

# Navigating Entrepreneurial Challenges in the Age of Artificial Intelligence: Barriers and Opportunities for First-Level Entrepreneurs

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## Abstract

Artificial Intelligence (AI) is emerging as a transformative driver of entrepreneurial innovation, yet empirical evidence on its adoption by first-level entrepreneurs in emerging economies remains scarce. This study investigates AI adoption in Kerala, India, through the Technology–Organisation–Environment (TOE) framework. Using snowball sampling, survey data from 240 entrepreneurs and aspiring entrepreneurs were analysed via descriptive statistics, t-tests, ANOVA, correlation, and regression. Findings show that technologically, AI is valued for productivity gains, cost reduction, and decision support, but adoption is constrained by data privacy concerns and regulatory uncertainty. Organisationally, significant skill gaps in data science, machine learning, and programming limit readiness, while partnering with AI experts and targeted training emerge as preferred solutions. Environmentally, unclear regulations and insufficient policy support are major barriers, though access to AI resources boosts adoption intent. This study advances AI entrepreneurship literature by contextualising TOE factors in a developing economy and demonstrating their interplay in shaping adoption readiness. Practical implications include the need for capacity-building programmes, ethical AI guidelines, and supportive policy frameworks to foster sustainable AI integration within entrepreneurial ecosystems.

**Keywords:** Artificial Intelligence, Entrepreneurship, AI Adoption, TOE Framework, Emerging Economies, Innovation

## Introduction

Artificial Intelligence (AI) is reshaping the entrepreneurial landscape in 2025, becoming a key driver of how ventures are launched, grown, and managed (Kietzmann et al., 2020). AI technologies, including automation, advanced analytics, machine learning, and natural language processing (NLP), enable businesses to process and interpret vast amounts of data efficiently and adaptively (Shen et al., 2023). Unlike traditional software that relies on static programming, AI systems continuously learn from new inputs, allowing entrepreneurs to optimise workflows, make faster decisions, and foster innovation at an unprecedented speed and scale (Brynjolfsson & McAfee, 2017; Davenport & Ronanki, 2018).

The rise of generative AI, exemplified by tools such as OpenAI's ChatGPT, marks a milestone in entrepreneurial innovation (Zhou et al., 2023). Such platforms support a range of activities, from streamlining operations and recognising opportunities to strategic planning and customer engagement (Holton & Pearson, 2024). Entrepreneurs increasingly use these tools for ideation, business plan development, marketing content, and investor presentations, reflecting the growth of AI-enabled business ecosystems (Kaplan & Haenlein, 2023). Research links AI adoption to higher productivity, service innovation, and improved customer experiences, particularly among startups and small businesses (Agrawal et al., 2022).

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Educational institutions are integrating AI literacy and practical skills, including generative AI, into entrepreneurship curricula to prepare students for the digital economy (Ravichandran et al., 2024). Educators use AI for adaptive content design, automated assessment, and personalised feedback, while students apply it to enhance project work and digital competencies (Wu et al., 2023). However, research on the pedagogical role of generative AI in entrepreneurship remains limited (Mikalef et al., 2024).

While AI adoption is accelerating, expectations should remain realistic. Amara's Law notes that people overestimate the short-term effects and underestimate long-term impacts (Amara, 1991). As with the internet, AI's transformative influence will unfold gradually, requiring strategic integration and continuous adaptation (West & Allen, 2023; Bughin et al., 2019).

### **Technology–Organisation–Environment (TOE) Framework**

To systematically examine the drivers and barriers influencing AI adoption in entrepreneurship, this study adopts the TOE framework (Tornatzky & Fleischer, 1990). This framework provides a holistic lens by categorising adoption factors into three dimensions:

*Technological Context* – This refers to the characteristics of AI technologies, including their perceived benefits, ease of use, complexity, and limitations. In entrepreneurship, these include operational efficiency, cost reduction, decision-making support, and personalisation benefits, balanced against challenges such as technical complexity, algorithmic bias, and data privacy concerns (Shin, 2023; Floridi et al., 2018).

*Organisational Context* – This encompasses the internal resources, skills, and managerial commitment available for AI integration. Factors include AI literacy, the availability of a skilled workforce, funding capacity, leadership support, and the organisation's innovation orientation (Kraus et al., 2021; Schiavone & Simoni, 2022).

*Environmental Context* – This captures external influences such as market competition, regulatory requirements, technological infrastructure, and ecosystem support from

accelerators, incubators, and public–private partnerships (Cockburn et al., 2018; Graham & Dutton, 2022).

