RESEARCH
www.commprac.com
ISSN 1462 2815

DIGITAL TRANSFORMATION IN MEDAN'S SMEs: ASSESING THE IMPACT ON OPERATIONAL EFFICIENCY AND CUSTOMER SATISFACTION

NATALIA E T SIHOMBING

HKBP Nommensen University. Email: natalia.sihombing@uhn.ac.id

DOI: 10.5281/zenodo.13832546

Abstract

Research Objectives The purpose of this study is to find out and analyze the extent to which business automation variables, and the use of artificial intelligence affect MSME customer satisfaction in Medan City through operational efficiency as an intervening variable. Originality The subject of this study is MSMEs in the city of Medan, where the variables in this study are independent variables, namely business automation and the use of artificial intelligence, dependent variables, namely customer satisfaction variables and intervening variables are operational efficiency variables. The results of the data analysis were used using SEM analysis using SMART PLS 4.0 software. The data collection techniques with questionnaires and interviews, as well as observation.Design/methodology/approach The research method uses a quantitative descriptive method of data analysis using *the structural equation model* (SEM) method, where the results of data processing using the SEM method are carried out with the PLS 4.0 application. Findings From the results of the study, the existing conclusion, namely partially the variables of business automation and the use of artificial intelligence affect the customer satisfaction of Medan MSMEs and affect the operational efficiency of Medan MSMEs. Simultaneously, the variables of business automation and the use of artificial intelligence have an effect on customer satisfaction of MSMEs in Medan City through the variable of operational efficiency as an intervening variable. Implementation The greater the increase in the use of digitalization, the more MSMEs in Medan City will be able to increase business automation in operational activities as well as carry out operational efficiency in order to increase service speed and work speed to increase customer satisfaction.

Keywords: Digital Transformation, Business Automation, Use Of Artificial İntelligence, Operational Efficiency, Customer Satisfaction.

INTRODUCTION

Digital transformation is often associated with the Fourth Industrial Revolution, which is characterized by the incorporation of physical, digital, and biological technologies. Technologies such as the Internet of Things (IoT), artificial intelligence (AI), and big data play an important role in this era (Khalil, Afef, Abdelli, Mohammed El Amine and Mogaji, 2022).

The development of computers and information technology at the end of the 20th century became the main driver of digital transformation. From mainframe computers to personal computers, and finally the internet, these technologies are beginning to change the way organizations operate and communicate.

The advent of the internet in the 1990s and the development of the World Wide Web created new opportunities for businesses in terms of e-commerce, digital marketing, and communications. It also allows organizations to collect and analyze data in an unprecedented way (Amaral, Afonso and Peças, 2021). With the increasing use of mobile devices and the adoption of technology *Cloud Computing*, organizations can access and share data in a *Real-time* from anywhere.

This speeds up business processes and allows for greater flexibility. Big data collection and analysis allows companies to make smarter, data-driven decisions. With

advanced analytics, organizations can identify trends, understand customer behavior, and optimize their operations (Costa, Alessandra, 2023).

Artificial intelligence and *Machine Learning* providing the ability for organizations to automate complex tasks, improve efficiency, and offer personalized customer experiences*. Blockchain* bringing innovations in data and transaction security. The technology has been applied in areas such as finance, supply chain, and health to improve transparency and security (Gessa, Ana, Jiménez, Amor and Sancha, 2023).

The Covid-19 pandemic that shook the world is a factor that must be seen, where this factor will make the company carry out a policy of technological transformation process, so that a massive revolution is needed by implementing work from home, where tasks can be completed from home without having to be face-to-face, where companies automate work processes that were previously carried out in the office offline to improve the work process from home, Where the work reporting poses are carried out by the digital transformation process through the use of artificial intelligence, so that the work process and the company's operational activities become efficient and effective (Canhoto, Ana Isabel, 2021).

The automation of business processes so far can be well established if there is a will and also a creative revolutionary idea, where this creative idea is able to create a transformation process in the digital world, where the transformation process of this digital world is getting bigger and more sophisticated day by day, and increasingly making the business operational process efficient and effective in the process, So as to reduce costs that should be incurred for operations into a comprehensive cost reduction (Priyono, Anjar, Moin & Putri, 2020).

Business process automation also creates a correction process for human errors, where this correction process needs to be carried out so that mistakes and mistakes do not occur that make the company lose money or make the cost of correcting these errors greater (Telukdarie, Arnesh, 2023).

This can indeed be a double-edged sword not only for the company, but for improving the company's image, where this digitalization development process can have positive and negative impacts, where the positive impact can correct mistakes made by humans, and have an impact on the speed and acceleration of work processes in order to increase cost efficiency, as well as improve services quickly, carefully, Effective and efficient (Review, 2019).

