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A system modeling approach for business intelligence system design in the Indonesian kite string industry

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ABSTRACT

Kite strings in Indonesia are crafted by local artisans who have learned from their predecessors, but the industry struggles to deliver quality products that meet customer standards. A Systematic approach to this problem could involve designing a business intelligence (BI) system to improve decision-making. Based on the main premises of the kite string industry, this paper focuses on developing a causal loop diagram (CLD) model as a first step toward designing an effective BI system for the kite string industry. The CLD model captures the relationships between core variables and brain areas, offering crucial insights into customer perceptions, production quality, and market dynamics. Based on data up to October 2023, the study uses a systematic approach to pinpoint the feedback loops enabling product quality and business performance. This framework can be used as a strategic approach to assist in decision-making, refine operational processes, and enhance overall product quality. This research provides a new perspective to the literature by combining systems thinking into BI system design under the context of traditional industries as an elaboration of findings aimed to gain a competitive advantage in Indonesian kite string business practices.

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1. INTRODUCTION

Industrial development presents challenges for companies operating in it. To survive and to succeed in competition, companies must design analyses that turn challenges into business systems. The Indonesian kite string industry faces unique challenges due to its segmented market, influenced by regional playing styles, cultural traditions, and material preferences. These factors necessitate innovative approaches to enhance operational efficiency and market alignment [1], [2]. Business intelligence (BI) systems have proven essential for transforming raw data into actionable insights, especially in industries with complex supply chains and fragmented markets [3]. The integration of causal loop diagrams (CLDs) with BI systems has shown significant potential in addressing dynamic complexities and feedback mechanisms within business processes [4]. CLDs provide a robust framework for visualizing interdependencies and identifying leverage points, making them invaluable for optimizing strategies in segmented markets [5]. The research study uses CLD for a dynamic representation of relations between factors like equipment availability, maintenance requirements, and customer satisfaction [6]. Recent studies have highlighted the effectiveness of hybrid models that combine data mining and system dynamics for generating insights in niche industries [7]. Cultural fit has emerged as a critical factor in aligning business strategies with regional market demands [8].

By incorporating cultural and regional data into BI systems, businesses can achieve better customer alignment and satisfaction. Moreover, dynamic feedback models, such as CLDs, enhance the predictive capabilities of BI systems by accounting for the complex interplay of market variables [9]. Service quality models also play a pivotal role in improving customer satisfaction and loyalty, particularly when they incorporate cultural dimensions. Such adaptations make these models more applicable in global and culturally diverse markets [10], [11]. For instance, hierarchical approaches to service quality modelling provide deeper insights into customer needs by considering regional and cultural variations [12], [13]. This study aims to develop a CLD model for designing a BI system tailored to the Indonesian kite string industry. By addressing the challenges of market segmentation, material acceptance, and cultural alignment, this research seeks to provide a comprehensive framework for strategic decision-making in this culturally significant industry [14].

2. METHOD

This research adopts a mixed-methods approach to develop a CLD model for designing a BI system tailored to the Indonesian kite string industry. The study integrates both qualitative and quantitative methodologies to ensure a comprehensive understanding of the dynamic and segmented market environment [15]. To capture the intricate relationships between market variables, the study employs system dynamics modelling, specifically focusing on CLDs, to visualize feedback loops and identify leverage points within the niche industry. This method has been widely utilized in industries characterized by complex interdependencies and regional variations [16]. The quantitative phase of the study involves data mining techniques to analyse customer preferences, regional playing styles, and material acceptance patterns. This approach enables the identification of meaningful patterns and trends from historical and real-time data, which are critical for designing effective BI systems [17]. Advanced algorithms, such as clustering and association rule mining, are employed to segment the market and uncover hidden insights [18]. Additionally, the qualitative phase includes interviews and focus group discussions with key stakeholders, such as kite string manufacturers, players, and distributors. These sessions provide valuable contextual insights into the cultural and regional dynamics influencing the industry [19]. The integration of qualitative data into the CLD framework ensures that the model reflects real-world complexities and stakeholder perspectives [20]. A hybrid modelling approach is adopted, combining system dynamics with data mining to enhance the BI system's predictive and prescriptive capabilities. This hybrid approach has been demonstrated to improve decision-making processes in various industries by bridging the gap between data-driven insights and system-level understanding [21]. The proposed methodology also incorporates sensitivity analysis to evaluate the robustness of the CLD model under different scenarios [22]. This step is crucial for ensuring that the BI system remains adaptable to market fluctuations and seasonal variations, such as the kite-playing season [23]. The methodology is validated through case studies and scenario simulations, allowing the researchers to test the effectiveness of the proposed BI system in real-world settings. These simulations are designed to assess the system's ability to optimize production, distribution, and marketing strategies in the kite string industry [24].