In this study, the TOE framework is used to map how technological readiness, organisational capacity, and environmental conditions interact to influence entrepreneurial AI adoption. It also underpins the development of hypotheses that test the relationship between these dimensions and entrepreneurial engagement with AI.

### **Literature Review**

AI is increasingly recognised as a transformative force in entrepreneurship, enhancing innovation, operational efficiency, and strategic decision-making (Agrawal, Gans & Goldfarb, 2018). Core AI technologies, including machine learning, NLP, and advanced data analytics, enable rapid and accurate processing of large datasets, allowing entrepreneurs to identify market trends, anticipate customer needs, and monitor competitors in real time (Shin, 2023; Davenport & Ronanki, 2018).

Automation of business functions such as customer service chatbots, inventory management, and predictive maintenance reduces operational costs while improving productivity (Huang & Rust, 2021). AI-driven personalisation further allows entrepreneurs to tailor experiences, refine marketing strategies, and implement dynamic pricing, fostering stronger customer engagement and loyalty (Wedel & Kannan, 2016; Gentsch, 2018).

Despite these advantages, Small and Medium Enterprises (SMEs) face notable adoption challenges, including financial constraints, limited access to high-quality datasets, and shortages of specialised AI talent (Mikalef et al., 2019; Li, Siau, & Nah, 2022). Continuous workforce upskilling and competition for AI-skilled professionals further intensify the challenge (Schiavone & Simoni, 2022; Gretz & White, 2023).

Collaborative approaches such as public–private partnerships, incubator programmes, and knowledge-sharing platforms are increasingly recommended to provide the training, mentorship, and resources necessary for effective AI integration (Kraus, Jones, & Kailer, 2021).

Ethical considerations also feature prominently in the AI entrepreneurship literature. Concerns about algorithmic

bias, lack of transparency, data privacy, and accountability must be addressed to ensure fairness, compliance, and stakeholder trust (Floridi et al., 2018; Jobin, Ienca, & Vayena, 2019). Entrepreneurs are urged to adopt ethical AI frameworks to mitigate both reputational and operational risks (Rahwan et al., 2019).

Given AI's rapid evolution, entrepreneurs must foster a culture of continuous learning and adaptability to remain competitive and to mitigate technological and ethical risks (Ransbotham et al., 2021).

## Hypotheses

Demographic Profile and AI Understanding:

- *H1*: Significant differences exist in levels of AI understanding across demographic variables such as age, education, and entrepreneurial experience (Mikalef et al., 2019).
- *H2*: Respondents with prior entrepreneurial experience exhibit higher AI engagement and interest compared to those without an entrepreneurial background (Zhou, Cao & Chen, 2023).

Perceptions of AI Benefits and Challenges:

- *H3*: Respondents perceive AI benefits (including efficiency, decision-making support, personalisation) more positively than challenges (including cost, complexity, and ethical issues) (Shin, 2023; Huang & Rust, 2021).
- *H4*: AI understanding is positively correlated with perceived benefits in entrepreneurship (Mikalef et al., 2019).
- *H5*: Higher AI literacy is associated with lower perception of ethical and technical barriers to AI adoption (Floridi et al., 2018).

AI's Impact on Entrepreneurial Engagement:

- *H6*: Perceived usefulness of AI positively influences entrepreneurial interest and engagement (Ransbotham et al., 2021).
- *H7*: Access to AI-related resources such as training, funding, and mentorship significantly increases first-time entrepreneurs' willingness to adopt AI technologies (Kraus, Jones & Kailer, 2021).

## Methodology

### Sampling Technique

This study employed the snowball sampling method, a non-probabilistic approach effective for reaching dispersed or hard-to-access populations lacking a well-defined sampling frame. Initial participants ("seeds") were identified through the researcher's professional and academic networks and were asked to refer other eligible individuals. This chain-referral process facilitated the recruitment of a diverse pool of entrepreneurs and individuals with experience or interest in applying AI in business contexts.

### Sample Size and Inclusion Criteria

A total of 240 respondents participated. Inclusion criteria required that participants:

- Possess direct entrepreneurial experience or a clear interest in entrepreneurship, and
- Have at least a basic awareness or exposure to AI concepts or tools.