The negative impact that has arisen is the increasing number of unemployment, so the Government needs to find emergency solutions so that the existing digital transformation does not harm the community and also the workforce in the company, so it is needed *Win-win solution* which can prevent as well as become a concrete solution in preventing these negative impacts (Radicic, Dragana and Petković, 2023).

Artificial intelligence applied by every business entity, especially for MSMEs, can improve the quality of services owned by the company, where this artificial intelligence has flexible and not rigid work operations, such as those carried out by humans, where work operations tend to be effective and error-free, so that they are able to serve customers and satisfy customers (Arranz, Carlos F.A., 2023).

Artificial intelligence is also beneficial for companies in pursuing complex and difficult work for humans, where this kind of work will have a significant impact on company performance, so that companies, especially MSMEs, can grow quickly and be able to

improve work performance and productivity, where artificial intelligence will create business connectivity, thereby increasing overall success (Gouveia, Fernando Diogo and Mamede, 2022).

MSMEs need a digitalization transformation process, where MSMEs have operations that can also be said to be complicated, customer service is sometimes less than optimal, so it tends to harm customers, because customers feel dissatisfied with the MSME service, so a revolution is needed in the digital field to be able to accommodate customer complaints that have been complaining about poor service (Marzi, Giacomo, 2023). MSMEs can improve cost efficiency with digital transformation, where this digital transformation requires maximum time and energy to help serve customers quickly and effectively (Yilmaz, Gokcen, 2023).

MSMEs can organize their work procedures well, as well as create effectiveness in completing the work of serving customers, where customers will always be happy with effective and efficient services from MSMEs, so that something maximum is needed in striving for the transformation process to digitalization by taking time to change the process from services carried out by humans to services carried out by the digital world (Kim, Goo Young, 2023).

MSMEs need a clear vision when they want to transform manual technology using humans to digital technology using artificial intelligence, this will have an impact on increasing the number of unemployed people, and on the one hand, MSMEs need large business development, so there needs to be clarity on where the MSME strategy wants to be directed to where the existing business is (Hoang, Ha and Le Tan, 2023).

Medna City is one of the cities that is the center of MSMEs, where the number of MSMEs in this city in 2023 is 38,343 business units, while in 2022 the number of MSMEs is 56,750 business units, where in 2023 there will be a decrease in the number of MSMEs, where many existing MSMEs are experiencing bankruptcy due to customer responses that have many complaints about service, So that loyal customers are decreasing.

This is due to the lack of MSME initiatives in the use of transformation from menual work to automated work, where existing work has not been able to improve the quality of good work, so that the lack of use of artificial intelligence (digital technology) in the implementation of operations will tend to reduce efficiency, so that the costs incurred increase and are not proportional to the costs incurred when the operation process is manual as a result of ineffectiveness and tends to be inefficient, so that it has an impact on a decrease in the ability to serve well, so that customer satisfaction tends to decrease.

Problem Formulation

The formulation of the problem that emerged from this study is how the business automation variable, and the use of artificial intelligence affect the satisfaction of MSME customers in Medan City through operational efficiency as an intervening variable.

Research Objectives

The purpose of this study is to find out and analyze the extent to which business automation variables, and the use of artificial intelligence affect MSME customer satisfaction in Medan City through operational efficiency as an intervening variable.

Originality of Research

The subject of this study is MSMEs in Medan City, where the variables in this study are independent variables, namely business automation and the use of artificial intelligence, dependent variables, namely customer satisfaction variables and intervening variables are operational efficiency variables. The results of the data analysis were used using SEM analysis using SMART PLS 4.0 software. The data collection techniques with questionnaires and interviews, as well as observation.

LITERATURE REVIEW

Business Automation

Business process automation is the use of technology to carry out repetitive tasks or business processes automatically, without the need for direct human intervention. It can include everything from simple operations to complex workflows (Jing, Hao, Zhang, Yaoyao and Ma, 2023). Automating business processes is an important strategic step in digital transformation, helping companies to become more efficient, responsive, and competitive (Yu, Honglan, Fletcher, Margaret and Buck, 2022). Examples of business process automation are:

1. Inventory management with automatic stock monitoring that serves as a system can automatically monitor and manage stock, reorder goods when quantity is low.
2. Customer service with chatbots and virtual assistants provides 24/7 customer support by using AI to answer common questions and solve simple problems.
3. Marketing and sales through email marketing serve as a place to send automated emails based on customer behavior and targeted campaigns
4. Financial processes through automated payroll serve as an automated system for calculating salaries, taxes, and other deductions, as well as managing payments (Hidayat-your-Rehman, Imdadullah and Alsolamy, 2023).

