Chapter 4. Artificial Intelligence Adoption and Its Effect on Small and Medium Enterprises' Performance: A Lens of Technology-Organisation-Environment Framework and Ethical Principles

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Abstract

In the digital era, small and medium enterprises (SMEs) adopt AI for business operations to enhance firm performance. The adoption of AI is driven by multiple factors influencing the business landscape, while ethical principles may also impact adoption. The aim of this study is to develop a model that explains factors influencing AI adoption by SMEs to enhance business performance, by integrating the technology-organization-environment (TOE) framework with the diffusion of innovation (DOI) theory and ethical principles. The study employed a quantitative method, using a self-administered questionnaire disseminated among 150 respondents from South African SMEs and analysed using structural equation modelling (SEM). The results showed that compatibility, top management support, organisational readiness, employee capability, customer pressure, vendor support, fairness, accountability, and transparency significantly influence AI adoption, while relative advantage, complexity, high costs, and competitive pressure were less significant. The study concludes that AI adoption is key to enhancing the performance of South African SMEs.

Keywords: artificial intelligence, ethical principles, diffusion of innovations, small and medium enterprises, technology-organisation-environment.

Introduction

The digital era has created many opportunities and challenges for organisations worldwide (Achieng & Malatji, 2022). Leading this change is artificial intelligence (AI) (Rajaram & Tinguely, 2024; Rana, Pillai, Sivathanu & Malik, 2024). AI enables machines to imitate human intelligence using technologies like natural language processing (NLP), image recognition, machine learning (ML), and deep learning (Badghish & Soomro, 2024), transforming how organisations operate (Sanchez, Calderon & Herrera, 2025).

Research shows AI adoption benefits organisations by boosting creativity and productivity (Wang, Lin, & Shao, 2023; Rajaram & Tinguely, 2024). Across sectors, AI is especially valuable for small and medium enterprises (SMEs) (Badghish & Soomro, 2024), helping them deliver personalised and effective marketing strategies (Mokhtar & Salimon, 2022).

Knowledge Gaps and the Purpose of the Study

The present literature divulges why SMEs need to adopt AI and mainly emphasizes the benefit of AI to SMEs (Rana et al., 2024; Sanchez et al., 2025; Ardito, Filieri, Raguseo & Vitari, 2025; Visuthiphol & Pankham, 2025). A plethora of research on the adoption of AI in the SMEs environment has revealed various factors of the adoption of AI (Mokhtar & Salimon, 2022; Badghish & Soomro, 2024; Hamida, 2025).

Nevertheless, there is limited research on technological, organisational, environmental, and ethical principles influencing AI adoption among SMEs in developing countries. Thus, scholarly research is needed to understand these factors, particularly in South Africa. This study aims to develop a model explaining factors influencing AI adoption in SMEs.

Research Questions

The present study aims to answer the following research questions:

- What are the technological, organisational and environmental factors influencing the adoption of AI in SMEs?

- What are the ethical principles influencing the adoption of AI in SMEs?

Problem Statement

Many countries are benefiting from AI adoption, and South Africa has seen an increase in this trend (Muzuva, Zhou & Zondo, 2024). However, inequality, inadequate infrastructure, and unemployment remain challenges (Vuyani, Gervase-Iwu, Tengeh & Esambe, 2021; Matekenya & Moyo, 2022). The government considers SMEs key drivers of economic growth (Bvuma & Marnewick, 2020; Enaifoghe & Ramsuraj, 2023), yet SMEs have a high failure rate of 70% to 80 % (Tlhagale & Nyoka, 2025; Bolosha, Sinyolo & Ramoroka, 2022) due to limited digital skills, poor access to global markets, and inadequate ICT infrastructure (Bvuma & Marnewick, 2020; Vuyani et al., 2022). AI can help SMEs address these challenges (Wang et al., 2023). However, AI is often perceived as complex and difficult to adopt (Chatterjee Rana, Dwivedi & Baabdullah, 2021;

O'Shaughnessy, Schiff, Varshney, Rozell, & Davenport, 2023), and its impact on SME performance in South Africa remains underexplored (Muzuva, Zhou, & Zondo, 2024).

Literature Review

The Benefits of AI Adoption in SMEs

AI has become a new and strategic trend for all economic sectors, particularly SMEs (Badghish & Soomro, 2024). AI is strategically utilised to share information and long-term relationship building with customers (Khan, Emon & Rahman, 2024), making it a prevalent form of marketing adopted by SMEs (Kedi, Ejimuda, Idemudia & Ijomah, 2024). Therefore, a plethora of research asserts that the adoption of AI by SMEs during crises can also aid in company survival since AI can facilitate closer customer engagement with customers and the supply chain while reducing costs (Chen, Hu, Zhou and Yang, 2023; Rajaram & Tinguely, 2024). Through the adoption of AI, SMEs can engage in two-way communication with customers and interact with each other (Visuthiphol & Pankham, 2025).

