Relationship of Big Data-Driven Supply Chain Capabilities and Competitive Advantages

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ABSTRACT

As technology in supply chain advanced, a large amount of big data has been generated and companies employ big data can gain competitive advantages through their supply chain capabilities. However, companies are lack of knowledge regarding big data and its management methods in the early phase of big data adoption. The objectives of this research are to identify the relationship of big data-driven supply chain towards supply chain capabilities and the relationship of supply chain capabilities towards competitive advantages. This research surveys the managers of manufacturing companies in Selangor. By using convenience sampling techniques, 162 online questionnaires were distributed. A total of 123 questionnaires were collected. The 5-point likert scale is adopted to evaluate the agreement level and descriptive analysis employed in the research. This research also uses the quantitative method to collect and analyse the data. IBM Statistical Package for Social Sciences (SPSS) software is adopted to analyse the data. The findings indicated that big data-driven supply chain have a positive and significant relationship with supply chain capabilities. Moreover, supply chain capabilities also have a positive and significant relationship with competitive advantages. All hypotheses in this research are significant and accepted. Therefore, manufacturing companies can find the best methods to facilitate competitive advantages by using big data-driven supply chain capabilities.

Keywords: Big data, Supply chain capabilities, Competitive advantages

INTRODUCTION

Industry 4.0 technologies are one of the industrial revolutions. The evolution of the Industrial Revolution began from industry 1.0 to industry 4.0 (Ghobakhloo, 2018). Industrial 4.0 technologies can be defined as the technologies which can intelligently connect machines, information and communication technology (ICT) systems, objects and people. This means that the value of an industry in the future is created in real-time capable, connected, digitised, intelligent as well as autonomous industry and production networks. Hence, industry 4.0 technologies may contribute to the industry to stay competitive with other rivals. Industry 4.0 technologies could also bring a wide range of opportunity of the industry-spanning, such as enhance in flexibility, efficiency and quality (Muller, Buliga, & Voigt, 2018). Industry 4.0 technologies can be clustered into nine categories. For instance, cloud computing, big data, cybersecurity, horizontal and vertical integration, robotics, augmented reality, additive manufacturing (3D printing), simulation as well as the internet of things (IoT) (Gokalp, Sener, & Eren, 2017).

As the development of technology, a large amount of multidimensional data has been generated and it surpassed the traditional information technology. Hence, companies use big data in the practices of supply chain management to improve decision-making as well as information flows (Ramanathan, Philpott, Duan, & Cao, 2017). By using the big data, the current operating models of the company could be affected, and the company may gain sustainable competitive advantages (Roden, Nucciarelli, Li, & Graham, 2017; Matthias, Fouweather, Gregory, & Vernon, 2017). From the perspective of the business process, big data can help companies to enhance the quality of decision-making but this usually non-linear process varies with a large number of data sources (Janssen, Voort, & Wahyudi, 2017). By using the big data, communication and

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information technologies allow information easy to access and enhanced analytic capabilities to yield new perspectives that can change the supply chain, such as reconfiguring the process of supply chain (Nudurupati, Tebboune, & Hardman, 2015; MacCarthy, Blome, Olhager, Srai, & Zhao, 2016).

Besides that, companies employ the big data properly may revolutionise their performance of its supply chain capabilities (Fosso Wamba, Akter, Edwards, Chopin, & Gnanzou, 2015). For example, supply chain managers proper use of big data to enter the system can provide useful insights to improve the supply chain capabilities and competitive (Yu, Chavez, Jacobs, & Feng, 2018). Supply chain capabilities are the capability of an organisation that utilises both external and internal resources to enhance the activities throughout the supply chain (Yeniyurt, Wu, Kim, & Cavusgil, 2019). Supply chain capabilities can be clustered into four dimensions, such as interfirm coordination, supply chain responsiveness, information exchange and activity integration (Chavez, Yu, Jacobs, & Feng, 2017). Supply chain capabilities can facilitate the competitive advantages of an organisation when big data-driven supply chain capabilities (Liao, Hu, & Ding, 2017).

Research Background

This research is about the relationship of big data-driven supply chain capabilities and competitive advantages in manufacturing companies in Selangor. With technological development, the company has invested heavily in information technology to optimise supply chain decisions and inventory levels, automate transactions as well as track operations and merchandise (Chae, 2015). Information technology can also provide the company with large amounts of big data. Through the big data, the company can gain deep insights on logistics and supply chains (Tiwari, Wee, & Daryanto, 2018).