The indicators of this business automation are:

1. Operational efficiency, where operational efficiency measures the time it takes to complete a full cycle of an automated process. A decrease in cycle time indicates an increase in efficiency.
2. Quality and accuracy, where quality and accuracy are needed to measure changes in the number of errors or defects in the output after the implementation of automation. A decrease in error rate indicates an improvement in quality.
3. Cost reduction, which is done to measure changes in operational costs after the implementation of automation, including labor, material, and overhead costs.
4. Customer satisfaction, where this automation measures changes in customer satisfaction levels based on feedback or surveys (Lestantri, Inda D., 2021)

Use of Artificial Intelligence

Artificial Intelligence (AI) has become a crucial tool in various industries, helping organizations to improve efficiency, make better decisions, and create innovation (Coenen, Jenny, 2022). With its wide application in various industries, artificial intelligence not only improves efficiency and productivity but also opens up new opportunities for innovation and business growth (Lee, Jeoung Yul, 2022).

The indicators of the use of artificial intelligence are:

1. Operational efficiency, where artificial intelligence is able to measure the time it takes to complete a full cycle of AI-automated processes.
2. Productivity, where the use of artificial intelligence measures changes in employee productivity levels after using AI tools or systems.
3. Quality and accuracy, where artificial intelligence measures changes in operational costs after the implementation of AI, including labor, material, and overhead costs.
4. Customer satisfaction, where artificial intelligence can measure changes in the time it takes to respond to customer requests or queries after the implementation of AI.
5. The speed of innovation, where the use of artificial intelligence measures an increase in the number of new innovations or initiatives launched after the adoption of AI (Soluk, Jonas, Decker-Lange, Carolin and Hack, 2023).

Customer Satisfaction

Customer satisfaction is a measure of how well the products or services provided by a company meet or exceed customer expectations. Maintaining and improving customer satisfaction is essential for long-term business success and growth (Ardito, Lorenzo, 2021). The strategies to increase customer satisfaction are:

1. Improving the Quality of Products/Services by ensuring that products or services always meet or exceed quality standards.
2. Improve Customer Service by providing training to customer service staff to improve communication and problem-solving skills.
3. Customer Experience Personalization is done by using customer data to provide a more personalized experience.
4. Collecting and Using Feedback Routinely collects customer feedback and uses that information to make improvements.
5. Providing Additional Value by offer additional features or benefits that make the product or service more attractive (Spaltini, Marco, 2022).

By monitoring and optimizing these indicators, companies can understand their customer satisfaction levels and take the necessary steps to improve them, which will ultimately support long-term business growth and success (Uddin, Md Hamid, 2023). Indicators of customer satisfaction include:

1. There are product recommendations to other parties made by loyal customers
2. There is a tendency for customers to feel good product quality
3. There is a tendency for products to be beneficial to customers (Matarazzo, Michela, 2021)

Operational Efficiency

Operational efficiency refers to an organization's ability to maximize its output with available resources, including time, labor, and cost (Chatzistamoulou, 2023). The goal is to reduce waste, increase productivity, and achieve better results by using fewer

resources (Grooss, Oliver Fuglsang, Presser, Mirko and Tambo, 2022). The indicators of economic efficiency are:

1. The cycle time of the process, which is the time it takes to complete a full cycle of a given process, from start to finish.
2. Operating costs, which are the total costs incurred to run business operations, including labor, materials, and overhead costs.
3. Error and quality rate, i.e. the number of errors or defects in production output (Viswanathan, Radhakrishnan and Telukdarie, 2021).

Conceptual Framework

The conceptual framework of the research is:

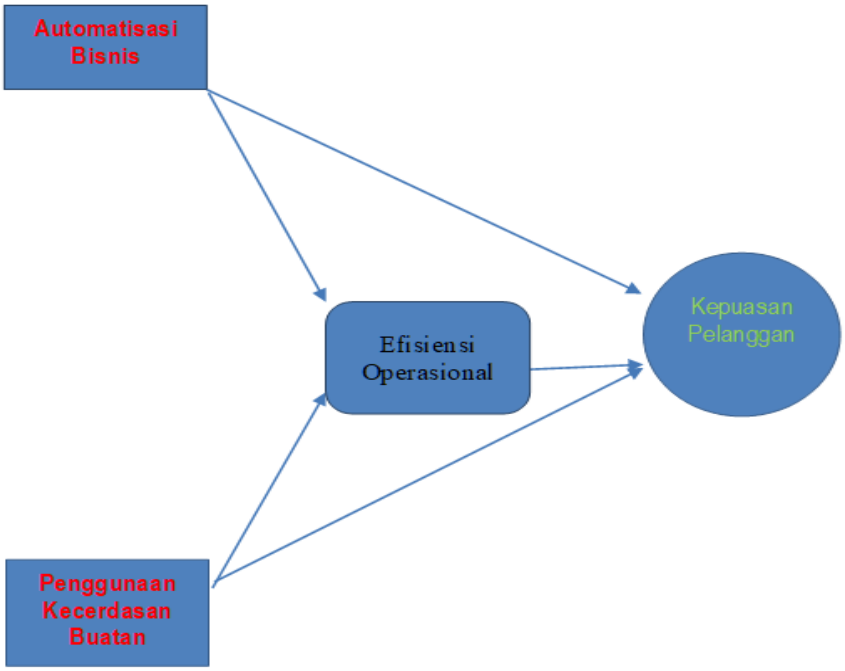

Figure 1: Conceptual Framework

Hypothesis

1. Business automation affects MSME customer satisfaction in Medan City
2. The use of artificial intelligence has an effect on customer satisfaction of MSMEs in Medan City
3. Business automation affects the operational efficiency of MSMEs in Medan City
4. The use of artificial intelligence has an effect on the operational efficiency of MSMEs in Medan City
5. The operational efficiency of MSMEs in Medan City affects the economic growth of Medan City
6. Business automation has an effect on MSME customer satisfaction in Medan City through operational efficiency as an intervening variable
7. The use of artificial intelligence has an effect on MSME customer satisfaction in Medan City through operational efficiency as an intervening variable.

RESEARCH METHODS

This research method was carried out using a quantitative descriptive method using method analysis *Structural Equation Model* (SEM), where according to (Härting, Ralf Christian, 2022) SEM analysis is a combination of factor analysis and regression analysis and can be used to test hypotheses regarding the relationship between latent variables (not directly measured) and measured variables (directly observable). The population in this study is 38,343 MSMEs in Medan City in 2023, where the sampling method is carried out using the *accidental sampling*, which according to (Bhatti, Sabeen Hussain, 2023) sampling method using *accidental sampling* is a sampling method in which the sample is beaded at the location or place of research.

The number of samples taken can be done using the slovin formula as follows:

n = N / (1 + Ne²) = 38,343 / (1 + 38,343 x 0.1²) = 99.73 = 100 MSMEs in Medan City.

RESEARCH RESULTS AND DISCUSSION

Research Results

The output of the SEM test can be described through the following *Bootstraping* diagram:

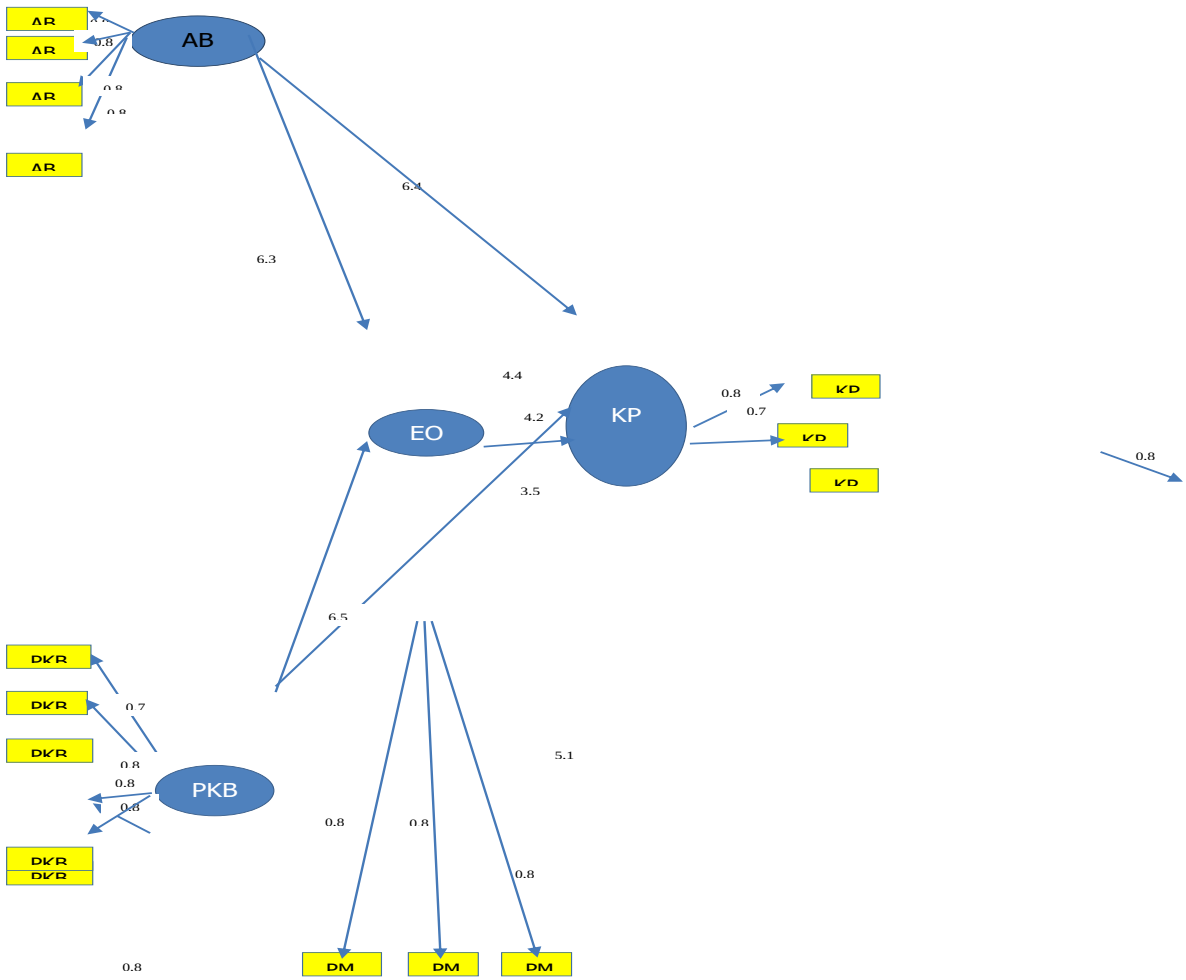

Figure 2: *Bootsraping Diagram*

Convergent Validity Analysis

(Härting, Ralf Christian, 2022) states that the analysis *convergent validity* is one type of feasibility test of existing construct variables. The test results *convergent validity* In this study, it is as follows:

Table 1: *Convergent Validity Test*

Variable	Indicators	Outer Loading
Business Automation (X1)	AB 1	0,866
	AB 2	0,876
	AB 3	0,886
	AB 4	0,856
Use of Artificial Intelligence (x2)	PKB 1	0,849
	PKB 2	0,759
	PKB 3	0,869
	PKB 4	0,849
	PKB 5	0,839
Customer Satisfaction (Y)	KP 1	0,833
	KP 2	0,843
	KP 3	0,883
Operational Efficiency (Z)	PM 1	0,881
	PM 2	0,761
	PM 3	0,811

Source: Results of Data Processing with PLS 3.0, 2024

The table above states that the data from each variable is valid, so it can be used well for the next data analysis process.

Analysis of Average Variant Extracted (AVE)

(Härting, Ralf Christian, 2022)cstated that the AVE test is one of the techniques used to validly assess the validity of the construct variables that appear. The test results *Average Variant Extracted* (AVE) is in the following table:

Table 2: AVE Test

Variable	AVE
Business Automation (X1)	0,830
Use of Artificial Intelligence (x2)	0,872
Customer Satisfaction (Y)	0,841
Operational Efficiency (Z)	0,861

Source: Data Processing Results with PLS 4.0, 2024

The table above describes the *Average Variant Extracted* (AVE) value greater than 0.5 which means that the model of the equation of construct and data distribution is appropriate and valid.

Composite Reliability Analysis

According to (Härting, Ralf Christian, 2022) Testing *Composite Reliability* It is a technique to understand whether the data is appropriate and reliable. This can be seen in the following table:

Table 3: *Composite Reliability Test*

Variable	Composite Reliability
Business Automation (X1)	0,882
Use of Artificial Intelligence (x2)	0,820
Customer Satisfaction (Y)	0,775
Operational Efficiency (Z)	0,851

Source: Data Processing Results with PLS 4.0, 2024

The table above states that the *composite reliability* value is greater than 0.6, where the existing data is reliable and good for further tests.

Discriminant Validity *Analysis*

In confirmatory factor analysis (CFA) or structural equation modeling (SEM), the validity analysis of discrimination is how different the construct equations differ from each other (Härting, Ralf Christian, 2022). The results of the Discriminant Validity analysis can be seen in the following Table 5:

Table 5: *Discriminant Validity Analysis*

	Customer Satisfaction Moderating Effect 1	Customer Satisfaction Moderating Effect 2	Customer Satisfaction Moderating Effect 3	Customer Satisfaction Moderating Effect 4
Business Automation	.757	1.000	.756	.624
Use of Artificial Intelligence	.664	.737	1.000	.724
Customer Satisfaction	.756	.784	.837	1.000
Operational Efficiency	1.000	.746	.668	.636

Source: PLS Data Processing Results, 2023

Based on the table above, it can be seen that the AVE value exists from one equation to another construction equation and already meets the *Discriminant Validity assumption*.

Path Coefficient *Testing*

As for the *path coefficient test*, it can be found through the following table:

Table 6: R Square Test

Variable	R Square
Business Automation (X1)	0,880
Use of Artificial Intelligence (x2)	0,841
Customer Satisfaction (Y)	0,872
Operational Efficiency (Z)	0,863

Source: Data Processing Results With PLS 3.0, 2023

From the existing table, R Square's customer satisfaction variables can be explained by the variables of business automation, the use of artificial intelligence and operational efficiency by 87.2%, while the remaining 12.8% can be explained by other variables that are not in this study.

