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The Influence of Digital Supply Chain on Operational Performance: A Case Study at Food and Beverage Industry in Malaysia

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Technology adoption, digital supply chain, big data analytic, internet of things, operational performance, food and beverage industry

Abstract

This study investigates the impact of digital supply chain (DSC) on operational performance in the food and beverage industry in Malaysia. With the rapid advancement of digitalization, companies in this industry are increasingly adopting these technologies to improve their supply chain operations. However, there is a lack of comprehensive research specifically focusing on the Malaysian food and beverage sector. Thus, this research aims to address this gap by examining the current level of operational performance and analyzing the relationships between digital supply chain and operational performance. The research objectives include assessing the extent of operational performance, investigating the connection between big data analytic and operational performance, and examining the relationship between internet of things and operational performance. The study will target companies in the food and beverage industry in Malaysia and will be conducted within this specific context. The findings of this research have revealed that big data analytic and internet of things have positive significant influence on operational performance in food and beverage industry in Malaysia. The value of determination coefficient correlation between big data analytic, internet of things, and operational performance shows a positive correlation.

1. Introduction

The rapid pace of technological advancements in recent years has necessitated digitalization across industries. Within supply chain management (SCM), there is anticipation that the digitalization of supply chains will expand and take on a critical role. Recognizing digital technology's significance and utility for business growth, numerous companies seek active participation in embracing digital transformation (Bughin, Chui & Manyika, 2015). Companies who fail to keep up with technological changes can risk falling behind hence the pressure on all firms facing this dynamic challenge. Despite benefits across industries from the integration of available technologies, uncertainty remains over how best these should be used specifically by particular companies within its operations. Hence, many company reticence when considering substantial investment needed. Many businesses continue relying on traditional management practices ultimately limiting financial growth.

The food and beverage industry play a vital role in the global economy by giving customers all over the world access to necessities. Organizations in food and beverage industry face several difficulties in guaranteeing effective operations and maintaining high standards performance as a result of the complexity and globalization of supply chains. The emergence of DSC technologies in recent years has significantly changed several industries,

including the food and beverage industry. This study attempts to look into the impact of DSC on Malaysia's food and beverage industry's operational performance.

For businesses in the food and beverage sector to establish competitive advantage and satisfy customer expectations, operational performance is a key factor. Numerous metrics are included in it, such as cost effectiveness, quality, delivery speed, adaptability, and reactivity. Organizations may improve their operational performance by optimizing processes, eliminating inefficiencies, managing risks, boosting traceability, and assuring product quality and safety by utilizing DSC.

1.1 Research Background

The food and beverage industry in Malaysia is a dynamic and rapidly growing sector, driven by changing consumer preferences, globalization, and increasing competition. However, the industry faces numerous challenges, including complicated supply chain networks, perishable goods, strict laws, and the requirement to ensure food safety and quality. In this context, the adoption of DSC technologies holds significant potential to address these issues and enhancing operational efficiency.

DSC is one that uses cutting-edge digital technologies to transform the way tasks related to supply chain planning and execution are typically performed, how they interact with different supply chain participants, and how they enable new business models for companies. According to Saryatmo and Sukhotu (2021a), DSC can be summarized as a novel strategy that uses cutting-edge technology that can transform traditional supply chain operations and enable more efficient integration between supply chain members.

Ensure Previous studies have extensively investigated the advantages of implementing digital supply chain (DSC) technologies across various industries. These technologies have been shown to enhance visibility, inventory management, demand forecasting, and collaboration (Wang *et al.*, 2022). However, there remains a significant research gap when it comes to comprehensively studying the specific impact of DSC in the food and beverage industry in Malaysia. Additionally, the potential of DSC to enhance trust, transparency, and traceability in supply chains has garnered considerable attention. While several studies have explored the applications of DSC in sectors like finance and logistics (Kouhizadeh *et al.*, 2021; Saberi *et al.*, 2019; Lim *et al.*, 2021; Gad *et al.*, 2022), limited research has been conducted on its influence within the food and beverage industry, particularly in Malaysia. Consequently, this study aims to bridge this research gap by providing valuable insights into how digital supply chain impact operational performance in the Malaysian food and beverage sector.

1.2 Problem Statement

Digital technologies have significantly transformed supply chain operations, enabling greater precision and transparency and empowering managers with increased control over business decisions. It is important to view digitalization as more than just an extension of existing business models but rather as a catalyst for entirely new operating models. However, the implementation of digitalization can be complex and perplexing for many business professionals, despite the numerous possibilities it offers.

