and geopolitical elements were not included as part of the study. The future research suggested the potential for the exploration of other industries such as manufacturing, pharmaceutical, agriculture, and others. Besides, the future study can also explore the readiness of our industries in the adoption of Industrial 4.0 and its potential linkage to other internal and external factors which could further improve the adoption and practices of Industrial 4.0 in other neighboring countries of Malaysia.

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 its benefits. A unique set of 5 variables were identified and its detailed items were drawn to measure the importance of industry 4.0 readiness among logistics firms. A framework linking the 5 independent variables toward readiness was measured and the outcome was statistically tested and reported. The statistical analysis outcome shows that financial availability and the organization's vision and strategy have a greater impact on the industry 4.0 readiness, which is then followed by economic benefits. However, among the variables, the perceived benefit had the lowest influence on industry 4.0 readiness in logistics. Various researchers such as Azmi et al. (2018), Tanjung (2019), Tsekeris (2019) Ra et al. (2019), and Dash et al. (2019), have argued that skills development is paramount for getting ready for 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 need to be first budgeted before committing to enhancing skills development in any given organization. Finally, there is room for future research to investigate these variables in a variety of forms and settings.

References

1. Azmi, A. N., Kamin, Y., Noordin, M. K., & Nasir, A. N. M. (2018). Towards industrial revolution 4.0: employers' expectations on fresh engineering graduates. International Journal of Engineering & Technology, 7(4.28), 267-272.
2. Berger, R. (2016). Beyond technologies: Industrie 4.0 means a paradigm shift in companies' manufacturing strategies. [Ebook]. Munich: ROLAND BERGER GMBH. A. Retrieved from http://www.roland_berger_industry_40_20160609.pdf
3. Brettel, M., Friederichsen, N., Keller, M., & Rosenberg, M. (2014). How virtualization, decentralization and network building change the manufacturing landscape: An Industry 4.0 Perspective. International Journal of Information and Communication Engineering, 8(1), 37-44.
4. Dalenogare, L. S., Benitez, G. B., Ayala, N. F., & Frank, A. G. (2018). The expected contribution of Industry 4.0 technologies for industrial performance. International Journal of production economics, 204, 383-394.
5. Dana, L. P., Salamzadeh, A., Mortazavi, S., & Hadizadeh, M. (2022). Investigating the impact of international markets and new digital technologies on business innovation in emerging markets. Sustainability, 14(2), 983.
6. Dana, L. P., Salamzadeh, A., Mortazavi, S., Hadizadeh, M., & Zolfaghari, M. (2022). Strategic futures studies and entrepreneurial resiliency: a focus on digital technology trends and emerging markets. Tec Empresarial, 16(1), 87-100.
7. Dana, L. P., Salamzadeh, A., Hadizadeh, M., Heydari, G., & Shamsoddin, S. (2022). Urban Entrepreneurship and Sustainable Businesses in Smart Cities: Exploring the Role of Digital Technologies. Sustainable Technology and Entrepreneurship, 100016.
8. Dash, D., Farooq, R., Panda, J. S., & Sandhyavani, K. V. (2019). Internet of Things (IoT): The New Paradigm of HRM and Skill Development in the Fourth Industrial Revolution (Industry 4.0). IUP Journal of Information Technology, 15(4), 7-30.
9. Erol, S., Schumacher, A., & Sihn, W. (2016). Strategic guidance towards Industry 4.0–a three-stage process model. International conference on competitive manufacturing, 9(1), 495-501.
10. Evjemo, B., Akselsen, S., Slettemeås, D., Munch-Ellingsen, A., Andersen, A., & Karlsen, R. (2014). "I Expect Smart Services!" User Feedback on NFC Based Services Addressing Everyday Routines. In International Internet of Things Summit, (pp. 118-124). Springer, Cham.
11. Ghobakhloo, M. (2020). Industry 4.0, digitization, and opportunities for sustainability. Journal of cleaner production, 252, 119869.