Hypothesis Test

The results of hypothesis testing can be seen through the following table:

Table 7: Hypothesis Test

Hypothesis	Influence	T-Statistics	P-Value	Result
H1	Business automation for MSME customer satisfaction in Medan City	6,411	0,000	Accepted
H2	The use of artificial intelligence on MSME customer satisfaction in Medan City	5,132	0,001	Accepted
H3	Business automation for MSME operational efficiency in Medan City	6,303	0,001	Accepted
H4	The use of artificial intelligence on the operational efficiency of MSMEs in Medan City	6.513	0,000	Accepted
H5	Operational efficiency to customer satisfaction of Medan City MSMEs	4,251	0,000	Accepted
H9	Business automation of MSME customer satisfaction in Medan City through operational efficiency as an intervening variable	4,402	0,000	Accepted
H10	The use of artificial intelligence on MSME customer satisfaction in Medan City through operational efficiency as an intervening variable	3,510	0,000	Accepted

Source : Data Processing Results With PLS 3.0, 2023

According to the table above, it can be concluded that partially, the variables of business automation and the use of artificial intelligence affect the customer satisfaction of Medan MSMEs and affect the operational efficiency of Medan MSMEs. Simultaneously, the variables of business automation and the use of artificial intelligence have an effect on customer satisfaction of Medan City MSMEs through the operational efficiency variable as an intervening variable.

Discussion

Business Automation Affects MSME Customer Satisfaction in Medan City

The results of the study stated that Business automation affect the satisfaction of MSME customers in Medan City. This is in accordance with research from (Bhatti, Sabeen Hussain, 2023) which states that business outsourcing can reduce service errors and be able to improve service in order to create customer satisfaction.

The Use of Artificial Intelligence Affects MSME Customer Satisfaction in Medan City

The results of the study explain that the use of artificial intelligence has an effect on customer satisfaction of MSMEs in Medan City. This is in line with research (Matarazzo, Michela, 2021) which states that the better the use of artificial intelligence, the more it will create operational work that serves and reduces human errors in order to increase customer satisfaction.

Business Automation Affects MSME Operational Efficiency in Medan City

According to the results of existing research, business automation variables affect MSME operational efficiency in Medan City. This is in accordance with research (Denicolai, Stefano, Zucchella, Antonella and Magnani, 2021) which states that the better the business automation, the faster and more effective the work will be completed, so that the more efficient the business operations will be.

The Use of Artificial Intelligence Affects the Operational Efficiency of MSMEs in Medan City

According to the results of existing research, the variables of the use of artificial intelligence affect operational efficiency of MSMEs in Medan City. This is in line with research (Gamache, Sébastien, Abdul-nour, Georges and Baril, 2020) which states that the more the use of artificial intelligence increases, the more costs that do not need to be incurred in business operations, so that the more efficient the existing operational activities will be.

The operational efficiency of MSMEs in Medan City affects MSME customer satisfaction in Medan City

The results of the study stated that the operational efficiency of MSMEs in Medan City has an effect on MSME customer satisfaction in Medan City. This is in accordance with research (Gao, Xue and Ren, 2023) which explains that the more efficient the business operational activities, the more likely it will be able to serve customers on time and make customers feel their own satisfaction using the product.

Business Automation Affects MSME Customer Satisfaction in Medan City through Operational Efficiency as an Intervening Variable

The results of the study explain that the business automation variable has an effect on the growth of MSME customer satisfaction in Medan City through operational efficiency as an intervening variable. This is in accordance with research (Liu, Zixu, 2022) which explains that the more it works automatically and is able to serve well, it will make the company's work and operation more effective and able to increase customer satisfaction to continue using certain products.

The Use of Artificial Intelligence Affects MSME Customer Satisfaction in Medan City through Operational Efficiency as an Intervening Variable

The results of the study explain that the variable of the use of artificial intelligence has an effect on the operational efficiency of MSME customers in Medan City through operational efficiency as an intervening variable. This is in accordance with research (Spaltini, Marco, 2022) which states that artificial intelligence which is a digital transformation will tend to increase the efficiency of operational activities and tend to improve waiters because it is serving and makes customer satisfaction increase.

IMPLEMENTATION

The greater the increase in the use of digitalization, the more MSMEs in Medan City will be able to increase business automation in operational activities as well as carry out operational efficiency in order to increase service speed and business speed to increase customer satisfaction.

CONCLUSION

From the results of the study, the existing conclusions are that partially the variables of business automation and the use of artificial intelligence affect the customer satisfaction of Medan MSMEs and affect the operational efficiency of Medan MSMEs. Simultaneously, the variables of business automation and the use of artificial intelligence have an effect on customer satisfaction of Medan City MSMEs through the operational efficiency variable as an intervening variable.