Because SMEs often face resource scarcity and limited technical capabilities, AI helps address these challenges by offering cost-effective and user-friendly solutions that support business operations (Mokhtar & Salimon, 2022; Wang et al., 2023). Extant research has identified several advantages of AI adoption for SMEs, including reduced costs, improved customer awareness and knowledge sharing (Hamida, 2025; Maiti, Kayal & Vujko, 2025; Visuthiphol & Pankham, 2025). Furthermore, Badghish and Soomro (2024) found that AI adoption can improve SMEs performance. Although AI improve SMEs performance, it is essential to uphold ethical principles (Omonov & Ahn, 2025).

Ethical AI Principles

Organisations with clear ethical principles are more likely to adopt AI responsibly (Rana et al., 2024). Ethical AI principles include fairness, accountability, and transparency (Omonov & Ahn, 2025). Fairness of AI refers to treating everyone equally. It means AI should not be used in a way that is unfair or harmful to employees (Ashok, Madan, Joha & Sivarajah, 2022). If AI ensures outcomes that are fair, unbiased, and devoid of prejudice, it would likely be adopted by organisations (Shin & Park, 2019).

Accountability in AI refers to the responsibility of organisations to ensure that AI function correctly and produce ethical outcomes (Floridi, Cowls, King & Taddeo, 2020). It includes deciding who is responsible for the decisions made by AI, such as the organisation using the system or the developers who created it (Rana et al., 2024).

Since AI relies on programmed code and existing data, errors or unfair results can occur (Melnyk, 2025; Omonov & Ahn, 2025). Therefore, organisations must take responsibility for how AI is developed and used (Ashok et al., 2022). AI transparency means being clear about how AI works and what data it uses (Floridi

et al., 2020). It helps people and organisations understand how the AI makes decisions and whether the results make sense (Rana et al., 2024).

Because AI systems are complex, they can be hard to understand (Shin & Park, 2019). Organizations should clearly explain what data AI uses, how it processes the data, and if the data is suitable, so people can trust and use AI properly (Omonov & Ahn, 2025).

Conceptual Framework and Hypotheses Development

The present study employs technology-organisation-environment (TOE) framework and the diffusion of innovations (DOI) theory to explain AI adoption by SMEs. TOE, introduced by Depietro, Wiarda and Fleischer in 1990 examines why organisations adopt new technologies through three contexts: technology, organisation, and environment. The TOE framework has been applied in Saudi Arabia (Badghish & Soomro, 2024), India (Karan & Angadi, 2025), and Malaysia (Masod & Zakaria, 2023).

The DOI theory, introduced by Rogers in 2003, is a theory used to explain how organisations accept new ideas and new technology. DOI has five attributes, including relative advantage, compatibility, trialability, complexity and observability (Rogers, 2003). DOI has been applied in studies on AI adoption (Badghish & Soomro, 2024; Sanchez et al., 2025).

Figure 4.1
Conceptual Framework
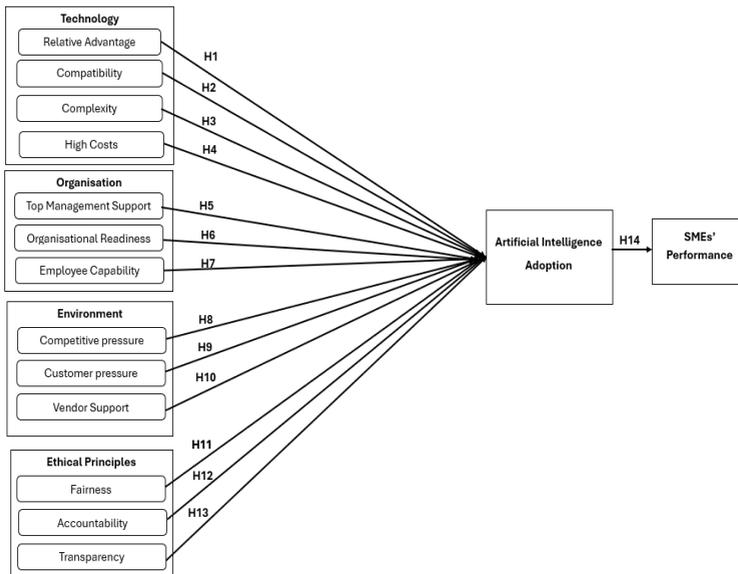
Technology

