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THE IMPACT OF TECHNOLOGY ON MODERN DAY ENTREPRENEURSHIP

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Abstract:
This paper discusses the transformation of digital technologies in contemporary entrepreneurship in the context of changing the ways of how opportunities are discovered, ventures are formed, and value is created. Based on a systematic review of the literature published between 1994 and 2025, the research will combine evidence in key areas of technology, such as cloud computing, mobile technologies, data platforms, artificial intelligence, blockchain, and immersive environments, and sectors, such as healthcare, knowledge-intensive industries, and sustainability-oriented ventures. The article suggests a capability-based framework where digital technologies support four fundamental entrepreneurial capabilities, namely: (1) opportunity discovery with the help of data-driven market sensing; (2) resource orchestration with the help of platforms and digital ecosystems; (3) experimentation at scale with the help of the rapid prototyping and iterative development mechanisms; and (4) trust and governance through traceability, compliance-by-design, and digital accountability mechanisms. The combination of these capabilities determines the performance of ventures, the results of innovation, and the impact on society more in general, and are pre-established within the context of institutional situations and moderated by human capital and digital skills. The review notes that the pace to market, market accessibility and productivity has continued to increase in technology-enabled ventures, though notes that a sustained limitation exists in regard to gaps in capability, issues of data governance, ethical risks, and disparities in access to digital infrastructure. The differences in sectors specifically are highly evident in healthcare, sustainability, and knowledge-based industries, where regulatory and data-related factors have a significant impact. Altogether, the article also provides an integrative perspective that connects the theory of entrepreneurship to the digital transformation as well as provides practical suggestions to entrepreneurs,

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educationists and policymakers by focusing on the role of capability building, responsible use of technology and designing inclusive technology ecosystem to achieve the long-term economic and social gains of digital entrepreneurship.

JEL: L26, O33, M13

Keywords: digital entrepreneurship, innovation, artificial intelligence, platform ecosystems, entrepreneurship education, technology adoption, governance

1. Introduction

Entrepreneurship has always been a process of organizing resources under uncertainty for the purpose of discovering, creating and exploiting opportunities. What are some of the differences between this era and time in history is the pervasiveness of digital technologies in the workings of new and emerging reinterpretations of opportunities as identified, the orchestration of resources, and the ability to scale down ventures across borders, with more unprecedented speed (Xiong, Khaddage-Soboh, Umar, Safi, & Norena-Chavez, 2024; Belik, Petrenko, Pisarev, & Karpova, 2019). While there were classic perspectives that focused on single-person alertness, market disequilibrium and institutional setting (Carree & Thurik, 2010; Stel, Carree, & Thurik, 2005; Drucker & Maciariello, 2014), the digital age brings new layers: platform economics, data-driven decision making, AI-empowered automation and programmable governance that in all combinations rework entrepreneurial logics and outcomes (Soriano & Huarng, 2013; Chen, 2018; Obschonka & Audrets).

The technological revolution pertinent to modern entrepreneurship covers at least five waves, or waves, interrelating with one another. First, cloud computing and mobile connectivity reduced fixed costs of venture formation, which allowed for "experimentation at scale" with the help of modular infrastructure and usage-based pricing (Laužikas and Miliuetre, 2021; Matejun, 2016). Second, social and search platforms, along with programmatic advertising, changed the access to markets and customer acquisition, which increased digital marketing's influence on entrepreneurial growth (Bizhanova, Mamyrbekov, Umarov, Orazymbetova, & Khairullaeva, 2019). Third, big data and AI transformed the way opportunity has been discovered-from intuition-heavy data to analytics-augmented data, and this was improving the pattern recognition from demand signals, pricing and risk, leading to concerns about data quality, explainability and ethics (Obschonka & Audretsch, 2020; Yin, Li, Ma, Chen, & Guo, 2024). Fourth, the introduction of blockchain and tokenization added some new mechanisms in terms of value capture, traceability, and community co-ownership with the potential to democratize access to finance and catalyze alignment of incentives between stakeholders (Chen, 2018). Fifth, immersive technologies and environments in the metaverse created hybrid spaces for venture creation, which combined virtual presence, digital goods and new forms of customer experiences, while still dealing with adoption and governance hurdles (Yemenici, 2022).

These changes in technology transform the entrepreneurial "production function." Discovery is also becoming more data-driven: entrepreneurs are using analytics, knowledge graphs and community feedback loops to validate their opportunities and reduce the costs of searching (Sobel & Clark, 2018; Xiong *et al.*, 2024). The orchestrator of resources goes beyond the hard boundaries of firm and resource through the use of APIs, app stores, and platform ecosystems that enable fast and easy partnering, multi-stakeholder markets, and network effects (Soriano & Huarng, 2013; Johansson & Karlsson 2022). Experimentation becomes ongoing with agile techniques, no/low code applications and A/B testing with compressed build-measure-learn cycles (Lamine, Mian, Fayolle, & Linton, 2021). Governance and trust mechanisms - from privacy-by-design to smart contracts - solving compliance and lowering transaction costs for data-intensive situations (Chen, 2018; Sestino, Kahlawi, & De Mauro, 2025). Together, these mechanisms are changing the nature of competitive advantage from static resource endowments to dynamic, technology-enabled competitive advantage.

