

# An Artificial Intelligence-Based Sustainable Halalan Toyyiban Supply Chain Knowledge Dissemination System: The Conceptual Model

Mohd Misron Omar<sup>1\*</sup>, Hezlin Shadan<sup>2</sup>, Romiza Md Akhir<sup>3</sup>, M. Faris M. Misron<sup>4</sup>

<sup>1</sup>Sunway Business School, Sunway University, 47500 Bandar Sunway, Selangor, Malaysia

<sup>2</sup>Malaysia Institute of Transport (MITRANS), Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia

<sup>3</sup>The Y's Kitchen (Threewise Enterprise), 68000 Ampang, Selangor, Malaysia

<sup>4</sup>UNITAR International University, 47301 Petaling Jaya, Selangor, Malaysia

Corresponding author's e-mail address: [misrono@sunway.edu.my](mailto:misrono@sunway.edu.my)

## ARTICLE INFO

### Article history:

Received: 13 January 2025

Revised: 20 March 2025

Accepted: 30 May 2025

Online first

Published : 1 August 2025

### Keywords:

Artificial intelligence

Sustainable halalan toyyiban

HTSC

Supply chain

Knowledge dissemination system

<http://doi.org/10.24191/jikm.v15iSI2.8291>

## ABSTRACT

The issue involving non-halal products, claimed to be halal has been circulated in the Muslim market and remains unsolved. It would always link to how supply chain management (SCM) may incorporate sustainability and Halalan Toyayiban (HT). Knowledge is the main resource and essential for the organisation and people. Unsuccessfully disseminating knowledge to ensure adherence to the standards of HT across all stakeholders needs to be resolved immediately. This is only a concept paper; hence the purpose of this paper is to reveal that SCM would utilize artificial intelligence (AI), to successfully disseminate knowledge and taking advantage of advanced technology, big data and users. The initial concept was developed by use of a literature review of the AI-based Sustainable Halalan Toyayiban Supply Chain Knowledge Dissemination System (AiBas-HalaToyib-SCKnoDeS). The key concept can be used by organizations in developing AiBas-HalaToyib-SCKnoDeS. The result of AiBas-HalaToyib-SCKnoDeS is an interesting area for future research. However, the current concept of value underlies its offering organizations as a starting point. This conceptual model fills important gaps in ethical and sustainable supply chain management that are in line with Halalan Toyayiban's requirements, laying the groundwork for further study and real-world application.

## INTRODUCTION

The fact that Muslim consumers in the Muslim majority population country, the issue of Halal supposedly is not a major concern (MYC, 2025; The Sun, 2025). The specific rules and regulations are upheld by the

Muslims but there is a situation that could not be determined (FMT, 2025; Ziegler et al., 2023). This would cause HT status dubiousness in the supply of goods for consumers, especially food (NST, 2025). The Halalan Toyyiban Supply Chain (HTSC) is regarded as 'Syumul' (Comprehensive) framework that amalgamates the Islamic principles of permissibility (halal) and quality (Toyyiban) in handling goods and services throughout the supply chain. It guarantees that goods are manufactured, handled, and delivered in accordance with Shariah law, placing a great emphasis on both legal sourcing and the end products' ethical, safe, and healthful criteria (Ahmad et. al., 2024; Shadan, 2023). The HTSC focuses on sustainability, traceability, and transparency across a product's lifecycle, which includes sourcing, production, storage, transportation, and delivery (Ahmad et. al., 2024; Shadan, 2023; Zulfakar, Anuar, & Ab Talib, 2014).

"Toyyiban" complements "Halalan" by demanding that goods be pure, safe, and advantageous to customers, while "Halalan" guarantees that all materials and procedures comply with Islamic dietary regulations and ethical norms (Shadan, 2023; Omar et al., 2013). This dual compliance meets the growing demand for ethical and environmental activities worldwide while also fostering consumer trust (Talib et al., 2017). In the food, medicine, and cosmetics industries, where maintaining quality and compliance is crucial, the incorporation of HTSC principles is crucially important. The adaptation of Toyyiban concepts is not only for the Muslims but also for other religions when it comes to pure, safe, clean and wholesome. The example of HT adaption was implemented by Japan during the Olympic Games 2020 (90degreeasia, 2020).