Bibliography

1) Amaral, Afonso and Peças, P. (2021). SMEs and Industry 4.0: Two case studies of digitalization for a smoother integration. *Journal Computers in Industry*, *125*, 103333. https://doi.org/10.1016/j.compind.2020.103333

2) Ardito, Lorenzo, et al. (2021). The duality of digital and environmental orientations in the context of SMEs: Implications for innovation performance. *Journal of Business Research*, *123*, 44–56. https://doi.org/10.1016/j.jbusres.2020.09.022

3) Arranz, Carlos F.A., et al. (2023). Digitalisation dynamics in SMEs: An approach from systems dynamics and artificial intelligence. *Journal Technological Forecasting and Social Change*, *196*, 122880. https://doi.org/10.1016/j.techfore.2023.122880

4) Bhatti, Sabeen Hussain, et al. (2023). Servitized SMEs' performance and the influences of sustainable procurement, packaging, and distribution: The mediating role of eco-innovation. *Technovation*, *127*, 102831. https://doi.org/10.1016/j.technovation.2023.102831

5) Canhoto, Ana Isabel, et al. (2021). Digital strategy aligning in SMEs: A dynamic capabilities perspective. *Journal of Strategic Information Systems*, *30*, 101682. https://doi.org/10.1016/j.jsis.2021.101682

6) Chatzistamoulou, N. (2023). Is digital transformation the Deus ex Machina towards sustainability transition of the European SMEs? *Journal Ecological Economics*, *206*, 107739. https://doi.org/10.1016/j.ecolecon.2023.107739

7) Coenen, Jenny, et al. (2022). Lessons-learnt on articulating and evaluating I4.0 developments at SME manufacturing companies. *Procedia Computer Science*, *217*, 238–247. https://doi.org/10.1016/j.procs.2022.12.219

8) Costa, Alessandra, et al. (2023). SMEs and open innovation: Challenges and costs of engagement. *Journal Technological Forecasting and Social Change*, *194*, 122731. https://doi.org/10.1016/j.techfore.2023.122731

9) Denicolai, Stefano, Zucchella, Antonella and Magnani, G. (2021). Internationalization, digitalization, and sustainability: Are SMEs ready? A survey on synergies and substituting effects among growth paths. *Technological Forecasting and Social Change*, *166*, 120650. https://doi.org/10.1016/j.techfore.2021.120650

10) Gamache, Sébastien, Abdul-nour, Georges and Baril, C. (2020). ScienceDirect ScienceDirect Development Development of of a a Digital Digital Performance Performance Assessment Assessment Model Model for for Quebec Manufacturing SMEs Quebec Manufacturing SMEs. *Journal Procedia Manufacturing*, *38*, 1085–1094. https://doi.org/10.1016/j.promfg.2020.01.196

11) Gao, Xue and Ren, Y. (2023). The impact of digital finance on SMEs financialization: Evidence from thirty million Chinese enterprise registrations. *Heliyon*, *9*, e18664. https://doi.org/10.1016/j.heliyon.2023.e18664

12) Gessa, Ana, Jiménez, Amor and Sancha, P. (2023). Exploring ERP systems adoption in challenging times. Insights of SMEs stories. *Journal Technological Forecasting and Social Change*, *195*, 122795. https://doi.org/10.1016/j.techfore.2023.122795

13) Gouveia, Fernando Diogo and Mamede, H. S. (2022). Digital Transformation for SMES in the Retail Industry. *Journal Procedia Computer Science*, *204*, 671–681. https://doi.org/10.1016/j.procs.2022.08.081

14) Grooss, Oliver Fuglsang, Presser, Mirko and Tambo, T. (2022). Balancing Digital Maturity and Operational Performance - Progressing in a Low-digital SME Manufacturing Setting. *Journal Procedia Computer Science*, *200*, 495–504. https://doi.org/10.1016/j.procs.2022.01.247

15) Härting, Ralf Christian, et al. (2022). The threat of industrial espionage for SME in the age of digitalization. *Journal Procedia Computer Science*, *207*, 2934–2943. https://doi.org/10.1016/j.procs.2022.09.352

16) Hidayat-your-Rehman, Imdadullah and Alsolamy, M. (2023). A SEM-ANN analysis to examine sustainable performance in SMEs: The moderating role of transformational leadership. *Journal of Open Innovation: Technology, Market, and Complexity*, *9*(4), 100166. https://doi.org/10.1016/j.joitmc.2023.100166

17) Hoang, Ha and Le Tan, T. (2023). Unveiling digital transformation: Investigating technology adoption in Vietnam's food delivery industry for enhanced customer experience. *Journal Heliyon*, *9*, e19719. https://doi.org/10.1016/j.heliyon.2023.e19719