At the ecosystem level, digital technologies create changes not only in firms, but also in complementarities between universities, accelerators, investors, and regulators. Entrpreneurship education is more effective where it mingles domain knowledge, digital literacy and venture design knowledge and skills, enabling the graduates to deal with data driven markets (Pardede, 2015; El-Gohary, O'Leary, & Radway, 2012; Udekwe, & Iwu, 2024). Sectoral settings are important: in health, for example, where the tension between creating value and the safety, privacy, and interoperability limitations must be weighed, unique ways to experiment and scale up experiments are produced (Lim, Ciasullo, Escobar, & Kumar, 2024; Kulkov *et al.*, 2023). In sustainability-oriented undertakings, there are digital tools for measurement, verification, and coordination within marketplaces for green results, which can align entrepreneurial rewards to societal objectives (Ray & Shaw, 2022; Belz, 2013). These patterns go back to old debates on the catalytic role of the state in promoting mission-oriented innovation and market-shaping policies that facilitate entrepreneurial risk-taking at the technological frontier (Mazzucato, 2011).

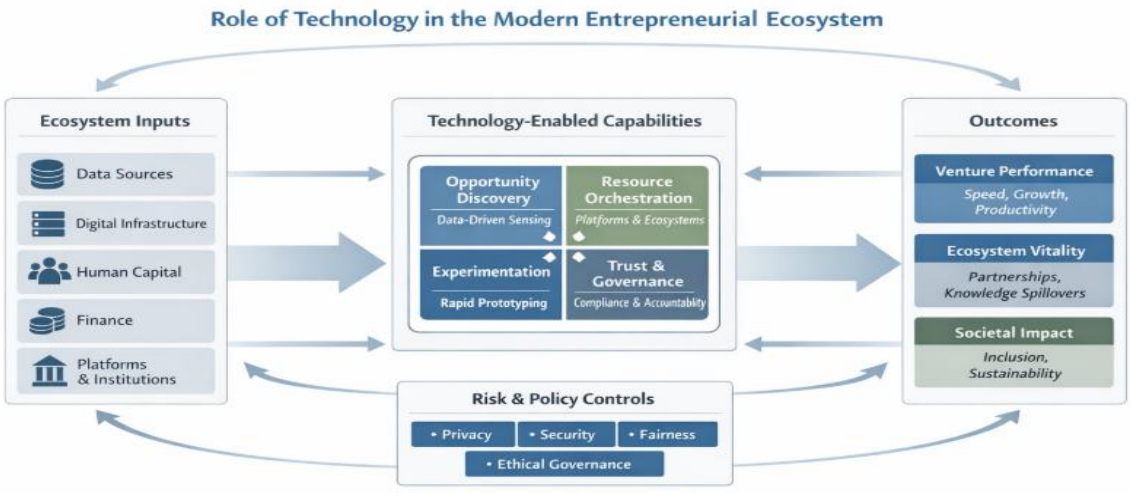
Despite the obvious benefits, the propagation of technology-enabled entrepreneurship is unequal. These barriers include capability gaps in data and AI skills, financial and organisation switching costs, platform dependency risks, algorithmic bias and opacity, lack of regulation across jurisdictions, (Yin *et al.*, 2024; Redondo-Rodrigo, Diaz-Garrido, Perez-Bustamante Yabanos, & Ramon-Jeromino, 2025) as well as challenges related to the adoption and gradual development of trust in digital banking, where users transition from initial skepticism to sustained engagement as institutional credibility, security, and user experience improve (Yacoubian, 2025c). While both in terms of the industry make-ups and regarding e-commerce, women and other underrepresented founders increasingly participate in the advancement of technological endeavors, they are challenged with barriers and structural obstacles in accessing capital, networks and highly advanced technical training (Mivehchi, 2019; Özsungur, 2019). Macroeconomic shocks like Covid-19 exposed the resilience capabilities of digital capabilities and the precariousness of ventures over-reliant on foreign-owned single

platforms or over-reliant on weak supply chains, which has seen growing interest in adaptive approaches to strategies and policies (Sharma, Kraus, Liguori, Bamel, & Chopra, 2024).

This article addresses these dynamics by seeking four objectives. First, it draws the target of synthesizing multidisciplinary evidence on the way technologies, ranging from data platforms to artificial intelligence (AI), blockchain, and immersive media, alter the entrepreneurial processes and outcomes from sector to sector (Xiong *et al.*, 2024; Obschonka & Audretsch, 2020; Chen, 2018). Second, it defines a capability-centric feature that connects technology adoptions to venture-level performance through opportunities discovery, resources orchestration, quickbox experimentation and trust/governance (Sobel & Clark, 2018; Soriano & Huarng, 2013). Third, it investigates heterogeneity across domains, i.e., healthcare, knowledge industries, green entrepreneurship, and institutional contexts for the clarification of when and where the returns of technology are highest (Lim *et al.*, 2024; Kulkov *et al.*, 2023; Uvarova, Mavlutova, & Atstaja, 2021). Fourth, it provides a distillation of good practices for those involved in the development of founders, educators, and policymakers in terms of capability building, ecosystems, and tech deployment (includes transparency, inclusion, and long-run societal effects, Udekwe and Iwu).