In 2020, there are 44 zettabytes of big data is estimated to be produced every day (Desjardins, 2019). The big data consists of a burgeoning volume of transactional data related to operations, suppliers and customers (Mittal, Balas & Hemanth, 2018). Big data-driven supply chain refers to analyse, process and manage data throughout the supply chain to enhance the competitive advantages and firm performance (Kamble & Gunasekaran, 2020). The company employs the big data properly may revolutionise the performance of its supply chain capabilities (Fosso Wamba, Akter, Edwards, Chopin, & Gnanzou, 2015).

Supply chain capabilities are the capability of the organisation that utilises both external and internal resources to enhance the activities throughout the supply chain (Yeniyurt, Wu, Kim, & Cavusgil, 2019). Supply chain capabilities can be clustered into four dimensions, such as interfirm coordination, supply chain responsiveness, information exchange and activity integration (Chavez, Yu, Jacobs, & Feng, 2017). The company employs the supply chain capabilities properly can enhance its competitive advantages through integrating the main business processes from users to vendors and suppliers. The integration of the main business processes is related to the flows of relevant information in the supply chain and the goods flow from the stage of raw material to the users (Liao, Hu, & Ding, 2017).

Competitive advantages can be defined as the condition that enables an organisation to produce products or services of equal value in a more ideal way or at a lower price. Hence, competitive advantage can help the company to yield superior profits or more sales compared with market competitors (Twin, 2019). Based on the view of the end-users or buyers, competitive advantages can distinguish the company or company's products from competitors or competitor's products. Therefore, the company can prioritise the positive progress and excellence of competitors in a specific industry or market (Onur & Knouch, 2018). Through this, competitive advantage shows that the company can outperform their competitors (Savitskie, Sen, & Ranganathan, 2016). According to (Liao et al., 2017), supply chain capabilities could facilitate the competitive advantages of an organisation when big data-driven supply chain capabilities.

Problem Statements

With technological development, big data-driven supply chains have become more important for companies. According to Yu et al. (2018), supply chain managers proper employ of big data in the system can provide useful insights to improve the supply chain competitive and capabilities. The managers increasingly see big data as a key source of the creation of value and competitive advantages (Tan, Zhan, Ji, Ye, & Chang, 2015).

Big data can help the managers to understand expenditures, support planning control and process, optimise production, determine trends in performance and costs as well as monitor inventory and capacity (Tan et al., 2015; Wang, Gunasekaran, Ngai, & Papadopoulos, 2016; Tiwari et al., 2018). As leading manufacturing companies, Apple, Samsung, BMW, Dell, Sony and Volvo are actively using big data to open up novel business opportunities and improve the processes of supply chain. However, these companies are lack of knowledge regarding big data and its management methods in the early phase of big data adoption. These companies can be called early adopters (Yu et al., 2018).

There are ten challenges of supply chain capabilities that faced by companies (Statista, 2020). Multiple supply chain data sources indicate that many experts are having problems with meeting the changing customer needs and enhancing their operational visibility. Due to the increasingly competitive business landscape and cost increases, this is in addition to being constrained. The ten challenges of supply chain capabilities are inventory management (13.2%), available talent (9.2%), coordinating across departments (11.8%), fluctuating consumer demand (19.7%), visibility (21.1%), keeping pace with technology (6.6%), data management (1.3%), manufacturing (4.0%), sourcing (5.3%) and ensuring an ethical supply chain (5.3%).

According to Yeniyurt et al. (2019), many studies have investigated the relationship of supply chain capabilities on different aspects of company performance, customer-supplier relationship satisfaction, innovation performance, risk management, customer satisfaction, brand equity and supply chain finance. Furthermore, consultancy white papers and conceptual research have recommended that the interpretation and big data analysis adopted in the supply chain may improve competitive advantages (Chavez, Yu, Jacobs, & Feng, 2017). Although big data-driven supply chain is important to the organisations, there are lack of research to determine the relationship of big data-driven supply chain on the supply chain capabilities and competitive advantages (Schoenherr & Speier-Pero, 2015). Therefore, this research intends to determine the relationship of big data-driven supply chain on the supply chain capabilities towards competitive advantages.

Research Questions

(i) What is the relationship of big data-driven supply chain towards supply chain capabilities?
(ii) What is the relationship of supply chain capabilities towards competitive advantages?

Research Objectives

(i) To identify the relationship of big data-driven supply chain towards supply chain capabilities.
(ii) To study the relationship between supply chain capabilities towards competitive advantages.

LITERATURE REVIEW

Resource-Based View

The resource-based view (RBV) describes how companies can gain sustainable competitive advantages by controlling and acquiring resources. When the capabilities and resources become sources of abnormal profits, they are associated with competitive advantages (Ahmad, 2015). The resource-based view (RBV) of the company determines an organisation integration of capabilities as well as both intangible and tangible resources that contribute to achieve competitive advantages (Wijethilake & Ekanayake, 2018).