Büyüközkan and Göçer (2018) highlighted the scarcity of research on the practical applications of digital supply chain (DSC) in specific industrial sectors. They emphasized that different industries have unique strategies, approaches, and practices when it comes to DSC. Therefore, it is crucial to conduct future studies to develop industry-specific sub-frameworks that enhance key trends in DSC. To effectively implement DSC, it is essential to have an appropriate structure and framework, as digitalization tends to reshape supply chain operations. With the rapid advancement of technology, research on DSC adoption in various industry sectors becomes increasingly important. Moreover, most existing studies on this topic predominantly come from Western literature, and only a limited number of studies have focused on the relationship between DSC implementation, operational performance, and overall firm performance within the manufacturing industry in Malaysia. Consequently, this study aims to investigate the relationship between digital supply chain and operational performance in the food and beverage industry specifically in Malaysia. By exploring this relationship, the research aims to contribute to a better understanding of the impact of DSC in the Malaysian context and provide insights for industry professionals and policymakers.

The food and beverage industry in Malaysia face challenges as indicated by the data provided by the Bernama (Bernama, 2019). Domestic Trade and Consumer Affairs ministry reported 127 complaints against food and beverage providers from 2014 to September 2019, with Minister Datuk Seri Saifuddin Nasution Ismail highlighting that the majority of these issues occurred during specific seasons, particularly school holidays. Furthermore, the Malaysian Consumer Claims Tribunal recorded 65 complaints in 2018 and 35 complaints from January to September in the 2019. The majority of these complaints involved issues like insufficient food, inappropriate quantity of meals, and delivery delays. Based on available data, it appears that the food and beverage industry face significant issues with supply chain management and operational performance. These issues could lead to unsatisfied customers and financial implications for both consumers and organizations. In order to improve customer satisfaction and reduce complaints, food and beverage providers may need to closely

examine their supply chain processes, logistics, and overall operational strategies in order to improve the quality, quantity, and timeliness of food delivery.

Therefore, to achieve the research objectives the level of operational performance at food and beverages industry in Malaysia is determined. Furthermore, the relationship between big data analytic and operational performance at food and beverages industry in Malaysia also determined. Consequently, the relationship between internet of things and operational performance at food and beverages industry in Malaysia is identified.

1.3 Research Scope

The scope of this study was limited to food and beverages industry in Malaysia. This study will be conducted in Malaysia. The target population of this study is employee in food and beverages industry in Malaysia.

1.4 Significance of Study

The results of this study will practical implications for business professionals, empowering them to choose wisely whether to implement digital supply chain technology. The findings of the research can be used by policymakers to create beneficial laws and policies that encourage innovation and digital transformation in the food and beverage industry. Additionally, this study will contribute to the knowledge by addressing the research gap and expanding understanding of the influence of digital supply chain on operational performance in the food and beverage industry in Malaysia.

2. Literature Review

The information gathered in this chapter primarily consists of secondary sources. Within this chapter, significant concepts, research methods, and findings that have contributed to the study topic has been conducted. Dependent variable in this project is operational performance and independent variables such as big data analytic and internet of things discussed below. Additionally, the definition of operational performance and relevant previous studies are also addressed in the subsequent sections.

2.1 Conceptual Definition

2.1.1 Operational Performance

According to Lu *et al.* (2017), operational performance plays a crucial role in overall supply chain performance and is influenced by multiple factors within the system. When studying performance measurement systems, researchers should provide clear and specific characteristics of the systems they analyze. Companies typically focus on financial metrics such as cost, profitability, revenue, and return on investment (ROI) to gain insights into the economic aspects of performance. Additionally, non-financial metrics like process quality and flexibility are important for assessing operational aspects (Ebrahimi, 2021).

Operational performance is frequently included as a variable in research studies for several reasons. Firstly, it is recognized as a key driver of overall supply chain performance and has been extensively studied by scholars (Devaraj *et al.*, 2007). Secondly, operational performance is a measurable variable, and previous research has shown that digital supply chain practices can have an impact on operational performance (Croom *et al.*, 2018). Motivated and loyal employees have been found to be more productive than average employees (Pfeffer, 2010), and social sustainability supply chain practices (SSSC practices) prioritize human health and well-being in supply chains (Marshall *et al.*, 2015), which can influence operational performance through factors such as product development efficiency, process improvement, and lead time reduction. Lastly, scholars like Ageron, Bentahar & Gunasekaran (2020) have emphasized that operational performance encompasses various dimensions, including quality, costs, productivity, flexibility, and dependability. Building on a previous study by Wong, Boon-itt & Wong (2011), this research specifically focuses on quality, productivity, and cost as key performance factors.

