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RESEARCH ARTICLE

The Role of Ai In UMKM: How Artificial Intelligence Helps UMKM Survive And Thrive In The Digital Era In Medan City

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Abstract

Micro, Small, and Medium Enterprises (MSMEs) are the backbone of Indonesia's economy, yet face major challenges in digital transformation, particularly in adopting emerging technologies. This study aims to analyze how artificial intelligence (AI) adoption contributes to digital transformation and competitive advantage among MSMEs in Medan City. A quantitative approach was employed, involving 154 MSME respondents. The key variables examined include Diffusion of Innovation, Technology-Organization-Environment (TOE), Digital Transformation, and Competitive Advantage using SEM-PLS. The results indicate that both Diffusion of Innovation and TOE significantly influence Digital Transformation and Competitive Advantage. Moreover, Digital Transformation significantly mediates the effects of both independent variables on competitive advantage. This study highlights the critical role of digital readiness, organizational support, and AI integration in fostering sustainable competitiveness among MSMEs in the digital era.

Keyword: *Msmes, Artificial Intelligence, Digital Transformation, Competitive Advantage, TOE, SEM-PLS.*

Introduction

Micro, Small, and Medium Enterprises (MSMEs) are an important component of the Indonesian economy. Data from the Indonesian Ministry of Cooperatives and SMEs shows that MSMEs contribute around 60% to the Gross Domestic Product (GDP) and absorb 97% of the national workforce (Kemenkop, 2025). In the midst of the global shift towards a digital economy, MSMEs are faced with great challenges to survive and compete effectively, including in Medan City which is one of the economic centres of North Sumatra.

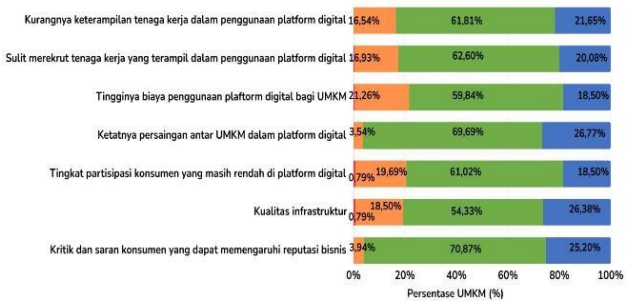

Figure 1. Digital Platform Usage Challenge (%)

Based on the data (Institute for Development of Economics and Finance (INDEF), 2024) above, overall, the use of digital platforms in MSMEs can increase the development of the businesses of these MSME players, but there are several challenges that are problematic in the application of these digital platforms, namely 21.26% of the high cost of using digital platforms for MSMEs, 19.69% the level of consumer participation is still low in using digital platforms, and the survey also states that 16.54% lack of labour skills in using digital platforms.Digital transformation has become an inevitable demand. One form of technology that is growing rapidly and has a significant impact in the business world is artificial intelligence (AI). AI is not only applied on a large industrial scale, but also has the potential to empower MSMEs in improving operational efficiency, customer understanding, and product innovation (Dwivedi et al., 2019).

Research shows that AI can be used for digital marketing automation, market demand prediction, and improved customer service through chatbots and virtual assistants (Soni et al., 2020). In the context of MSMEs, AI utilisation also helps in financial management, and data-driven decision-making (Mammadov et al., 2024). However, AI adoption by MSMEs is still relatively low due to limitations in human resources, digital infrastructure, and access to technology training (Badghish & Soomro, 2024).

In Medan City, many MSMEs do not fully understand the concrete benefits of AI technology and how to integrate it into their business (Hutagaol et al., 2024). This gap hinders innovation and sustainable business growth.Meanwhile, a study by (Soni et al.,

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2020) confirmed that the successful integration of AI in MSMEs is highly dependent on digital readiness, technology ecosystem support, and strategic partnerships with supporting institutions such as government and universities. Effective AI adoption will strengthen the resilience of MSMEs in the face of economic uncertainty, while opening up wider market expansion opportunities (Denicolai et al., 2021).

Research (Soomro et al., 2024) states that the use of social media applications, big data analytics, IoT applications and blockchain applications can create economic and social value for these SMEs.

On the other hand, in a report (Chui et al., 2023) predicted that the use of AI by MSMEs can contribute significantly to local economic growth, especially if supported by local government policies that are inclusive and responsive to technological developments.

Considering these potentials and challenges, it is important to conduct an in-depth study on how AI helps MSMEs in Medan City to survive and thrive in the digital era. This research will provide an empirical understanding of AI implementation in the MSME sector and formulate strategies that can accelerate AI-based digital transformation in an inclusive and sustainable manner.From the findings of the research findings described above, this research still aims to analyse the level of understanding and application of AI in MSME players in Medan City and how AI plays a role in increasing the efficiency, innovation and competitiveness of MSMEs in Medan City.