In research methodology, CLD analysis is used as the main tool for identification and understanding relationship between variables related to traceability in equipment rental systems. Research methodology the process flow is shown in Figure 1.

a. Research questions

This study focuses on exploring the perception of the key stakeholders on the solution to overcome these challenges in the first stage of this research: kite string manufacture after an exploratory data analysis, it was found out that kite string injuries happened in high percentage during kite flying. Problem solver: system developers and business analysts. Customer issue at hand: kite string community and agent. Management and production team: problem user.

b. Identification of related properties

These variables are identified so that they can be identified as variables related to this study. These include the preferences of customers, shaped by regional playing styles, cultural influences and material quality. We also considered the extent to which these preferences coincide with the local kites and traditions associated with kites and kite flying, which differ from region to region [25]. Importantly, the external factors such as market trends, customer perceptions about product quality and kite seasons also significantly influence consumer behaviour [26]. Through the exploration of these variables, the analysis investigates what relationships underlie purchase decisions and how the marketing strategy by type of kite string material would look like. This can be useful in building an understanding of the motivators behind the decisions that consumers take and how to utilize them for prosperous business strategies [27].

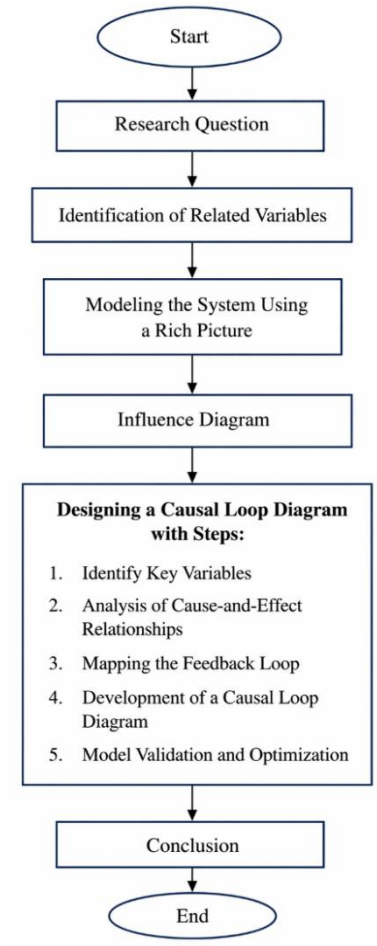

Figure 1. Research flow chart

c. Modelling system by rich picture diagram (RPD)

RPD use: this is a technique of modelling systems using RPD. In particular, RPD supports understanding of the components, stakeholders, and processes involved in a system, including relationships among them, conflicts, and issues of interest. This diagram helps us to look at everything as a whole and to detect problems, solutions and ramifications much easier enabling us to convey information to different people. Through this combination of both (interval) technical and social aspects, RPD addresses the dynamic and multi-faceted nature of the real-world systems that we wish to model in order to understand them better [28], [29].

d. Influence diagram

An influence diagram is a graphical representation of the relationships between variables, decisions, and outcomes in decision analysis. It allows to visualize how various elements impact one another, streamlining complex decision-making processes. The diagram has nodes for decisions, uncertainties, and objectives, and uses arrows to describe the causal connections between them [30].

e. Designing a CLD

A CLD is a visual representation of feedback loops and causal relationships in a system. It illustrates the connection between the different variables and what loops, both positive and negative, govern the behaviour of the system over a period of time. In system dynamics, CLDs are a popular tool for open- or closed-loop behaviour modelling of complex systems, which helps understand the fundamental structures of the problems and suggests the direction of their future trends. These loops help decision-makers understand how to control and optimize system performance [31].

f. System diagram of the proposed BI model

Figure 2 illustrates the system diagram of the proposed BI model for product quality improvement in the kite string (glass-coated thread) industry. The model integrates customer data, analytical methode, and decision-support tools to systematically transform customer needs into technical specifications and strategic recommendations.