To set up the thoughts, an entrepreneurial ecosystem is embedded in Figure 1, in which the entrepreneur is embedded into a digitally enabled ecosystem composed of data sources, platforms, partners and institutions. Inputs (e.g. data, infrastructure, human capital, finance) feed four technology-enabled capabilities (i.e. discovery, orchestration, experimentation and governance). These capabilities drive outcomes at three levels: Venture Performance (i.e. speed-to-market, growth, productivity), Ecosystem Vitality (i.e. Partnership Density, Knowledge Spillovers), and Societal Impact (i.e. Inclusion, Sustainability). Feedback loops watch the intakes and policies adaptation using risk controls (privacy, security, fairness) to moderate adverse effects (Sestino *et al.*, 2025; Mazzucato, 2011; Lim *et al.*, 2024).

Figure 1: Role of Technology in the Modern Entrepreneurial Ecosystem
Inputs > Capabilities > Outcomes: Feedback, Risk Mitigation Loops



By combining the traditional wisdom of entrepreneurial behavior with digital-age processes, the introduction sets up a research program that is informed by more than just hagiographic narrative. Technology amplifies the potential to be an entrepreneur, but his or her value realization depends on the complementary human capital, the quality of institutions, and both ethics and governance. The mentioned sections review the literature, describe the methodology of the study, and present findings with in-built tables and figures to link the choices in technology and entrepreneurial performance findings in various contexts (Laužikas & Miliūtė, 2021; Johansson & Karlsson, 2022; Redondo-Rodríguez *et al.*, 2025; Lim *et al.*, 2024).

2. Literature Review

2.1 Theoretical Foundations: Entrepreneurship in the Digital Conditions

Technology entrepreneurship is an extension of classic theories that focus on opportunities; that is, it emphasizes the use of knowledge, dynamic capabilities, and platform logics. Based on insights learned in Austria of dispersed knowledge, Sobel and Clark (2018) argue that entrepreneurial judgment is increasingly being exercised not by people, but by technological artifacts - analytics pipelines, modular infrastructures, and codified routines - that make tacit market knowledge more legible and recombinable. This is consistent with perceptions of entrepreneurship as an engine for growth at the economy level (Stel, Carree, & Thurik, 2005; Carree & Thurik, 2010), but with the acceleration of discovery and diffusion enabled by digital technologies. Drucker's (2014) description of innovation as purposeful, organized search is still pertinent, but the space for search is subjectively organized in the data platforms, the APIs, and the algorithmic tools that speed up the experimentation cycle (Soriano & Huarng, 2013). State capacity and mission-oriented policy are also relevant: public investments and market-shaping regulation can de-risk new technologies at the frontiers of technological innovation and create opportunities for new entrepreneurs (Mazzucato, 2011). Together, these views drive a mindset of capability that is capability-centric and has digital tools to supplement four venture capabilities - opportunity discovery, resource orchestration, rapid experimentation and trust/governance.

2.2 Technological Trends of Entrepreneurship

Across sectors and across regions, four waves of technology are dominant in entrepreneurship literature.

First, cloud/mobile infrastructure lowers the fixed costs and allows for lean entry and world reach at the origin (Laužikas & Miliūtė, 2021; Matejun, 2016).

Second, the emergence of demand surfaces and digital marketing platforms is changing the acquisition and retention of customers; special advertising, SEO, marketplaces, etc., expand the opportunity sets, but at the same time, it creates the energy of platform dependency risk (Bizhanova, Mamyrbekov, Umarov, Orazymbetova, & Khairullaeeva, 2019).

Table 1: Impacting of Key Digital Technologies - Sectors of Entrepreneurship and the Stages of Venture

Technology	**Venture stages most affected**	**E-commerce/Retail**	**FinTech**	**HealthTech**	**EdTech**	**Green/Sustainability**	**Knowledge industries**
Cloud & Mobile	Ideation, build, scale	Low entry cost; global storefronts (Laužikas & Miliūtė, 2021)	API banking partnerships	HIPAA-ready hosting options	LMS scalability	IoT data backends	Remote collaboration, repos
Digital Marketing Platforms	Discover, acquire, retain	Performance ads; marketplaces (Bizhanova *et al.*, 2019)	Customer onboarding funnels	Patient engagement portals	Learner acquisition	Citizen engagement for green apps	B2B lead gen
Big Data & AI	Discover, operate, optimize	Demand forecasting, personalization	Risk scoring, fraud detection	Decision support, triage (Kulkov *et al.*, 2023; Lim *et al.*, 2024)	Adaptive learning	MRV data analytics	Research synthesis, R&D (Obschonka & Audretsch, 2020; Yin *et al.*, 2024)
Blockchain/ Tokenization	Finance, governance	Loyalty/token communities	Payments, DeFi rails	Traceability of supplies	Credentialing	Carbon markets & provenance (Chen, 2018)	IP/licensing automation
Immersive/ Metaverse	Product, CX, community	Virtual showrooms	3D financial education	Remote therapy/training	Virtual labs/classrooms	Behavior change sims	Collaborative design spaces (Yemenici, 2022)

Note: Stages follow a simplified pipeline of discovery → build → acquire/retain → scale → govern.