The increasing of the Muslim's world population in 2024 is approximately 1.9 billion in the year 2024 equivalent to 24.1% of the world's population (World Bank, 2024). In addition to that, Muslims are the majority in 49 countries. It shows that the demands for the legitimate Halalan Toyyiban Supply Chain (HTSC) is highly needed by the Muslim population (Mukti et. al., (2024).

According to the 2020 Malaysian census, the percentage of 63.5% of the country's population are Muslims. A report by the largest private-sector economic association in Malaysia, the Federation of Malaysian Manufacturers (FMM), stated that FMM represents thousands of manufacturing and industrial service companies including food, medicine and cosmetics (FMM, 2024).

Thus, to ensure the sustainable Halalan Toyyiban Supply Chain is adhered, the consumers would be able to verify the origin and movement of the product easily (Latif et. al, 2023). Accordingly, based on ongoing research, this study access Halalan Toyyiban Supply Chain using the Home-Based Food industry as the case study. This paper identifies Sustainable Halalan Toyyiban Supply Chain critical control point in the knowledge dissemination of the small business industry.

## **BACKGROUND OF STUDY**

This paper does not discuss the concept of HTSC, if the earlier section addressed the general understanding of HTSC. AiBas-HalaToyib-SCKnoDeS is an application that could benefit especially consumers in ensuring the relevant parties adhere to the HT implementation. Moreover, in tackling the sustainable HT issues along the supply chain, this research focuses on the Small Business of the Home Food industry. The objective for choosing the Small Business Home Food industry is subject to the limited manpower utilization to monitor the supply chain process. Leveraging on AiBas-HalaToyib-SCKnoDeS would give a competitive advantage to the consumers equivalent to the business owner with limited resources. As HT is the main concern, that could not be compromised, AiBas-HalaToyib-SCKnoDeS is vital. Due to the lengthy analysis, this paper only covers the analysis conducted for the Small Business Home Food industry.

## **LITERATURE REVIEW**

The AI integration into SCM has revolutionized operations, enabling better decision-making, enhanced efficiency, and improved transparency (Hasnan et al., 2024). From the HTSC context, the application of AI is particularly relevant, as it addresses the dual requirement of adhering to Islamic principles (Halal) and ensuring safety, quality, and sustainability (Toyyiban).

### **Halalan Toyyiban Supply Chain and Knowledge Dissemination**

The Halalan Toyyiban Supply Chain requires strict compliance with Shariah principles and ethical standards, demanding robust mechanisms for traceability, transparency, and collaboration across stakeholders (Zulfakar, Anuar, & Ab Talib, 2014). Effective knowledge dissemination is crucial for aligning stakeholders' practices with HTSC principles. However, the current lack of integrated systems that combine knowledge sharing with compliance monitoring has been identified as a critical gap (Talib, Zailani, & Ahim, 2017).

The application of AI in developing a Sustainable Halalan Toyyiban Supply Chain Knowledge Dissemination System proposed a solution to address the challenges of compliance, transparency, and sustainability. By integrating AI technologies, future systems can enable real-time monitoring, effective knowledge sharing, and enhanced collaboration, ensuring alignment with Halalan Toyyiban principles. Further research should focus on developing and validating conceptual models for practical implementation.

### **Role of Artificial Intelligence in Supply Chains**

Utilizing AI technologies, including the adaptability of machine learning, natural language processing, and blockchain, have been instrumental in enhancing supply chain operations. The mentioned technologies would be used to facilitate real-time data analysis, predictive insights, and automation, which are essential for managing complex supply chains (Ivanov & Dolgui, 2020). In the HTSC, AI can be leveraged to monitor compliance with Halalan Toyyiban standards, ensuring traceability and transparency (Rahman et al., 2021).

### **Sustainable Supply Chain Practices**

Sustainability in supply chains has gained prominence due to increasing environmental concerns and consumer demand for ethical products. Integrating sustainability with HTSC principles requires innovative approaches to reduce waste, optimize resource use, and ensure ethical sourcing (Ab Talib et al., 2020). AI-driven systems can enhance sustainability by providing real-time monitoring and predictive analytics, supporting decision-making that aligns with both environmental and Halalan Toyyiban standards.

