



Theoretical Framework for the Implementation of Data Analytics in Measuring Small Business Performance in Indonesia

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Abstract. Small Business faced a lack of human resources to manage a business so they have no ability to use and analyze descriptive or predictive data. Weakness in analyzing data causes them to be unable to make strategic decisions in improving their business performance and unable to display competitive advantage, especially in developing innovation chains. This study aims to develop a theoretical framework for the implementation of data analytics in measuring their performance by studying business data to find and understand historical patterns to predict and improve business performance. Using a systematic literature review of previous studies to obtain the state of the art which is supported by two type of data including internet data analytics from social media and marketplace also historical performance data from 50 micro business's Key Performance Indicator. The theoretical framework that was developed involves the hexahelix elements include academic, business, corporate, government, media and business assistance in the application of the analytical data process and is most needed by them. Now small business owners can improve their business performance by applying data analytics that is structured based on the concept of technology innovation 4.0 based on 3 elements including technology, organization and environment. It is concluded that they can apply data concepts analytics and the results can be used to make decisions in taking actions to improve business performance in the future.

Keywords: Data Analytics, Small Business, Performance Measurement

1 Introduction

Today's business world is inseparable from the process of globalization, the application of innovation, the speed of digitalization, and the spread and competition of information, which has changed business models. The digital era has made some businesses use new advanced innovations, for example, cell phones and social media, technologies in terms of raw data that can be accessed especially to be understood, stored, analyzed, and used at a lower cost [1]. The existence of digital records on the internet and the ever-increasing volume, commonly referred to as big data, is produced by each person all over the world [2]. Big data has been recognized as one of the technological pillars

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of the future and has the potential to offer companies excellent business value. By implementing it, benefits are obtained in the form of improved company performance through customer satisfaction [3]. Despite the fact that big data analytics provides a number of advantages, little study has been done on how businesses may use it and get economic value from such technology. According to [4] data analytics has been widely regarded as a breakthrough technology development in academia and the business community. Although many companies that use data analytics have a limited understanding of how they translate the potential of such technology into business value, there is a lack of research on how businesses may embrace it and benefit from it in terms of commercial value.

Information and Communication Technology (ICT) applications that are newly developed have two economic effects: they provide value for businesses and customers and spur economic growth by raising standards of living. [5]. The extent to which big data analytics solutions can contribute to the creation of competitive advantage can be assessed by considering the resource-based view (RBV) [6]. [7] argue that to succeed in big data analytics it is necessary to consider that data is no longer an information asset but a strategic asset of a company. The application of data analytics in the company contributes conceptually and empirically to improving company performance [8].

Successful strategic organizational performance is achieved through the combination of critical business intelligence and data analytics to improve organizational performance [9]. [10] Relation to Organizational Performance and Top Management Engagement stated that predictive data analytics is important for predicting organizational performance with structured performance indicators. Several large companies have implemented data analytics but only a few have succeeded in utilizing it to improve their performance, [11] developed a data analytics method based on RBT - Resources Based Theory.

The issue of applying Industry 4.0 technology is one that Small and Medium Enterprises (SMEs) must overcome in order to stay up with giant corporations, open the door for sustainable company growth, and undergo digital transformation. [12],[13] investigated the integration of the Technology-Organization-Environment (TOE) model and the Resource Based View (RBV) of the organization aims to give a single and unified model for BDA adoption among SMEs and how SMEs benefit from the business values of adopting BDA.

[14] Conducted research theoretically and tested empirically by conducting data analytics on social media, and theoretically obtained data on the diversity of social media as part of data analytics. Through its easy accessibility and usability, it can take part in efforts to break the reservation of SMEs towards Big Data analytics. It allows SMEs to utilize their data and participate in analyzing the data [15].

According to [16], entrepreneurs tend to make decisions independently and creatively to provide added value for customers and impact the economy. Entrepreneurs need to be more inventive by changing the current state of the market and bringing new value to the marketplace in order to strengthen their edge over competitors. [17]. Therefore, adopting new technologies in SMEs can be one of the important strategies to improve their position in the market and become more inventive and competitive. [18]; [19].

BDA is a new growth strategy for SMEs that enables them to use analytical tools to make better judgments regarding the market and client demands. They will also benefit from increased market competition. [20].