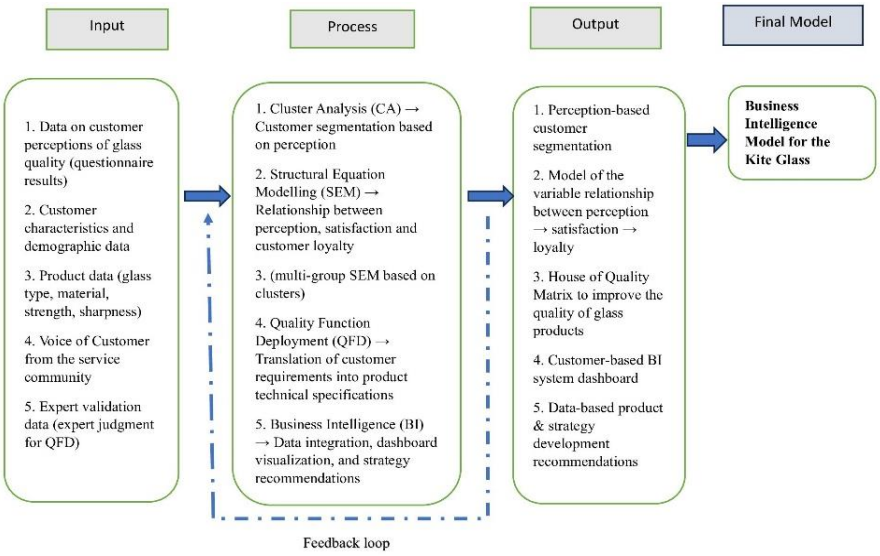

Figure 2. System diagram of the propose BI model

3. RESULTS AND DISCUSSION

3.1. RPD

The RPD provides an integrated overview of the BI system for product quality improvement in the traditional kite string industry. The diagram visualizes the interactions among stakeholders, processes, data, and decision-making elements, while also capturing the influence of local cultural and market characteristics. Through this representation, the RPD helps clarify system complexity and supports a holistic understanding of the technical and contextual factors that affect product quality and business performance.

Figure 3 presents the RPD of the proposed BI system for product quality improvement in the traditional kite string industry. The diagram illustrates the interactions among stakeholders, analytical sub-models, and decision-making processes, while capturing both technical and contextual influences within the systems. The use of RPD in this study follows the systems thinking approach, which emphasizes holistic problem understanding by integrating multiple perspectives, stakeholder interactions, and contextual factors in a complex socio-technical system [32]. The integration of cluster analysis (CA), structural equation modeling (SEM), and quality function deployment (QFD) within a BI-based decision-making framework is consistent with prior studies that highlight the role of analytical integration in supporting data-driven quality improvement and strategic decision-making [33], [34].

