JOURNAL OF TECHNOLOGY AND OPERATIONS MANAGEMENT

https://e-journal.uum.edu.my/index.php/jtom

How to cite this article:
Ahmad, M. F., Abdullah, H., Ahmad, A. N. A., Chan, S. W., Hamid, N. A., & Shahron, S. A. (2025). The relationship of digital transformation and value architecture towards business performance in manufacturing industry. *Journal of Technology and Operations Management*, *20*(1), 77-90. https://doi.org/10.32890/jtom2025.20.1.6

THE RELATIONSHIP OF DIGITAL TRANSFORMATION AND VALUE ARCHITECTURE TOWARDS BUSINESS PERFORMANCE IN MANUFACTURING INDUSTRY

[1]Md Fauzi Ahmad, [2]Huda Abdullah, [3]Ahmad Nur Aizat Ahmad, [4]Chan Shiau Wei, [5]Norhadilah Abdul Hamid, & [6]Syairah Aimi Shahron

[1,3,4,5]Faculty of Technology Management and Business, Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Batu Pahat, Johor, Malaysia

[2]Department of Electrical, Electronic and Systems Engineering, Universiti Kebangsaan Malaysia, 43600 UKM, 43600 Bangi, Selangor, Malaysia.

[6]School of Technology Management and Logistics, Sintok, 06010 Bukit Kayu Hitam, Kedah, Malaysia.

[1]Corresponding author: mohdfauzi@uthm.edu.my

Received: 13/11/2024 Revised: 12/12/2024 Accepted: 13/12/2024 Published: 31/1/2025

ABSTRACT

The digital economy has become a pivotal force driving nations towards enhanced competitiveness and customer value delivery, with Malaysia being no exception. Despite this imperative, the pace of digital adoption within Malaysian businesses trails considerably behind the global average. This research endeavours to elucidate the intricate relationship between digital transformation, value architecture, and business performance. Employing a quantitative methodology and random sampling technique, data was gathered through a survey questionnaire administered to 150 respondents from the manufacturing sector. Results revealed significant correlations between digital transformation, value architecture, and business performance. Notably, the manufacturing subsector emerges as a significant influencer on both digital transformation and business performance. These findings underscore the widespread acceptance of digital transformation and value architecture within the manufacturing industry as indispensable tools for augmenting business performance. Consequently, the manufacturing sector assumes a pivotal role in driving economic growth and societal advancement, characterized by employment expansion and export stimulation. Moreover, this study advocates for enhanced operational efficiency, aligning with Malaysia's strategic initiative, My Digital, aimed at catapulting the nation into a high-income, digitally-driven economy.

Keywords: Digital transformation, value architecture, business performance, manufacturing.

INTRODUCTION

In contemporary discourse, "manufacturing" encompasses the comprehensive chain of operations spanning from the initial design phase to the eventual production of finished goods. This modern paradigm of manufacturing encapsulates all requisite procedures for component production and seamless integration. Malaysia's manufacturing sector has experienced significant growth since the early 1980s, emerging as a cornerstone of the nation's economy, particularly in the realm of digitalization (UPEN, 2021). The impact of digitalization on society and the economy is profound, as evidenced by the transformative influence of social networks, smartphones, big data, the Internet of Things, and block chain technology (Khairuddin et al., 2018). These advancements empower firms to adapt their business models and operations, thereby creating enhanced value for customers and improving their overall business performance (Ahmad et al., 2013). Consequently, the imperative to transform business operations, goods, processes, and organizational structures becomes evident, enabling companies to establish effective management strategies to navigate these complex transitions, gain a competitive edge in the marketplace, and bolster long-term economic performance. As digital technology continues to expand, the ongoing process of digital transformation is anticipated to exert a significant influence on critical sectors of society, including transportation and logistics (Fellenstein & Umaganthan, 2019).

According to Ahmad et al. (2019), Digital transformation is the use of new digital technologies to make big changes to a business, like improving the customer experience, enhancing operation, or constructing new business models. Furthermore, according to (Ing et al., 2019), Business models are a "mediating construct between technology and economic value" and can be separated into value-creation and value-capture processes (Chan et al., 2018).