[21] stated that most multinational and large companies may have already implemented BDA aiming to improve organizational performance, but many Small and Medium Enterprises (SMEs) are still in the exploratory stage. Today, a variety of online and offline data sources may be used by small businesses to their benefit and for their hidden value in order to make judgments that are reliable and in line with their objectives [22]. Embracing big data can be beneficial for SMEs, as this technology can boost SMEs' confidence by applying real-time solutions to problems that every business may face [23].

SMEs using big data analytics are flexible and can make a big effort [22]. Competition has been reported as one of the main reasons for SMEs to adopt BDA [24]. Strong competition among SMEs in the market forces them to adopt BDA to improve their performance and remain competitive [25]; [24]. Since many big data projects have managed to improve competitiveness [26] SMEs have worked on using BDA technology [24]; [27]. Existing studies also highlight that SMEs should consider introducing BDA in their operations [18]; [8]. Considering SMEs's role in developing countries the acceptance of BDA as a new rider should not underestimate the innovation of SMEs. According to [8] the majority of recent literature emphasizes the importance of BDA in large projects [11]; [6]. However most SMEs do not want to implement big data technologies in their business or fail to invest in BDA practice due to lack of awareness and knowledge about big data [28]; [18].

SMEs are reluctant to embrace BDA due to poor IT infrastructure, improper skills, insufficient support from top executives, insufficient technology to manage high-volume unstructured data, nebulous business and IT strategy alignment plans, and limited financial assistance. [20]; [27]; [29].

[30] conducted research by identifying the main trends, opportunities and challenges faced by large enterprises and SMEs. He described situations where Big Data analytics are considered significant and favorable applications to improve the innovation process.

The Processes of Technological Innovation by Tornatzky and Fleischer, which describes the Technology-Organization-Environment (TOE) framework [31] describes the entire innovation process - from the development of innovations by engineers and entrepreneurs to the adoption and implementation of those innovations by users in the context of the firm. One stage of this process, the company context's effect on the acceptance and implementation of innovations, is represented by the TOE framework.

An organizational-level theory called the TOE framework indicates that there are three different aspects of the company setting that affect adoption choices. Technological context, organizational context, and environmental context comprise the three components, they all have an impact on technological innovation. From the environmental context SMEs have the potential to grow with tremendous conditions and constraints but they run their business efficiently and still need a lot of support from the government and other major players in the market and this is needed to strengthen them [32].

Several previous studies have found that the application of data analytics is only carried out by large companies, not yet widely practiced by SMEs due to limited resources. A theoretical framework is needed to apply this innovation as a reference for SMEs to make decisions to improve business performance. Three technology-organization-environment contexts are used as the basis for developing this framework by referring to the analysis of two types of data, namely data from the internet and data developed based on historical business performance. According to [33], one of the successes of SMEs in their business is through a sustainable business assistance process involving hexahelix elements (academics - business - community - government, media and sustainable assistance is needed).

2 Method

2.1 Systematic Literature Review (SLR)

SLRs come in two forms: (1) Reviews that serve as the basis for empirical studies and (2) stand-alone works background reviews are typically used as justification for decisions made in the research design, provide theoretical context, or identify gaps in the literature that the research seeks to fill [34]. a research design conducted to systematically synthesize existing research evidence in terms of searching for research articles, critical appraisal and synthesis of research results to answer a question. SLR research is conducted for various purposes, including to identify, review and interpret all available research with the topic area of phenomena of interest with specific relevant research questions using journal literature that uses the keywords: big data analytics, data analytics, small business and TOE.

2.2 Database Development

The database development process was carried out on a sample of 50 MSMEs spread throughout Indonesia by taking data from the internet, especially on marketplaces, social media Instagram, and Facebook: real-time data on profile visits, demographic data on social media visitors, web click data, web click hours data. In addition to data from the internet, there is also data compiled based on Key Performance Indicators (KPI) based on past historical records containing performance data.

2.3 Data Analytic

It is a process that uses tools, technology, to find trends and solve problems using data that may influence corporate procedures, enhance decision-making, and promote business expansion. Analyze SME Problems and Set an Action Plan or corrective action plan to improve MSME business performance and compare before and after implementation with KPIs accordance with [35].