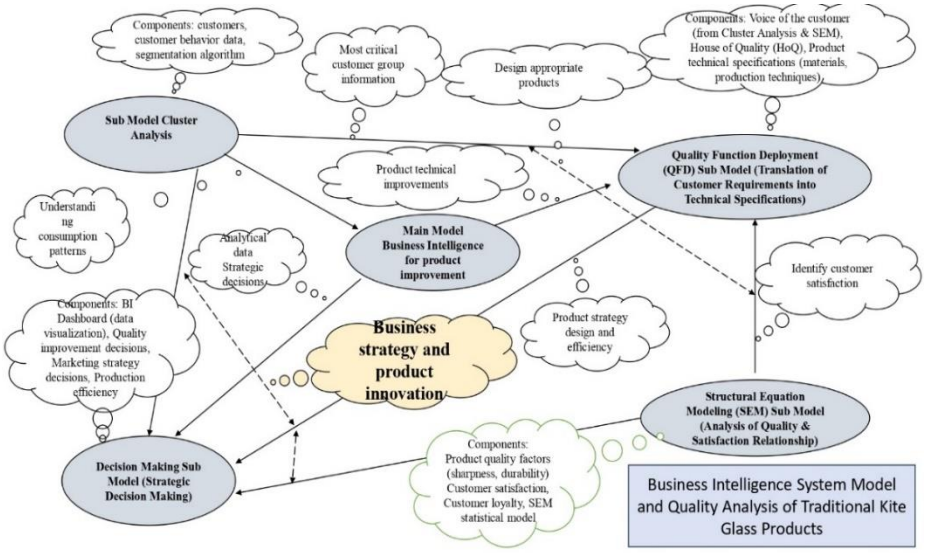

Figure 3. RPD

3.2. Influence diagram

The influence diagram in used to illustrate the key causal relationships that support data-driven decision making within the proposed BI framework. As shown in Figure 4, the diagram highlights how market data, cultural fit, customer segmentation, marketing strategy, service quality, and operational efficiency interact to influence customer satisfaction, market acceptance, and business performance. The diagram shows that market data collection plays a central role, serving as the primary input for customer segmentation, cultural fit assessment, and marketing strategy formulation. Information related to local playing styles, seasonal patterns, and raw material preferences enables firms to align products and services with regional customer characteristics, thereby strengthening cultural fit and operational alignment. Proper segmentation further supports service quality improvement by ensuring that products and service are tailored to the specifics needs of each customer group [35]. Moreover, the influence diagram indicates that effective marketing strategies and operational efficiency contribute directly to customer satisfaction and profitability, which in turn enhance market acceptance and competitiveness. Thes interdependencies demonstrate how BI-supportd insights can be translated into coodinated managerial actions rather than isolated analytical outputs. Overall, the influence diagram confirms that integrating customer data, cultural considerations, and operational factor within a BI-based decision support framemwork is essential for improving performance and sustainability in traditional industries.

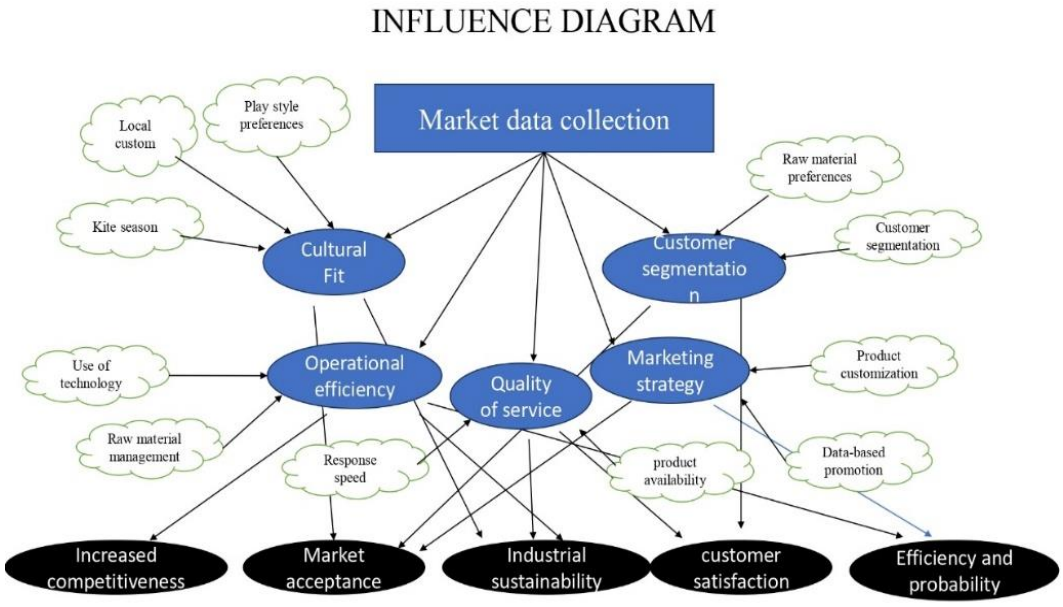

Figure 4. Influence diagram

3.3. CLD

The CLD is employed to provide a dynamic perspective of the relationships among key variables within the traditional kite string industry system. The CLD illustrates how market conditions, seasonal factors, customer consumption behaviour, production processes, and distribution activities interact through reinforcing and balancing feedback loops, influencing demand, operational performance, and business sustainability. The model was developed using Venzim personal learning edition (PLE) software to support the visualization of these dynamic interactions [36].