12. Giusti, R., Manerba, D., Bruno, G., & Tadei, R. (2019). Synchromodal logistics: An overview of critical success factors, enabling technologies, and open research issues. Transportation Research Part E: Logistics and Transportation Review, 129, 92-110.
13. Hallie Detrick, (2018), Lego is Drowing in Bricks, and Its Sales Are Sinking Too, FORTUNE. Available from: http://fortune.com/2018/03/06/lego-bricks-sales-fall-2017/, viewed 9 March 2019.
14. Hazwani, K. N., & Fitri, A. R. N. S. (2018). Warehousing productivity assessment on logistics service sector. Advances in Transportation and Logistics Research, 1, 889-903.
15. Intal Jr, P., Saat, H. H. M., & Setyadi, E. (2021). Trade Facilitation in Malaysia and the Results of the ASTFI Baseline Study1. Towards Seamless Trade Facilitation in ASEAN, 78.
16. Kagermann, H., Helbig, J., Hellinger, A., & Wahlster, W. (2013). Recommendations for implementing the strategic initiative INDUSTRIE 4.0: Securing the future of German manufacturing industry; final report of the Industrie 4.0 Working Group. Forschungsunion.
17. Lee, J., Bagheri, B., & Kao, H. A. (2015). A cyber-physical systems architecture for industry 4.0-based manufacturing systems. Manufacturing Letters, 3, 18-23.
18. Lin, H. W., Nagalingam, S. V., Kuik, S. S., & Murata, T. (2012). Design of a global decision support system for a manufacturing SME: Towards participating in collaborative manufacturing. International Journal of Production Economics, 136(1), 1-12.
19. Malaysia. (2015). Executive Summary Eleventh Malaysia Plan 2016-2020: Anchoring Growth on People. Prime Minister's Department.
20. Mkumbo, F.A.E., Ibrahim, A.R., Salleh, A.L., Sundram V.P.K., & Atikah S.B. (2019) "The Influence of Supply Chain Practices and Performance Measurement Practices towards Firm Performance", International Journal of Supply Chain Management, Vol. 8 (3), 809-819.
21. Mohan K., and Sundram V.P.K., (2017), “Supply Chain Cost Reduction using Mitigation & Resilient Strategies in the Hypermarket Retail Business”, International Journal of Supply Chain Managemant, Vol.6 (2) 116-121
22. Nakata, C., & Weidner, K. (2012). Enhancing new product adoption at the base of the pyramid: A contextualized model. Journal of Product Innovation Management, 29(1), 21-32.
23. Qadeer, N., Shah, J. H., Sharif, M., Khan, M. A., Muhammad, G., & Zhang, Y. D. (2022). Intelligent Tracking of Mechanically Thrown Objects by Industrial Catching Robot for Automated In-Plant Logistics 4.0. Sensors, 22(6), 2113.
24. Ra, S., Shrestha, U., Khatiwada, S., Yoon, S. W., & Kwon, K. (2019). The rise of technology and its impact on skills. International Journal of Training Research, 17(sup1), 26-40.

25. Rahman, N. S. F. A., Karim, N. H., Hanafiah, R. M., Hamid, S. A., & Mohammed, A. (2021). Decision analysis of warehouse productivity performance indicators to enhance logistics operational efficiency. International Journal of Productivity and Performance Management.
26. Schuh, G., Potente, T., Wesch-Potente, C., Weber, A. R., & Prote, J. P. (2014). Collaboration Mechanisms to increase Productivity in the Context of Industrie 4.0. Procedia Corp, 19, 51-56.
27. Shafiq, S. I., Sanin, C., Toro, C., & Szczerbicki, E. (2015). Virtual engineering object (VEO): Toward experience-based design and manufacturing for industry 4.0. Cybernetics and Systems, 46(1-2), 35-50.
28. Sineviciene, L., Hens, L., Kubatko, O., Melnyk, L., Dehtyarova, I., & Fedyna, S. (2021). Socio-economic and cultural effects of disruptive industrial technologies for sustainable development. International Journal of Global Energy Issues, 43(2-3), 284-305.
29. Stearns, P. N. (2020). The industrial revolution in world history. Routledge.
30. Stentoft, J., Adsbøll Wickstrøm, K., Philipsen, K., & Haug, A. (2021). Drivers and barriers for Industry 4.0 readiness and practice: empirical evidence from small and medium-sized manufacturers. Production Planning & Control, 32(10), 811-828.
31. Sundram, V.P.K., Atikah, S.B. and Chandran, V.G.R. (2016), Supply Chain Management: Principles, Measurement and Practice, University of Malaya Press, Kuala Lumpur.
32. Sundram, V.P.K., Atika, S.B., Akmal, A.O. and Zarina, A.M. (2017), "Green supply chain management practices in Malaysia manufacturing industry", International Journal of Supply Chain Management, Vol. 6 No. 2, pp. 89-95.
33. Sundram, V.P.K., Rajagopal, P., Atikah, S.B. and Subramaniam, G. (2018), "The role of supply chain integration on green practices and performance in a supply chain context. a conceptual approach to future research", International Journal of Supply Chain Management, Vol. 7 No. 1, pp. 95-104.
34. Sundram, V.P.K., Rajagopal, P., Nur Atiqah, Z.A., Atikah, S.B. and Appasamy, G. (2018), "Supply chain responsiveness in an Asian global electronic manufacturing firm: ABX energy (M)", International Journal of Supply Chain Management, Vol. 7 No. 2, pp. 23-31.
35. Sundram, V.P.K., Atikah, S.B., Hafiz, M.Z., Azimah, D., Shahrin, N. and Thirunavukkarasu, K. (2017), Supply Chain Logistics: A Malaysian Perspective, Selangor Malaysian Logistics and Supply Chain Association, Petaling Jaya.
36. Tabim, V. M., Ayala, N. F., & Frank, A. G. (2021). Implementing Vertical Integration in the Industry 4.0 Journey: Which Factors Influence the Process of Information Systems Adoption?. Information Systems Frontiers, 1-18.
37. Tang, C. S., & Veelenturf, L. P. (2019). The strategic role of logistics in the industry 4.0 era. Transportation Research Part E: Logistics and Transportation Review, 129, 1-11.