### **Knowledge Dissemination Systems**

The effectiveness of a supply chain depends on seamless knowledge dissemination among stakeholders. AI-based knowledge dissemination systems utilize advanced algorithms to deliver personalized, real-time information to stakeholders, enabling better compliance and decision-making (Xu et al., 2021). In the HTSC, such systems can ensure that all parties are informed about current standards, regulations, and best practices, reducing the risk of non-compliance.

## **METHODOLOGY**

The Methodology for developing a conceptual model for an Artificial Intelligence-Based Sustainable Halalan Toyriban Supply Chain Knowledge Dissemination System started through problem identification and requirement analysis. A comprehensive review of Halalan Toyriban principles and sustainability requirements was conducted. It identified key challenges in current supply chain knowledge dissemination (Handayani et al., 2024). An engagement with stakeholders (e.g. consumers, buyers, sellers) to gather requirements.

The qualitative method is selected since the AiBas-HalaToyib-SCKnoDeS due to less attention in management literature. Generative research is a qualitative research methodology aimed at uncovering user's problems and discovering new opportunities for innovative solutions (Sanders, & Stappers, 2012). The lack of availability of the AI-based Sustainable Halalan Toyriban Supply Chain Knowledge Dissemination System is a major disadvantage to consumers. The disruption involves the coordination and cooperation among Halal stakeholders. The issue must be solved by creating a conceptual diagram using generative AI with the prompt "Conceptual Diagram for AI-Based Sustainable Halalan Toyriban Supply Chain Knowledge Dissemination System." The diagram output is as follows: -

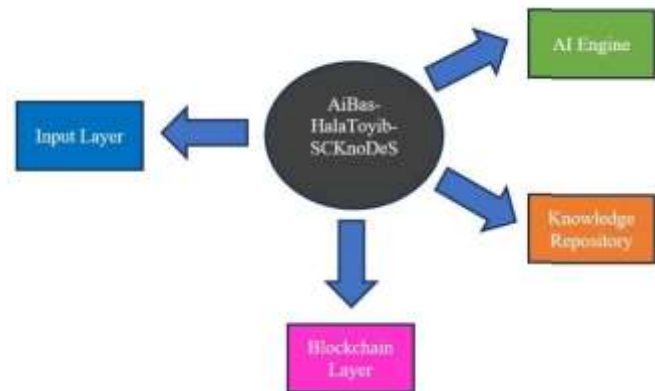


Figure 1: AiBas-HalaToyib-SCKnoDeS Conceptual Model

## THE PROPOSED MODEL

The proposed model integrates AI technologies into the Halalan Toyriban Supply Chain (HTSC) to ensure compliance with Islamic principles (Halal), quality and safety (Toyyiban), and sustainability. The system focuses on knowledge dissemination across stakeholders, ensuring transparency, traceability, and efficiency (Jackson et al., 2024).

### Key Components

The main function from the input layer of AiBas-HalaToyib-SCKnoDeS is to collect and aggregate big data from stakeholders within the supply chain such as the main suppliers, producers, transporters, regulatory bodies and consumers (Islam, et al., 2023). The big data comprises of crucial information in ensuring compliances with HT principles and sustainability standards such as Halal certifications status and compliances, quality audit assessment, environmental impact report (location), details of productions and logistics information (Rahman et al., 2021). Furthermore, it is very important to maintain transparency and traceability with the cycle of the supply chain itself. The utilization of IoT and mobile technologies would

capture big data in a real time environment. For instance, the usage of mobile applications can be used to ensure the products meet the HT standards (Ali et al., 2020). System integration would allow big data to be accessed by the users to decide in a timely manner and accurately. It serves as a foundation for fast decision making and continuous improvement of the HTSCM.

The AI engine is the most vital component for AiBas-HalaToyib-SCKnoDeS. The main function of AI engine is to process, analyses and disseminate all actionable insights retrieve from the SC big data, including extracting and disseminating. It utilizes the Natural language Processing (NLP) to analyze related documents such as regulatory documents, industry standards and guidelines and certification requirements (Dossou et al., 2024). NLP contributes to extracting and disseminating information and knowledge in ensuring HT principles is compliance (Zaina et al., 2022). Furthermore, the compliance monitoring could be done through machine learning tools models when analyzing SC processes and detecting product data for non-compliance cases (Khan et al., 2021). The AI engine would incorporate predictive analytics to leverage on historical and real time data for potential risks forecasting where preventive measures can be done earlier (Ahmad & Ibrahim, 2020).