As shown in Figure 5, the CLD captures the influence of critical factors such as kite flying season, rainy season, buyer consumption level, production process, and distribution on system behaviour. Positive and negative causal relationships indicate how changes in one variable may amplify or dampen other variables over time. These feedback mechanisms help explain fluctuations in demand, inventory levels, and production planning, particularly in industries that are highly affected by seasonality and local market conditions [37].

Rather than serving as a predictive simulation tool, the CLD in this study function as a supporting system-thinking instrument to complement the BI framework. It provides contextual insight into System dynamics and helps decision-maker understand the broader implications of strategic choices derived from BI

analytics. By clarifying dynamic interactions within the system, the CLD support more informed and adaptive decision-making without replacing the core BI-based analytical and decision-support processes.

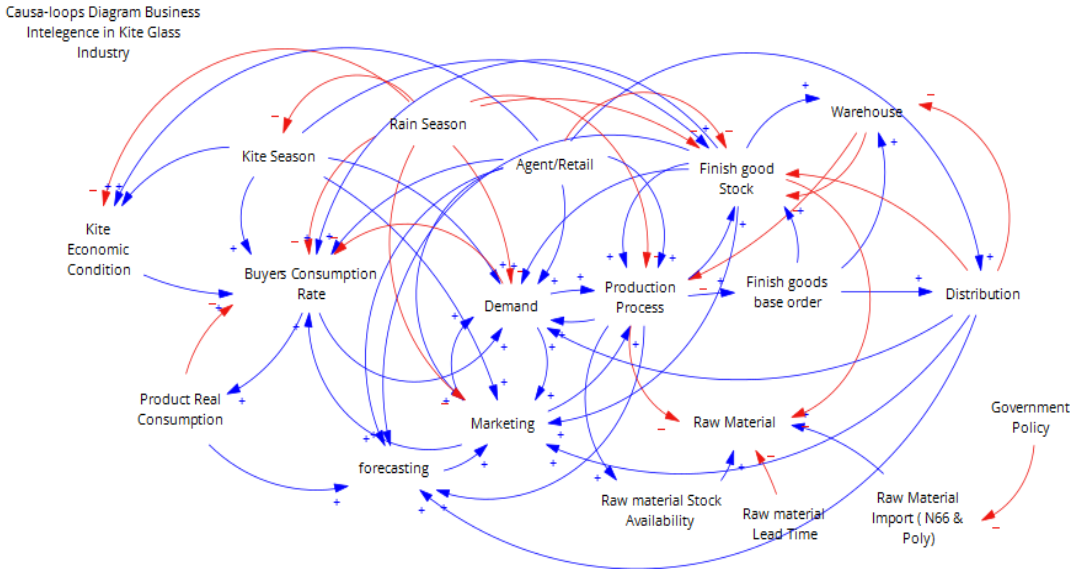

Figure 5. CLD

4. CONCLUSION

Utilising a CLD, this study offers an in-depth examination of 42 interrelated variables that shape the kite string industry. Historical data takes you billion miles ahead because of the idea that seasonal factors e.g., kite season and rain season. Have a crucial role to play in terms of demand, the production process or the marketing process. In conclusion, a range of variables in the system, such as buyers consumption rate, agen/retail and finish goods stock, are identified as sensitive parameters in the system that shape the system's behaviour using both reinforcing and balancing feedback loops. Understanding these dynamic interactions for the optimal decision and for better strategic planning process has been highlighted in the study. The research provides actionable insights for maximizing the industry as a whole by characterizing leverage points, such as better stock management and matching marketing with seasonal trends. Moreover, incorporating these insights into a systemic model leads to a robust and agile business strategy for the kite string industry.