The difference between the current research and previous research (Surya, Aditi, et al., 2020);(Surya & Saragih, 2020);(Surya, Rusiadi, et al., 2020);(Putra et al., 2025);(Surya & Saragih, 2019);(Surya et al., 2022);(Mesra et al., 2024) is that most of the previous research has been conducted in the field of AI, 2024), namely most of the previous studies focused on national or international areas without underlining the local characteristics of MSMEs, this research not only reviews the technological aspects, but also pays attention to the social dimensions and digital cultural readiness of MSME actors

- an approach that is still rarely done in the study of AI and MSMEs, Not only describing the application of AI, this research seeks to develop applicable strategies that can be used as practical recommendations for local governments, supporting institutions, and MSME actors themselves, in the context of post-pandemic COVID-19, the need for digitalisation of MSMEs is increasing. This research raises the latest data and dynamics relevant to the latest field conditions in 2024-2025, as a bridge between the academic discourse on AI and the practical reality of MSME actors, especially in understanding simple and affordable ways to implement AI technology in stages.

Method

Types of Research

The type of research that researchers use is quantitative research according to Sugiyono (2010) Quantitative research can be defined as a method based on the philosophy of positivism, used to research on certain populations or samples, sampling techniques are generally carried out randomly, data collection uses research instruments, data analysis is quantitative / statistical with the aim of testing predetermined hypotheses. This type of quantitative research is conducted to create a study that aims to complete a study entitled 'The Role of Brand Attachment and Brand Trust on Customer Retention with Brand Loyalty as an Intervening Variable for Bank Bjb Kc Medan Customers'.

Research Location And Research Time

The research location was conducted at MSME actors in Medan City. The research time was carried out for 3 months.

Population and Sample

Sugiyono (2017) population is a generalisation area consisting of objects or subjects that have certain qualities and characteristics set by researchers to study and then draw conclusions. The population and sample in this study were customers of Medan MSME players, totalling 250 MSMEs and using the Slovin formula, a sample of 154 people was obtained.

Tabel 1. Operational Definition Of Research Variables

Variable Type	Definition	Indicator
Diffusion of Innovation (X1)	Innovation diffusion is the process of spreading a new idea, product, or technology over time through various communication channels among members of a social system (Rogers, 1983). In the context of the research, the innovation is artificial intelligence (AI), and the social system is MSME players in Medan City.	a. Increase profits, operational efficiency, marketing effectiveness b. Fit with business model, organisational culture, market needs. c. Easy to use, does not require high expertise, minimal training. d. Can be trialled on a limited basis, demo or free version available. e. Results are clearly visible, can be compared with old

		practices, reference other users. (Rogers, 1983)
TOE (X2)	The TOE Framework was introduced by (Tornatzky et al., 1990) in their book The Processes of Technological Innovation. The TOE Framework helps understand how internal and external organisational factors play a role in the decision to adopt innovations, including technologies such as Artificial Intelligence (AI) in the context of MSMEs.	a. Availability of IT infrastructure, suitability of technology to the needs of MSMEs, perceived benefits of AI, technology complexity. b. Management support, HR readiness, innovative culture, organisational structure, business size. c. Intensity of competition, pressure from consumers, governmentsupport, strategic partnerships (Tornatzky et al., 1990)
Competitive Advantage (Y)	According to (Porter, 1985) in his book Competitive Advantage: Creating and Sustaining Superior Performance, competitive advantage is the ability of a company to create greater value for customers than competitors, through product differentiation or cost leadership.	a. Cost efficiency, economies of scale, cost-effective operational processes. b. Product uniqueness, high quality, innovation, customer loyalty. c. Niche market penetration, specialisedservices, fulfilment of needs. (Porter, 1985)
Digital Transformation (Z)	According to (Westerman et al., 2014) in his book Leading Digital: Turning Technology into Business Transformation, digital transformation is the process by which organisations leverage digital technologies to improve performance, expand reach, and create new value for customers. Digital transformation is not only about adopting new technologies, but also includes significant changes in organisational culture, business processes, and business models across the board.	a. Transformation vision, digital strategy, management engagement. b. Utilisation of AI, cloud, big data, IoT. c. HR training, change resistance, digital culture. d. Service innovation, personalisation, customer satisfaction. e. Business process change, digital platform adoption, automation (Westerman et al., 2014)

Results and Discussion

Data Analysis Technique

Data analysis in this study used Structural Equation Modeling (SEM) based on Partial Least Square (PLS) using Smart- PLS software. According to (Gozali, 2014) Partial Least Square (PLS) is a fairly powerful analysis method because it is not based on many assumptions..