38. Tanjung, R. F. (2019). Answering the Challenge of Industrial Revolution 4.0 Through Improved Skills Use of Technology College. International Journal for Educational and Vocational Studies, 1(1), 11-14.
39. Tsekeris, C. (2019). Surviving and thriving in the Fourth Industrial Revolution: Digital skills for education and society. Homo Virtualis, 2(1), 34-42.
40. Wang, S., Wan, J., Zhang, D., Li, D., & Zhang, C. (2016). Towards smart factory for industry 4.0: a self-organized multi-agent system with big data-based feedback and coordination. Computer networks, 101, 158-168.
41. Weller, C., Kleer, R., & Piller, F. T. (2015). Economic implications of 3D printing: Market structure models in light of additive manufacturing revisited. International Journal of Production Economics, 164, 43-56.
42. Yadav, G., Kumar, A., Luthra, S., Garza-Reyes, J. A., Kumar, V., & Batista, L. (2020). A framework to achieve sustainability in manufacturing organizations of developing economies using industry 4.0 technologies' enablers. Computers in Industry, 122, 103280.
43. Yean, T. S. (2018). FDI Liberalization in Malaysia's Logistics Services. Services Liberalization in ASEAN
44. Yakubu, B. N., Salamzadeh, A., Bouzari, P., Ebrahimi, P., & Fekete-Farkas, M. (2022). Identifying the key factors of sustainable entrepreneurship in the Nigerian food industry: The role of media availability. Entrepreneurial Business and Economics Review, 10(2), 147-162.

Syamaruthadevi Sivan holds a Master's degree in Transport and Logistics from the Malaysia University of Science and Technology. She was awarded the best graduate in the class of 2021 and completed her master's year in Nov 2020 with a Distinction. Syama received a bachelor's degree in Business from Victoria University. Her current field placement is with FedEx Malaysia as a senior customer executive. She is interested in supply chain and Industry 4.0 implementation patterns in logistics sector.

Seyed Mohammadreza Ghadiri has been a Dean School of Transport and Logistics at Malaysia University of Science and Technology since 2017. His research interests involve Transportation, logistics and supply chain. His teaching interests mostly involve courses for Intelligent transportation and planning, Freight forwarding and supply chain, including for example a recently developed "MSc in Road Safety".

Premkumar Rajagopal - Dr. Premkumar is currently the President at Malaysia University of Science and Technology, he also holds the Chair in Logistics and Supply Chain. He obtained his PhD in supply chain from University of Science Malaysia and participated in several high-profile conferences as the

Keynote speaker. In addition to his academic career, Dr Premkumar held several managerial positions in Intel Technology.

Atikah binti Shamsul Bahrin serves as a postgraduate Research Assistant (RA) at Universiti Teknologi MARA Shah Alam, Malaysia. She holds a Bachelor's Degree in Business Management specialized in Finance from Universiti Teknologi MARA Johor, Malaysia and a Master's (MSc) in Business and Management from UiTM Shah Alam, Malaysia. Currently she is furthering her studies toward Doctor of Philosophy (PhD) in Business and Management. Her current research is mainly focus on the area of supply chain management and green practices in the supply chain. Furthermore, her research interest also include the manufacturing industries especially in logistics and transportation sectors. In addition, due to her interest in research, she is able to pursue further knowledge and involvement in publishing books and journal articles.

Veera Pandiyan Kaliani Sundram is accomplished, dynamic, professional trainer and Certified Supply Chain Manager at International Purchasing and Supply Chain Management Institute. He holds a Doctorate degree in supply chain management from the University of Malaya, an MBA degree and Bachelor's degree in analytical economics. He is also chartered member from the Chartered Institute of Logistics and Transport, UK, and Certified Purchasing Professional from American Purchasing Society. Currently, he serves as Professor for Operations Management and Supply Chain at Universiti Teknologi MARA. His passion toward research enabled him to publish books and research articles in different journals of national and international repute, mainly in the area of logistics and supply chain.