The resource-based view (RBV) aims to interpret why the companies in the same field have different performance over time (Gao, Li, & Huang, 2019). The resources-based view (RBV) disputes that the differences between companies are mainly the result of company heterogeneity about their bundles of capability endowments and resources (Eloranta & Turunen, 2015). Companies should possess VRIN-criteria in their capability and resources to obtain sustainable competitive advantages. VRIN criteria consists of valuable, rare, inimitable and non-substitutable resources (Bogodistov & Wohlgemuth, 2017).

The resource-based view (RBV) proposes that the resources should be categorised based on their contribution to sustainable competitive advantages. The section on combination and components recommends that the

division of resources into dynamic and static as well as intangible and tangible (Ujwary-Gil, 2017). Capabilities are difficult to transfer and more company-specific as well as embedded in the dynamic interaction of knowledge sources (Yu, Chavez, Jacobs, & Feng, 2018). Capabilities can be widely clustered into those that guide the renewal and improvement of the company activities as well as those that relate to the execution of the company's basic functional activities (Yu & Ramanathan, 2016). Therefore, capabilities could bring competitive advantages to the company. The resource-based view (RBV) considers that companies have different levels of capability and distinct resources in resource exploitation. The survival of a company depends on the ability to make the capabilities more unique, develop novel resources and build on current capabilities (Yu et al., 2018).

Big Data-Driven Supply Chain

Nowadays, big data is rapidly growing and very important in the information economy society. Big data has penetrated every industry and affected industry development (Liu & Yi, 2018). Hence, many companies begin to invest in big data and employ it to obtain value and meaningful information (Hogarth & Soyer 2015). Big data is the data set that the functions of data storage, analysis, collection and management surpass the typical database software tool (Liu & Yi, 2018).

In the supply chain context, big data-driven supply chain is the use of big data as the foundation for qualitative and quantitative techniques to improve the competitiveness of the supply chain. For companies that have the ability to use big data, it is becoming important as a driver of improved business performance and better decision making (Yu et al., 2018). In the RBV context, the ability to use big data is the company's assets because it reflects the strategic intent of the company as well as hard to replicate in short to medium term and unique. Some companies used big data to understand elements of market demand, customers and suppliers as well as process design and product. Besides that, the companies also used big data to determine the opportunities of the business and obtain novel insights (Schoenherr & Speier-Pero, 2015; Tan et al., 2015).

The deployment of big data strategies in the supply chain may improve the efficiency and effectiveness of activities (Yu et al., 2018). Companies can administer demand planning across expanded global supply chains and enterprises as well as rework and decreasing defects within production factory by adopting big data in the process of the supply chain (Hofmann & Rutschmann, 2018; Gunasekaran, Yusuf, Adeleye, & Papadopoulos, 2017). Besides that, companies need to share information across processes within the companies and outside the companies to provide end-to-end process view for supply chain partners and connect supply chain partners (Chavez et al., 2017).

In conclusion, big data-driven supply chain enables companies to obtain significant improvements in administrating the extended, global and complex supply chains by using precise and innovative methods, such as cooperative product development based on lean production and operations, advance supply planning and demand forecasting as well as customer data (Yu et al., 2018). Thus, companies have an insightful and thorough understanding of their supply chain management practices through big data-driven supply chain. Due to the understanding of the companies, companies can strengthen interfirm coordination, supply chain responsiveness, information exchange and activity integration. Big data-driven supply chain can help companies to gain competitive advantages as the analysing, processing and management of data throughout the supply chain.

Supply Chain Capabilities

Supply chain capabilities is the organisation's abilities that assimilate, use and identify both external and internal information and resources to promote the activities of the supply chain (Liao, Hu, & Ding, 2017). According to the resource-based view (RBV), the supply chain capabilities have been conceptualised as a multidimensional structure that includes four dimensions, such as interfirm coordination, supply chain responsiveness, information exchange and activity integration. The four dimensions represent the organisation's abilities to carry out inter-organisational activities and cross-functional in administrating the process of the supply chain (Yu et al., 2018).

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Interfirm coordination is one of the supply chain capabilities that requires the organisation's ability to coordinate the activities of the supply chain related to transactions with suppliers and customers. For example, the activities of the supply chain are delivery, sales and procurement (Yu et al., 2018). As the company increasingly important in the supply network and the numbers of partnerships increases, interfirm coordination has become more costly, difficult and even inhibiting the additional new partnerships (Yeniyurt et al., 2019). Therefore, companies should use the big data-driven supply chain to decrease interfirm coordination costs and promote interfirm coordination among supply chain partners. Interfirm coordination can help companies increase flexibility to manage with demand uncertainty, enhance the efficiency of operational, enhance the efficiency of product development as well as decrease lead times and transaction costs (Lambourdiere, & Corbin, 2020).