2.4 Developing Theoretical Framework

The preparation of the conceptual framework for applying analytical data to MSMEs uses several stages, namely: (1) Developing a Data Analytical Application Model based on the TOE Context; (2) Develop data, internet data and business performance historical data; (3) Processing data using descriptive and predictive data methods with Key Performance Indicators (KPI); and (4) Designing the Theoretical Framework for the Implementation of Data Analytics

3 Result and Discussion

3.1 Technology-Organization-Environment Context

Adoption of innovation is influenced by technology, organization, and the environmental context within the company, and for small businesses, a model for implementing data analytics is needed by modifying the TOE Concept. In Technology Context, small businesses are expected to be able to adopt technology 4.0 by applying data analytics for their business development. From the organizations context of small business and their supporting resources, they are part of the Triangle TOE Framework, which was adapted from the book *The Processes of Technological Innovation* by Tornatzky and Fleischer. The last context is the environment where the supporting factors for the application of data analytics in MSMEs are Hexahelix Stakeholders, namely academic – business – community – government – media and business assistance (Fig. 1).

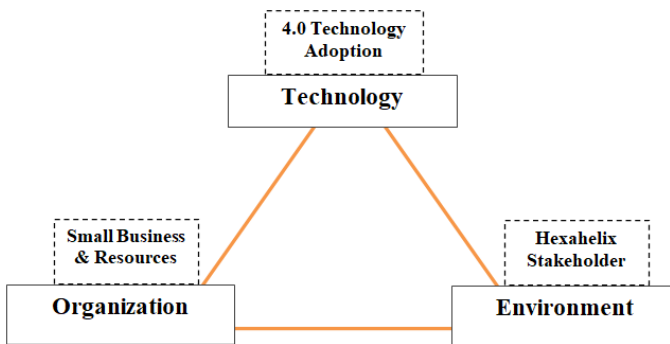


Fig. 1. Triangle TOE Framework for Small Business Sustainability adapted from Tornatzky and Fleischer's *The Processes of Technology Innovation*

3.2 Database Development Process

Small businesses with sustainable business assistance carry out a data development process consisting of 2 categories, namely: (1) data from the internet (social media Facebook and Instagram, market place and google trend analysis) (2) Historical Business

Performance Data compiled from key performance indicators consisting of the 5 determining factors are financial factors, production factors, marketing factors, HR factors, and organizational factors. Details of the stages of data development were listed in Fig. 2.

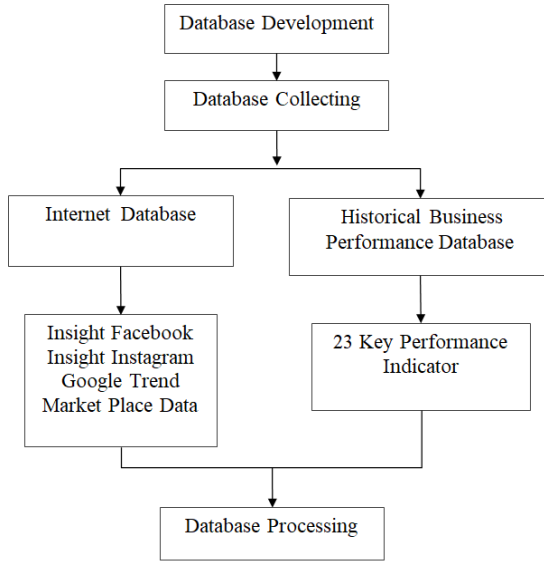


Fig. 2. Flow Chart of the Performance Report Preparing Process at the Data Development Stage

3.3 Data Processing

Conducted based on the best performance and the results of data processing are several decisions that must be taken by small business owners who become strategic decisions to develop their business. The conceptual framework at the data processing stage is performed with the flow as shown in Fig. 3.

3.4 Design Theoretical Framework for Implementation Data Analytics

The Integrated Theoretical Framework by combining several stages and elements assembled according to the TOE components - Technology, Organization and Environment is depicted in Fig. 4. Sustainable business assistance as one of the Hexahelix components in this concept plays an important role in realizing success in the application of this theoretical framework.