18) Jing, Hao, Zhang, Yaoyao and Ma, J. (2023). Influence of digital ambidextrous capabilities on SMEs' transformation performance: The mediating effect of business model innovation. *Journal Heliyon*, *9*, e21020. https://doi.org/10.1016/j.heliyon.2023.e21020

19) Khalil, Afef, Abdelli, Mohammed El Amine and Mogaji, E. (2022). Do Digital Technologies Influence the Relationship between the COVID-19 Crisis and SMEs' Resilience in Developing Countries? *Journal of Open Innovation: Technology, Market, and Complexity*, *8*(100), 1–14. https://doi.org/10.3390/joitmc8020100

20) Kim, Goo Young, et al. (2023). Customized Digital Twin Platform for SMEs in South Korea. *Journal IFAC-PapersOnLine*, *56*(2), 11044–11049. https://doi.org/10.1016/j.ifacol.2023.10.806

21) Lee, Jeoung Yul, et al. (2022). The Impact of Social Media and Digital Platforms Experience on SME International Orientation: The Moderating Role of COVID-19 Pandemic. *Journal of International Management*, *28*(4), 100950. https://doi.org/10.1016/j.intman.2022.100950

22) Lestantri, Inda D., et al. (2021). The perceptions towards the digital sharing economy among SMEs: Preliminary findings. *Journal Procedia Computer Science*, *197*, 82–91. https://doi.org/10.1016/j.procs.2021.12.121

23) Liu, Zixu, et al. (2022). The Architectual and implementation of a digital platform for Industry 4.0 SME collaboration. *Journal Computer-in Industry*, *138*, 103623. https://doi.org/10.1016/0010-4485(90)90082-N

24) Marzi, Giacomo, et al. (2023). B2B digital platform adoption by SMEs and large firms: Pathways and pitfalls. *Industrial Marketing Management*, *114*, 80–93. https://doi.org/10.1016/j.indmarman.2023.08.002

25) Matarazzo, Michela, et al. (2021). Digital transformation and customer value creation in Made in Italy SMEs: A dynamic capabilities perspective. *Journal of Business Research*, *123*, 642–656. https://doi.org/10.1016/j.jbusres.2020.10.033

26) Priyono, Anjar, Moin, A., & Putri, and V. N. A. O. (2020). Identifying digital transformation paths in the business model of smes during the covid-19 pandemic. *Journal of Open Innovation: Technology, Market, and Complexity*, *6*(104), 1–22. https://doi.org/10.3390/joitmc6040104

27) Radicic, Dragana and Petković, S. (2023). Impact of digitalization on technological innovations in small and medium-sized enterprises (SMEs). *Journal Technological Forecasting and Social Change*, *191*, 122474. https://doi.org/10.1016/j.techfore.2023.122474

28) Soluk, Jonas, Decker-Lange, Carolin and Hack, A. (2023). Small steps for the big hit: A dynamic capabilities perspective on business networks and non-disruptive digital technologies in SMEs. *Journal Technological Forecasting and Social Change*, *191*, 122490. https://doi.org/10.1016/j.techfore.2023.122490

29) Spaltini, Marco, et al. (2022). Defining the Roadmap towards Industry 4.0: The 6Ps Maturity Model for Manufacturing SMEs. *Journal Procedia CIRP*, *105*, 631–636. https://doi.org/10.1016/j.procir.2022.02.105

30) Telukdarie, Arnesh, et al. (2023). The opportunities and challenges of digitalization for SME ' s. *Journal Procedia Computer Science*, *217*, 689–698. https://doi.org/10.1016/j.procs.2022.12.265

31) Uddin, Md Hamid, et al. (2023). Does digital transformation matter for operational risk exposure? *Journal Technological Forecasting and Social Change*, *197*, 122919. https://doi.org/10.1016/j.techfore.2023.122919

32) Ulas, D. (2019). Digital Transformation Process and SMEs. *Journal Procedia Computer Science*, *158*, 662–671. https://doi.org/10.1016/j.procs.2019.09.101

33) Viswanathan, Radhakrishnan and Telukdarie, A. (2021). A systems dynamics approach to SME digitalization. *Journal Procedia Computer Science*, *180*, 816–824. https://doi.org/10.1016/j.procs.2021.01.331

34) Yilmaz, Gokcen, et al. (2023). Low-cost (Shoestring) digital solution areas for enabling digitalisation in construction SMEs. *Computers in Industry*, *150*, 103941. https://doi.org/10.1016/j.compind.2023.103941

35) Yu, Honglan, Fletcher, Margaret and Buck, T. (2022). Managing digital transformation during re-internationalization: Trajectories and implications for performance. *Journal of International Management*, *28*(4), 100947. https://doi.org/10.1016/j.intman.2022.100947