Supply chain responsiveness is the supply chain capabilities that used by companies and their supply chain partners to respond the environmental changes (Yeniyurt et al., 2019). The characteristics of the supply chain responsiveness is being flexible and responsive to the rapidly changing markets and evolving customer needs (Yang, Xie, Yu, & Liu, 2019). For example, supply chain managers change product mix as well as delivery and production quantities based on changes in supply and demand. These changes may help companies to enhance performance results, such as high customer satisfaction, increase on-time performance, low production cost and faster delivery (Yu et al., 2018).

Information exchange is the capability of the companies to share information and knowledge related to process and product with their supply chain partners in an efficient and effective method (Yu et al., 2018). Information exchange can offer the fundamental for the decision support about the supply chain and high level of business planning to enhance the performance of supply chain (Yeniyurt et al., 2019). Furthermore, information exchange allows companies to pull away from competitors as well as gain efficient and effective flows of information, services and products. Hence, information exchange can help companies to deliver services and products on time and create production plans (Yu et al., 2018).

Finally, activity integration is the degree to which companies cooperate with their supply chain partners and jointly administer the process of inter-organisational and intra-organisational. Activity integration may help companies to gain effective and efficient integration of financial flows, information and physical (Novais, Manuel Maqueira, & Ortiz-bas, 2019). The cross-functional border integration of activities that involve customers and suppliers in the supply chain could be considered the key to gain competitive advantages (Bruque, Moyano, & Maqueira, 2015). For example, the company cooperates with its suppliers and customers to manage its business activities, such as joint product development, forecasting and planning and collaboration in purchasing (Yu et al., 2018). Activity integration will also affect brand equity, overall company performance, innovation and operational performance (Yeniyurt et al., 2019). Besides that, activity integration that uses the knowledge embedded in cooperative processes can help companies to increase delivery performance, value creation and reduce cost.

Supply Chain Capabilities and Competitive Advantages

The resource-based view (RBV) describes that companies with rare, non-substitutable, valuable and difficult to imitate supply chain capabilities and resources can obtain sustained competitive advantages (Liu, Srai, & Evans, 2016). Supply chain capabilities can facilitate the competitive advantages of an organisation when big data-driven supply chain capabilities (Liao, Hu, & Ding, 2017). According to empirical researches, researchers broadly accepted the argument that the supply chain capabilities and resources affect its performance (Yu et al., 2018). However, there are few empirical researches have studied the linkage between supply chain capabilities and competitive advantages. Companies used a second-order factor that includes the supply chain capabilities to examine the effect on business performance. (Yeniyurt et al., 2019).

In this research, researchers will investigate the relationship between supply chain capabilities on competitive advantages. The supply chain capabilities consist of interfirm coordination, supply chain responsiveness, information exchange and activity integration. This research can help companies to develop a deep understanding about the relationship between supply chain capabilities and competitive advantages by investigating the relationship of each dimension on competitive advantages.

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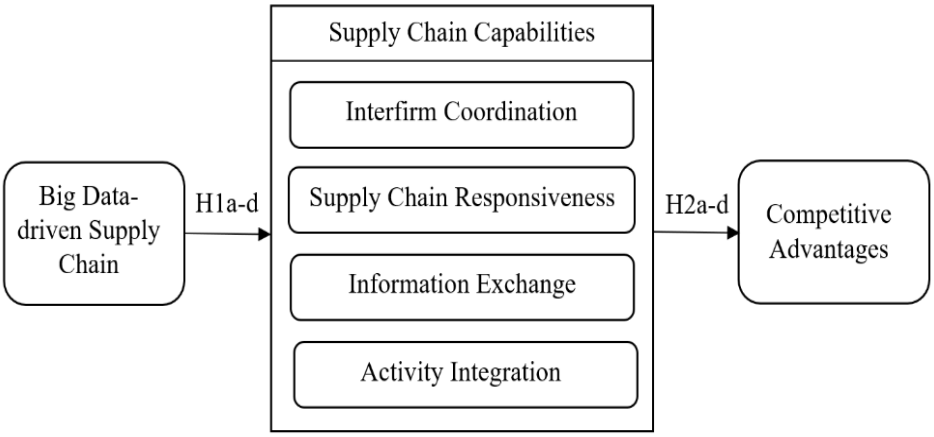
Conceptual Framework



Hypotheses Development

H1a-d: Big data-driven supply chain have a significant relationship with (a) interfirm coordination; (b)supply chain responsiveness; (c) information exchange and (d) activity integration.