The business model defines operations that satisfy customers and describes how the operational business earns profit (Ahmad et al., 2015). The digital transformation also improves corporate resilience through exploitative and exploratory innovation through their processes and technologies to generate a standard of value, generating a customer experience and capturing values in companies (Zhang et al., 2021). The efficiency in delivering process outputs should be weighed against the company's bottom line to improve business procedures and boost business performance by adopting digital transformation and creating value for consumers. As mentioned above, these new value architectures—value creation, value delivery, value standard, and value capture—are well-developed and significant to digital transformation dimensions (Ghezzi & Cavallo, 2017). Author finds that there is not enough research on the value architecture of digital transformation in Asia and Malaysia, especially related to business performance. In general, scientific research into Digital Transformation is still in its early stages (Chanias et al., 2019), and studies that have been done on it are often overly optimistic about its potential. This is one reason why researchers have recently become interested in studying digital transformation in more depth.

Since April 2019, DOSM reported that manufacturing business performance dropped at 37.2% respectively and affected the manufacturing industries. Thus, UNIDO recommends industries to adopt the digital transformation that allowed manufacturers to create value creation process and improve business performance in manufacturing industries. However, according to Yapp (2020), Malaysian enterprises' readiness for digital transformation still in a moderate level as several industry leaders and observers believed that some of the manufacturing firms have made progress on their transformative journeys, but they are still falling behind their regional peers in terms of speed need improvements to be made. Yapp (2020) and Ahmad et al. (2016) reported that Albert Chai from CISCO recognizes that the industry in Malaysia is lack of skills in specialized IT industries such as Industry 4.0. On the other hand, Malaysia is

regarded as being much behind other countries in terms of the rapidly evolving technology-driven innovation (Tang, 2018).

According to the World Group Bank (2018) and Tiwari et al. (2019), the rate of digital adoption by businesses in Malaysia is much lower than the global average. Thus, Malaysia's government are determining to strengthen the digital economy to accomplish its 2030 Shared Prosperity Vision goals as The Malaysia's Digital Economy Blueprint aims to make it a digital hub by 2030. However, Malaysia's GDP ranked 39th behind China, India, and Brazil despite ranked 26th in IMD's digital competitiveness 2020 rankings. This is concerning since manufacturing companies like SME company business models must adapt to IR4.0. Therefore, by adopting digital technology in Malaysia's Manufacturing companies especially in SME sector, will boost their business performance and help to enhances country's GDP as well. Meanwhile, the current business models also do not place enough emphasize value architecture and digital transformation, which are digital business model weaknesses (Teece, 2018). Thus, organizations fail to meet customers' expectations regarding the value of their products and services because they do not emphasize value (Li, 2020). There are also numerous researchers were claimed that firms undergoing digital transformation have yet to achieve most of their short- and long-term value (Björkdahl, 2020). According to Pousttchi et al. (2019) and Ahmad et al. (2017), they stated that there is a limited research about the impact of digital transformation on businesses' value creation, operational efficiency, competitive advantage, and improved relationships.

LITERATURE REVIEW

Digital Transformation

The implementation of computer-based technologies throughout a company in terms of its products, processes, and strategies is one definition of what is referred to as "digital transformation." According to Omar (2019), businesses conduct digital transformation in order to improve their level of competitiveness by more effectively involving their workforces and catering to the needs of their customers. It can be said that the "Digital transformation" refers to the application of information and communication technology to develop fundamentally new capabilities in commercial and public sector organisations, as well as in private lives.

Business Model

The Business Model is crucial in identifying critical digital strategy aspects. It lets organisations apply a digital lens to Business Models to create new value as this process is still evolving (Ferreira et al., 2019). A new study by Udovita (2020) showed that digital transformation and its opportunities which it was created for Business Models, are only the beginning of the process. Therefore, according to the literature of Vaska et al. (2021), in the digital context, Business Models are a new unit of analysis to investigate how digital technologies affect the organisations to produce and deliver value. Business Model offers potential to capture profits in a networked system and improve corporate performance.

Processes

"Digitalization" uses digital technologies to transform a business model and create new profit and value. Implementing digital technologies and digitalized operation procedures is one method for measuring a company's digitalization (Kotarba, 2017). Industry 4.0 has led to technological advances in several domains, including business economics (Kotarba, 2017). New technologies have automated company

operations, increased productivity, and reduced operating costs. Digitizing manufacturing processes allows all production facilities to be merged into a single virtual fabrication facility (Schneider et al., 2021).

Customer Experience

Customer Experience or CX is a customer's internal, subjective reaction to any direct or indirect business engagement (Udovita, 2020). It is also known as the customer's "whole picture" of the business (Matt et al., 2015). Digital transformation helps firms improve customer experience. Companies must provide good customer experiences, not just offer products and services (Sahu et al., 2018). According to Sahu et al. (2018) and Omar et al. (2019), the customer dimension consists all processes, features, functions, and activities relevant to organisations' relationship with their customers.