The main function of the blockchain layer is to enhance transparency, traceability, and compliance of HTSC through decentralized and unchanging record management system (RMS) or immutable RMS. The advantage of the blockchain technology is the ability to trace end-to-end tracking of the subjects across the SCM in ensuring all stages from sourcing to distribution are mandatorily recorded and cannot be altered nor tampered (Kim & Alzubi, 2024). The immutable RMS would gain trust among the stakeholders due to verifiable proof of product ethnicity and HT compliances (Rahman et al., 2021). Hence, it would ensure that all SC flows are accordance with the Islamic principles and sustainability requirements, plus fostering consumer confidence (Ali et al., 2020). Other than that, it would eliminate the needs for intermediaries' involvement, minimize human errors, and increase operational efficiency (Hassan et al., 2022). As a result, the integration between blockchain and HTSC not only ensuring compliances and accountability but also lead to sustainability goals in term of ethical sourcing and reducing risks of fraud.

The function of the knowledge repository is to centralize the storage system. It consolidates all the important information of HT standards not only from Malaysia but also from other recognized foreign halal certification bodies and authorities (Myehalal, 2024). This would ensure the HT standards and sustainability flows within SC is adhered. Not only functioning as the digital library, but it also serves as storage for critical documents such as guidelines, certifications, best practices and regulatory requirement based on Islamic principles and sustainability objectives (Dolgui & Ivanov, 2024). As a single legitimate checkpoint, it provides easy access, accurate, and updated information for the stakeholders (Ahmad et al., 2021). It would benefit the organization where it aligns their operations with HT principles for ensuring product integrity and ethical compliance. The additional function would be continuous online learning and improvement by incorporating best practices from the major industry players (Rahman & Hassan, 2020). AI integration within the knowledge repository would enhance search and recommendations functionalities to enable users to retrieve relevant knowledge based on their needs (Ali et al., 2022). This would also give an advantage to JAKIM in combating the unauthorized use of their halal logo and certifications.

## CONCLUSION

The sustainable HT issues along the supply chain resulted in an uncomfortable situation among stakeholders. The recent incident involving the so-called 'flying containers syndicate' involving 100 companies where the shipping forwarding agents paid bribes to the rogue customs officers (NST, 2024) had compromised the HT Supply Chain. Recent incidents in Malaysia's most prestigious university involving 'Hams sandwiches' with a Halal logo have created public tension plus a loss of people's trust towards government agencies.

The need for comprehensive AiBas-HalaToyib-SCKnoDeS is to ensure the HT principles are adhered to. The flying containers case is an example where accountable people have been involved in corruption. When corruption happens, any rules, regulations, principles and morality are jeopardized. Although the usage of AiBas-HalaToyib-SCKnoDeS could not guarantee a 100% of SHTSC compliance, the initiative would tally with the Malaysia Madani policy framework (PMO, 2023). The Halal GDP value that contributed to Malaysia's economy, exists because of Muslims' belief towards HT. It should be guarded carefully to sustain its value (YCP, 2024) especially in the country as Malaysia where the majority are Muslims.

The establishment of the National AI Office (NAIO) by the government of Malaysia in August 2024, would spearhead Malaysia's AI agenda (MyDigital, 2024). The Applied AI in the Transportation sector of NAIO, could be used to transform Malaysian industries to the next level (NAIO, 2024).

This research underscores the importance of developing an AI-based Sustainable Halalan Toyiban Supply Chain Knowledge Dissemination System for current usage. The proposed conceptual model is meant to be further extended. It has the potential to overcome challenges in ensuring the high impact of the SHTSC.

## ACKNOWLEDGEMENT

The researchers would like to extend Sunway University, Universiti Teknologi MARA (UiTM), UNITAR International University and The Y's Kitchen for providing the necessary support throughout the conduct of the study.