H2a-d: (a) interfirm coordination; (b)supply chain responsiveness; (c) information exchange and (d) activity integration have a significant relationship with competitive advantages.

RESEARCH METHODOLOGY

Research Design

This research employs a quantitative method to gather data from the respondents. Quantitative method concentrated on survey and questionnaire. The questionnaire was distributed through Google Form to the managers of manufacturing companies in Selangor. This research also uses computational techniques to manipulate pre-existing statistical data. For example, SPSS software. The objectives of the researcher in carrying out quantitative study are to identify the relationship of big data-driven supply chain capabilities towards competitive advantages in manufacturing companies in Selangor.

Research Process

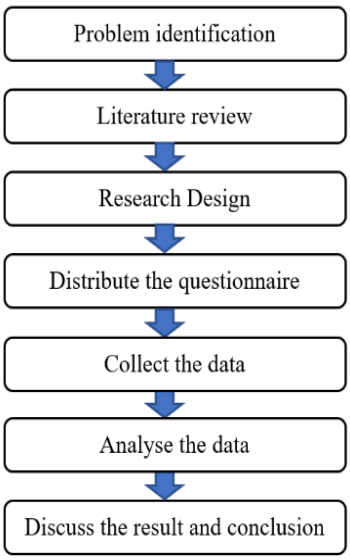


Figure 3.1: The steps of the research process

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Population and Sample Size

The target population in this research is the managers of manufacturing companies in Selangor with at least five years of experience in the field of big data analytics related to supply chain capabilities. Based on SME Corp. Malaysia (2020) and Department of Statistics Malaysia (2020), manufacturing companies in Selangor in totality is 287 companies. According to the sample determination table of Krejcie & Morgan (1970), the sample size of this research is 162 respondents. These 162 respondents need to answer the questionnaires and the questionnaires will be collected after completed by respondents.

Sampling Techniques

Sampling techniques that adopted in this research is convenience sampling. Convenience sampling is one of the non-random sampling techniques where samples are selected from the population only and did not consider selecting a sample that represents the entire population. Convenience sampling can help researcher fast, inexpensive and easy to carry out this research.

Construct Measurement

There are 4 sections in the questionnaire of this research, which is A, B, C and D. Section A represents demographic profile of respondents, which comprised of gender, age, nationality, ethnic background, marital status, educational background, industry age, employment status and year in current position. Section A will use multiple choice in each question. Section B is the question of big data-driven supply chain in manufacturing companies in Selangor. Section C is the question of supply chain capabilities when companies using the big data in the supply chain. There are four dimension of supply chain capabilities, which is interfirm coordination, supply chain responsiveness, information exchange and activity integration. Section D is the question of competitive advantages that gained by big data-driven supply chain capabilities.

This research uses 5-point likert scale to evaluate the agreement level of respondents for Section B, C and D. The measurement level of demographic is nominal while the measurement level of independent variable, dependent and independent variables and dependent variables is ordinal. The 5-point likert scale that employed by researcher to rate the agreement level are 1 stand for Strongly Disagree, 2 stand for Disagree, 3 stand for Neutral, 4 stand for Agree and 5 stand for Strongly Agree.

Questionnaire Survey

The questionnaire survey was developed in Google form. The survey link of the Google form was mailed to 162 managers of manufacturing companies in Selangor with at least five years of experience in the field of big data analytics related to supply chain capabilities. After a gap of one week, the respondents were received a polite and gentle reminder by email and phone. The respondents who have completed the questionnaire will also receive a appreciation token of RM2 from the researcher. Hence, there are 123 questionnaires were received back. This resulted in 123 final responses and the response rate was 76%.

Data Collection

In this research, data was gathered through primary data and secondary data. Primary data that adopted in this research is quantitative method, such as SPSS software, questionnaire and survey. The researcher adopts the quantitative method to survey, collect and analyse the data. The data that collected also used to carry out the hypotheses test to evaluate the competitive advantages. In addition, secondary data that used in this research is journal articles, books, official websites and conference proceedings. Secondary data can help researcher to gain the information in the literature review when conducting this research.

Data analysis

The questionnaire that had been created is used to obtain the information from the managers of manufacturing companies in Selangor that had been selected to become the respondent in this research. After collect the data from respondents, SPSS software will be used to analyse the data. In this research, data analysis will use

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descriptive analysis to analyse data. Through using the descriptive analysis, researcher can determine the frequency, median, mean and standard deviation. The inferential statistic will be adopted in this research to identify the relationship between independent variable, dependent and independent variables as well as dependent variable. Researcher also uses Spearman's correlation in SPSS software to evaluate the correlation between independent variable, dependent and independent variables as well as dependent variable.