Technologies

"Digital" refers to the fundamental aspects, features, characteristics, and capabilities of digital technology that companies and other organisations implement in their digital transformation elements (Sahu et al., 2018). According to the study, greater integration and utilization of digital technology may help organisations establish better features, capabilities, and procedures for customer processing, improving the customer experience and business performance. The E-mail, video conferencing, and other collaborative tools are required, but manufacturing companies must also adopt cloud computing, IoT, Big data, and data analysis to reduce operating expenses and inefficiency (Udovita, 2020). IoT, Robotics, Big Data, and Real-Time Analytics enable digital innovation. Implementing technology enables businesses make better decisions, build business relationships, and drive digital transformation (Matt et al., 2015).

Value Architecture

This part integrates the literature review's results to better understand the impact of digital technologies on value creation, value capture and value delivery in business models. The business model describes the value architecture as value creation, delivery, and capture in that process (Teece, 2018). A business model defines how a company gives value to clients, convinces them to pay for it, and turns those payments into profit (Fellenstein & Umaganthan, 2019).

Value Creation

Value creation describes consumer products and services in the Business Model. The digital transformation allows organizations to create new value by revising and expanding their product line (Nobeoka, 2018). Next digital transformation support organizations to understand customer demands and develop new value offering. Digital transformation is a particular kind of transformation that is driven by new technology and brings in distinctive changes in business operations, business processes, and value creation (Park & Kim, 2007).

Value Delivery

Value delivery refers to the operations and processes of a firm that deliver value to the customers of that company (Vaska et al., 2021). As a result of digital transformation, the processes and activities of an organization are susceptible to change. When companies enter a market, the roles of existing participants

in that market will undoubtedly change. The distribution of value is impacted when new companies enter the telecommunications market (Ghezzi & Cavallo, 2020).

Value Capture

Value capture is a value that can be extracted from the Business Model depends on the revenue model and how financially viable it is (Li, 2020). According to the assessment of relevant literature, digital transformation may present a number of new opportunities for businesses to reduce expenses while simultaneously increasing income (Vaska et al., 2021). By embracing new technologies and improving their level of customer intimacy, businesses can capture value on platforms as a result of digital transformation. Digital transformation also involves data-driven business activities and the creation of digital business models that capture value in new ways.

Value Standard

The Value Standard applies to value methodology concepts to industrial or consumer products, construction projects, manufacturing processes, business procedures, services, and business plans (June, 2007). Value from diverse user perspectives and a reduction in the complexity of understanding the role digital technologies, organisational changes, and capabilities play in adding value to the business standard (Sathananthan et al., 2020). When multiple digitalization projects adopt the same framework to assess benefits and costs, investment decision making in a firm becomes more standardised in creating value for customers and the organisation (Sathananthan et al., 2020).

Business Performance

Business performance can be defined as a corporation's ability to adapt to its corporate environment and market changes produced by competitors, customers, and other external variables that impact business operations. Besides, there are a variety of ways to define and evaluate the performance of a business, including profitability, growth, market value, total return on shareholder investment, economic value added, and customer satisfaction (Herciu, 2018). Business performance measures how a company's management utilizes its resources to accomplish its objectives and satisfy its stakeholders (Omar et al., 2019). Seng (2021) said that Malaysian manufacturing is regaining speed after a year of halts and starts leading due to the global health crisis. In today's competitive market, global competitiveness has pushed numerous companies to improve their manufacturing performance to meet consumer needs (MIDA, n.d.).

Hypotheses Development

The Relationship between Digital Transformations on Value Architecture

As digital transformation advances, firms should create and deliver value (Belmudes, 2019). Digital business model transformation is a framework that benefits customers and business owners (Osterwalder et al., 2010). Business Models evaluate how digital technologies impact company value creation and delivery. Digitalization includes using digital technologies in business (Omar et al., 2019). Digital technologies provide resource density, co-creation, and value capture (Hönigsberg et al., 2020). Digital Transformation of the customer experience can boost a company's revenue by 20 to 50% (Omar et al., 2019). Furthermore, the technology adoption has a strong connection to digital transformation in delivering

value to customers (Aloni et al., 2022). Customers can co-create value by customising goods, completing last-mile distribution tasks, and sharing product reviews. Therefore, the hypothesis is form as follows:
H1: *The digital transformation has a significant relationship with value architecture*.