2.1.2 Food and Beverage Industry

The food and beverage industry hold a significant position in economies worldwide. Tristar (2023) defines this industry as encompassing companies involved in the transformation of raw materials into food products, as well as the preparation and serving of food and drinks to customers. In recent years, the food and beverage market in Malaysia has experienced substantial growth, driven by factors such as population expansion, rising disposable income, evolving consumer preferences, and product innovations (Research and Markets, 2019). The proliferation of food delivery apps, along with a wide range of restaurants and fast food chains, has further enhanced consumer accessibility and contributed to the industry's robust growth.

According to Statista (2023), the food market in Malaysia is projected to generate a revenue of approximately US$49.51 billion (RM228.07 billion) in 2023. The market is expected to exhibit an annual growth

rate of 7.69% (CAGR 2023-2028). The per capita revenues of US$1,474.00 in the food market highlight the economic significance of the sector for individuals. Moreover, the average volume per person, reaching approximately 395.40 kilograms, underscores the vital role of the food industry in meeting consumer needs and sustaining their dietary requirements. The market's growth trajectory is driven by increasing revenue, the dominance of specific segments, the impact of online sales, and rising volume figures. These trends demonstrate the evolving dynamics within the industry and the continued global demand for food products.

2.2 Factors Influencing Operational Performance in Food and Beverages Industry

2.2.1 Digital Supply Chain

A supply chain refers to the network established between a company and its suppliers for the production and distribution of a specific product. However, traditional supply chains often lack the necessary attributes to meet the demands of modern business requirements. These traditional chains consist of isolated steps that hinder seamless integration. By transitioning to a Digital Supply Chain (DSC), these barriers are dismantled, transforming the supply chain into a fully integrated and efficient system.

Conventional supply chains often rely on a combination of electronic processes and paper-based documentation, leading to suboptimal performance due to information silos and limited collaboration. In contrast, a Digital Supply Chain enables widespread availability of information, improved collaboration, and enhanced reliability, agility, and effectiveness (Raab & Griffin-Cryan, 2011). Accenture Consulting highlights the transformative potential of digitalization in supply chains, emphasizing the increased value, accessibility, and affordability of services. To effectively leverage digital technologies, organizations should view their supply chains as digital supply networks, integrating physical flows, talent, information, and finance. This holistic approach ensures that people, data, materials, products, and supplies travel seamlessly across the extended enterprise (Raj & Sharma, 2014).

2.2.2 Big Data Analytic

Emerging Big Data Analytics (BDA) has become a disruptive force that has enormous business consequences for companies in a variety of industries, including the food and beverage industry. The implementation of BDA has great potential in the context of Malaysia's food and beverage industry. According to Zikopoulos and Eaton (2011), one of the key differentiators of big data analytics (BDA) is its capacity to handle and evaluate huge, complicated datasets, or "big data," which are beyond the capabilities of standard database management systems (DBMS).

Volume, Velocity, Variety, Veracity, and Value—often referred to as the five significant aspects of big data—highlight the special opportunities and problems that come with big data (Addo-Tenkorang & Helo, 2016). Variability, velocity, and volume of data from many sources are especially important in the food and beverage industry because supply chain challenges, operational effectiveness, and prompt decision-making are critical. BDA has proven effective with its predictive analytics skills in a number of industries, including manufacturing, logistics, and supply chain management (Nguyen *et al.*, 2018; Wang *et al.*, 2016). Future developments in supply chain management are thought to be predicated on the incorporation of BDA into supply chain procedures (Fawcett and Waller, 2014). According to some research, BDA enhances overall corporate performance, sustainability, and operational efficiency (Gunasekaran *et al.*, 2017; Singh *et al.*, 2019).

2.2.3 Internet of Things

With profound effects on many industries, including the food and beverage industry, the Internet of Things (IoT) has become a paradigm-shifting technological advance. IoT technologies have developed into essential instruments in recent years to handle data-related issues in supply chain management and performance assessment. According to Kevin Ashton, the Internet of Things (IoT) is a huge network of intelligently communicating devices that are uniquely identified through connecting objects using radio-frequency identification (RFID) technology (Li *et al.*, 2014). IoT adoption has the potential to transform operational procedures and improve overall performance in Malaysia's food and beverage sector.

IoT technologies are essential for enabling connectivity and intelligence throughout the supply chain. These include RFID, cloud computing, middleware, wireless sensor networks (WSN), and IoT application software (Lee and Lee, 2015). For example, RFID technology uses radio waves to automatically identify and collect data, giving precise tracking information for goods in logistics and a variety of industries, such as retail and pharmaceutical manufacturing. In contrast, WSN makes use of self-governing sensor-equipped devices to keep an eye on things like position, temperature, and motion, which improves supply chain process tracking.