The adoption of AI in SMEs is influenced by technological factors, particularly relative advantage. SMEs are more likely to adopt new technology if it improves on current systems (Maroufkhani, Tseng, Iranmanesh, Ismail & Khalid, 2020) and aligns with existing business processes (Badghish & Soomro, 2024). However, adoption may fail if AI is seen as costly or very difficult to adopt (Apostoaie, Roman, Maxim & Jijie, 2025). Based on this, we propose the following hypotheses:

> H1: Relative advantage influences AI adoption in SMEs.
> H2: Compatibility influences AI adoption in SMEs.
> H3: Complexity influences AI adoption in SMEs.
> H4: High costs influence AI adoption in SMEs.

Organisation

AI adoption in SMEs is also influenced by organisational factors, especially top management support. Siradhana and Arora (2024) and Mathagu (2024) find that strong top management support boosts AI adoption success. Apostoaie et al. (2025) note that SMEs also need financial, technological, and skilled human resources, and that qualified employees are key to successful AI adoption. Based on these findings, the following hypotheses are formulated:

> H5: Top management support influences AI adoption in SMEs.
> H6: Organisational readiness influences AI adoption in SMEs.
> H7: Employee capability influence AI adoption in SMEs.

Environment

A study by Apostoaie et al. (2025) highlight that environmental factors, especially competitive pressure, influence AI adoption in SMEs. Mokhtar and Salimon (2022) support this, noting competitor pressure drives adoption. Badghish and Soomro (2024) add that customer awareness of new technologies can push organisations to adopt AI to meet service needs. Apostoaie et al. (2025) also argue that vendor support and training increase adoption likelihood. Based on this, we propose the following hypotheses:

> H8: Competitive pressure influences AI adoption in SMEs.
> H9: Customer pressure influences AI adoption in SMEs.
> H10: Vendor support influences AI adoption in SMEs.

Ethical Principles

Ethical principles such as fairness, accountability, and transparency are key for AI adoption (Ashok, Madan, Joha & Sivarajah, 2022). Fairness means treating everyone equally and avoiding discrimination (Ashok et al., 2022). AI is more likely to be adopted if it produces fair results (Rana et al., 2024). Accountability involves responsibility for AI outcomes, which can be difficult to assign because they depend on programming, data, and engineers' decisions (Floridi, Cowls, King & Taddeo, 2020).

Ensuring ethical AI behavior builds trust and supports adoption (Floridi et al., 2020; Rana et al., 2024). Transparency requires clarity on how AI works and learns from users (Shin & Park, 2019). It helps organisations understand decision-making and data quality, influencing interaction and adoption (Rana et al., 2024). Based on these claims, we propose the following hypotheses:

> H11: Fairness influences AI adoption in SMEs.
> H12: Accountability influences AI adoption in SMEs.
> H13: Transparency influences AI adoption in SMEs.

AI Adoption and SMEs' Performance

AI applications enable SMEs' facilitates data driven, agile, and proactive decision-making for immediate business impact (Mokhtar & Salimon, 2022; Rajaram & Tinguely, 2024). By adopting AI, SMEs' can leverage customers' engagements in business and thereby improve their market performance (Badghish & Soomro, 2024; Siradhana & Arora, 2024). Accordingly, the present study suggests the following hypothesis:

> H14: AI adoption influences SMEs' performance.

Methodology

Research Design and Approach

The present study employed a quantitative approach to empirically test the hypotheses derived from the conceptual framework. A cross-sectional survey was utilised, meaning data was gathered from respondents at a single point in time. This method is appropriate for exploring relationships among variables within a conceptual framework and is widely applied in studies focusing on AI adoption. The study aligns with the positivist paradigm, which posits that social phenomena can be examined objectively and that variable relationships can be measured and validated through statistical analysis (Saunders, Lewis & Thornhill, 2009).

Data Collection and Analysis

This present study targeted SMEs operating in South Africa. To collect data from South African SMEs, a closed-ended questionnaire was developed and physically distributed. A study conducted by Saunders Lewis and Thornhill (2019), asserts that closed-ended questions are more specific and less susceptible to interpretation and verbosity than open-ended questions.

The questionnaire items were measured using a five (5)-point Likert-type scale ranging from 1 to 5, where 1 and 2 represented strongly disagree and disagree, respectively, and 4 and 5 represented agree and strongly agree. A total of 200 questionnaires were distributed to South African SMEs, and 150 were returned. The collected data were analysed using the Statistical Package for the Social Sciences (SPSS) version 28.