RESULTS AND DISCUSSION

Hypotheses Testing

Spearman's Correlation Analysis

According to Table 4.1, it shows the results of big data-driven supply chain are correlated to supply chain capabilities. The value of correlation coefficient between big data-driven supply chain and four dimensions of supply chain capabilities is between 0.288 to 0.686. Based on the table, the value of correlation coefficient between big data-driven supply chain and interfirm coordination is 0.686, supply chain responsiveness is 0.670, information exchange is 0.470 and activity integration is 0.288. Therefore, the correlation coefficient between big data-driven supply chain to interfirm coordination, supply chain responsiveness and information exchange is moderate positive correlation. However, the correlation coefficient between big data-driven supply chain to activity integration is weak positive correlation. Besides that, the significance value between big data-driven supply chain and four dimensions of supply chain capabilities is in the range from 0.000 to 0.001, which is lower than 0.01. Hence, big data-driven supply chain have a significant relationship with four dimensions of supply chain capabilities. Table 4.1 is listed in the Appendix.

According to Table 4.1, it shows the results of supply chain capabilities are correlated to competitive advantages. The value of correlation coefficient between four dimensions of supply chain capabilities and competitive advantages is between 0.326 to 0.743. Based on the table, the value of correlation coefficient between competitive advantages and interfirm coordination is 0.326, supply chain responsiveness is 0.570, information exchange is 0.743 and activity integration is 0.676. Therefore, the correlation coefficient between information exchange to competitive advantages is strong positive correlation. While the correlation coefficient between supply chain responsiveness and activity integration to competitive advantages is moderate positive correlation. However, the correlation coefficient between interfirm coordination to competitive advantages is weak positive correlation. Besides that, the significance value between four dimensions of supply chain capabilities and competitive advantages is 0.000, which is lower than 0.01. Hence, four dimensions of supply chain capabilities have a significant relationship with competitive advantages.

Result of Major Findings

Table 4.1 shows the result of major findings. The significance value of all hypotheses is in the range from 0.000 to 0.001, which is less than 0.05. Thus, the data of all hypotheses are significant and accepted. This means that manufacturing companies in Selangor can employ big data to improve its supply chain capabilities and thus to gain competitive advantages. This result was supported by Liao et al. (2017), supply chain capabilities can facilitate the competitive advantages of an organisation when big data-driven supply chain capabilities.

Table 4.1: Result of major findings

Research Objectives	Hypotheses	Results	Accepted or Rejected Hypotheses
To identify the relationship of big data-driven	H1a: Big data-driven supply chain have a significant relationship with interfirm coordination.	Correlation Coefficient = 0.686	The result shows the p-value is lower than 0.50. Thus, the research rejects the null hypothesis and accept the H1a hypothesis. The finding

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supply chain towards supply chain capabilities.	H0: Big data-driven supply chain have an insignificant relationship with interfirm coordination.	P = 0.000	shows the big data-driven supply chain have a significant relationship with interfirm coordination.
	H1b: Big data-driven supply chain have a significant relationship with supply chain responsiveness. H0: Big data-driven supply chain have an insignificant relationship with supply chain responsiveness.	Correlation Coefficient = 0.670 P = 0.000	The result shows the p-value is lower than 0.50. Thus, the research rejects the null hypothesis and accept the H1b hypothesis. The finding shows the big data-driven supply chain have a significant relationship with supply chain responsiveness.
	H1c: Big data-driven supply chain have a significant relationship with information exchange. H0: Big data-driven supply chain have an insignificant relationship with information exchange.	Correlation Coefficient = 0.470 P = 0.000	The result shows the p-value is lower than 0.50. Thus, the research rejects the null hypothesis and accept the H1c hypothesis. The finding shows the big data-driven supply chain have a significant relationship with information exchange.
	H1d: Big data-driven supply chain have a significant relationship with activity integration. H0: Big data-driven supply chain have an insignificant relationship with activity integration.	Correlation Coefficient = 0.288 P = 0.001	The result shows the p-value is lower than 0.50. Thus, the research rejects the null hypothesis and accept the H1d hypothesis. The finding shows the big data-driven supply chain have a significant relationship with activity integration.
To identify the relationship of supply chain capabilities towards competitive advantages.	H2a: Interfirm coordination have a significant relationship with competitive advantages. H0: Interfirm coordination have an insignificant relationship with competitive advantages.	Correlation Coefficient = 0.326 P = 0.000	The result shows the p-value is lower than 0.50. Thus, the research rejects the null hypothesis and accept the H2a hypothesis. The finding shows the interfirm coordination have a significant relationship with competitive advantages.
	H2b: Supply chain responsiveness have a	Correlation Coefficient	The result shows the p-value is lower than 0.50. Thus, the