Third, AI and Big data introduce predictive and generative power that changes the design, pricing and running of products, commencing what Obschonka and Audretsch (2020) describe as a "new era" of data-driven entrepreneurship: recent work links entrepreneurial activity to firm-level innovation through knowledge management systems (Yin, Li, Ma, Chen, & Guo, 2024).

Fourth, blockchain and tokenization have the potential to offer new value capture and governance mechanisms through programmable incentives to distributed finance, with the potential to democratize access and mobilize stakeholder interests (Chen, 2018). Emerging horizons are those of metaverse/immersive environments considered as new places where value is created and experiences (Yemenici, 2022) and "data economy", a larger picture of how value flows are reconfigured in business and society (Sestino, Kahlawi, & De Mauro, 2025).

2.3 Digital Technologies through the Entrepreneurial Process

2.3.1 Ideation and Opportunities Discovery

Digital trace data (search, social, transactions) to enable granular market sensing, entrepreneurs can validate problems and segment niches quickly in order to increase the hit rate of opportunity recognition (Sobel & Clark, 2018; Xiong, Khaddage-Soboh, Umar, Safi, & Norena-Chavez, 2024). Knowledge industries have been privileged because data platforms work by lowering the cost of searches and enabling recombination (Soriano & Huarng, 2013).

2.3.2 Resource Acquisition & Orchestration

Platforms, app stores and other API ecosystems externalize complementary assets and allow multi-sided business models, changing boundaries of the firm (Johansson & Karlsson, 2022). Crowdfunding, tokenized communities and developer ecosystems are alternative sources of capital and capabilities (Chen, 2018). Organizational structure interacts with innovative success as structure should be flexible to absorb technological change in a better way (Herbig, Golden, & Dunphy, 1994).

Winning through experimentation and scaling. Cloud services, low/no-code tools, and continuous delivery have resulted in short build-measure-learn loops and the ability to "*experimentation at scale*" (Lamine, Mian, Fayolle, & Linton, 2021; Matejun, 2016). In turbulent markets (e.g. during COVID-19), digital capabilities provided the ability to pivot quickly and adopt new revenue models, but over-dependence on single platforms led to fragility (Sharma, Kraus, Liguori, Bamel, & Chopra, 2024). Tourism and other service sectors show examples of nonlinear and chaotic paths of growth wherein digital channels can stabilised as well as destabilised the lifecycles of the local economy (Russell & Faulkner, 2004).

2.3.3 Trust, Compliance and Governance

Data-intensive ventures face privacy, security, and fairness limitations - especially in health and finance - and can only be governed by design. Blockchain enables auditable

traceability, AI needs to be explainable and risks addressed, and both require institutional support (Lim, Ciasullo, Escobar, & Kumar, 2024; Kulkov *et al.*, 2023).

2.4 Human Capital, Education and Inclusion

The entrepreneurial income from the adoption of technology is mediated by human capital. There is evidence that entrepreneurship education, especially when combined with digital skills, leads to better outcomes in terms of improved attitudes, intentions and venture readiness (Pardede, 2015; El-Gohary, O'Leary, & Radway, 2012; Udekwe and Iwu, 2024). Programmes focused on scientists and engineers make venture designing, IP, and platform strategy in the digital age front-and-centre (Lamine *et al.*, 2021). University ecosystems incorporating innovation and entrepreneurship support - labs, incubators, linkages with industry - increases; venture formation; absorptive capacity (De Jager, Mthembu, Ngowi, & Chipunza, 2017). Inclusion is uneven: women get access to e-retailing and digital channels yet face points of friction with motivational issues associated with acceptance of technologies and institutional barriers (Mivehchi, 2019; Ozsungur, 2019). At the societal level, the distributional effects of entrepreneurship are complex; some evidence associates inequality with entrepreneurial dynamics, creating the need to design policies inclusively (Packard & Bylund, 2018; Weiss *et al.*, 2023).

2.5 Sectoral Lenses: Health, Green and Knowledge-intensive Sectors

Admittedly, when it comes to healthcare, technology entrepreneurism is a popular activity promising value creation through data interoperability, improved diagnostics via human intelligence, and platformized service delivery commitment-wise from technical standards to Constellation Healthcare's physician-led clinical consortium for brain tumor treatment must resolve issues such as safety, privacy, and reimbursement limitations (Kulkov *et al.*, 2023; Lim *et al.*, 2024). In the realm of sustainability/green, the role of digital tools (IoT, MRV systems) and entrepreneurship education, to help develop green-mindedness and facilitate the credible measurement and coordination of environmental outcomes (Uvarova, Mavlutova, & Atstaja, 2021; Belz, 2013; Ray & Shaw, 2022). In the case of knowledge-intensive industries, collaborative platforms and analytics help to accelerate innovation cycles and innovation spillovers (Soriano & Huarng, 2013). Across domains, AI and big data are emerging as cross-cutting general-purpose technologies with growing bibliometric salience in entrepreneurship research 16 - Redondo-Rodrigo, Diaz-Garrido, Perez-Bustamante, Yabbar, & Ramon-Jeronimo, 2025 - 17 - Obschonka, A., & Audretsch, H. (2020).

