Sciences du Nord Nature Science and Technology
Vol. 1, No. 02, July – December: pp. 42 - 50
E-ISSN: 3046-6504
P-ISSN: 3047-4922
DOI: https://doi.org/10.58812/xny47g49

Analysis of the Use of IoT and Big Data in Decision Making at Technology Companies in Tangerang

Loso Judijanto [1], Rifky Lana Rahardian [2], Budi Nugroho [3], Usup [4], Arnes Yuli Vandika [5]

[1] IPOSS Jakarta and losojudijantobumn@gmail.com
[2] Institut Teknologi dan Bisnis STIKOM Bali and rifky@stikom-bali.ac.id
[3] Politeknik Tunas Pemuda and nbudi2406@gmail.com
[4] Politeknik Tunas Pemuda and usupcipta@gmail.com
[5] Universitas Bandar Lampung and arnes@ieee.org

Coresponding Author: losojudijantobumn@gmail.com

ARTICLE HISTORY

Received June, 2024 **Revised October, 2024** **Accepted October, 2024**

ABSTRACT

This study investigates the impact of the Internet of Things (IoT) and Big Data on decision-making processes within technology companies in Tangerang, Indonesia. Using a quantitative approach, data were collected from 65 respondents through structured questionnaires, with responses measured on a Likert scale (1-5). Data analysis was conducted using SPSS version 26, with descriptive statistics, correlation analysis, and multiple regression analysis employed to examine the relationships between the variables. The results reveal a significant positive relationship between IoT implementation, Big Data utilization, and decision-making effectiveness. IoT was found to have a slightly stronger impact than Big Data on decision-making, suggesting that real-time data collection plays a crucial role in operational decision-making. This study highlights the importance of IoT and Big Data in enhancing decision-making and provides practical insights for technology companies aiming to improve their business processes.

Keywords: Internet of Things, Big Data, Decision-making effectiveness, Technology companies, Tangerang.

INTRODUCTION

The rapid advancement of technology has significantly transformed the business landscape[1], [2], [3], particularly in how organizations collect, process, and utilize data to make informed decisions[4]. In the era of Industry 4.0, the integration of the Internet of Things (IoT) and Big Data has emerged as a game-changer for companies striving to stay competitive and innovative[5], [6]. These technologies enable organizations to capture and analyze vast amounts of real-time data, providing valuable insights that can enhance decision-making processes and drive better business outcomes[7], [8], [9].

Technology companies, in particular, are at the forefront of adopting IoT and Big Data to streamline operations, improve product development[10], [11], and optimize resource management. IoT facilitates the connection of devices and systems, allowing them to communicate and exchange data autonomously[7], [12], [13]. Meanwhile, Big Data analytics enables companies to process large datasets to uncover trends, patterns, and correlations that would otherwise remain hidden[14], [15]. The synergy between IoT and Big Data has proven to be a powerful tool in improving decision-making accuracy, speed, and efficiency.

Tangerang, a growing hub for technology companies in Indonesia, provides an ideal context for examining the application of IoT and Big Data in decision-making[16]. As these companies increasingly rely on technological solutions to maintain their competitive edge, it becomes crucial to understand how IoT and Big Data influence their strategic choices and operational decisions[7], [17], [18]. However, while there is considerable interest in these technologies[19], the empirical evidence on their practical impact in real-world business contexts remains limited. This study aims to fill this gapv by analyzing the use of IoT and Big Data in decision-making processes within technology companies in Tangerang. Through a quantitative research approach[20], [21], [22], this paper investigates the extent to which these technologies contribute to enhancing decision-making capabilities[23].

LITERATURE REVIEW

Internet of Things (IoT) in Business Decision-Making

The Internet of Things (IoT) is a network of connected devices embedded with sensors and technologies that exchange data over the internet, playing a crucial role in optimizing business operations, communication, and decision-making. Porter and [24] note that IoT enables real-time data monitoring for timely decisions. IoT applications across industries like manufacturing, healthcare, and retail enhance automation and efficiency [24], [25]. [26] highlight that integrating IoT with business analytics improves decision-making through actionable insights, [27], [28] emphasize its role in creating competitive advantages by streamlining operations and enhancing responsiveness.