### Data Collection Procedure

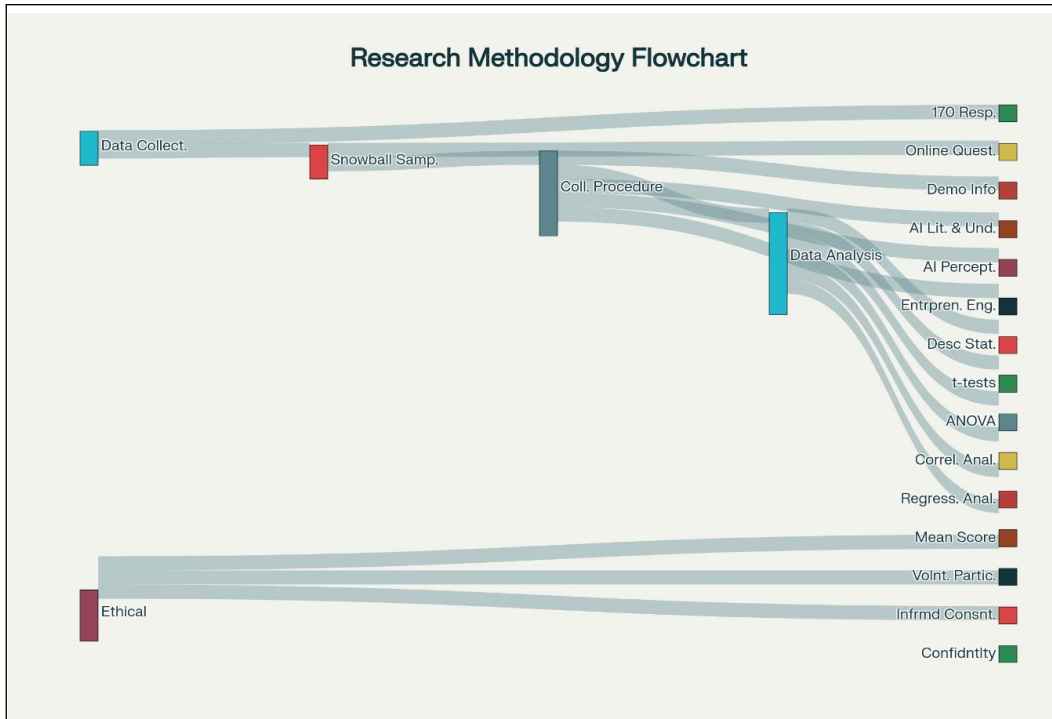
Data were gathered via an online questionnaire hosted on platforms such as Google Forms, Microsoft Forms, and Qualtrics. The survey link was distributed through email, professional networks, and social media channels to maximise reach and participation.

### Data Analysis

SPSS was used for descriptive statistics and hypothesis testing, including independent samples t-tests, one-way ANOVA, Pearson' correlation, multiple regression, and mean score analysis.

### Ethical Considerations

Participation was voluntary, informed consent was obtained, and data confidentiality was maintained.



## Data Analysis

### Demographic Profile of Respondents

**Table 1: Frequency and Percentage Distribution of Respondents by Gender, Age, Education, Occupation, and Industry**

Variable	Category	Frequency	Percent
Gender	Male	119	49.6%
	Female	121	50.4%
Age	18–25	78	32.5%
	26–35	28	11.7%
	36–45	34	14.2%
	46–55	48	20.0%
	Above 55	52	21.7%
Education	HSC	55	22.9%
	Undergraduate	68	28.3%
	Postgraduate	72	30.0%
	Doctorate	45	18.8%
Occupation	Entrepreneur	48	20.0%
	Employee	68	28.3%
	Freelancer	64	26.7%
	Consultant	61	25.4%
Industry	Technology/IT	49	20.4%
	Healthcare	41	17.1%

Variable	Category	Frequency	Percent
	Finance/Investment	35	14.6%
	Retail/E-commerce	45	18.8%
	Manufacturing	31	12.9%
	Education	38	15.8%

Table 1 presents the frequency distribution of respondents’ demographic and occupational characteristics. The gender composition is nearly equal, with males comprising 49.6% of the sample and females 50.4%, ensuring a balanced gender representation. In terms of age, the largest group is aged between 18–25 years (32.5%), reflecting strong participation from young adults, followed by respondents above 55 years (21.7%), indicating substantial representation from experienced individuals.

Educationally, the sample is relatively well-qualified, with the highest proportion holding postgraduate degrees (30.0%), followed by undergraduates (28.3%), higher secondary certificate (HSC) holders (22.9%), and doctorate holders (18.8%). Occupationally, the

respondents span diverse roles, with employees (28.3%) forming the largest group, closely followed by freelancers (26.7%) and consultants (25.4%), while entrepreneurs constitute 20.0% of the sample.