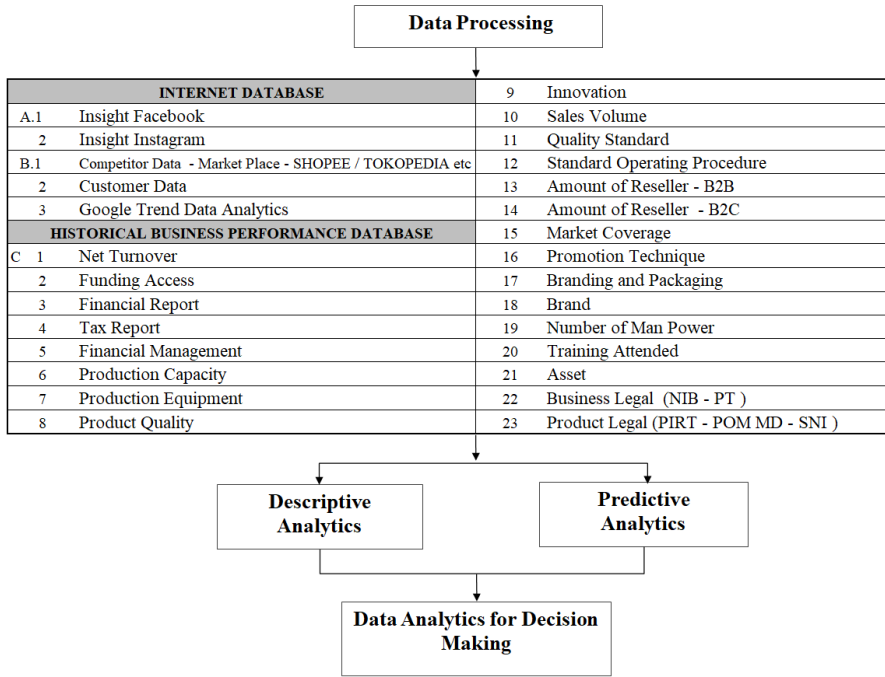


Fig. 3. Data Processing for Decision Making

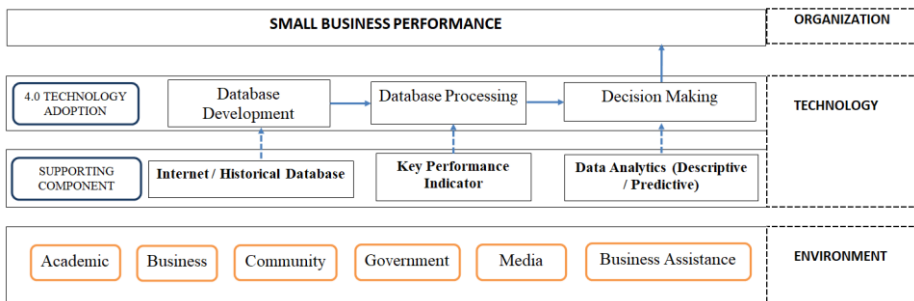


Fig. 4. Theoretical Framework Implementation Data Analytics for Supporting Small Business Performance

4 Conclusion

From some earlier literature, it is often discussed about the application of data analytics in some major companies where the resources and ability to carry out the data analysis process are very supportive, so the company can immediately take strategic policies to improve its business. Unlike the case with SMEs which have limited resources, so the application of data analytics systems is very limited and has not been able to do so.

Based on the theoretical framework for the application of data analytics systems developed by integrating the TOE concept with data analytics implementation methods in MSMEs by involving sustainable Hexahelix elements (Academics - Business - Community - Government - Media - and Business Assistance), SMEs are able to implement this technology adoption system so their business performance can improve.