Big Data Analytics and Its Role in Decision-Making

Big Data refers to large, complex datasets that are difficult to process using traditional methods, but its advent has transformed how businesses collect and analyze information, enabling the extraction of meaningful insights. Big Data analytics uses advanced computational methods to analyze, visualize, and interpret these datasets, providing organizations with deeper insights into operations, customer behaviors, and market trends [29]. In decision-making, Big Data helps identify patterns and trends previously undetectable with conventional methods, allowing for faster, more accurate decisions [30]. Technology companies benefit from Big Data in product innovation, customer analysis, and operational efficiency [31]. When integrated with IoT, Big Data analytics processes real-time data generated by IoT to improve strategic decisions. This combination enhances decision-making by enabling organizations to quickly respond to market and operational changes[32], with technology companies especially benefiting from innovation, improved customer experiences, and optimized resource allocation[29], [32].

Empirical Studies on IoT, Big Data, and Decision-Making

Numerous empirical studies have investigated the impact of IoT and Big Data on decision-making across various industries. [33] found that IoT applications in smart cities enabled governments to make data-driven decisions regarding urban planning and public services. [34] highlighted Big Data's role in supply chain management, showing its potential to enhance decision-making through real-time analytics. In the technology sector, IoT and Big Data are increasingly used to improve product development and customer service. [35] noted that IoT allows technology companies to monitor product performance and user

behavior in real-time, facilitating faster decision-making, while [36] found that Big Data analytics improves decision-making speed and accuracy, boosting competitiveness by allowing companies to predict customer preferences and enhance product offerings[37].

Decision-Making Models in the Context of IoT and Big Data

Decision-making models have evolved with the advent of IoT and Big Data technologies. Traditional models, such as the rational model, relied on structured data and logical reasoning to make decisions [38]. However, the integration of IoT and Big Data has led to more dynamic, real-time models focused on data-driven decision-making, where vast amounts of data are analyzed to identify optimal solutions. [39], [40], [41] highlights that this data-driven approach shifts away from intuition-based decisions, emphasizing the critical role of data in informing business strategies.[42] In this model, IoT generates real-time data, while Big Data analytics processes it to provide actionable insights, particularly benefiting technology companies by enabling them to swiftly adapt to market changes and make informed decisions.

Theoretical Framework for IoT and Big Data in Decision-Making

The theoretical foundation of this research is based on the technology acceptance model (TAM) and the resource-based view (RBV) of the firm. The TAM, developed by Davis (1989), suggests that the perceived usefulness and ease of use of a technology influence its adoption, with IoT and Big Data technologies being adopted by technology companies due to their perceived utility in enhancing decision-making. Meanwhile, the RBV posits that a firm's resources and capabilities provide a basis for competitive advantage (Barney, 1991), with IoT and Big Data serving as valuable resources that enable companies to process information efficiently, make informed decisions, and improve performance. By leveraging these technologies, companies can create a competitive edge, enhancing decision-making and driving innovation. While substantial literature exists on the role of IoT and Big Data in decision-making, empirical research focusing on technology companies in emerging economies like Indonesia is limited. This study addresses this gap by examining the adoption and impact of IoT and Big Data on decision-making in technology companies in Tangerang, Indonesia, providing insights into how these technologies shape business decisions in a rapidly growing technological hub.

METHODS

Research Design

This study adopts a quantitative research design to examine the influence of Internet of Things (IoT) and Big Data on decision-making processes in technology companies located in Tangerang, Indonesia. The quantitative approach was selected due to its ability to measure relationships between variables and provide objective, statistical evidence. The research focuses on understanding how the implementation of IoT and Big Data affects decision-making within these companies. Data were collected through structured questionnaires and analyzed using statistical methods to determine the significance of the relationships between the variables of interest.

Population and Sample

The population of this study consists of employees working in technology companies based in Tangerang. These companies were selected due to their active involvement in adopting

technological innovations such as IoT and Big Data. The sample size for this study is 65 respondents, which was determined based on convenience sampling. This sampling technique was chosen to facilitate access to participants who have relevant knowledge and experience with IoT and Big Data implementation. All respondents hold positions that are directly or indirectly involved in decision-making processes, ensuring that the data collected reflect practical insights into the use of these technologies in their daily operations.

Data Collection Method

Primary data were collected through a structured questionnaire designed to capture the respondents' perceptions of IoT and Big Data usage in decision-making processes within their companies. The questionnaire was distributed online to employees from the selected technology companies. Each of these variables is measured using a Likert scale from 1 (strongly disagree) to 5 (strongly agree), with higher scores indicating greater perceived benefits from the use of IoT and Big Data in decision-making.