Results

Demographic Profile of Respondents

As depicted in Table 4.1, 66.6% of the respondents were male and 33.3% were female. Most respondents were aged 20 to 29 years (46.6%), followed by those aged 30 to 39 years (40%), while 13.3% were aged 50 years and above.

Table 4.1 further indicates that the majority of respondents held a diploma (46.6%), with others holding a B-tech (20%), a master's degree (13%), a PhD (10%), and a matric (10%). Regarding AI adoption, most respondents (86.6%) stated that they had adopted AI, whereas 13.3% reported that they had never adopted it.

Table 4.1

Demographic Profile of Respondents (N=150)

Variables		Frequency	Percentage
	Male	100	66.6
Gender	Female	50	33.3
	Total	150	100.0
	20-29 years	70	46.6
	30-39 years	60	40.0
Age	50 years and above	20	13.3
	Total	150	100.0
	Matric	15	10.0
	Diploma	70	46.6
	B-tech	30	20.0
Education	Master's	20	13.3
	PhD	15	10.0
	Total	150	100.0
Artificial	Yes	130	86.6
Intelligence	No	20	13.3
Adoption	Total	150	100.0

Assessment of Measurement Model

In this section, the measurement model was examined. As noted by Hair, Gudergan, Fischer, Nitzl and Menictas (2019), the measurement model is assessed by using factor loadings (FL), composite reliability (CR), and average variance extracted (AVE). According to Hair et al. (2019), the values of FL, CR and AVE should be greater than 0.7, 0.5, and 0.7, respectively. As in Table 4.2, all the constructs meet the threshold requirements and demonstrate acceptable convergent validity.

Table 4.2
Loadings Reliability and Validity Statistics

Construct	Item	Outer Loading	FL	CR	AVE
Relative Advantage (RA)	RA1	0.816	0.868	0.855	0.925
	RA2	0.819			
	RA3	0.850			
Compatibility (CM)	CM1	0.806	0.762	0.839	0.785
	CM2	0.756			
	CM3	0.825			
Complexity (CX)	CX1	0.915	0.870	0.918	0.875
	CX2	0.786			
	CX3	0.865			
High Costs	HC1	0.925	0.623	0.855	0.925
	HC2	0.856			
	HC3	0.775			
Top Management Support (TMS)	TMS1	0.775	0.778	0.834	0.775
	TMS2	0.782			
	TMS3	0.894			
Organisational Readiness (OR)	OR1	0.894	0.765	0.856	0.905
	OR2	0.744			
	OR3	0.825			
Employee Capability (EC)	EC1	0.855	0.862	0.872	0.835
	EC2	0.775			
	EC3	0.802			
Competitive Pressure (CP)	CP1	0.775	0.716	0.924	0.844
	CP2	0.893			
	CP3	0.755			
Customer Pressure (CSP)	CSP1	0.935	0.885	0.789	0.943
	CSP2	0.819			
	CSP3	0.766			
Vendor Support (VS)	VS1	0.884	0.967	0.815	0.977
	VS2	0.952			
	VS3	0.778			
Fairness (FE)	FE1	0.841	0.909	0.875	0.845
	FE2	0.857			
	FE3	0.910			
Accountability (AC)	AC1	0.812	0.918	0.798	0.757
	AC2	0.856			
	AC3	0.924			
Transparency (TP)	TP1	0.840			
	TP2	0.765			
	TP3	0.816			

Assessment of Structural Model
In this section, SEM was used to test hypotheses (Figure 4.3). Of 14 paths, ten are significant. Table 4.3 shows that compatibility (H2, p<0.05), top management

support (H5, p<0.05), organisational readiness (H6, p<0.05), employee capability (H7, p<0.05), customer pressure (H9, p<0.05), vendor support (H10, p<0.05), fairness (H11, p<0.05), accountability (H12, p<0.05), transparency (H13, p<0.05), and AI adoption (H4, p<0.05) are supported, significantly influencing AI adoption by SMEs. Nevertheless, Relative advantage (H1, p>0.05), complexity (H3, p>0.05), high costs (H4, p>0.05), and competitive pressure (H8, p>0.05) are not supported, indicating these four factors are insignificant to AI adoption.