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AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

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Emilia Sari		✓		✓						✓		✓		

C : **C**onceptualization	I : **I**nvestigation	Vi : **Vi**sualization
M : **M**ethodology	R : **R**esources	Su : **Su**pervision
So : **So**ftware	D : **D**ata Curation	P : **P**roject administration
Va : **Va**lidation	O : Writing - **O**riginal Draft	Fu : **Fu**nding acquisition
Fo : **Fo**rmal analysis	E : Writing - Review & **E**diting	

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interest.

INFORMED CONSENT

Informed consent was obtained from all participants, and their data were treated confidentially and used only for research purpose.

ETHICAL APPROVAL

This research involving human participants was conducted in accordance with applicable ethical standards and institutional guidelines. Informed consent was obtain from all participants, and all data were collected anonymously.

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author, HA, upon reasonable request. The data are not publicly available due to privacy and confidentiality considerations.

REFERENCES

[1] K. Tabianan, S. Velu, and V. Ravi, "K-Means Clustering Approach for Intelligent Customer Segmentation Using Customer Purchase Behavior Data," *Sustainability (Switzerland)*, vol. 14, no. 12, p. 7243, Jun. 2022, doi: 10.3390/su14127243.

[2] S. Monalisa, Y. Juniarti, E. Saputra, F. Muttakin, and T. K. Ahsyar, "Customer segmentation with RFM models and demographic variable using DBSCAN algorithm," *Telkomnika (Telecommunication Computing Electronics and Control)*, vol. 21, no. 4, pp. 742–749, Aug. 2023, doi: 10.12928/TELKOMNIKA.v21i4.22759.

[3] S. Fosso Wamba, A. Gunasekaran, T. Papadopoulos, and E. Ngai, "Big data analytics in logistics and supply chain management," *International Journal of Logistics Management*, vol. 29, no. 2, pp. 478–484, May 2018, doi: 10.1108/IJLM-02-2018-0026.

[4] N. Hosseinichimeh, A. Majumdar, R. Williams, and N. Ghaffarzadegan, "From text to map: a system dynamics bot for constructing causal loop diagrams," *System Dynamics Review*, vol. 40, no. 3, Jul. 2024, doi: 10.1002/sdr.1782.

[5] O. Akande, E. O. Asani, and B. Dautare, "Customer Segmentation Through RFM Analysis and K-Means Clustering: Leveraging Data-Driven Insights for Effective Marketing Strategy," *Ceddi Journal of Information System and Technology (JST)*, vol. 3, no. 1, pp. 14–25, Apr. 2024, doi: 10.56134/jst.v3i1.81.

[6] A. E. Nurhidayat, R. Fitriana, D. Suhardini, and A. Nugrahanti, "The causal loop diagram model of traceability system rental equipment in oil and gas supporting companies," *Telkomnika (Telecommunication Computing Electronics and Control)*, vol. 22, no. 5, pp. 1104–1112, Jul. 2024, doi: 10.12928/TELKOMNIKA.v22i5.26084.

[7] Y. Yin, L. Long, and X. Deng, "Dynamic Data Mining of Sensor Data," *IEEE Access*, vol. 8, pp. 41637–41648, 2020, doi: 10.1109/ACCESS.2020.2976699.

[8] M. Waheeda, S. Iftikharb, and S. Azharc, "Integration of Cultural Fit, Strategy Fit and Strategic Fit to Harness the Competitive Advantage: A Dynamic Capabilities Paradigm," *Integration*, vol. 15, no. 5, pp. 282–310, 2021.

[9] M. Muthuswamy and A. M. Ali, "Sustainable Supply Chain Management in the Age of Machine Intelligence: Addressing Challenges, Capitalizing on Opportunities, and Shaping the Future Landscape," *Sustainable Machine Intelligence Journal*, vol. 3, Jun. 2023, doi: 10.61185/smij.2023.33103.