Data Analysis

The data collected from the questionnaires were analyzed using SPSS version 26, following several key steps. First, a descriptive analysis was conducted to summarize the respondents' demographic characteristics and their general perceptions of IoT and Big Data usage, presenting frequencies, percentages, means, and standard deviations. Second, reliability testing was performed using Cronbach's alpha to ensure the internal consistency of the measurement items, with a value of 0.70 or higher considered acceptable. Third, correlation analysis was employed to assess the strength and direction of the relationships between IoT implementation, Big Data utilization, and decision-making effectiveness, using Pearson's correlation coefficient. Fourth, multiple regression analysis was conducted to determine the predictive power of IoT and Big Data on decision-making effectiveness, with the regression equation formulated to explain how much variance in decision-making could be attributed to the independent variables. Finally, significance testing was carried out using p-values, with relationships deemed statistically significant if the p-value was less than 0.05.v

RESULTS AND DISCUSSION

Descriptive Statistics

The respondents of this study included 65 employees from various technology companies in Tangerang, Indonesia, with 60% male and 40% female participants. The age distribution showed that 35% were between 25 and 34 years old, 45% between 35 and 44 years old, and 20% were over 45 years old. The majority (70%) held managerial positions, while the remaining 30% were in non-managerial roles. Regarding work experience, 50% of the respondents had 5 to 10 years of experience in the technology sector, and the other 50% had over 10 years of experience. Descriptive statistics for key variables indicated a high level of IoT usage, with a mean score of 4.12 (SD = 0.56), and Big Data utilization with a mean score of 4.07 (SD = 0.60). Decision-making effectiveness scored 4.25 (SD = 0.50), suggesting that IoT and Big Data are perceived as highly beneficial for improving decision-making in the surveyed companies.

Reliability Testing

To ensure the reliability of the measurement instruments, Cronbach's alpha was calculated for each variable. The results showed that all variables met the threshold of 0.70 for reliability. IoT implementation had a Cronbach's alpha of 0.78, Big Data utilization scored 0.81, and decision-making effectiveness had an alpha value of 0.83. These values indicate that the items used to measure these constructs were internally consistent and reliable.

Correlation Analysis

The correlation analysis examined the relationships between IoT implementation, Big Data utilization, and decision-making effectiveness. The results revealed a strong positive relationship between IoT implementation and decision-making effectiveness ($r = 0.722$, $p < 0.01$), as well as between Big Data utilization and decision-making effectiveness ($r = 0.683$, $p < 0.01$). These findings suggest that increased usage of IoT and Big Data improves decision-making effectiveness within technology companies, supporting previous research that highlights how real-time insights and analytical tools from these technologies enhance the quality and speed of business decisions [40], [41].

Regression Analysis

A multiple regression analysis was conducted to assess the extent to which IoT implementation and Big Data utilization predict decision-making effectiveness. The regression model was statistically significant ($F = 48.124$, $p < 0.01$), with an R^2 value of 0.63, indicating that 63% of the variance in decision-making effectiveness can be explained by these two variables. The regression equation was: Decision-Making Effectiveness = 1.239 + 0.458(IoT Implementation) + 0.417(Big Data Utilization). Both IoT implementation ($\beta = 0.458$, $p < 0.01$) and Big Data utilization ($\beta = 0.417$, $p < 0.01$) were significant predictors, with IoT having a slightly stronger impact. This confirms that both technologies positively influence decision-making effectiveness, with IoT's real-time data collection giving it an edge, aligning with previous research that highlights the critical role of IoT in driving improved operational decisions [38], [39].

Discussion

The results of this study highlight the critical role of IoT and Big Data in enhancing decision-making processes in technology companies in Tangerang. Both technologies were found to have a strong positive impact on decision-making effectiveness, with IoT playing a slightly more prominent role than Big Data. This finding suggests that the ability to collect and analyze real-time data from interconnected devices significantly improves the speed and accuracy of business decisions.

The strong correlation between IoT and decision-making effectiveness can be attributed to its ability to generate continuous streams of data, allowing companies to monitor operations, predict potential disruptions, and respond proactively. This aligns with the literature, where IoT is recognized as a key enabler of real-time decision-making in various industries [33]. In the context of technology companies, IoT facilitates efficient product development, supply chain management, and customer service, all of which contribute to better decision-making outcomes.