Table 4.3

Hypotheses Testing

Constructs	Std. Beta	T-Value	*p* values	Results
H1 Relative advantage →AI adoption	0.052	0.645	0.612	Not supported
H2 Compatibility →AI adoption	0.132	0.124	0.002	Supported
H3 Complexity →AI adoption	0.273	1.756	0.752	Not supported
H4 High Costs →AI adoption	0.142	0.432	0.678	Not supported
H5 Top Management Support→AI adoption	0.147	1.572	0.000	Supported
H6 Organisational Readiness →AI adoption	0.235	4.552	0.001	Supported
H7 Employee Capability →AI adoption	0.178	2.071	0.003	Supported
H8 Competitive Pressure →AI adoption	0.052	9.357	0.527	Not supported
H9 Customer Pressure →AI adoption	0.346	2.473	0.005	Supported
H10 Vendor Support →AI adoption	0.234	0.451	0.006	Supported
H11 Fairness →AI adoption	0.126	3.124	0.002	Supported
H12 Accountability →AI adoption	0.057	1.756	0.002	Supported
H13 Transparency →AI adoption	0.132	0.432	0.003	Supported
H14 AI adoption →SMEs' performance	0.427	12.357	0.002	Supported

Figure 4.2

Structural Model
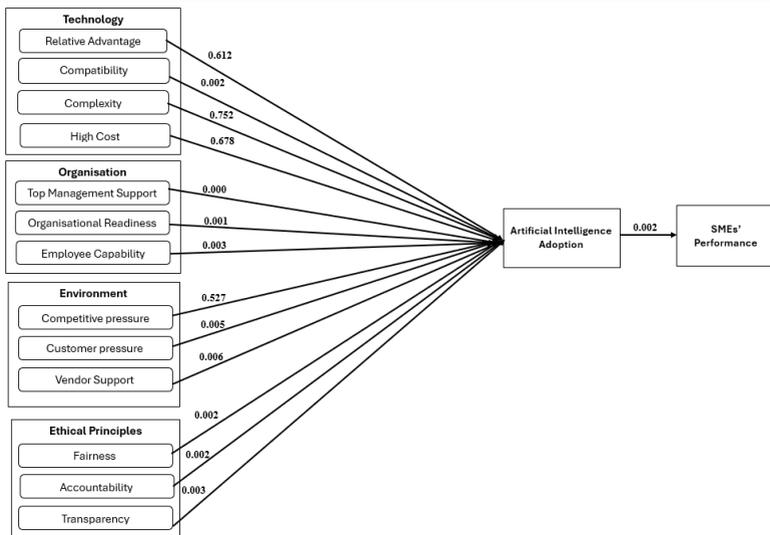
Discussion

This study examined factors influencing AI adoption in SMEs. Technological factors showed that relative advantage (H1) had no significant effect, and this is supported by Fu, Silalahi, Yang and Eunike (2024). Compatibility (H2) positively influenced adoption, and this is supported by Bhardwaj, Garg, and Gajpal (2021). Complexity (H3) and high costs (H4) negatively affected adoption, and this is supported by Apostoaie et al. (2025).

Organisational factors including top management support (H5), organisational readiness (H6), and employee capability (H7) positively influenced adoption. This is supported by Siradhana and Arora (2024) and Apostoaie et al. (2025), suggesting SMEs adopt AI when management supports it, resources are available, and employees understand its benefits.

Environmental factors showed that competitive pressure (H8) negatively affects AI adoption, and this is supported by Mokhtar and Salimon (2022), while customer pressure (H9) and vendor support (H10) positively influence AI adoption. This is supported by Badghish and Soomro (2024) and Apostoaie et al. (2025).

Ethical principles including fairness (H11), accountability (H12), and transparency (H13) significantly affect AI adoption, and this is supported by Rana et al. (2024). AI adoption (H14) positively impacts SME performance, and this is supported by Badghish and Soomro (2024).

Theoretical and Practical Contribution

This study develops a model that integrates the TOE framework with AI ethical principles to explain AI adoption and its impact on SME performance. It addresses calls to examine technological, organizational, and environmental factors influencing AI adoption. The study adds a new perspective by incorporating ethical principles at the organizational level. Practically, the model helps SME managers understand lower AI adoption compared to large firms and assess technological, organizational, environmental, and ethical factors influencing AI adoption in South African SMEs.

Conclusion

The rapid growth of AI has encouraged researchers and practitioners to study its role in improving enterprise performance using the TOE framework. This study proposes a model to identify factors influencing AI adoption and its impact on South African SME performance. The results show that compatibility, management support, organisational readiness, employee capability, customer pressure, vendor support, fairness, accountability, and transparency strongly influence AI adoption, while relative advantage, complexity, cost, and competitive pressure are less influential. The study concludes that AI adoption is important for improving South African SME performance.

Ethical Approval

The study obtained ethical clearance from the institution's Ethics Committee (Ref no. FCRE/ICT/2022/03/001 (1).

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