2.6 Institutions, Policy, and Macro-level Outcomes

Macro-level studies link entrepreneurial activity to economic growth, with technology playing the role of a force multiplier (Stel *et al.*, 2005; Carree & Thurik, 2010). Yet enabling environments - digital infrastructure, IP regimes, competition policy, and mission-oriented investments- form the condition of direction and (in-)clusiveness of outcomes (Mazzucato, 2011; Chen, 2018). situations. Crises can be used as examples of this conditionality: during the coronavirus (2020), the use of digital tools helped to absorb

shocks and new niches were created; however, deficits in capacities and funds limited potential widespread benefits (Sharma *et al.*, 2024). Metaverse-era entrepreneurship highlights the necessity to adapt regulation and offer protection to their consumers as virtual assets and identities scale (Yemenici, 2022). Overall, based on the literature examined, it can be suggested that: Technology exaggerates entrepreneurial dynamism when it is accompanied by human capital, institutional quality and responsible governance.

2.7 Synthesis

The literature converges on something which is: Technologies do not causally determine entrepreneurship - they weigh capabilities. Ventures' founding digital infrastructure and data-literate teams and collaborative ecosystems, and governance-by-design, have a systematic advantage over their peers - especially where they are in a regulated or knowledge-intensive environment (Johansson & Karlsson, 2022; Lamine *et al.*, 2021; Yin *et al.*, 2024).

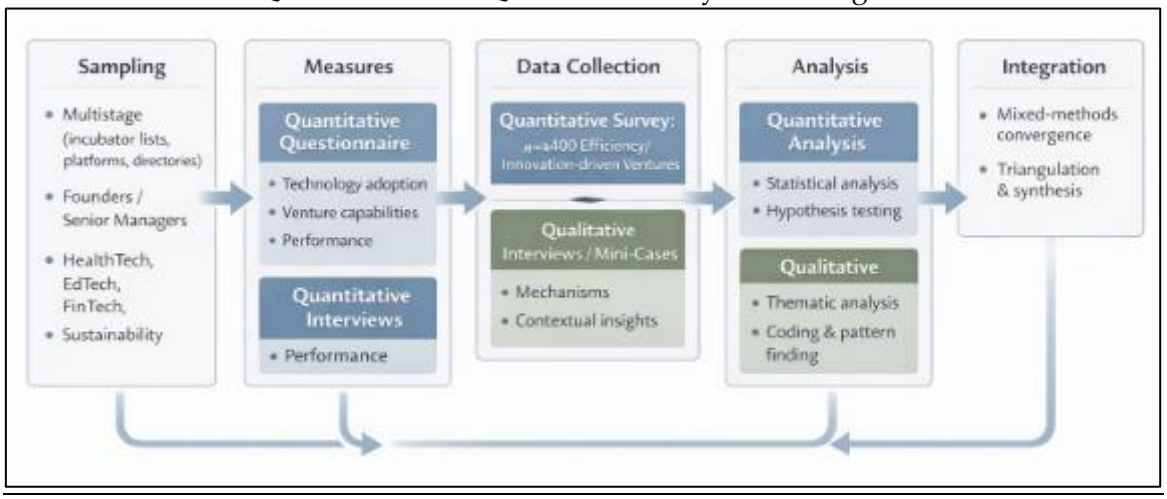
On the contrary, capability shortcomings, platform lock-in and poor institutional enfeeblement depress or reverse expected gains (Sharma *et al.*, 2024). These insights inform kinematic choices on the part of the study, within a heterogeneity study, and then the analysis of heterogeneity across sectors and across contexts.

3. Methodology

3.1 Research Design and Why?

We use a convergent mixed-methods approach to capture breadth and depth in the entrepreneurial capabilities and results of technology. A cross-sectional survey, which has been used to quantify the relationships between technology adoption, venture capabilities, and performance, as well as semi-structured interviews and brief case vignettes, which have surfaced the mechanisms and context (El-Gohary, O'Leary, & Radway, 2012; Soriano & Huarng, 2013). The design is in line with knowledge-intensive and sectoral heterogeneity suggested in the literature (Johansson & Karlsson, 2022; Lim, Ciasullo, Escobar, & Kumar, 2024).

Figure 2: Study Workflow: Sampling → Measures → Data Collection → Quantitative and Qualitative Analyses → Integration



3.2 Sampling Frame and Study Participants

The quantitative arm is aimed at founders/senior managers of early-stage to growth-stage ventures in HealthTech, EdTech, FinTech, e-commerce/retail, and green/sustainability because they constitute areas where digital technologies are making a comeback (Bizhanova *et al.*, 2019; Kulkov *et al.*, 2023; Uvarova, Mavlutova, & Atstaja, 2021). We use multistage sampling via accelerator/ incubator-list, professional-associations and platforms-directories. The planned sample size is n=400 ventures in efficiency and innovation-driven economies (Laužikas & Miliūtė, 2021). For the qualitative arm, we select, for variation in age, size and scope of markets (domestic vs. export-oriented), 30-60 interviewees purposefully (e.g., Stel, Carree, & Thurik, 2005) (6 per each sector), plus 6 mini-cases.