## REFERENCES

- Ab Talib, M. S., et al. (2020). Halal supply chain critical success factors: A literature review. *Journal of Islamic Marketing*, 11 (6), 1665-1685.
- Ahmad, J., Widayatmoko & Md Taib, F. (2024). Enhancing Malaysia's halal brand identity: insights and strategies for sustainable global halal hub. *Kajian Malaysia*, Vol. 42, No.2, 2024, 73-94.
- Ahmad, R., Ismail, N., & Wahid, M. (2021). Centralized knowledge management for Halal SC: A sustainable approach. *Journal of Halal Research*, 9(2), 112-125.
- Ahmed, S., & Ibrahim, Y. (2020). Predictive analytics in Islamic SCM. *International Journal of Supply Chain Management*, 9(3), 112-124.
- Ali, S. M., Zulkifli, N., & Rahman, M. (2022). Leveraging AI in Halal supply chain knowledge repositories. *Sustainability*, 14(3), 1876.
- Dolgui, A., & Ivanov, D. (2024). Internet behaviors: Conceptual model, practical and theoretical implications for supply chain and operations management. *International Journal of Production Research*. <https://doi.org/10.1080/00207543.2024.2372008>.
- Dossou, P. E., Alvarez-de-los-Mozos, E., & Pawlewski, P. (2024). A conceptual framework for optimizing performance in sustainable supply chain management and digital transformation towards industry 5.0. *Mathematics*, 12(17). <https://doi.org/10.3390/math12172737>
- Farooq, M., Bashir, R., & Latif, K. (2021). Optimization strategies for sustainable Halal supply chains. *Sustainable Supply Chain Review*, 15(2), 75-91.
- FMM, (2024). The FMM. <http://https://www.fmm.org.my/> [cited 12 December 2024].

- FMT, (2025). Halal certification of meat doesn't apply to entire sandwich, says Jakim. Retrieved: <https://www.freemalaysiatoday.com/category/nation/2025/01/16/halal-certification-of-meat-doesnt-apply-to-entire-sandwich-says-jakim/>.
- Handayani, D. I., Masudin, I., Susanty, A., & Anna, I. D. (2023). Modeling of halal supplier flexibility criteria in the food supply chain using hybrid ISM-MICMAC: A dynamic perspective. *Cogent Engineering*, 10(1). <https://doi.org/10.1080/23311916.2023.2219106>
- Hasnan, N., Kohda, Y., & Saad, S. (2024). Mapping the future of Halal supply chain management: A biblioshiny R application. *Paper Asia*, 40(1), 39–50. [https://doi.org/10.59953/paperasia.v40i1\(b\).46](https://doi.org/10.59953/paperasia.v40i1(b).46)
- Hassan, R., Yusuf, M., & Khan, N. (2022). Smart contracts in the Halal industry: A blockchain-based approach. *International Journal of Supply Chain Management*, 10(1), 120-135.
- Islam, M. S., Hoque, I., Rahman, S. M., & Salam, M. A. (2023). Evaluating supply chain resilience using supply chain management competencies in the garment industry: a post COVID analysis. *Journal of Industrial and Production Engineering*, 40(5), 323–342. <https://doi.org/10.1080/21681015.2023.2197907>
- Ivanov, D., & Dolgui, A. (2020). Viable supply chain model: Integrating agility, resilience, and sustainability perspectives—Lessons from COVID-19. *International Journal of Production Research*, 58(10), 2904–2915.
- Jackson, I., Ivanov, D., Dolgui, A., & Namdar, J. (2024). Generative artificial intelligence in supply chain and operations management: a capability-based framework for analysis and implementation. *International Journal of Production Research*, 62(17), 6120–6145. <https://doi.org/10.1080/00207543.2024.2309309>
- Khan, R., Abdul, H., & Noor, S. (2021). Machine learning applications in Halal logistics compliance. *Sustainability*, 13(9), 4207.
- Kim, S.-Y., & AlZubi, A. A. (2024). Blockchain and artificial intelligence for ensuring the authenticity of organic legume products in supply chains. *Legume Research - An International Journal*. <https://doi.org/10.18805/lrf-786>
- Latib, L., Wan Hassan, W. A., Raja Lope Ahmad, R. M. T., Marjudi, S., & Megat Mohd Zainuddin, N. (2023). Verification of Halal supply chain implementation framework for small and medium enterprises. *Selangor Science & Technology Review (SeSTeR)*, 7(2), PREPRINT. Retrieved from <https://sester.journals.unisel.edu.my/ojs/index.php/sester/article/view/327>.
- Mukti, K. T., et. al., (2024). Halal traceability model using cld approach to supply chain management of food and beverage packaging for msme products in Serang City using blockchain technology. *Proceedings of the 2nd International Conference on Management and Business (ICOMB 2023)*.
- MYC, (2025). Universiti Malaya shuts down convenience stores over allegations of selling non-halal ham sandwiches. Retrieved: <https://www.myc.my/articles/4060/universiti-malaya-shuts-down-convenience-stores-over-allegations-of-selling-non-halal-ham-sandwiches>