2.3 Previous Study

Numerous research works have examined how Big Data Analytics (BDA) affects operational effectiveness, providing insight into how it functions in various organisational settings. BDA has been recognised as a vital tool for improving competitiveness and attaining operational excellence in the particular field of supply chain and operations management (Gunasekaran *et al.*, 2017). By dealing with the issues given by enormous volumes of data with different characteristics, the adoption of BDA tools considerably improves an organization's operational efficiency. Achieving operational excellence is facilitated by the combined strategy of gathering big data and using it for business analytics (Frank *et al.*, 2019). The benefits of BDA include strategic decision-making, risk management, and agility in the food and beverage industry, where supply chain sustainability and efficiency are crucial (Papadopoulos *et al.*, 2017; Singh and El-Kassar, 2019). Moreover, Singh *et al.* (2018) and Liu (2019) have shown the value of BDA capabilities in tackling environmental issues, such as the costs associated with carbon emissions in the beef supply chain.

Numerous studies investigated into how the Internet of Things affects operational performance in a range of businesses. Teimoury *et al.* (2013) divided data-related issues into four categories: information gathering delays, data assessment, feedback provision, and system transformation. By implementing IoT technology, these obstacles and other concerns related to Supply Chain Performance Measurement System (SCPM) can be efficiently handled. The potential for transforming operational performance in Malaysia's food and beverage business depends on the Internet of Things (IoT), a new technology that possesses real-time internet-based networks and information-sensing devices. The Internet of Things' architecture, which consists of the management service layer, application layer, gateway and network layer, and sensor layer, offers a framework for the smooth integration and communication of devices and processes throughout the supply chain.

In summary, prior research offers strong proof of BDA's beneficial effects on operational performance in a variety of industries. It is crucial to acknowledge that the diverse dynamics of the food and beverage sector in Malaysia may present various challenges and prospects, requiring targeted analysis. Furthermore, the research lends credence to the notion that IoT technologies could fundamentally alter how the food and beverage sector operates. In the Malaysian context, the effective integration of RFID, WSN, middleware, cloud computing, and IoT application software can improve supply chain visibility, solve data-related issues, and streamline a number of operational procedures.

2.4 Research Framework

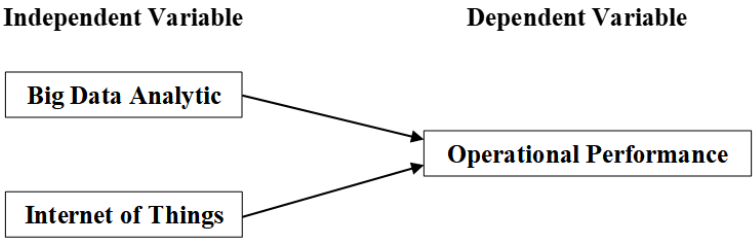

Fig. 1 *Conceptual framework*

2.5 Research Hypotheses

H1: Big data analytic has a positive effect on operational performance
H2: Internet of things has a positive effect on operational performance

3. Research Methodology

Outlining the concept and the numerous research methodology approaches that were used is the responsibility of the researcher. The research flow chart, research design, population and sampling, research instruments, pilot study, reliability and validity, data collecting, and data analysis are all included in this chapter on methodology.

3.1 Research Design

For this study, the researcher opted to utilize quantitative research as the primary method. This approach focuses on objective measurement and numerical analysis of data collected through surveys and questionnaires. The questionnaire employed in this study comprised four sections: Section A, Section B, Section C, and Section D. The aim was to investigate the factors influencing operational performance in the food and beverage industry, namely digital supply chain which are big data analytic and internet of things. Surveys were distributed to employees working in the food and beverage industry as participants in the study. The total number of responses collected for the survey was 285. Quantitative methods will be employed to analyze the gathered data and derive results. These methods utilize numerical data and employ specific statistical techniques to address

research questions. The data collected in this study, being in numerical form, falls under the category of hard data, which is well-suited for quantitative analysis.

3.2 Data Collection

A primary data collection will be conducted using a questionnaire. Companies in the food and beverage industry will be the focus of the inquiry. 367 respondents will make up the sample, and simple random sampling will be used to obtain the data. Demographic data, adoption of big data analytic, internet of things installation, and operational performance measures are all covered in the questionnaire.

3.3 Research Instrument

Table 1 *Research instrument questionnaire*

Section	Category	Number items	Sources
A (Demographic)		6	
B (Independent variable)	Big Data Analytic	5	Saryatmo & Sukhotu, 2021, Al-Khatib (2022)
C (Independent variable)	Internet of Things	5	Saryatmo & Sukhotu, 2021, Al-Khatib (2022)
D (Dependent variable)	Operational Performance	6	Saryatmo & Sukhotu, 2021

Based on Table 1, there have 4 sections in the questionnaire for respondent. Section A is demographic part, Section B is the question related to part of independent valuable which is big data analytic, Section C is the question related to independent variable which is internet of things, and Section D consists of question related to dependent valuable in the study which is operational performance.