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References

1. H. Alsghaier, "The Importance of Big Data Analytics in Business: A Case Study," *Am. J. Softw. Eng. Appl.*, vol. 6, no. 4, p. 111, 2017, doi: 10.11648/j.ajsea.20170604.12.
2. O. Müller, I. Junglas, J. Vom Brocke, and S. Debortoli, "Utilizing big data analytics for information systems research: Challenges, promises and guidelines," *Eur. J. Inf. Syst.*, vol. 25, no. 4, pp. 289–302, 2016, doi: 10.1057/ejis.2016.2.
3. E. Raguseo and C. Vitari, "Investments in big data analytics and firm performance: an empirical investigation of direct and mediating effects," *Int. J. Prod. Res.*, vol. 56, no. 15, pp. 5206–5221, 2018, doi: 10.1080/00207543.2018.1427900.
4. P. Mikalef, M. Boura, G. Lekakos, and J. Krogstie, "Big data analytics and firm performance: Findings from a mixed-method approach," *J. Bus. Res.*, vol. 98, no. July 2018, pp. 261–276, 2019, doi: 10.1016/j.jbusres.2019.01.044.
5. T. Bresnahan and P. L. Yin, "Adoption of new information and communications technologies in the workplace today," *Innov. Policy Econ.*, vol. 17, no. 1, pp. 95–124, 2017, doi: 10.1086/688846.
6. S. F. Wamba, A. Gunasekaran, S. Akter, S. J. fan Ren, R. Dubey, and S. J. Childe, "Big data analytics and firm performance: Effects of dynamic capabilities," *J. Bus. Res.*, vol. 70, pp. 356–365, 2017, doi: 10.1016/j.jbusres.2016.08.009.
7. I. R. Varela and B. Tjahjono, "Big data analytics in supply chain management: trends and related research," *6th Int. Conf. Oper. Supply Chain Manag.*, vol. 1, no. 1, pp. 2013–2014, 2014, [Online]. Available: <http://www.researchgate.net/publication/270506965>
8. P. Maroufkhani, R. Wagner, W. K. Wan Ismail, M. B. Baroto, and M. Nourani, "Big data analytics and firm performance: A systematic review," *Inf.*, vol. 10, no. 7, pp. 1–21, 2019, doi: 10.3390/INFO10070226.
9. M. A. L. Jaykrishnan, A. K. Bin Mohamad, and M. B. M. Yusof, "The holistic view of business intelligence (BI) and big data analytics (BDA) towards designing strategic performance management framework: A case study," *J. Theor. Appl. Inf. Technol.*, vol. 96, no. 7, pp. 2025–2045, 2018.
10. A. Gunasekaran *et al.*, "Big data and predictive analytics for supply chain and organizational performance," *J. Bus. Res.*, vol. 70, pp. 308–317, 2017, doi: 10.1016/j.jbusres.2016.08.004.
11. S. Akter, S. F. Wamba, A. Gunasekaran, R. Dubey, and S. J. Childe, "How to improve firm performance using big data analytics capability and business strategy alignment?," *Int. J. Prod. Econ.*, vol. 182, pp. 113–131, 2016, doi: 10.1016/j.ijpe.2016.08.018.
12. S. Rautenbach, I. H. de Kock, and J. Grobler, "Data Science for Small and Medium-Sized Enterprises: a Structured Literature Review," *South African J. Ind. Eng.*, vol. 33, no. 3, pp. 83–95, 2022, doi: 10.7166/33-3-2797.