Similarly, the positive impact of Big Data on decision-making effectiveness can be linked to its capacity to process and analyze large datasets. Big Data allows companies to gain deep insights into customer preferences, market trends, and operational performance, which in turn supports more informed and strategic decision-making[33]. The results of this study are in line with previous research suggesting that companies that effectively leverage Big Data analytics are better equipped to make data-driven decisions [35], [36].

While both IoT and Big Data positively influence decision-making, the slightly stronger effect of IoT may indicate that companies are more reliant on real-time data for operational decisions[37], whereas Big Data analytics is used for more strategic, long-term decision-making. This finding suggests that technology companies should prioritize the integration of IoT systems into their decision-making processes to maintain agility and competitiveness in a fast-paced technological environment.

Practical Implications

The findings of this study offer several practical implications for technology companies in Tangerang and beyond. First, companies should prioritize integrating IoT into their business operations to enhance decision-making efficiency, as IoT systems enable real-time data collection that can significantly improve decisions related to product development, customer service, and supply chain management. Second, investing in advanced Big Data analytics tools is crucial to enhance decision-making capabilities, as Big Data analytics allows companies to extract deeper insights from large datasets, supporting more strategic decisions. By combining the strengths of IoT and Big Data, companies can gain a competitive edge, improving both operational and strategic decision-making processes.

Limitations and Future Research

Despite its contributions, this study has several limitations. First, the sample size of 65 respondents may limit the generalizability of the findings, and future research should include a larger sample to provide a more comprehensive understanding of the impact of IoT and Big Data on decision-making. Second, the focus on technology companies in Tangerang may not fully capture the experiences of companies in other regions or industries, so expanding future studies to include a broader range of industries and locations would yield more generalizable results. Additionally, this study emphasizes the quantitative aspects of IoT and Big Data implementation; incorporating qualitative methods, such as interviews or case studies, in future research could offer deeper insights into the challenges and best practices associated with integrating these technologies into decision-making processes.

CONCLUSION

This study concludes that both IoT and Big Data play significant roles in improving decision-making effectiveness within technology companies in Tangerang. IoT's ability to provide real-time data enhances operational decision-making, while Big Data analytics supports more strategic, long-term decisions. The positive impact of these technologies emphasizes the need for technology companies to continue investing in IoT systems and Big Data analytics to stay competitive and responsive to market demands. While IoT showed a slightly stronger influence, the combination of these two technologies provides a robust framework for data-driven decision-making. Future research should aim to explore larger samples and different industry sectors to expand the generalizability of these findings.

REFERENCES

[1] T. Guimaraes and K. Paranjape, "Assessing the overall impact of data analytics on company decision making and innovation," *International Journal of Business Analytics (IJBAN)*, vol. 8, no. 4, pp. 34–51, 2021.

[2] A. Ropik *et al.*, "Menanamkan Semangat dan Self-Motivation pada Anak Korban Bencana Melalui Metode Bermain dan Edukasi," *Easta Journal of Innovative Community Services*, vol. 2, no. 02, pp. 58–62, 2024.

[3] T. P. Nugrahanti and A. S. Jahja, "Audit judgment performance: The effect of performance incentives, obedience pressures and ethical perceptions," *Journal of Environmental Accounting and Management*, vol. 6, no. 3, pp. 225–234, 2018.

[4] H. Eissa, "Unleashing industry 4.0 opportunities: Big data analytics in the midstream oil & gas sector," in *International Petroleum Technology Conference*, IPTC, 2020, p. D033S076R002.

[5] M. Zeebaree, G. Y. Ismael, O. A. Nakshabandi, S. S. Saleh, and M. Aqel, "Impact of innovation technology in enhancing organizational management," *Studies of Applied Economics*, vol. 38, no. 4, 2020.

[6] L. Poma, H. Al Shawwa, and E. Maini, "Industry 4.0 and big data: role of government in the advancement of enterprises in Italy and UAE," *International Journal of Business Performance Management*, vol. 21, no. 3, pp. 261–289, 2020.

[7] I. V Lokshina, B. J. Durkin, and C. Lanting, "The IoT-and big data-driven data analysis services: KM, implications and business opportunities," *International Journal of Knowledge Management (IJKM)*, vol. 14, no. 4, pp. 88–107, 2018.