3.4 Population and Sampling

The primary objective of this study is to investigate the impact of digital supply chain on the operational performance of the food and beverage industry in Malaysia. Therefore, the target population for this study comprises all companies in the food and beverage industry across Malaysia. According to the data provided by the HRD Corp's Industrial Skills Framework (2022), the total number of companies in this industry in 2022 was reported as more than 8000 companies. To determine the sample size for this study, the researcher employed the Krejcie and Morgan (1970) approach, which facilitated the calculation process. Consequently, a sample size of 367 respondents was determined as appropriate for this study.

The researcher opted to utilize simple random sampling as the sampling method to select the final sample for the study. According to Baraka (2023), simple random sample is a sample drawn at random from a statistical population. It provides a fair representation of the greater community. Compared to other sampling techniques, random sampling can be more efficient because it is the quickest way to select a sample from a bigger group. When gathering a sample, statisticians and statistical analysts can utilise this fundamental starting sample. There is an equal chance for every pick to be included in the sample. The selected person cannot be redrawn from the population if simple random sampling is done without a replacement. This will enhance the representation of the target population and enable a comprehensive analysis of the influence of digital supply chain on operational performance.

3.5 Data Analysis

Descriptive analysis and correlation analysis are both included in the SPSS software. Software such as SPSS can be used to analyze the data gathered from the questionnaire. For instance, descriptive statistics will be utilized to compute the mean in section A, which is about the demographics of the respondents. The researcher will have access to a complete figure, graph, and table to the descriptive statistics. Additionally, sections B, C, and D will employ correlation analysis to ascertain the connection between big data analytic and internet of things on operational performance in food and beverage industry in Malaysia.

4. Data Analysis and Findings

This chapter presents the research findings and explores the relationship between digital supply chain and operational performance within the Food and Beverage (F&B) industry in Malaysia. A comprehensive investigation was conducted, involving the distribution of questionnaires to 367 companies within the F&B sector in Malaysia. The analysis focuses on establishing connections between big data analytic (BDA), the Internet of Things (IoT), and their impacts on operational performance. The data collected were subjected to analysis employing the Statistical Package for Social Sciences (SPSS), with the results presented in the form of average values and percentages.

4.1 Response Rate

Overall, a total of 367 questionnaires were distributed by various companies in the food and beverage industry. However, the actual response rate did not reach 100%. Table 2 illustrates that only 285 set were returned for analysis, accounting for a response rate of 77.66%.

Table 2 *Response rate of questionnaire*

Questionnaire	Total
Population	8000
Number of sets distributed	367
Number of sets returned	285
Percentage of returned	77.66%

4.2 Reliability Analysis

4.2.1 Pilot Study

The findings from Table 3 demonstrate the reliability analysis outcomes for the pilot study involving 30 participants. The overall measurement scale comprising 16 items exhibited a high level of internal consistency, as evidenced by a Cronbach's Alpha value of 0.919, denoting excellence. Specifically, the six items measuring operational performance showcased a good level of reliability with a Cronbach's Alpha of 0.827. Moreover, the independent variables—Big Data Analytic and Internet of Things—consisting of five items each, demonstrated commendable internal consistency, recording Cronbach's Alpha values of 0.885 and 0.850, respectively.

Table 3 *The results of reliability analysis for pilot study (N=30)*

Variables	N of items	Cronbach's Alpha	Interpretation
Dependent variable			
Operational Performance	6	0.827	Good
Independent variable			
Big Data Analytic	5	0.885	Good
Internet of Things	5	0.850	Good

4.2.2 Actual Study

Table 4 illustrates the reliability analysis results for the actual test involving 285 respondents. The overall set of 16 measured items displayed a good level of internal consistency, recording a Cronbach's Alpha value of 0.873. However, within specific variables, the operational performance variable, consisting of six items, indicated an acceptable level of internal consistency with a Cronbach's Alpha of 0.738, while the independent variables, Big Data Analytic and Internet of Things, comprising five items each, demonstrated good (0.823) and acceptable (0.730) levels of internal consistency, respectively. These findings highlight varying degrees of reliability across the different variables in the actual study, with the overall set presenting a good level of internal consistency.