Industry-wise, participation is spread across multiple sectors, with technology/IT (20.4%) leading, followed by Retail/e-commerce (18.8%), Healthcare (17.1%), Education (15.8%), Finance/Investment (14.6%), and Manufacturing (12.9%). This diversity in demographics, education, occupation, and industry provides a well-rounded perspective for analysing AI adoption and its implications for entrepreneurship across varied professional and sectoral contexts.

### AI Knowledge, Entrepreneurial Involvement, and Perceptions

**Table 2: Frequency and Percentage Distribution of Respondents’ AI Knowledge, Entrepreneurial Involvement, Perceived Benefits, Challenges, Opportunities, and Suggested Strategies**

Variable	Category	Frequency	Percent
How would you rate your understanding of artificial intelligence?	Limited understanding	61	25.4%
	Basic understanding	54	22.5%
	Intermediate understanding	62	25.8%
	Advanced understanding	63	26.3%
Are you currently involved in entrepreneurship or have you previously been involved in entrepreneurial activities?	Yes	119	49.6%
	No	121	50.4%
Perception of AI’s potential benefit – Streamlining business processes.	—	64	26.7%
In what ways do you think AI can improve efficiency and automation in entrepreneurial ventures?	Reducing operational costs	80	33.3%
	Enhancing productivity	96	40.0%
Do you believe AI has the potential to drive innovation and creativity in entrepreneurship?	Yes	76	31.7%
	No	89	37.1%
	Unsure	75	31.3%
What are the major concerns or challenges you foresee regarding data privacy and security when integrating AI into entrepreneurial ventures?	Unauthorised access to sensitive data	79	32.9%
	Data breaches	76	31.7%
	Compliance with data protection regulations	85	35.4%

<i>Variable</i>	<i>Category</i>	<i>Frequency</i>	<i>Percent</i>
In your opinion, what are the key skill gaps that entrepreneurs may face when implementing AI technologies in their ventures?	Data science	73	30.4%
	Machine learning	62	25.8%
	Programming	61	25.4%
	Ethical AI design	44	18.3%
Based on your knowledge and experience, what do you think are the most promising opportunities for entrepreneurs in leveraging AI technologies?	Enhanced decision-making	82	34.2%
	Automation of tasks	54	22.5%
	Personalised customer experiences	51	21.3%
	Innovation and creativity	54	22.5%
How can entrepreneurs best address the challenges posed by AI in their ventures?	Investing in AI education and training	49	20.4%
	Partnering with AI experts or firms	69	28.8%
	Implementing robust data privacy measures	61	25.4%
	Advocating for clearer AI regulations	61	25.4%
In your opinion, what role should policymakers play in supporting the integration of AI into entrepreneurship?	Enacting clear and supportive AI regulations	82	34.2%
	Providing funding for AI research and development	85	35.4%
	Promoting AI education and training initiatives	73	30.4%

Table 2 presents the distribution of respondents' knowledge, experiences, and perceptions regarding AI in the context of entrepreneurship.

In terms of AI knowledge, the sample shows a balanced spread across four levels: limited understanding (25.4%), basic understanding (22.5%), intermediate understanding (25.8%), and advanced understanding (26.3%). This diversity in AI literacy suggests that the findings capture perspectives from both novices and more experienced AI users.

When asked about entrepreneurial involvement, 49.6% reported current or prior engagement in entrepreneurial activities, while 50.4% indicated no such experience. This near-equal split provides insights from both entrepreneurial practitioners and non-practitioners.

Regarding AI's role in enhancing efficiency and automation within ventures, respondents highlighted enhancing productivity (40.0%) as the top perceived benefit, followed by reducing operational costs (33.3%) and streamlining business processes (26.7%).

Perceptions of AI's potential to drive innovation and creativity were mixed: 31.7% agreed, 37.1% disagreed, and 31.3% were unsure, indicating ongoing skepticism and uncertainty about AI's creative contributions in entrepreneurship.

Concerns about data privacy and security emerged strongly, with compliance with data protection regulations (35.4%), unauthorised access to sensitive data (32.9%), and data breaches (31.7%) ranking as the most pressing issues.

Skill gap analysis revealed that entrepreneurs may face challenges in data science (30.4%), machine learning (25.8%), programming (25.4%), and ethical AI design (18.3%). This reflects both technical and ethical competency needs for successful AI adoption.