The Relationship between Value Architecture on Business Performance

The values indicate the conditions that are crucial for evaluating business performance in the long term (Auliana, 2012). When an organisation and its rivals have resources that are comparable to one another, the development of a positional advantage and business performance can be achieved through the application of a competitive advantage-based strategy to a customer value perspective on the market or through market-based strategies (Herciu, 2018). According to Beckers et al. (2018), the value capturing, value delivering and value co-creation has given an impact to a firm's performance. A company that achieve value standard can maximize their profit and sustainability in their business processes (June, 2007). Thus, the following hypothesis is developed:
H2: *The value architecture has a significant relationship with business performance.*

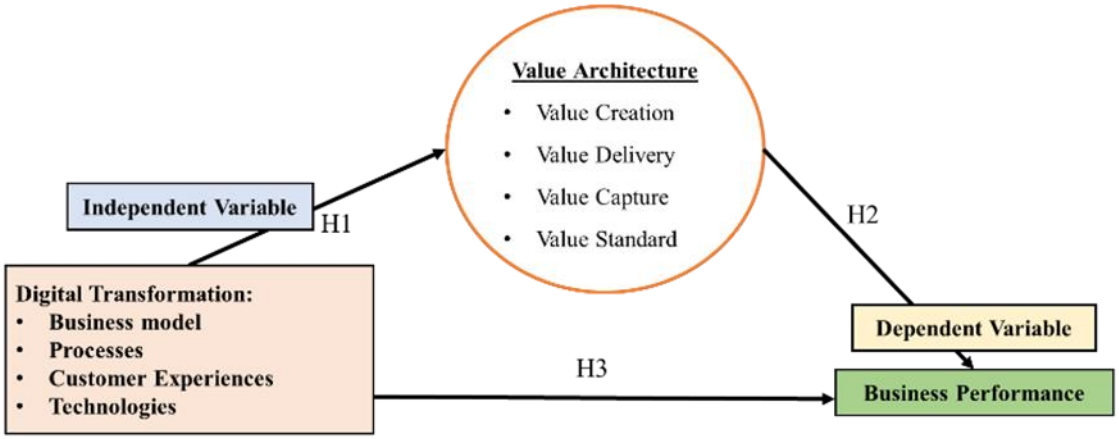
The Relationship between Digital Transformations on Business Performance

Digital transformation uses advanced technologies to improve a business's operations and performance (Fitzgerald et al., 2014). In addition, previous research also showed that cost reduction, operating efficiency improvement, and innovative thinking are Digital Transformation's transmission channels for business performance (Zhai et al., 2022). The digital transformation of business models has become a major component in business performance, identified a significant relationship between business model design (both novelty-centred and efficiency-centred) and performance (measured as stock market value). As a result of digital transformation, a business can evaluate its customers' values, which can give it a competitive edge and improve business performance (Chen et al., 2021). Some scholars have examined the relationship between digital technology use and business performance (Zhang et al., 2021). In addition, the Digital Transformation utilizes technology to create new business models, processes, and technological systems. This enhances income and customer satisfaction (Schwertner, 2021). Hence, the following hypothesis is developed.
H3*: The digital transformation has a significant relationship with business performance*

Research Framework

In addition, the effect of the market knowledge competence on business performance and value creation has a positive significant impact as shown Figure 1. There is a positive impact between value creation on business performance.

Figure 1
Research Framework



RESEARCH METHODOLOGY

Research Design

This study adopts a descriptive quantitative methodology, employing a survey questionnaire to elucidate the current status of implementation and correlations among variables. The research process unfolds systematically through six steps: problem identification, literature review, hypotheses development, research instrument design, data collection, data analysis, and results. Refer to Figure 2 in the appendix for a visual depiction of the research process flow. Primary data collection entails the distribution of a survey questionnaire to respondents. Utilizing online platforms such as email and Google Forms facilitates ease of distribution and response accessibility. Additionally, in-person distribution further supplements the dataset. Both online and in-person data are analysed to derive conclusive insights.

Sampling Design and Sample size

Sampling design involves several steps, including defining the target population, determining the sampling frame, selecting the sampling technique, and establishing the sample size. This study employs simple random sampling, ensuring each member of the population has an equal chance of selection. Following Krejcie and Morgan's guidelines, a minimum sample size of 140 companies is determined based on the estimated manufacturing workforce of 220 companies. Consequently, this study elicits 150 responses from manufacturing companies.

Questionnaire Design

The questionnaire in this study consists of three sections. Section A pertains to demographic information and comprises 10 items, including gender, age, race, educational background, position in the company, company size, ownership, work experience, manufacturing subsector, and company certification. Section B focuses on digital transformation and value architecture, while Section C delves into digital transformation dimensions and value architecture's impact on business performance. Nominal Scale is utilized for demographic questions in Section A, while a 7-point Likert Scale is employed to gauge the objectives of the study. The independent variable questions are derived from the dimensions of digital transformation (Verina & Titko, 2019), while mediator variable questions are formulated based on the

concept of value in digital transformation business models, known as Value Architecture (Teece, 2018). Dependent variable questions are developed to assess business performance.