Table 4 *The results of reliability analysis for actual test (N=285)*

Variables	N of items	Cronbach's Alpha	Interpretation
Dependent variable			
Operational Performance	6	0.738	Acceptable
Independent variable			
Big Data Analytic	5	0.823	Good
Internet of Things	5	0.730	Acceptable

4.3 Demographic Analysis

Demographic analysis serves to gauge the background information of the participants. This study examines various demographic factors, including age of the company, number of employees, legal entity status, educational background, years of experience in the company, and role in the organization. Table 5 provides a numerical representation of all the information, frequencies, and percentages pertaining to the 285 companies.

Table 5 *Demographic information of respondents*

Category	Details	Frequency	Percentage (%)
Age of the company	0 – 10 years	1	0.4
	11 – 20 years	14	4.9
	Over 20 years	270	94.7
Number of employees	0 – 20 persons	4	1.4
	21 – 100 persons	52	18.2
	Over 100 persons	229	80.4
Legal entity status	Limited company	142	49.8
	Limited partnership	26	9.1
	Private/individual company	117	41.1
Educational background	High school and Diploma	32	11.2
	Undergraduate degree	148	51.9
	Master's degree	96	33.7
	Doctoral degree	9	3.2
Years of experience in the company	0 to 4 years	8	2.8
	5 to 10 years	88	30.9
	11 to 20 years	116	40.7
	Over 20 years	73	25.6
Role in the organization	Supervisor	133	46.7
	Department Head	90	31.6
	Assistant Manager	32	11.2
	Manager	24	8.4
	Vice Director	6	2.1
	Director	0	0

4.4 Descriptive Analysis

Table 6 shows the results of the overall descriptive analysis of variables in this study (N=285). The data will be analysed using two values: the mean score (M) and the standard deviation (SD). The mean ranges from 4.0661 to 4.12 and the standard deviation ranges from 0.49293 to 0.65611. Variable data include big data analytic (M = 4.12, SD = 0.65611), internet of things (M = 4.0989, SD = 0.49522), and operational performance (M = 4.0661, SD = 0.49293). Since the mean scores ranged from 3.68 to 5.00, the explanations for big data analytic, internet of things, and operational performance are hypothesized to be high. Besides, the standard deviations are all at lower values, which means that the data dispersion is smaller, and the data points are more concentrated around the mean. This result indicates that big data analytic and internet of things have a direct relationship with operational performance.

Table 6 *Overall descriptive analysis of variables*

Variables	N	Mean (M)	Std. deviation (SD)	Interpretation
Big Data Analytic	285	4.12	0.65611	High
Internet of Things	285	4.0989	0.49522	High
Operational Performance	285	4.0661	0.49293	High

4.5 Normality Test

Based on the Table 7, the data shows the results of the normality test. The findings were gathered from 285 sets of data collected according to Kolmogorov-Smirnov and Shapiro-Wilk is significant because the value is below 0.05 (p-value = 0.000). Since the significance value is lower than 0.05, the data in this study are abnormal. Thus, researcher will use Spearman's correlation test to perform the data continuously.

Table 7 *Result of normality test for operational performance*

Dependent variable	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Operational performance	0.128	285	0.000	0.935	285	0.000

4.6 Correlation Analysis

Table 8 displays the results of Spearman's correlation analysis, examining the relationships among big data analytic, internet of things, and operational performance. Initially, a moderate positive correlation (r = 0.469, p = 0.000) is observed between the big data analytic and internet of things, indicating a discernible connection between these operational approaches. Additionally, a strong positive correlation is identified between big data analytic and operational performance (r = 0.631, p = 0.000), signifying that a higher degree of technological usage corresponds to elevated performance levels. Furthermore, the adoption of a internet of things demonstrates a strong positive correlation (r = 0.689, p = 0.000) with operational performance, underscoring the positive impact of strategic decisions on overall performance. The substantial sample size (N = 285) for each correlation enhances the reliability of these findings, emphasizing the interconnected nature of big data analytic and internet of things, and their collective influence on augmenting operational performance.

Table 8 *Spearman correlation with big data analytic, internet of things and operational performance*

Correlations					
			Big Data Analytic	Internet of Things	Operational Performance
Spearman's rho	Big Data Analytic	Correlation coefficient	1.00	0.469**	0.631**
		Sig.(2-tailed)		0.000	0.000
		N	285	285	285
	Internet of Things	Correlation coefficient	0.469**	1.000	0.689**

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	Sig.(2-tailed)	0.000		0.000
	N	285	285	285
Operational Performance	Correlation coefficient	0.631**	0.689**	1.00
	Sig.(2-tailed)	0.000	0.000	
	N	285	285	285

5. Conclusion

This chapter is more than a summary; it is a synthesis of the research journey, this chapter integrate together the objectives, research questions, and findings contained in the findings. Additionally, it highlights the broad scope of the study by profiling the demographics of the respondents, overcoming barriers, and making practical recommendations beyond the limitation of this particular research project.