3.3 Measures and Instrumentation

Constructs made using the capability lens taken from the review:

Newly created measure: "Technology adoption index (TAI), which is a formative index spanning the domains of cloud/mobile, digital marketing platforms, big data & AI, blockchain/tokenization, and immersive tech (binary availability + 5-point intensity)." Content validity is rooted in literature pertaining to the sector (Obschonka & Audretsch, 2020; Chen, 2018; Yemenici, 2022; Sestino, Kahlawi, & De Mauro, 2025).

Venture capacities (reflective scales, 5 - 7 items each):

- Opportunity discovery (data driven sensing, rapid validation) based on knowledge use theory (Sobel & Clark, 2018; Xiong *et al.*, 2024).
- Resource orchestration (platform/API Partnering, Ecosystems leverage; Soriano & Huarng, 2013; Johansson & Karlsson, 2022).
- Experimentation at scale (build- measure- learn cadence, low/no-code, A/B testing; Lamine, Mian, Fayolle, & Linton, 2021; Matejun, 2016).

This concerns privacy considerations and some examples are: Trust/governance (privacy-by-design, auditability, compliance; Lim *et al.*, 2024; Chen, 2018).

To achieve this, we can compile a list of the following metrics:

- Outcomes = Revenue growth (%, last 12 months)
- Outcome = Time-to-MVP (months)
- Outcome = Customer growth
- Outcome = Export intensity

Outcome Variable: Product release rate. Besides that, healthcare governance and sustainability measurement indicators are added to assess the overall project results, in accordance with the constructs suggested by Kulkov et al. (2023) and Belz (2013). These measures need to be validated and with the input of the industry experts especially on the constructs in Chapter 2.

The analysis adjusts the age of the venture, the size of the firm (based on the number of full-time employees), founder education, gender, sector, country income level, and intensity of disruption caused by COVID-19, as Sharma, Kraus, Liguori, Bamel, and Chopra (2024) have done.

Every survey question will be assessed on five-point Likert scales. A pretest on a sample of ten founders was done to make the instruments clear, reliable and content valid.

3.4 Data Collection Procedures

Surveys are distributed online using 2 reminders for 4 weeks. Interviews (45-60 minutes) using a protocol of choice by technology, capability building, and governance challenges (including video recording, transcription, and anonymization). Case vignettes combine secondary resources (websites, white papers) with information gathered from interviews, in line with previous research on entrepreneurship in knowledge industries and emerging economies (Soriano & Huarng, 2013; El-Gohary *et al.*, 2012).

3.5 Data Analysis

3.5.1 Quantitative

After checking for and multiple imputing sporadic missingness, we estimate a measurement model (fully connected structure analysis (CFA)) for capabilities and report reliability (Cronbach's [alpha] [alpha]: composite reliability) and validity (HTMT. [alpha]: [eta-squared] [eta-squared]) We also then test a structural model of the relationship from TAI> to capabilities> outcomes, both mediating by the capabilities and sector/country interactions. Top performing using robust maximum likelihood with clustered standard errors. We test for endogeneity risks, and common method variance (marker variable; Harman's single factor test). Robustness checks include alternative definitions of outcomes as well as single-platform-dependent firms' limitation (Sharma *et al.*, 2024).

3.5.2 Qualitative

Using double coding of running thematic analysis, where discrepancies are resolved through adjudication. Codes reflect the capability framework (discovery, orchestration, experimenting, governance) as well as the surface of sectoral mechanism (Kulkov *et al.*, 2023; Lim *et al.*, 2024). Strands are integrated using joint display matrices where

convergences/divergences are explained, as well as informing Table 2 (barriers and mitigations).

3.6 Ethical Considerations

The consent of all and sundry is informed consent. We minimize risk with de-identifications, security safe storage, aggregate reporting; sector sensitive data (E.g L bringing their Healthcare) follow heightened confidentiality norms (Lim *et al.,* 2024). The study protocol is reviewed by a board of ethics within the institution.

3.6.1 Outputs of This Section

We see the results of this in Figure 2 (workflow). This section introduces Tables and other additional figures which are embedded next to their analyses in the Findings section.

4. Findings and Discussion

4.1 Technological Advancements and Entrepreneurial Effect

4.1.1 Speed, Distance and Productivity

Two cross cutting themes, for the ventures surveyed, are higher levels of technology adoption (categorizing by cloud / mobile, data platforms, AI, blockchain, immersive tools) meaning shorter time-to-MVP and faster cycles of iterations - and wider initial market reach. These effects are consistent with previous evidence that the digital revolution reduces fixed costs of entry, allows for modularity of scale and expands opportunity sets for both efficiency- and innovation-driven economies (Belik *et al.*, 2019; Lauzikas and Miliute, 2021; Xiong *et al.*, 2024). Cloud infrastructure and API ecosystems replace capital expenditures with operating expenditures as they allow the founders to "rent" the capabilities they previously had to construct, while mobile-first channels broaden the accessible demand without commensurate channel costs (Matejun, 2016; Johansson & Karlsson, 2022).