	significant relationship with competitive advantages.	= 0.570	research rejects the null hypothesis and accept the H2b hypothesis. The
	H0: Supply chain responsiveness have an insignificant relationship with competitive advantages.	P = 0.000	finding shows the supply chain responsiveness have a significant relationship with competitive advantages.
	H2c: Information exchange have a significant relationship with competitive advantages. H0: Information exchange have an insignificant relationship with competitive advantages.	Correlation Coefficient = 0.743 P = 0.000	The result shows the p-value is lower than 0.50. Thus, the research rejects the null hypothesis and accept the H2c hypothesis. The finding shows the information exchange have a significant relationship with competitive advantages.
	H2d: Activity integration have a significant relationship with competitive advantages. H0: Activity integration have an insignificant relationship with competitive advantages.	Correlation Coefficient = 0.676 P = 0.000	The result shows the p-value is lower than 0.50. Thus, the research rejects the null hypothesis and accept the H2d hypothesis. The finding shows the activity integration have a significant relationship with competitive advantages.

DISCUSSION AND CONCLUSION

Discussion

Discussion for Objective 1

Based on Table 4.1, the result shows the big data-driven supply chain have a positive and significant relationship with four dimensions of supply chain capabilities where the value of correlation coefficient is between 0.288 to 0.686 and the significance value is in the range from 0.000 to 0.001. Therefore, the research accepts the H1a until H1d hypotheses because the significance value is less than 0.05. The result shows that big data-driven supply chain can help manufacturing companies to strengthen their supply chain capabilities, such as interfirm coordination, supply chain responsiveness, information exchange and activity integration. The result are proven by previous research, which is supply chain managers proper employ of big data in the system may provide useful insights to improve the supply chain competitive and capabilities (Yu, Chavez, Jacobs, & Feng, 2018). Table 4.2 is listed in the Appendix.

Discussion for Objective 2

Based on Table 4.1, the result shows the four dimensions of supply chain capabilities have a positive and significant relationship with competitive advantages where the value of correlation coefficient is between 0.326 to 0.743 and the significance value is 0.000. Therefore, the research accepts the H2a until H2d hypotheses because the significance value is less than 0.05. The result shows that the four dimensions of supply chain capabilities can help manufacturing companies to obtain competitive advantages. The four

dimensions of supply chain capabilities are interfirm coordination, supply chain responsiveness, information exchange and activity integration. The result are proven by previous research, which is supply chain capabilities are a valuable source of sustainable competitive advantages for companies (Yeniyurt, Wu, Kim, & Cavusgil, 2019). Table 4.2 is listed in the Appendix.

Implication of Research

Manufacturing Companies

Manufacturing companies can find the best methods to facilitate the competitive advantages by using big data-driven supply chain capabilities. Besides that, manufacturing companies can also determine the strong relationship and weak relationship between big data-driven supply chain capabilities and competitive advantages. Hence, manufacturing companies can maintain the strong relationship between big data-driven supply chain capabilities and competitive advantages as well as make some improvements on weak relationships. This can help manufacturing companies to obtain competitive advantages. Indeed, manufacturing can gain competitive advantages if they succeed in improving the weak relationship between big data-driven supply chain capabilities and competitive advantages.

Limitation of Research

During this research, there are four limitations have been encountered by the researcher. The first limitation is the lack of data accuracy. Due to the outbreak of coronavirus disease, the researcher cannot conduct face-to-face interviews and can only circulate the questionnaire to the respondents through email and Google form. Hence, the respondents may not be able to answer the questionnaire truthfully due to differences in the interpretation and understanding of the questionnaire. This situation might lead to the questionnaire data gathered from the respondents is not accurate.

The second limitation is the limitation of questionnaire language. The questionnaires that circulated to the respondents were written in English only. This research is conducted in Malaysia, where Bahasa Melayu is the first official language and English is the second official language. This situation has caused some respondents may not fully understand the questionnaire and answer the questionnaire incorrectly. Therefore, the research results may be less reliable or incorrect.

The third limitation is the limitation of geography. This research is only concentrated on manufacturing companies in Selangor. Due to the limitation of geography, the population and sample size has also been restricted. Besides that, the research on manufacturing companies in Selangor is not sufficient to support relevant analysis because it is not representative of all manufacturing companies in Malaysia. Thus, the result may be inaccurate or less reliable.