[10] A. I. Maghsoodi, A. Saghaei, and A. Hafezalkotob, "Service quality measurement model integrating an extended SERVQUAL model and a hybrid decision support system," *European Research on Management and Business Economics*, vol. 25, no. 3, pp. 151–164, Sep. 2019, doi: 10.1016/j.iedeen.2019.04.004.

[11] H. Lee, Y. Lee, and D. Yoo, "The determinants of perceived service quality and its relationship with satisfaction," *Journal of Services Marketing*, vol. 14, no. 3, pp. 217–231, Jun. 2000, doi: 10.1108/08876040010327220.

[12] X. X. Liu and Z. Y. Chen, "Service quality evaluation and service improvement using online reviews: A framework combining deep learning with a hierarchical service quality model," *Electronic Commerce Research and Applications*, vol. 54, p. 101174, Jul. 2022, doi: 10.1016/j.elerap.2022.101174.

[13] M. Ingaldi, "E-Service Quality Assessment According to Hierarchical Service Quality Models," *Management Systems in Production Engineering*, vol. 30, no. 4, pp. 311–318, Dec. 2022, doi: 10.2478/mspe-2022-0040.

[14] S. L. Wang, Q. Gu, M. A. V. Glinow, and P. Hirsch, "Cultural industries in international business research: Progress and prospect," *Journal of International Business Studies*, vol. 51, no. 4, pp. 665–692, Jun. 2020, doi: 10.1057/s41267-020-00306-0.

[15] E. E. Agu, U. S. Nwabekee, T. I. Ijomah, and O. Y. A. -Azeez, "The role of strategic business leadership in driving product marketing success: Insights from emerging markets," *International Journal of Frontline Research in Science and Technology*, vol. 3, no. 2, pp. 001–018, Sep. 2024, doi: 10.56355/ijfrst.2024.3.2.0044.