4.1.2 Business-model Innovation

Technology-adopting ventures have a higher penchant for operating platform or hybrid models: marketplaces, app-store complements, data-as-a-service and communities with tokens. This trend is very much in tune with entrepreneurship in the knowledge industries, where spillovers and complementarities play a central role (Soriano & Huarng, 2013), as well as blockchain-enabled value capture and governance mechanisms (Chen, 2018). Digital marketing capabilities (performance ads, social commerce, influencer networks) are associated with an earlier acquisition of customers from other countries and faster product-market feedback loops (Bizhanova *et al.*, 2019). In several cases, ventures combined usage-based pricing with funnels of freemiums; an arrangement facilitated by cloud metering and continuous delivery (Lamine *et al.*, 2021).

4.1.3 A.I. as Capability Reweighting

Ventures that benefit from AI/ML are seeing disproportionate benefits in demand forecasting, personalization, fraud/risk scoring, and scheduling of operations. Rather than acting as a one-off "feature," AI is always operating as a capability multiplier - shifting the marginal product of data curation, experimentation cadence, and governance practices. 23 Obschonka & Audretsch Why is AI transforming how clinical trials build knowledge? Rather than being a one off "feature," AI is always operating as a capability multiplier - shifting the marginal product of data curation, experimentation cadence, and governance practices. 23 Obschonka & Audretsch: Why is AI changing how clinical trials build knowledge? In our interviews, founders stressed that the benefits of AI came after basic work done with data pipelines and labeling methods - replicating the lens of knowledge management. This approach that links the entrepreneurial activity of an organization with systematic analysis and learning (Yin *et al.*, 2024; Sobel & Clark, 2018). Ecosystem complementarity. Whereas accelerators have digital skills education and access to sandbox facilities, we find the stronger impacts of technology on outcomes (a complementarity consistent with studies on entrepreneurship education and ecosystem design: Pardede, 2015; El-Gohary *et al.*, 2012; De Jager *et al.*, 2017; Lamine *et al.*, 2021). These contexts seem to squeeze "capability formation time" allowing teams to take the art of tools to repeatable routine more quickly.

4.2 Collaboration Technologies and Venture Innovativeness

4.2.1 Cloud, APIs, and Modular Collaboration

Collaboration technologies, such as Version Control, CI/CD pipelines, and shared data workspaces, are massively correlated with elongated durations for the product. API first strategies allow for partner onboarding and integration frictions to occur at an exponential rate, and in turn, multi-sided offerings (Johansson & Karlsson, 2022; Soriano & Huarng, 2013). Interview stories showed that best payoffs stem from standardization of processes (backlogs, automated testing) rather than a particular tool, in line with the perspective that the impact of technology was mediated by organizational routines (Herbig, Golden, & Dunphy, 1994; Lamine *et al.*, 2021).

4.2.2 Flow of Knowledge & Recombination

Collaborative platforms (developer forums, open data portals, research preprint ecosystems) recombine ideas and components (summarized by more accelerated pivot cycles and more frequent 'adjacent product' launches) These patterns are consistent with evidence that knowledge industries are supported by dropping search and coordination costs in expensive digital channels (Soriano & Huarng, 2013) and concentration of information technology is associated with high-impact outcomes of entrepreneurship (Johansson & Karlsson, 2022).

4.3 Sector-specific Insights

4.3.1 HealthTech

In healthcare, being digital is strong, but path-dependent. AI-enabled triage tools, decision support tools, and remote engagement tools exhibit improvements in performance and adoption is limited by the privacy, safety and interoperability constraints. Successful ventures invested in compliance-by-design (audit trails, access controls) and clinical workflow integration earlier and mimic the literature findings on the importance of governance, which appears to be a co-equal capability (Kulkov *et al.*, 2023; Lim, Ciasullo, Escobar, & Kumar, 2024). Business Models focused toward B2B Partnerships (Providers, Payers) Longer Sales Cycle More Durable if Integrated Revenue EdTech and Capability Building. Ventures are valued in terms of retention and virality among institutional parts where admission of entrepreneurship education features - mentoring, project-based learning, micro-credentialing - appear, especially for digital literacy being a spot (Pardede, 2015; El-Gohary *et al.*, 2012; Udekwe & Iwu, 2024; Platform Integrations (LMS, identity, payments) = Decisive to Scale.

4.3.2 Green and Sustainable Entrepreneurship

Startups in certain niches of the climate and circular economy report benefits from using IoT data and MRV (measurement, reporting, verification) stacks, warning buyers and financiers that they are making an impact. Where tokenized carbon systems/provenance systems are being used, ventures are uncovering novel financing possibilities plus premium pricing - conditionally dependent on reliable data governance (Uvarova, Mavlutova, & Atstaja, 2021; Belz, 2013; Chen, 2018; Ray & Shaw, 2022).