The four limitation is the limitation of time. Due to the cases of COVID-19 increased, the Government announced the Conditional Movement Control Order (CMCO) in Selangor. Therefore, the researcher cannot conduct face-to-face interviews and can only circulate the questionnaire to the respondents through email and Google form. Due to the limitation of time, there are only 123 questionnaires were received back and about 39 respondents did not respond to the questionnaire.

RECOMMENDATION

Based on the limitations of this research, there are four recommendations have been identified for future research. The first recommendation for future research is to supplement the current method with a qualitative approach. The data that gathered by a qualitative approach can increase and fortify the data accuracy. The qualitative approach that can be adopted is interviews. The researcher can conduct face-to-face interviews with the respondents to ensure that respondents have an accurate understanding of the questions and answer the question correctly.

The second recommendation for future research is to prepare questionnaires in multiple languages such as Bahasa Melayu, Tamil or Chinese. This research is conducted in Malaysia, where Bahasa Melayu is the first official language while Tamil and Chinese language is being spoken daily by other races. The questionnaires that written in multiple languages can help respondents more understand the questionnaire and answer the questionnaire correctly.

The third recommendation for future research is the research population and sample size should be expanded to all manufacturing companies in Malaysia. This is because the opinions of the respondents will vary according to the research location. This situation can contribute to carry out more data analysis and support relevant analysis because it is representative of all manufacturing companies in Malaysia. Hence, the research result will be more reliable.

The fourth recommendation for future research is to extend the research time. In the future research, the researcher can conduct related research in a longer period of time, such as six months. Therefore, the researcher can increase the research population and sample size to gather more data. The research result will be more trustworthy or reliable.

Conclusion

With the technological development, there are 44 zettabytes of big data is estimated to produce every day. The big data consists of a burgeoning volume of transactional data related with operations, suppliers and customers. By using the big data, the current operating models of the company could be affected and company may gain sustainable competitive advantages. Therefore, this research was carried out to identify the relationship of big data-driven supply chain capabilities towards competitive advantages in manufacturing companies in Selangor. The researcher has circulated the questionnaires to the respondents for gathering data. After the questionnaires were received back, the data from the questionnaires will be analysed by using SPSS software.

According to the result of data analysis, big data-driven supply chain had a positive and significant relationship with four dimensions of supply chain capabilities where the value of correlation coefficient is between 0.288 to 0.686 and the significance value is in the range from 0.000 to 0.001. While the four dimensions of supply chain capabilities have a positive and significant relationship with competitive advantages where the value of correlation coefficient is between 0.326 to 0.743 and the significance value is 0.000. Therefore, the research accepts all the hypotheses because the significance value is less than 0.05.

Big data-driven supply chain management can help to improve the competitive advantage of the manufacturing company in a few aspects. The first is improved visibility across the entire related value chain. By integrating data from various sources, including suppliers, warehouses, transportation providers, and customers, companies gain real-time insights into inventory levels, shipment status, and demand patterns. Secondly, by integrating data from multiple sources, such as order platform, social media, and disaster report, companies can identify patterns and anomalies within the current supply chain. By having these data, more accurate prediction can be made in order to manufacture and fulfill the demand. Due to the nature of manufacturing industry that requires raw materials from many sources and supply it to customers, the logistical department deal with complex transportation networks and face challenges in finding the most efficient routes for deliveries. With the help of big data analytics, routes can be optimized by considering factors such as traffic conditions, weather patterns, and historical delivery data. By adopting complex yet advanced algorithms and real-time data feeds, companies can identify the closest and most efficient paths, reducing fuel consumption, minimizing delivery delays, and enhancing overall customer satisfaction. Therefore, the researcher can conclude that manufacturing companies in Selangor can use big data to enhance its supply chain capabilities and thus to obtain competitive advantages.

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APPENDIX A

Table 4.2: Result of Spearman Correlation Analysis

Hypotheses		Spearman's Correlation Coefficient	Significance	Accepted or Rejected Hypotheses
H1a	Big data-driven supply chain have a significant relationship with interfirm coordination.	0.686	0.000	Accepted
H1b	Big data-driven supply chain have a significant relationship with supply chain responsiveness.	0.670	0.000	Accepted
H1c	Big data-driven supply chain have a significant relationship with information exchange.	0.470	0.000	Accepted
H1d	Big data-driven supply chain have a significant relationship with activity integration.	0.288	0.001	Accepted
H2a	Interfirm coordination have a significant relationship with competitive advantages.	0.326	0.000	Accepted
H2b	Supply chain responsiveness have a significant relationship with competitive advantages.	0.570	0.000	Accepted
H2c	Information exchange have a significant relationship with competitive advantages.	0.743	0.000	Accepted
H2d	Activity integration have a significant relationship with competitive advantages.	0.676	0.000	Accepted