1. Results and Discussion
   Validity Test

Tabel 2. Test the validity of the Perceived Diffusion of Innovation (X1)

No Item	rxy	rtabel	Description
1	0,249	0,157	Valid
2	0,639	0,157	Valid
3	0,159	0,157	Valid
4	0,663	0,157	Valid
5	0,661	0,157	Valid

Based on the table above, it shows that all statement instruments on the Diffusion of Innovation variable are declared valid because the Pearson correlation of each statement item is above 0.157.

Tabel 3. Test the validity of the TOE (X2)

No Item	rxy	rtabel	Description
1	0,266	0,157	Valid
2	0,670	0,157	Valid
3	0,835	0,157	Valid

Based on the table above, it shows that all statement instruments on the TOE variable are declared valid because the Pearson correlation of each statement item is above 0.157.

Tabel 4. Test the validity of the Digital Transformation (Z)

No Item	rxy	rtabel	Description
1	0,537	0,157	Valid
2	0,798	0,157	Valid
3	0,470	0,157	Valid

Based on the table above, it shows that all statement instruments on the Digital Transformation variable are declared valid because the Pearson correlation of each statement item is above 0.157.

Tabel 5. Test the validity of the Competitive Advantage (Y)

No Item	rxy	rtabel	Description
1	0,425	0,157	Valid
2	0,737	0,157	Valid
3	0,391	0,157	Valid
4	0,603	0,157	Valid
5	0,553	0,157	Valid

Based on the table above, it shows that all statement instruments on the Competitive Advantage variable are declared valid because the Pearson correlation of each statement item is above 0.157.

Reliability Test

After the validity test is carried out, the next test is the reliability test as follows :

Table 6. Reliability Statistics

Cronbach's Alpha	N of Items
,901	4

a. Dependent Variable: Digital Transformation

Based on the reliability test above, the test results show that all statement instruments in the questionnaire have a strong reliability value where the Cronbach's Alpha value is 0.870 or greater than 0.80.

Direct Effect Test Results

1. It is suspected that the diffusion of innovation (X1) has a positive and significant effect on Digital transformation (Z) to help umkm survive and thrive in the digital era in the city of Medan.

Table 7 Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3,470	,672		5,161	,000
	Diffusion of Innovation	,378	,046	,554	8,213	,000

a. Dependent Variable: Digital Transformation

2. It is suspected that Technology Organisation Environment (X2) has a positive and significant effect on digital transformation (Z) to help MSMEs survive and thrive in the digital era in Medan City.

Table 8 Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	11,831	,466		25,364	,000
	TOE	,792	,060	,733	13,296	,000

a. Dependent Variable: Digital Transformation

3. It is suspected that digital transformation (Z) has a positive and significant effect on competitive advantage (Y) to help MSMEs survive and thrive in the digital era in the city of Medan.

Table 9. Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-4,030	,551		-7,314	,000
	Competitive Advantage	,726	,031	,887	23,648	,000

4. It is suspected that the diffusion of innovation (X1) has a positive and significant effect on competitive advantage (Y) helps MSMEs survive and thrive in the digital era in medan city.

Table 10. Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	10,083	,753		13,385	,000
	Diffusion of Innovation	,538	,052	,646	10,444	,000

a. Dependent Variable: Competitive Advantage

5. It is suspected that Technology Organisation Environment (X2) has a positive and significant effect on competitive advantage (Y) to help umkm survive and thrive in the digital era in the city of Medan.

Table 11. Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	11,831	,466		25,364	,000
	TOE	,792	,060	,733	13,296	,000

a. Dependent Variable: Competitive Advantage

Indirect Effect Test Results

6. It is suspected that the diffusion of innovation (X1) has a positive and significant effect on competitive advantage (Y) to help umkm survive and thrive in the digital era in Medan city with digital transformation (Z) as a mediating variable.

Table 12. Coefficientsa

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-4,018	,552		-7,275	,000
	Diffusion of Innovation	-,022	,034	-,032	-,654	,514
	Competitive Advantage	,743	,040	,908	18,432	,000

a. Dependent Variable: Digital Transformation

7. It is suspected that Technology Organisation Environment (X2) has a positive and significant effect on competitive advantage (Y) to help umkm survive and thrive in the digital era in Medan city with digital transformation (Z) as a mediating variable.