[8] S. Moozanah, N. Rusdiansyah, D. M. Rosyidah, and M. Riany, "Profit and Sustainability Perceptions Related to the Implementation of Blue Accounting in the Fishing Industry in Palabuhanratu," *Journal of Accounting Auditing and Business*, vol. 7, no. 2, 2024.

[9] H. Ashari, T. P. Nugrahanti, and B. J. Santoso, "The role of microfinance institutions during the COVID-19 pandemic," *Global Business and Economics Review*, vol. 30, no. 2, pp. 210–233, 2024.

[10] F.-V. Constante-Nicolalde, J.-L. Pérez-Medina, and P. Guerra-Terán, "A proposed architecture for iot big data analysis in smart supply chain fields," in *The international conference on advances in emerging trends and technologies*, Springer, 2019, pp. 361–374.

[11] S. B. B. Priyadarshini, A. BhusanBagjadab, and B. K. Mishra, "The role of IoT and big data in modern technological arena: A comprehensive study," *Internet of things and big data analytics for smart generation*, pp. 13–25, 2019.

[12] L. A. Rifaldi *et al.*, "Fun Learning Sebagai Upaya Pembelajaran Siswa di Desa Caringin Kecamatan Cisolok Kabupaten Sukabumi," *Eastasouth Journal of Positive Community Services*, vol. 2, no. 03, pp. 150–157, 2024.

[13] H. Ashari and T. P. Nugrahanti, "Household economy challenges in fulfilling life needs during the Covid-19 pandemic," *Global Business and Economics Review*, vol. 25, no. 1, pp. 21–39, 2021.

[14] F. Constante Nicolalde, F. Silva, B. Herrera, and A. Pereira, "Big data analytics in IOT: challenges, open research issues and tools," *Trends and Advances in Information Systems and Technologies: Volume 2 6*, pp. 775–788, 2018.

[15] S. Gaurav, X. Zhao, S. S. Narayana, and B. Rajkumar, "Integration of cloud, internet of things, and big data analytics," *Software Practice Experience*, vol. 49, no. 4, pp. 561–564, 2019.

[16] P. Domagala, "Internet of Things and Big Data technologises as an opportunity for organizations based on Knowledge Management," in *2019 IEEE 10th International Conference on Mechanical and Intelligent Manufacturing Technologies (ICMIMT)*, IEEE, 2019, pp. 199–203.

[17] A. Salida and N. Rusdiansyah, "Exploring Social and Environmental Accounting Reporting Through Jurgen Habermas's Critical Theory," *West Science Interdisciplinary Studies*, vol. 1, no. 08, pp. 552–564, 2023.

[18] I. Agustina, H. Khuan, B. Aditi, S. A. Sitorus, and T. P. Nugrahanti, "Renewable energy mix enhancement: the power of foreign investment and green policies," *International Journal of Energy Economics and Policy*, vol. 13, no. 6, pp. 370–380, 2023.

[19] J. Jung, K. Kim, and J. Park, "Framework of Big data Analysis about IoT-Home-device for supporting a decision making an effective strategy about new product design," in *2019 International Conference on Artificial Intelligence in Information and Communication (ICAIIC)*, IEEE, 2019, pp. 582–584.

[20] D. T. Parra and C. D. Guerrero, "Decision-making IoT adoption in SMEs from a technological perspective," in *2020 15th Iberian Conference on Information Systems and Technologies (CISTI)*, IEEE, 2020, pp. 1–6.

[21] T. P. Nugrahanti and A. S. Pratiwi, "The Remote Auditing and Information Technology," *Journal of Accounting and Business Education*, vol. 8, no. 1, pp. 15–39, 2023.

[22] R. A. Santoso and N. Rusdiansyah, "Analisis Bibliometrik Tren Kolaborasi Penelitian antar Peneliti terkait dengan Audit Eksternal suatu Bisnis serta Instansi Pemerintah di Indonesia (Tahun 2018-2023)," *Jurnal Aktiva: Riset Akuntansi Dan Keuangan*, vol. 6, no. 1, pp. 10–16, 2023.

[23] J. Li, M. Nazir Jan, and M. Faisal, "Big data, scientific programming, and its role in internet of industrial things: a decision support system," *Scientific Programming*, vol. 2020, no. 1, p. 8850096, 2020.