RESULTS AND DISCUSSION

Demographic Analysis

This research surveyed 150 respondents from manufacturing companies. Among the respondents, 60.7% were men and 39.3% were women. In terms of age distribution, 28.7% fell within the 30-34 years old category, 17.3% were 40 years old, and none were in the 18-24 age group. The majority of respondents identified as Malay (48.7%), followed by Chinese (28%), and Indian (23.3%). 68% of respondents hold degrees, with none having SPM or Ph.D. qualifications. Regarding job roles, 24.7% of survey questionnaires were completed by production managers and engineering department managers, 22% by HR personnel, 20.7% by QA and QC staff, and 8% by CEOs. Regarding working experience, 31.3% of respondents had 6 to 10 years of experience, while the lowest percentage (6%) had 21 years or more. The companies involved varied in size, with 43.3% having 151 to 300 workers, 28.7% having 51 to 150 employees, and 28% having fewer than 50 employees. 34.7% of respondents worked in companies with MS ISO 9001 certification, while only 10.7% worked in companies with OSHAS 18001 certification. Additionally, 45.3% of respondents were from Malaysian-founded companies, and 22.7% were from Japanese companies. Finally, the majority of respondents were from the automotive industry (31.3%), followed by machinery (14%), and plastics (14.7%).

Reliability Test

Since all Cronbach alpha values were over 0.7, all variables in this study (Digital Transformation, Value Architecture and Business Performance) were acceptable for this research as shown in Table 1.

Table 1
Cronbach Alpha

Variables	Cronbach's Alpha Coefficient	No of items	Result
Digital Transformation			
I. Business Model (BM)	0.729	3	Acceptable
II. Processes (P)	0.882	3	Good
III. Customer Experience (CE)	0.867	3	Good
IV. Technologies (T)	0.791	3	Acceptable
Value Architecture			
I. Value Creation (VCr)	0.723	3	Acceptable
II. Value Capture (VCp)	0.773	3	Acceptable
III. Value Delivery (VD)	0.851	3	Good
IV. Value Standard (VS)	0.939	3	Excellent
Business Performance (BP)	0.910	6	Excellent

Normality Test

In this study, to conduct the normality test on Business Performance (BP), each element of digital transformation and value architecture was transformed into two variables, labelled DX and VA. The results of the Kolmogorov-Smirnov test applied to all variables in the study indicate that the data is not normally distributed, as the significance level is below 0.05, as detailed in Table 2. Consequently, the Spearman method was employed for further analysis.

Table 2

Normality Test

Tests of Normality			
	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
Business Performance	0.328	150	0.000
Digital Transformation	0.132	150	0.000
Value Architecture	0.225	150	0.000

Correlation Analysis

Based on the findings presented in Table 3, the variables of digital transformation and value architecture demonstrate a significant relationship with business performance. Specifically, as shown in Table 3, the results indicate a moderate positive relationship between the digital transformation variable and business performance (r=0.408, p-value=0.000<0.01). Additionally, the analysis reveals that the variables of value architecture exhibit positive relationship with business performance (r=0.352, p-value=0.000<0.01), as depicted in Table 3. Furthermore, the examination of the relationship between digital transformation and value architecture reveals positive correlation (r=0.365, p-value=0.000<0.01). Consequently, all hypotheses are accepted, given that all p-values were lower than the predetermined significance level. These findings align with the research conducted by Chen et al. (2021), which underscores the significant relationship between digital transformation and business performance.

Table 3

Spearman's Correlation Coefficient

Correlations					
			DX	VA_1	BP
Spearman's rho	DX	Correlation Coefficient	1.000	0.365**	0.408**
		Sig. (2-tailed)	.	0.000	0.000
		N	150	150	150
	VA_1	Correlation Coefficient	0.365**	1.000	0.352**
		Sig. (2-tailed)	0.000	.	0.000
		N	150	150	150
	BP	Correlation Coefficient	0.408**	.352**	1.000
		Sig. (2-tailed)	0.000	0.000	.
		N	150	150	150
**. Correlation is significant at the 0.01 level (2-tailed).					