5.1 Overview of Study

The study aimed to investigate into the influence of digital supply chain which are big data analytic and internet of things on operational performance at food and beverage industry in Malaysia. Simple random sampling was used with a quantitative technique and a sample size of 367 companies within the food and beverage industry in Malaysia. The study duration took place in 1 year, from the proposal stage to its culmination. Data were collected through questionnaires and subsequently analyzed using Statistical Package for Social Sciences (SPSS) software.

5.2 Discussion of the Findings

This study was conducted among the communities in F&B industry. A total amount of respondents which are 285 companies were involved in this study. This section will further discuss the findings and results of the data analysis presented at the previous chapter based on the objectives that have been mentioned in Chapter 1.

The first objective in this study is to determine the level of operational performance at F&B industry. This objective has been achieved through descriptive analysis. The result of descriptive analysis showed a high level of operational performance within the F&B industry in Malaysia.

According to the Flanders Investment and Trade (2020), F&B industry in Malaysia is acknowledged as a rapidly growing sector that makes a substantial contribution to the country's economy. It grew at a steady yearly pace of 7.6%. This industry is diverse, providing a wide range of processed goods suited to Asian dietary requirements and taste preferences in addition to an abundance of Western recipes. Besides that, food processing industry accounts for 10% of Malaysia's manufacturing output, grows at a steady 3% each year (Flanders Investment and Trade, 2020). This illustrates that Malaysia's food and beverage industry is experiencing significant improvements in operational efficiency year-on-year, with several key indicators indicating higher revenue and productivity.

Notably, major F&B companies in Malaysia, displays from Nestle, have shown robust operational performance. Birruntha (2023) pointed out Nestle (Malaysia) Bhd reported higher net profit in Q2 2023, which it assigned to rapid expansion and savings within the company in the context of increasing pressure upon commodity costs. Rising advertising expenditure has been associated with improved margins of profit, thereby enable swifter development and stronger market share acquisition. The company's substantially boost to domestic sales remained the primary driver of the 6.8%, which was hike in earnings.

The second objective of this comprehensive research is to examine in detail how big data analytics (BDA) and operational performance relate to each other within F&B industry in Malaysia. A strong and statistically significant association between the independent variable (BDA) and the dependent variable (operational performance) was found by the insightful analysis, which used the Spearman correlation coefficient test. The results are remarkably consistent with those of a previous study by Saryatmo and Sukhotu (2021), verifying the argument that big data analytics, as an essential part of the digital supply chain, positively impacts a variety of operational performance characteristic. Notably, the impacts extend to quality performance, productivity performance, and cost reduction performance, confirming the revolutionary potential of BDA to improve operational effectiveness. Building upon this foundation, the insights from Mikalef *et al.* (2019) contribute different perspectives. They stated that the BDA is not directly influence competitive advantage but it directly exerts a positive and significant effect on operational performance. This emphasizes how BDA plays a complex role in determining the fundamental elements of organizational efficacy and efficiency.

The result of this study can be supported by the study executed by Rialti et al (2019) which pointed out that BDA have the power to revolutionize traditional ways of doing business. Their findings showed BDA had a

positive effect to operational performance. They found that organizational BDA capabilities affect ambidexterity and agility of firm which in turn to affect also the performance of firm. Besides that, Wamba *et al.* (2017) carried out a study to examine the direct effect of BDA on firm performance. The results showed that BDA had a positive effect to firm performance as the mediator of process-oriented dynamic capabilities in improving insights and enhancing firm performance. Furthermore, Chen and Chen (2022) also supported the finding of this study by using their result which is BDA positively related to the operational performance. The study supported and confirmed that the influence of BDA on operational performance as the internal integration is a significant mediator.

The third objective of this study aimed to examine the relationship between Internet of Things (IoT) and operational performance at F&B industry in Malaysia. Strong and significant association between the independent variable (IoT) and the dependent variable (operational performance) was found by the insightful analysis, which used the Spearman correlation coefficient test. Aeknarajindawat (2019) highlighted the critical role that operational performance plays in boosting production efficiency in the context of supply chain management, particularly with in terms of cost and time. Determining how the Internet of Things (IoT) affects supply chain performance is the main objective of the study. According to Aeknarajindawat (2019), the results highlight a positive relationship between IoT adoption and supply chain performance, indicating the significant and beneficial effect of IoT on supply chains' operational efficiency. According to Yu (2014), supply chain integration will greatly benefit from the possibilities that the Internet of Things has to offer. This resonance is especially evident when research was conducted on digitization driven by information and communication technology (ICT). According to Yu (2014), supply chain process integration was strengthened when IoT capabilities are combined with organizational ICT capabilities to improve integration skills. This advanced understanding supports the idea that a strategic use of IoT can improve supply chain performance as well as overall organizational efficiency through promoting seamless supply chain process integration.