Table 13. Coefficientsa

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-2,664	,515		-5,170	,000
	Competitive Advantage	,521	,039	,637	13,301	,000
	TOE	,301	,042	,341	7,117	,000

a. Dependent Variable: Digital Transformation

Disscussion

1. It is suspected that the diffusion of innovation (X1) has a positive and significant effect on digital transformation (Z) helps umkm survive and thrive in the digital era in the city of Medan.
   Based on table 7 above, it shows that the innovation diffusion variable (X1) has a tcount value of 8,213> from the ttable value of 1,655 with a significance value of 0.000 <0.05, which means that there is a significant effect on digital transformation (Z).Diffusion of innovation is the process of spreading a new idea, product, or technology over time through various communication channels among members of a social system (Rogers, 1983) can increase competitive advantage in MSMEs.

2. It is suspected that Technology Organisation Environment (X2) has a positive and significant effect on digital transformation (Z) to help MSMEs survive and thrive in the digital era in Medan City.
   Based on table 8 above, it shows that the TOE variable (X2) has a tcount value of 13,297> from the ttable value of 1,655 with a significance value of 0.000 <0.05, which means that there is a significant effect on digital transformation (Z). TOE can help in understanding how internal and external organisational factors play a role in the decision to adopt innovations, including technologies such as Artificial Intelligence (AI) in the context of MSMEs (Tornatzky et al., 1990).

3. It is suspected that digital transformation (Z) has a positive and significant effect on competitive advantage (Y) to help MSMEs survive and thrive in the digital era in the city of Medan.
   Based on table 9 above, it shows that the digital transformation variable (Z) has a tcount value of 23.648> from the ttable value of 1.655 with a significance value of 0.000 <0.05, which means that there is a significant effect on competitive advantage (Y), meaning that utilising digital technology can help MSMEs in expanding the reach of marketing networks and can also create new value for customers (Westerman et al., 2014).

4. It is suspected that the diffusion of innovation (X1) has a positive and significant effect on competitive advantage (Y) helps MSMEs survive and thrive in the digital era in medan city.
   Based on table 10 above, it shows that the diffusion innovation variable (X1) has a tcount value of 10.444> from the ttable value of 1.655 with a significance value of 0.000 <0.05, which means that there is a significant effect on competitive advantage (Y), meaning that by distributing products using AI technology, MSMEs can indirectly create competitive advantages compared to other MSMEs (Porter, 1985).

5. It is suspected that Technology Organisation Environment (X2) has a positive and significant effect on competitive advantage (Y) to help umkm survive and thrive in the digital era in the city of Medan.
   Based on table 11 above, it shows that the TOE (X2) variable has a tcount value of 13.296> from the ttable value of 1.655 with a significance value of 0.000 <0.05, which means that there is a significant effect on competitive advantage (Y), meaning that using the Technology Organization Environment approach will help MSME actors in creating an innovation (Tornatzky et al., 1990) as a demand in the world of MSMEs to create competitive advantage.

6. It is suspected that the diffusion of innovation (X1) has a positive and significant effect on competitive advantage (Y) to help umkm survive and thrive in the digital era in Medan city with digital transformation (Z) as a mediating variable.
   Based on table 12 above, it shows the beta value of variable X1 against Y is 0.646 while the beta value of variable Z against Y is 0.887, the direct influence value is 0.646 x 0.887, which is 0.573, meaning that the total direct influence value of 0.573 is smaller than the indirect influence value between variable Z against Y, which is 0.887. It is concluded that indirectly the digital transformation variable (Z) is able to mediate of the diffusion innovation variable (X1) on competitive advantage (Y). This is in line with research (Denicolai et al., 2021) which states that effective adoption of AI will strengthen the resilience of MSMEs in facing economic uncertainty, while opening up opportunities for wider market expansion.

7. It is suspected that Technology Organisation Environment (X2) has a positive and significant effect on competitive advantage (Y) to help umkm survive and thrive in the digital era in Medan city with digital transformation (Z) as a mediating variable
   Based on table 13 above, it shows the beta value of variable X2 against Y is 0.733 while the beta value of variable Z against Y is 0.887, the direct influence value is 0.733 x 0.887, which is 0.650, meaning that the total direct influence value of 0.650 is smaller than the indirect influence value between variable Z against Y, which is 0.887, so it is concluded that indirectly the digital transformation variable (Z) is able to mediate the TOE variable (X2) against competitive advantage (Y). This is in line with research (Soomro et al., 2024) which states that the use of social media applications, big data analysis, IoT applications and blockchain applications can create economic and social value for these MSMEs.

Conclusions and Recommendations

Based on the results of the research and discussion above, it is concluded that all research instruments are declared valid and reliable and the results of direct test calculations, both the influence of X1 on Z, X2 on Z, Y on Z, X2 on Y as a whole have a significant influence. Conversely, the results of indirect tests of variable Z are able to mediate X1 and X2 on Y. This study contributes to providing an understanding of how AI technology can create new market value for customers and create competitive advantages for MSMEs.

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