Digital transformation common factors such as business model, processes, technologies and customer experience used in an organization to help the company effectively adapt with the industrial 4.0 and it is significance for Malaysia's manufacturing sector to be able to respond to the upcoming digital needs and demands (Kahrović & Avdović, 2021). This is due to the fact that the digital transformation, which centres on new value architecture, is a new way of conducting business and has the potential to lead to the development of new methods of producing, delivering, and capturing value (Sjödin et al., 2020). The process of change and innovation in business models, customer systems, and operations is made easier by digital transformation when viewed from the perspective of capabilities to improve business performance (Wang et al., 2022). Meanwhile, the value architecture provides the founder with support in understanding the current position of the company as well as the implications of any future decisions. In addition to this,

it assists in providing a better description of the business strategy and model used by the company in terms of deploying digital transformation in their business operations (Tutaj et al., 2021). Thus, this study has also shown the elements of digital transformation and value architecture in business performance are highly implemented in the organization especially in manufacturing industries. This result shows that all of the elements contribute in a good way for their organization, whether in terms of finances, customers, the company's internal business processes, technologies or the learning and expansion of the business.

CONCLUSION

This research also has determined the relationship between digital transformation and value architecture on business performance in manufacturing companies. It indicates that all hypotheses are significant and accepted. Therefore, the researcher concludes that digital transformation and value architecture can be a good approach to be implemented to the organization and business operation to ensure a good result to increase operations' visibility and efficiency, enabling companies to continue giving value to customers in terms of product quality, safety, or customer experiences. This study also helps companies to leverage their industry 4.0 technologies to keep maintain high performance and create digital economy in Malaysia and achieved the target in My Digital and The Malaysian Digital Economy Blueprint as well.

ACKNOWLEDGMENT

This research was supported by Ministry of Higher Education Malaysia (MOHE) through Fundamental Research Grant Scheme FRGS/1/2021/SS02/UTHM/02/4.

REFERENCES

Ahmad, M. F., N. Zakuan, A. Jusoh, M. S. M. Ariff, & J. Takala. (2013). Relationship amongst TQM, business performance, tools and techniques: Qualitative study result. In *2013 IEEE Business Engineering and Industrial Applications Colloquium (BEIAC)*, Langkawi, Malaysia: IEEE, Apr. 2013, pp. 22–27. https://doi.org/10.1109/BEIAC.2013.6560120

Ahmad, M. F., N. Y. Ting, N. H. M. Nor, C. S. Wei, M. F. Hassan, & N. A. Abdul Hamid. (2017). Comparative study of lean practices between Japanese and Malaysian automotive service centres: A survey result. *International Journal of Supply Chain Management*, 6(4), 1–10.

Ahmad, M. F., N. Zakuan, R. Zuraidah R M Rasi, & M. N. N. Hisyamudin. (2015). Mediator effect of TPM between TQM and business performance in Malaysia automotive industry. *IOP Conf. Ser.: Mater. Sci. Eng.*, 83, 012015. https://doi.org/10.1088/1757-899X/83/1/012015

Ahmad, M. F., N. Zakuan, & M. F. Mohammad. (2019). A study of green factory practices in Malaysia manufacturing industry. *International Journal of Supply Chain Management*, 8(1), 1–10.

Aloini, D., L. Latronico, & L. Pellegrini. (2022). The impact of digital technologies on business models. Insights from the space industry. *Measuring Business Excellence*, 26(1), 64–80. https://doi.org/10.1108/MBE-12-2020-0161

Avdović, A., & E. Kahrović. (2021). Impact of digital technologies on business performance in Serbia. *Management: Journal of Sustainable Business and Management Solutions in Emerging Economies*. https://doi.org/10.7595/management.fon.2021.0039

Beckers, S. F. M., J. Van Doorn, & P. C. Verhoef. (2018). Good, better, engaged? The effect of company-initiated customer engagement behavior on shareholder value. *Journal of the Academy of Marketing Science*, 46(3), 366–383. https://doi.org/10.1007/s11747-017-0539-4

Belmudes, J. (2019). The importance of digital transformation in your business strategy. *Santos Pereira, Carla Durão, Natercia Moreira, Fernando Veloso, Bruno*, 14(2), 1–26.

Björkdahl, J. (2020). Strategies for digitalization in manufacturing firms. *California Management Review*, 62(4), 17–36. https://doi.org/10.1177/0008125620920349

Chan, S. W., et al. (2018). Comparative study of product quality perception between Malaysian and Non-Malaysian electrical appliance among tertiary students. *International Journal of Supply Chain Management*, 7(3), 12–20.

Chanias, S., S. Myers, M. D., & Hess, T. (2019). Digital transformation strategy making in pre-digital organizations: The case of a financial services provider. *The Journal of Strategic Information Systems*, 28(1), 17–26.