De Vass *et al.* (2018) provided insight into the beneficial relationship that exists between the use of IoT and the combination of vendor processes, internal operations, and consumer interactions within the supply chain. The study highlights the transformative potential of IoT in promoting interconnection across many elements of the supply chain and hypothesis that such integration is likely to be a driver for boosting organizational and supply chain performance. Men *et al.* (2022) offered other perspectives on the revolutionary possibilities of digital technologies. Their research examines the dynamics of new value chains as it explores the effects of big data and the Internet of things on productivity. The findings highlight a strong and direct correlation between the dependent variable (productivity performance) and the independent factors (big data and the Internet of Things). This empirical data supports the idea that integrating these digital technologies has enormous potential to boost productivity in the operational environment.

Adding to the conversation, Fawcett *et al.* (2011) asserted that digital technology operates as an opportunity to improve operational performance through the transfer of data and general supply chain efficiency. This works in well with the larger concept of using technology developments to streamline business procedures and increase supply chain efficiency. Additionally, as demonstrated by Raguseo (2018), who found that the integration of big data and digital technologies has a noticeable and positive impact on corporate performance, the study's conclusions are consistent with earlier studies. This supports the results of the present study and emphasizes the ongoing pattern in which digital technologies fundamentally alter the operational and performance environments of businesses.

5.3 Limitation of Study

Even though this research was comprehensive, there are a few limitations that need to be noted such as generalizability and sample size. Despite efforts to assure accuracy, the results of the research may not be fully applicable to the food and beverage sector as a whole in Malaysia, as it only examined a sample of 367 companies. Variations with regard to business formats, company sizes, and geographic locations may affect how applicable the findings are. Time Limitations also a limitation which is possible that the study's one-year timeframe limited the breadth of findings that may be discovered. Over a longer times horizon, several dynamics and trends in big data analytics, the Internet of Things, and the digital supply chain might change. A longer period of study could yield a more complex understanding of these factors. Data Collection Method is a limitation for this study. Although the study used questionnaires to gather data, response bias may arise since self-reported data is used on a regular basis. It's possible that respondents' responses reflected their perceptions of expectations rather than the actual, objective world. A more comprehensive viewpoint might be provided by using a wider range of data collection techniques, such as empirical investigations or interviews. Industry-Specific Factors is also a limitation. The Malaysian food and beverage industry were the study's main emphasis. It is critical to understand that different sectors may have different elements affecting operational effectiveness. It is advisable to exercise caution when extrapolating these findings to other industries, keeping in mind the distinctive features of each one.

5.4 Recommendation

Future research projects could take into account the following to expand on the results of this study while improving improve our comprehension of how digital supply chain components affect operational performance. Comparative research across different industries may shed light on the ways in which different industries are affected differently by digital supply chain components. A more thorough understanding would result from examining the parallels and divergences between the Internet of Things and big data analytics' effects on operational performance. Longitudinal studies that extend over a period of time might document the changing relationship between digital supply chain components and operational performance, given the dynamic nature of corporate environments and technology. This method would offer a more profound comprehension of the long-term consequences and patterns. Through in-depth interviews or case studies, qualitative insights can be added to quantitative data to provide a more comprehensive knowledge of the ways in which digital supply chain aspects affect operational performance. Complicated viewpoints and contextual elements that may not be revealed by quantitative data exclusively may be found through qualitative research. Further research with a global view and a broader geographic focus may reveal regional differences in the effects of digital supply chain components on operational performance. This would add to an accumulation of understanding that is more broadly appropriate.

5.5 Conclusion

In summary, this study generated significant findings about the impact of digital supply chain elements, including big data analytics and the Internet of Things, on operational efficiency within Malaysia's food and beverage industry. The results point to a substantial correlation between these digital technologies and improved operational effectiveness. Considering these drawbacks, the findings advance to the expanding literature of research in this area. Understanding the complex relationships between technology adoption and operational effectiveness is crucial as industries continue to embrace digital transformation. The present study establishes a basis for upcoming businesses, promoting continuous investigation and evaluation of the dynamically changing landscape of digital supply chains and their influence on operational performance.

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Conflict of Interest

All authors declare that they have no conflicts of interest.

Author Contribution

The authors confirm contribution to the paper as follows: ***study conception and design****: K.Y.Q., and H.Z;* ***data collection****: K.Y.Q;* ***analysis and interpretation of results****: K.Y.Q,;* ***draft manuscript preparation****: K.Y.Q., and H.Z. All authors reviewed the results and approved the final version of the manuscript.*

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