13. P. Maroufkhani, W. K. Wan Ismail, and M. Ghobakhloo, "Big data analytics adoption model for small and medium enterprises," *J. Sci. Technol. Policy Manag.*, vol. 11, no. 2, pp. 171–201, 2020, doi: 10.1108/JSTPM-02-2020-0018.
14. J. Q. Dong and C. H. Yang, "Business value of big data analytics: A systems-theoretic approach and empirical test," *Inf. Manag.*, vol. 57, no. 1, p. 103124, 2020, doi: 10.1016/j.im.2018.11.001.
15. M. Dittert, R. C. Härting, C. Reichstein, and C. Bayer, "A data analytics framework for business in small and medium-sized organizations," *Smart Innov. Syst. Technol.*, vol. 73, no. May, pp. 169–181, 2018, doi: 10.1007/978-3-319-59424-8_16.
16. A. Emami and D. Dimov, "Degree of innovation and the entrepreneurs' intention to create value: a comparative study of experienced and novice entrepreneurs," *Eurasian Bus. Rev.*, vol. 7, no. 2, pp. 161–182, 2017, doi: 10.1007/s40821-016-0068-y.
17. A. Emami and D. Khajeheian, "Social norms and entrepreneurial action: The mediating role of opportunity confidence," *Sustain.*, vol. 11, no. 1, pp. 1–18, 2019, doi: 10.3390/sul1010158.
18. A. Kazmi, S. Hasnain, R. Soomrani, S. Hussain, K. Adeel, and M. Iqbal, "Munich Personal RePEc Archive A Study of Big Data for Business Growth in SMEs : Opportunities Challenges A Study of Big Data for Business Growth in SMEs : Opportunities & Challenges," no. 96034, 2019.
19. D. Singh, "Implementation of technology innovation in MSMEs in India: Case study in select firms from Northern region," *J. Sci. Technol. Policy Manag.*, vol. 10, no. 3, pp. 769–792, 2019, doi: 10.1108/JSTPM-06-2018-0065.
20. D. H. Shin, "Demystifying big data: Anatomy of big data developmental process," *Telecomm. Policy*, vol. 40, no. 9, pp. 837–854, 2016, doi: 10.1016/j.telpol.2015.03.007.
21. L. C. Hong and T. A. Ping, "The Impact of Big Data Analytics Adoption on the Performance of Malaysian Small and Medium Enterprises," vol. 145, no. Icebm 2019, pp. 112–116, 2020, doi: 10.2991/aebmr.k.200626.021.
22. Ogbuokiri, Udanor C N, and M. N. Agu, "Implementing bigdata analytics for small and medium enterprise (SME) regional growth," *IOSR J. Comput. Eng. Ver. IV*, vol. 17, no. 6, pp. 2278–661, 2015, doi: 10.9790/0661-17643543.
23. D. Sen, M. Ozturk, and O. Vayvay, "An Overview of Big Data for Growth in SMEs," *Procedia - Soc. Behav. Sci.*, vol. 235, no. October, pp. 159–167, 2016, doi: 10.1016/j.sbspro.2016.11.011.
24. N. A. EL Tien, NM Ali, S Miskon, "Big Data Analytics Adoption Model for Malaysian SMEs," in *Emerging Trends in Intelligent Computing and Informatics. IRICT 2019. Advances in Intelligent Systems and Computing, vol 1073. Springer, Cham.*, 2019. doi: https://doi.org/10.1007/978-3-030-33582-3_5.
25. I. Malaka and I. Brown, "Challenges to the Organisational Adoption of Big Data Analytics," pp. 1–9, 2015, doi: 10.1145/2815782.2815793.
26. S. Mandal, "The influence of big data analytics management capabilities on supply chain preparedness, alertness and agility: An empirical investigation," *Inf. Technol. People*, vol. 32, no. 2, pp. 297–318, 2019, doi: 10.1108/ITP-11-2017-0386.
27. S. Coleman, R. Göb, G. Manco, A. Pievatolo, X. Tort-Martorell, and M. S. Reis, "How Can SMEs Benefit from Big Data? Challenges and a Path Forward," *Qual. Reliab. Eng. Int.*, vol. 32, no. 6, pp. 2151–2164, 2016, doi: 10.1002/qre.2008.
28. A. Oussous, F. Z. Benjelloun, A. Ait Lahcen, and S. Belfkih, "Big Data technologies: A survey," *J. King Saud Univ. - Comput. Inf. Sci.*, vol. 30, no. 4, pp. 431–448, 2018, doi: 10.1016/j.jksuci.2017.06.001.

29. Christina O'Connor Stephen Kelly, "Facilitating knowledge management through filtered big data: SME competitiveness in an agri-food sector," *J. Knowl. Manag.*, 2017, doi: <http://dx.doi.org/10.1108/JKM-08-2016-0357>.
30. P. Del Vecchio, A. Di Minin, A. M. Petruzzelli, U. Panniello, and S. Pirri, "Big data for open innovation in SMEs and large corporations: Trends, opportunities, and challenges," *Creat. Innov. Manag.*, vol. 27, no. 1, pp. 6–22, 2018, doi: 10.1111/caim.12224.
31. Jeff Baker, "The Technology–Organization–Environment Framework," Springer Science+Business Media, 2011. doi: DOI 10.1007/978-1-4419-6108-2_12,.
32. M. Shukla and R. Shankar, "An extended technology-organization-environment framework to investigate smart manufacturing system implementation in small and medium enterprises," *Comput. Ind. Eng.*, vol. 163, p. 107865, Jan. 2022, doi: 10.1016/j.cie.2021.107865.
33. M. R. Radyanto and E. N. Hayati, "Sistem Perbaikan Berkelanjutan Umkm Terdampak Pandemi Covid-19 Dengan Menerapkan Rekayasa Ulang Proses Bisnis," *PROFISIENSI J. Progr. Stud. Tek. Ind.*, vol. 9, no. 2, pp. 298–311, 2021, doi: 10.33373/profis.v9i2.3665.
34. M. Templier and G. Paré, "A framework for guiding and evaluating literature reviews," *Commun. Assoc. Inf. Syst.*, vol. 37, pp. 112–137, 2015, doi: 10.17705/1cais.03706.
35. M. R. Radyanto and E. Prihastono, "Pengembangan Sistem Pendampingan Usaha Berkelanjutan Bagi UMKM Berbasis Sistem Manajemen Kinerja," *Opsi*, vol. 13, no. 1, p. 17, 2020, doi: 10.31315/opsi.v13i1.3467.

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