- MyDigital, (2024). National AI Office. <https://www.mydigital.gov.my/initiatives/the-national-ai-office-naio/> [cited 12 December 2024].
- Myehalal, (2024). Recognized foreign halal certification bodies and authorities. Retrieved: - <http://myehalal.halal.gov.my>.
- NAIO, (2024). Applied AI. <https://ai.gov.my/applied-ai> [cited 12 December 2024].
- NST, (2024). MACC identifies over 100 companies in the 'flying container' case. <http://https://www.nst.com.my/news/crime-courts/2024/06/1063580/azam-baki-macc-identifies-over-100-companies-flying-container-case>. [cited 12 December 2024].
- NST, (2025). KPDN cracks down on non-halal sandwich at UM stores. Retrieved: <https://www.nst.com.my/news/nation/2025/01/1160294/kpdn-cracks-down-non-halal-sandwich-um-stores>.
- PMO, (2023). Malaysia MADANI. <https://www.pmo.gov.my/ms/membangun-malaysia-madani-2/>. [cited 12 December 2024].
- Rahman, M. A., Omar, N. A., & Karim, M. S. (2021). Blockchain for Halal supply chain traceability: Challenges and opportunities. *Journal of Islamic Marketing*, 12(3), 589-606.
- Rahman, M. T., & Hassan, S. A. (2020). Ensuring compliance through knowledge management in the Halal industry. *International Journal of Supply Chain Management*, 8(4), 98-110.
- Rahman, S. A., et al. (2021). AI and blockchain technologies for Halal logistics in ensuring traceability: A systematic review. *Journal of Cleaner Production*, 311, 127627.
- Sanders, E. B. N., & Stappers, P. J. (2012). *Convivial toolbox: Generative research for the front end of design*. BIS Publishers.
- Shadan, Hezlin (2023) Development of a Halalan Toyayiban warehouse performance measurement system model. PhD thesis, Universiti Teknologi MARA (UiTM).
- Shadan, H., Shariff, S. R., Abidin, Z., S. A. S., & Nasir, S. (2023). Chapter 17 - The development of Halalan Toyayiban warehouse performance measurement system model and its usability. *Innovation of Food Products in Halal Supply Chain Worldwide*, 205-219.
- Talib, M. S. A., Zailani, S., & Ahim, M. A. (2017). Halal logistics: Practices, integration, and performance of logistics service providers. *Journal of Islamic Marketing*, 8(1), 107–124.
- The Sun, (2025). UM shuts two campus retail outlets over non-halal sandwich packs. Retrieved: <https://www.thestar.com.my/news/nation/2025/01/11/um-shuts-two-campus-retail-outlets-over-non-halal-sandwich-packs>.
- World Bank, (2024). World population data. <https://databank.worldbank.org/> [cited 12 December 2024].
- Xu, K., et al. (2021). Knowledge dissemination in AI-enabled supply chains: A review and research agenda. *Expert Systems with Applications*, 185, 115602.

- YCP, (2024). Assessing Malaysia's Halal economic value. Retrieved: <https://ycp.com/insights/article/the-economic-value-of-malaysia-halal-industry>
- Zainal, A. B., Hassan, M. N., & Mahmud, M. (2022). NLP-based compliance management in Halal supply chains. *Journal of Islamic Business and Management*, 14(1), 45-63.
- Ziegler, Y., Uli, V., & Tatari, M. (2022). Implementing halal logistics in a non-Muslim-dominant environment: a proposal for reengineering the business processes in two stages. *Business Process Management Journal*, 28(8), 48-65.
- Zulfakar, M. H., Anuar, M. M., & Ab Talib, M. S. (2014). Conceptual framework on halal food supply chain integrity enhancement. *Procedia - Social and Behavioral Sciences*, 121, 58–67.
- 90degreeasia, (2020). <http://https://90degreesasia.com/capitalizing-the-japan-halal-industry-with-digital-marketing/> [cited 12 December 2024].