Respondents identified several promising AI opportunities for entrepreneurship, including enhanced decision-making (34.2%), automation of tasks (22.5%), innovation and creativity (22.5%), and personalised customer experiences (21.3%).

To address AI-related challenges, strategies such as partnering with AI experts or firms (28.8%), implementing robust data privacy measures (25.4%), advocating for clearer AI regulations (25.4%), and investing in AI education and training (20.4%) were suggested.

Finally, respondents expressed expectations from policymakers, emphasising providing funding for AI research and development (35.4%), enacting clear and

supportive AI regulations (34.2%), and promoting AI education and training initiatives (30.4%) as key policy measures to foster AI integration within entrepreneurship.

Overall, the results indicate a varied yet insightful mix of AI knowledge, practical experience, perceived benefits, concerns, and strategic recommendations, offering a comprehensive understanding of how AI is viewed in the entrepreneurial landscape.

### Perceptions of AI Opportunities and Challenges

**Table 3: Mean and Standard Deviation of Respondents’ Perceptions of AI’s Role, Importance, and Challenges in Entrepreneurship**

Statements	Mean	Std. Deviation
How do you perceive the role of AI in enhancing decision-making processes for entrepreneurs?	3.12	1.455
How important do you consider personalised marketing and customer insights facilitated by AI for entrepreneurial success?	3.09	1.398
How do you perceive the ethical considerations surrounding AI adoption in entrepreneurship, such as algorithmic fairness and transparency?	3.05	1.405
How significant do you consider the cost and resource constraints associated with AI implementation for entrepreneurs?	3.21	1.411
What are your thoughts on the regulatory uncertainty surrounding AI technologies and its impact on entrepreneurship?	4.19	1.026

Table 3 presents the mean scores and standard deviations for key statements assessing perceptions of AI’s role in entrepreneurship. Respondents moderately agreed that AI can enhance decision-making processes for entrepreneurs (Mean = 3.12, SD = 1.455), although the relatively high standard deviation indicates a wide range of opinions ranging from strong agreement to skepticism.

The importance of AI in enabling personalised marketing and customer insights for entrepreneurial success was similarly rated at a moderate level (Mean = 3.09, SD = 1.398), again showing notable variability in respondents’ viewpoints. Ethical considerations, including algorithmic fairness and transparency, were also moderately acknowledged (Mean = 3.05, SD = 1.405), with responses differing on the perceived seriousness of these concerns.

Cost and resource constraints associated with AI adoption were perceived as moderately significant barriers (Mean = 3.21, SD = 1.411), reflecting differing levels of concern

among participants. Notably, regulatory uncertainty emerged as the most pressing issue (Mean = 4.19, SD = 1.026), with a relatively strong consensus that unclear AI-related regulations pose a substantial challenge to entrepreneurial ventures.

### Findings

The survey of 240 respondents reflected balanced gender representation (49.6% male, 50.4% female) and diverse demographic profiles. Educationally, postgraduates formed the largest segment (30%), while the occupational mix included employees (28.3%), freelancers (26.7%), consultants (25.4%), and entrepreneurs (20%). Nearly half (49.6%) reported current or prior entrepreneurial experience. AI literacy levels were distributed across the spectrum, with 26.3% indicating advanced understanding, 25.4% reporting limited knowledge, and the remainder possessing moderate familiarity.

## Technology Context

Respondents identified productivity enhancement (40%), cost reduction (33.3%), and process streamlining (26.7%) as the most significant technological benefits of AI adoption. However, perceptions of AI's capacity to foster innovation and creativity were mixed—31.7% agreed, 37.1% disagreed, and 31.3% remained uncertain. The highest-rated opportunity was AI-enabled decision-making (34.2%), followed by automation (22.5%), innovation (22.5%), and personalised customer experiences (21.3%).

## Organisation Context

Skill gaps emerged as a prominent organisational barrier, with deficiencies reported in data science (30.4%), machine learning (25.8%), and programming (25.4%). Strategies favoured to overcome these internal capacity challenges included partnering with AI experts (28.8%) and investing in AI-focused education and training (20.4%).

## Environment Context

External challenges were dominated by regulatory and security concerns, including compliance with data privacy laws (35.4%), risks of unauthorised access (32.9%), and potential data breaches (31.7%). Regulatory uncertainty was the most pressing environmental concern ( $M = 4.19$ ), highlighting the urgent need for governance clarity. Respondents emphasised policy interventions such as funding AI research and development (35.4%), enacting supportive regulations (34.2%), and promoting AI training initiatives (30.4%).