Chen, C. L., Y. C. Lin, W. H. Chen, C. F. Chao, & H. Pandia. (2021). Role of government to enhance digital transformation in small service business. *Sustainability (Switzerland)*, 13(3), 1–26. https://doi.org/10.3390/su13031028

Fellenstein, J., & Umaganthan, A. (2019). Digital transformation: How enterprises build dynamic capabilities for business model innovation: A multiple-case study within the logistics and transportation industry. *Independen*, 81.

Ferreira, J. J. M., C. I. Fernandes, & F. A. F. Ferreira. (2019). To be or not to be digital, that is the question: Firm innovation and performance. *Journal of Business Research*, 101(June), 583–590. https://doi.org/10.1016/j.jbusres.2018.11.013

Fitzgerald, M., N. Kruschwitz, D. Bonnet, & M. Welch. (2014). Embracing digital technology a new strategic imperative: Findings from the 2013 Digital Transformation Global Executive Study and Research Project.

Ghezzi, A., & Cavallo, A. (2020). Agile business model innovation in digital entrepreneurship: Lean startup approaches. *Journal of Business Research*, 110, 519–537. https://doi.org/10.1016/j.jbusres.2018.06.013

Hönigsberg, S., B. Dinter, & H. Wache. (2020). The impact of digital technology on network value co-creation. *Proceedings of the Annual Hawaii International Conference on System Sciences*, 2020, 5233–5242. https://doi.org/10.24251/hicss.2020.643

Ing, T. S., T. C. Lee, S. W. Chan, J. Alipal, & N. A. Hamid. (2019). An overview of the rising challenges in implementing industry 4.0. *International Journal of Supply Chain Management*, 8(6), 1–10.

Kahrović, E., & Avdović, A. (2021). Impact of digital technologies on business performance in Serbia. *Management: Journal of Sustainable Business and Management Solutions in Emerging Economies*, March. https://doi.org/10.7595/management.fon.2021.0039

Khairuddin, M. M., N. A. A. Rahman, M. F. Mohammad, Z. A. Majid, & F. Ahmad. (2018). Regulator perspective on halal air cargo warehouse compliance. *International Journal of Supply Chain Management*, 7(3), 18–25.

Kotarba, M. (2018). Measuring digitalization-key metrics. *Foundations of Management*, 9(1), 123–138. https://doi.org/10.1515/fman-2017-0010

Lina, A. (2012). The impact of value creation on business performance: The case of small and medium business in West Java. *Jurnal Sosial Politik*, 2(1), 10–19.

Li, F. (2020). The digital transformation of business models in the creative industries: A holistic framework and emerging trends. *Technovation*, 92–93, 1–12.

Matt, C., T. Hess, & A. Benlian. (2015). Digital transformation strategies. *Business and Information Systems Engineering*, 57(5), 339–343. https://doi.org/10.1007/s12599-015-0401-5

MIDA. (2020). Manufacturing sector grew at quicker pace in December. *Malaysian Investment Development Authority*.

Nobeoka, K. (2018). Value creation and value capture at manufacturing firms: Importance of non-functional value. *International Journal of Business*, 39, 39.

Omar, S. S., R. Ramlan, S. W. Chan, & T. Otcenaskova. (2019). Entrepreneurial learning factors on e-commerce adoption of a small sized service-based company in Johor Malaysia. In *Proceedings of the 33rd International Business Information Management Association Conference, IBIMA 2019: Education Excellence and Innovation Management through Vision 2020*, 1–10.

Osterwalder, A., Y. Pigneur, A. Smith, & T. Movement. (2009). *You're holding a handbook for visionaries, game changers, and challengers striving to defy outmoded business models and design tomorrow's enterprises*. 1-50.

Park, J., & Y. Kim, J. (2022). Methodology for data analysis of digital transformation. *United Nations ESCAP, Information and Communications Technology and Disaster Risk Reduction Division*.

Pousttchi, K., A. Gleiss, B. Buzzi, & M. Kohlhagen. (2019). Technology impact types for digital transformation. In *Proceedings - 21st IEEE Conference on Business Informatics, CBI 2019*, 1, 487–494. https://doi.org/10.1109/CBI.2019.00063

Schneider, G., S. Keil, & F. Lindner. (2021). Benefits of digitalization for business processes in semiconductor manufacturing. In *Proceedings of the IEEE International Conference on Industrial Technology, vol. 2021-March*, 1027–1033. https://doi.org/10.1109/ICIT46573.2021.9453611

Sahu, N., H. Deng, & A. Mollah. (2018). Investigating the critical success factors of digital transformation for improving customer experience. In *Proceedings of the International Conference on Information Resources Management (Conf-IRM 2018)*, 1–13.