[16] H. Yang, L. Wang, Y. Ma, D. Zhang, and W. U. Hongbin, "Optimization strategy of price-based demand response considering the bidirectional feedback effect," *IET Generation, Transmission and Distribution*, vol. 15, no. 11, pp. 1752–1762, Jun. 2021, doi: 10.1049/gtd2.12131.
[17] B. S. Onggo, A. A. Juan, N. Mustafee, A. Smart, and O. Molloy, "Symbiotic simulation system: Hybrid systems model meets big data analytics," in *Proceedings - Winter Simulation Conference*, IEEE, Dec. 2018, pp. 1358–1369, doi: 10.1109/WSC.2018.8632407.
[18] S.-Y. Wong, L.-Y. Ong, and M.-C. Leow, "AIDA-Based Customer Segmentation With User Journey Analysis for Wi-Fi Advertising System," *IEEE Access*, vol. 12, pp. 111468–111480, 2024, doi: 10.1109/access.2024.3424833.
[19] L. Bich, M. Mossio, and A. M. Soto, "Glycemia Regulation: From Feedback Loops to Organizational Closure," *Frontiers in Physiology*, vol. 11, Feb. 2020, doi: 10.3389/fphys.2020.00069.
[20] J. N. Rodriguez, H. H. A. Sosa, S. M. V. Archila, and A. Ortiz, "System dynamics modeling in additive manufacturing supply chain management," *Processes*, vol. 9, no. 6, p. 982, Jun. 2021, doi: 10.3390/pr9060982.
[21] C. Cheng, H. Zhong, and L. Cao, "Facilitating speed of internationalization: The roles of business intelligence and organizational agility," *Journal of Business Research*, vol. 110, pp. 95–103, Mar. 2020, doi: 10.1016/j.jbusres.2020.01.003.
[22] Z. Barahmand and G. Samarakoon, "Sensitivity Analysis and Anaerobic Digestion Modeling: A Scoping Review," *Fermentation*, vol. 8, no. 11, p. 624, Nov. 2022, doi: 10.3390/fermentation8110624.
[23] F. Osei, G. Ampomah, C. K. -Kwarteng, D. O. Bediako, and R. Mensah, "Customer Satisfaction Analysis of Banks: The Role of Market Segmentation," *Science Journal of Business and Management*, vol. 9, no. 2, p. 126, 2021, doi: 10.11648/j.sjbm.20210902.19.
[24] M. M. D. Alam and N. A. M. Noor, "The Relationship Between Service Quality, Corporate Image, and Customer Loyalty of Generation Y: An Application of S-O-R Paradigm in the Context of Superstores in Bangladesh," *SAGE Open*, vol. 10, no. 2, Apr. 2020, doi: 10.1177/2158244020924405.
[25] R. Song, S. Moon, H. (Allan) Chen, and M. B. Houston, "When marketing strategy meets culture: the role of culture in product evaluations," *Journal of the Academy of Marketing Science*, vol. 46, no. 3, pp. 384–402, May 2018, doi: 10.1007/s11747-017-0525-x.
[26] H. Liu, "Cultural Influence on Consumer Behavior: Strategies for Adapting Marketing Campaigns in a Globalized World," *International Journal of Education, Humanities and Social Sciences*, vol. 1, no. 1, pp. 1–9, 2023, doi: 10.70088/k7dj3y16.
[27] I. Ghazali, S. H. A. Rashid, S. Z. M. Dawal, H. Aoyama, A. E. Tontowi, and R. A. R. Ghazilla, "Green product preferences with respect to cultural influences: Empirical study in indonesia," *International Journal of Automation Technology*, vol. 12, no. 6, pp. 842–852, Nov. 2018, doi: 10.20965/ijat.2018.p0842.
[28] K. P. Conte and S. Davidson, "Using a 'rich picture' to facilitate systems thinking in research coproduction," *Health Research Policy and Systems*, vol. 18, no. 1, p. 14, Dec. 2020, doi: 10.1186/s12961-019-0514-2.
[29] M. Reynolds and S. Holwell, "Introducing Systems Approaches," in *Systems Approaches to Making Change: A Practical Guide, Second Edition*, London: Springer London, 2020, pp. 1–24, doi: 10.1007/978-1-4471-7472-1_1.
[30] H. Yao, H. Wang, and Y. Wang, "UUV Autonomous Decision-Making Method Based on Dynamic Influence Diagram," *Complexity*, vol. 2020, pp. 1–14, Jun. 2020, doi: 10.1155/2020/8565106.
[31] P. B. -Johnson and A. S. Penn, "Systems Mapping: How to build and use causal models of systems," *Systems Mapping: How to Build and Use Causal Models of Systems*, pp. 1–186, 2022, doi: 10.1007/978-3-031-01919-7.
[32] I. U. Hassan and S. Asghar, "A framework of software project scope definition elements: An ism-dematel approach," *IEEE Access*, vol. 9, pp. 26839–26870, 2021, doi: 10.1109/ACCESS.2021.3057099.
[33] Y. Liang, D. Quan, F. Wang, X. Jia, M. Li, and T. Li, "Financial big data analysis and early warning platform: A case study," *IEEE Access*, vol. 8, pp. 36515–36526, 2020, doi: 10.1109/ACCESS.2020.2969039.
[34] F. N. Puglieri *et al*., "An Environmental and Operational Analysis of Quality Function Deployment-Based Methods," *Sustainability*, vol. 12, no. 8, p. 3486, Apr. 2020, doi: 10.3390/su12083486.
[35] S. Lee and B. G. Kim, "Attribute of Big Data Analytics Quality Affecting Business Performance," *Journal of Social Computing*, vol. 4, no. 4, pp. 357–381, Dec. 2023, doi: 10.23919/JSC.2023.0028.
[36] N. Dhirasasna and O. Sahin, "A multi-methodology approach to creating a causal loop diagram," *Systems*, vol. 7, no. 3, p. 42, Aug. 2019, doi: 10.3390/systems7030042.
[37] L. B. Littlejohns, C. Hill, and C. Neudorf, "Diverse Approaches to Creating and Using Causal Loop Diagrams in Public Health Research: Recommendations From a Scoping Review," *Public Health Reviews*, vol. 42, Dec. 2021, doi: 10.3389/phrs.2021.1604352.

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