## Overall Perceptions

Mean score analysis indicated moderate agreement on AI's role in decision-making ( $M = 3.12$ ), personalised marketing ( $M = 3.09$ ), and ethical considerations ( $M = 3.05$ ). The findings suggest that while entrepreneurs recognise AI's technological potential, organisational

readiness and environmental stability remain critical determinants of adoption success.

## Conclusion

The demographic composition of respondents in this study demonstrates substantial diversity across gender, age, education, occupation, and industry, thereby providing a comprehensive basis for examining the relationship between AI and entrepreneurship. Participants exhibited varying levels of AI literacy, with a significant proportion either actively engaged in or expressing interest in entrepreneurial activities, reinforcing the relevance of AI adoption in this sphere.

## Technological Context

The findings reveal a broad acknowledgment of AI's potential to enhance operational efficiency through productivity gains, cost reduction, and streamlined processes. However, perceptions of AI's role in stimulating innovation and creativity were more divided, reflecting technological maturity differences and varied sector-specific use cases. Key technological barriers identified include data privacy and security concerns, as well as limitations in algorithmic transparency. These challenges underscore the need for robust technological safeguards, high-quality datasets, and transparent AI design in order to build trust in adoption.

## Organisational Context

Skill gaps emerged as a significant organisational challenge, particularly in domains such as data science, machine learning, programming, and ethical AI design. This shortage constrains firms' ability to develop and maintain AI capabilities internally. Respondents emphasised the importance of targeted capacity-building initiatives, including continuous workforce training, leadership support, and fostering collaborations with AI experts and solution providers. Organisational readiness, in terms of both technical infrastructure and human capital, was widely seen as essential for achieving meaningful AI integration.

## Environmental Context

From an external perspective, respondents identified regulatory uncertainty as the most pressing concern. Ambiguity around AI-specific legal frameworks and compliance requirements was perceived as a barrier to confident and widespread adoption. Suggestions for overcoming these challenges included enacting supportive legislation, developing clear governance structures, and promoting ethical guidelines aligned with global best practices. The role of policymakers was seen as pivotal—not only in providing regulatory clarity but also in funding AI research and development, improving digital infrastructure, and encouraging industry–academia partnerships.

Overall, despite the barriers identified, respondents expressed optimism about AI’s potential to enhance entrepreneurial decision-making and deliver personalised customer experiences. A coordinated, multifaceted approach—strengthening technological capabilities, the enhancement of organisational readiness, and shaping a supportive environmental framework—will be critical for enabling entrepreneurs to harness AI responsibly and sustainably. Such alignment across the TOE dimensions can foster long-term competitiveness, innovation, and impactful business growth.

## Limitation

While this research provides meaningful insights into the relationship between financial, business, and digital acumen and SMME innovation and success through the lens of knowledge management and entrepreneurial creativity, certain limitations must be acknowledged.

First, the study is geographically limited to Kerala, India, and therefore the findings may not be fully generalisable to other regions or countries with different socio-economic, cultural, and policy environments. The contextual factors such as state-specific industrial policies, literacy rates, and infrastructure support may influence the results and limit their applicability to broader contexts.

Second, the data were collected using a cross-sectional design, which captures a snapshot of variables at a single point in time. While this design is effective for identifying associations, it does not allow for the determining causality

or the observation of how relationships evolve over time. A longitudinal approach in future research could provide deeper insights into the dynamic nature of entrepreneurial growth and innovation.

Third, the reliance on self-reported data from respondents introduces the possibility of response bias, including social desirability bias, whereby participants may present themselves or their businesses more favourably than is accurate. This could affect the precision of certain findings despite careful questionnaire design and anonymity assurances.

Fourth, while the study uses Structural Equation Modelling (SEM) to ensure robust statistical analysis, the complexity of entrepreneurial success is influenced by numerous external factors such as macroeconomic conditions, technological disruptions, and policy changes, which were beyond the scope of the present model.

Lastly, the constructs measured financial acumen, business acumen, digital acumen, knowledge management, and entrepreneurial creativity were operationalised using specific scales validated in prior studies. Although these tools are reliable, they may not capture every nuanced dimension of these concepts within the local entrepreneurial ecosystem.

Future research could address these limitations by expanding the geographic scope, employing mixed-method approaches to capture richer qualitative data, conducting longitudinal studies, and incorporating additional variables such as market competition, global trade linkages, and sustainability practices to enrich the theoretical and practical understanding of SMME success.

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