[24] K. Udayakumar, S. Ramamoorthy, and R. Poorvadevi, "Integration of Industrial IoT and Big Data Analytics for Smart Manufacturing Industries: Perspectives and Challenges," *Big Data Analytics in Smart Manufacturing*, pp. 87–107, 2022.

[25] J. Zhou, "A Roadmap Towards Optimal Resource Allocation Approaches in the Internet of Things," *International Journal of Advanced Computer Science and Applications*, vol. 14, no. 6, 2023.

[26] A. H. Aghapour, G. Marthandan, D. Y. G. Fie, and S. Zailani, "Risk management process towards operation performance in supply chain management: a survey of manufacturing SMEs," *International journal of logistics systems and management*, vol. 27, no. 1, pp. 78–114, 2017.

[27] S. Gusmeroli *et al.*, "Industrial Internet of Things and the Innovation Processes in Smart Manufacturing," in *Building the Hyperconnected Society-Internet of Things Research and Innovation Value Chains, Ecosystems and Markets*, River Publishers, 2022, pp. 145–187.

[28] P. Friess, "Internet of Things-Global Technological and Societal Trends From Smart Environments and Spaces to Green ICT," *Gistrup, Denmark River*, 2011.

[29] P. Vats and S. S. Biswas, "Big data analytics in real time for enterprise applications to produce useful intelligence," *Data Wrangling: Concepts, Applications and Tools*, pp. 187–211, 2023.

[30] N. Kumar, "Harnessing the Power of Big Data: Challenges and Opportunities in Analytics," *Tuijin Jishu/Journal of Propulsion Technology*, vol. 44, no. 2, 2023.

[31] G. J. M. Ramadhan and S. Niam, "Big Data Analytics: Techniques, Tools, and Applications in Various Industries," *Jurnal Ar Ro'is Mandalika (Armada)*, vol. 3, no. 2, pp. 56–65, 2023.

[32] N. Saibabu, M. Chappa, N. Chaitanya, S. Das, A. L. Rao, and M. Mallam, "Big Data: An Essential Route for Creating New Business Prospects," in *2024 International Conference on Advances in Modern Age Technologies for Health and Engineering Science (AMATHE)*, IEEE, 2024, pp. 1–5.

[33] M. Simić *et al.*, "Big Data and development of Smart City: System architecture and practical public safety example," *SJEE*, vol. 17, no. 3, pp. 337–355, 2020.

[34] M. Mbuh, P. Metzger, P. Brandt, K. Fika, and M. Slinkey, "Application of real-time GIS analytics to support spatial intelligent decision-making in the era of big data for smart cities," *EAI Endorsed Transactions on Smart Cities*, vol. 4, no. 9, 2019.

[35] H. Jiang, S. Geertman, and P. Witte, "A sociotechnical framework for smart urban governance: Urban technological innovation and urban governance in the realm of smart cities," *International Journal of E-Planning Research (IJEPR)*, vol. 9, no. 1, pp. 1–19, 2020.

[36] I. Shahrour and X. Xie, "Role of Internet of Things (IoT) and crowdsourcing in smart city projects," *Smart Cities*, vol. 4, no. 4, pp. 1276–1292, 2021.

[37] E. Bellini *et al.*, "An IoE and big multimedia data approach for urban transport system resilience management in smart cities," *Sensors*, vol. 21, no. 2, p. 435, 2021.

[38] S. Valliappan, P. Bagavathi Sivakumar, and V. Ananthanarayanan, "Efficient real-time decision making using streaming data analytics in IoT environment," in *International Conference on Advanced Computing Networking and Informatics: ICANI-2018*, Springer, 2019, pp. 165–173.

[39] S. Maghsudi and M. Davy, "Computational models of human decision-making with application to the Internet of everything," *IEEE Wireless Communications*, vol. 28, no. 1, pp. 152–159, 2020.

[40] L. Berntzen, M. R. Johannessen, and R. El-Gazzar, "Smart Cities, Big Data and Smart Decision-making-Understanding" Big Data" in Smart City Applications," in *ICDS 2018, The Twelfth International Conference on Digital Society and eGovernments*, 2018.

[41] J. Bernardino and P. C. Neves, "Decision-making with big data using open source business intelligence systems," in *Human Development and Interaction in the Age of Ubiquitous Technology*, IGI Global, 2016, pp. 120–147.

[42] Q. Qiao and P. A. Beling, "Decision analytics and machine learning in economic and financial systems," 2016, *Springer*.