Sathananthan, S., D. Gamrad, & J. Myrzik. (2020). Digital value dependency framework for digital transformation. In *ICEIS 2020 - Proceedings of the 22nd International Conference on Enterprise Information Systems, vol. 2*, 643–655. https://doi.org/10.5220/0009316106430655

Schwertner, K. (2021). The impact of digital transformation on business: A detailed review. In *Strategic Management in the Age of Digital Transformation*, 1–29. https://doi.org/10.51432/978-1-8381524-3-7_1

Teece, D. J. (2018). Business models and dynamic capabilities. *Long Range Planning*, 51(1), 40–49. https://doi.org/10.1016/j.lrp.2017.06.007

Teece, D. J. (2018). Profiting from innovation in the digital economy: Enabling technologies, standards, and licensing models in the wireless world. *Research Policy*, 47(8), 1367–1387. https://doi.org/10.1016/j.respol.2017.01.015

Tang, V. (2018). Digitalising manufacturing industries. *The Straits Times*.

Tiwari, S., C. S. Wei, & M. F. Mubarak. (2019). Sustainable procurement: A critical analysis of the research trend in supply chain management journals. *International Journal of Business Performance and Supply Chain Modelling*, 10(3), 1–10. https://doi.org/10.1504/IJBPSCM.2019.100855

Tutaj, J., M. Rutkowska, & P. Bartoszczuk. (2021). Enterprise business architecture as a tool for sustainable development in an enterprise - Case study. *Procedia Computer Science*, 192, 5050–5057. https://doi.org/10.1016/j.procs.2021.09.283

Udovita, P. V. M. V. D. (2020). Conceptual review on dimensions of digital transformation in modern era. *International Journal of Scientific and Research Publications (IJSRP)*, 10(2), p9873. https://doi.org/10.29322/ijsrp.10.02.2020.p9873

Verina, N., & J. Titko. (2019). Digital transformation: Conceptual framework. *CIBEMEE*, May. https://doi.org/10.3846/cibmee.2019.073

Wang, H., W. Cao, & F. Wang. (2022). Digital transformation and manufacturing firm performance: Evidence from China. *Sustainability (Switzerland)*, 14(16), 1–18. https://doi.org/10.3390/su141610212

World Group Bank. (2018). *The World Bank Annual Report*.

Yang, Z., & R. Liu. (2020). The impact of digital transformation on the business model innovation of small and medium enterprises in China. *Journal of Small Business and Enterprise Development*, 27(3), 489–507. https://doi.org/10.1108/JSBED-01-2019-0037

Yapp, E. (2020). Malaysia's digital transformation efforts progress. *ComputerWeekly.com*.

Yudono, S., & A. Kosaka. (2021). Digital transformation in the manufacturing sector: A case study of small and medium-sized enterprises in Japan. *Procedia Computer Science*, 180, 2046–2054. https://doi.org/10.1016/j.procs.2021.01.236

Zandi, M., & M. S. M. T. Azam. (2021). The role of digital transformation in improving supply chain resilience: Evidence from the automotive industry. *International Journal of Supply Chain Management*, 10(6), 1460–1469. https://doi.org/10.1108/IJSCM-03-2021-0159

Zhang, J., J. Long, & A. M. E. von Schaewen. (2021). How does digital transformation improve organizational resilience? Findings from pls-sem and fsqca. *Sustainability (Switzerland)*, 13(20), 1–22. https://doi.org/10.3390/su132011487

Zhang, Y., & X. Chen. (2020). Corporate innovation and digital transformation in the business-to-business (B2B) service sector. *Service Industries Journal*, 40(3-4), 213–235. https://doi.org/10.1080/02642069.2020.1712960

Zhao, L., & S. Chen. (2020). Digital transformation in Chinese enterprises: Challenges, opportunities, and strategies. *Journal of Business Research*, 116, 282–292. https://doi.org/10.1016/j.jbusres.2020.05.028

Zheludkov, A., & O. Tamosiuniene. (2019). The influence of digitalization on business models in the service industry. *Journal of Open Innovation: Technology, Market, and Complexity*, 5(4), 1–17. https://doi.org/10.3390/joitmc5040095

Zhu, K., & T. W. Anderson. (2021). Strategies for digital transformation in the industrial sector: Challenges and opportunities. *Technological Forecasting and Social Change*, 167, 120687. https://doi.org/10.1016/j.techfore.2021.120687