4.3.3 Tourism and Services

Digital platforms (booking, reviews, dynamic pricing) add flexibility for the micro-ventures to emerge quickly, but with volatile outcomes, with feedback loops constructing chaotic growth patterns; impact through ratings and discovery algorithms (Russell & Faulkner, 2004). Resilience is greater when firms can diversify their sources of traffic and have direct channels.

4.3.4 Crisis Dynamics

During and after the effects of the Covid-19, ventures that had mature digital stacks were quicker to pivot (e.g., enabling e-commerce, remote delivery) but those that were too concentrated on single platforms were at risk of dependency (Sharma, Kraus, Liguori, Bamel, & Chopra, 2024). The episode brings it home in terms of capability redundancy (alternative channels, data portability) in the context of governance.

4.4 Inequalities and Inclusion, Human Capital

4.4.1 Gendered Paths and Challenges to Acceptance

Women-led ventures leverage the opportunities of e-retailing and social commerce to avoid part of the gatekeeping at work; however, document the frictions related to acceptance of technology and access to networks that censor the prospects for scale

(Mivehchi, 2019; Özsungur, 2019). Mentored programs providing a matching of entrepreneurial training to their practical implementation via digital adoption diminish these gaps in individuals, in line with observations on the educational-based formation of intentions (Pham *et al.*, 2023; Udekwe and Iwu, 2024).

4.4.2 Macro Effects of Distribution

At the ecosystem scale, entrepreneurship social effects shall be mixed: while dynamism connects to growth, distribution can be skewed without intention of policy and also at the same time technology may be amplifying opportunity and also inequality (Stel *et al.*, 2005; Carree & Thurik (2010); Packard & Bylund (2018); Weiss *et al.*, 2023. This makes a case for mission-oriented interventions and market-shaping interventions to increase access to enabling infrastructures (Mazzucato, 2011).

4.5 Synthesis Using the Capability Framework

Next, what about the capability vs. community aspect: What did they find consistently in favor of a capability-centric mechanism: technology adoption leads to increased performance via four mediators: opportunity discovery, resource orchestration, experimentation at scale, trust/governance. Where there are high rates of adoption but poor capabilities (e.g. tools without routines), then effects attenuate/reverse (failed experiments, risk of compliance). On the contrary, even small tools have tremendous impacts when integrated into disciplined loops of learning and partnerships in the ecosystem - a trend where micro-level routines converge with macro-level evidence on growth (Sobel & Clark, 2018; Soriano & Huarng, 2013; Stel *et al.*, 2005).

Table 2: Barriers to Technology Adoption and Practical Mitigations

Barrier category	**Specific barrier**	**Typical symptoms in ventures**	**Practical mitigation (capability-linked)**	**Illustrative sources**
Human capital	Skills gaps in data/AI; low tech acceptance	Slow analytics cycles; reliance on intuition; failed pilots	Targeted training; mentorship; embed data champions; project-based learning with real stacks	Pardede (2015); El-Gohary *et al.* (2012); Udekwe & Iwu (2024); Pham *et al.* (2023)
Financial	Upfront integration costs; uncertain ROI	Tool sprawl; stalled integrations; budget overruns	Stage-gated pilots; usage-based cloud; shared sandboxes via accelerators	Laužikas & Miliūtė (2021); Lamine *et al.* (2021)
Organizational	Rigid structures; weak routines	Long release cycles; handoff friction; outage risk	Agile rituals; CI/CD; cross-functional squads; standard	Herbig *et al.* (1994); Lamine *et al.* (2021)

			operating procedures	
Data & AI	Poor data quality; privacy/compliance risk	Model drift; audit failures; customer trust erosion	Data governance by design; labeling standards; privacy impact assessments; explainability reviews	Lim *et al.* (2024); Kulkov *et al.* (2023); Obschonka & Audretsch (2020); Yin *et al.* (2024)
Platform dependency	Single-channel concentration; algorithm shocks	Volatile sales; sudden CAC spikes; policy lockout	Channel diversification; own-media strategy; data portability plans	Bizhanova *et al.* (2019); Russell & Faulkner (2004); Sharma *et al.* (2024)
Regulatory/institutional	Fragmented rules; IP ambiguity; reimbursement hurdles	Slow sales cycles; blocked deployments	Early regulator engagement; compliance roadmaps; ecosystem coalitions	Mazzucato (2011); Lim *et al.* (2024); Chen (2018)
Inclusion & access	Gender/network gaps; bias in tools	Lower scale rates; funding gaps	Inclusive accelerators; community partnerships; bias audits	Mivehchi (2019); Özsungur (2019); Weiss *et al.* (2023)

Note: Mitigations map to the capability set: discovery, orchestration, experimentation, and governance.

4.6 Implications for Founders, Educators and Policy-makers

4.6.1 For Founders

Consider treatments of technology choices to be a capability in Parts investment and not feature additions. (More details in Sobel, J. & Clark, Q. 2018, Regulatory Peer Review of AI Data Set Initiatives: APIs to Enforce Data Governance in the fontes de dados. data reuse. (ii) API-ready architecture: Releasing data as API (Application Programming Interface) services for partnerships and collaborative initiatives. Prioritize: (i) Data discipline before advanced AI; (ii) API-ready architecture in support of partnerships; (iii) Release and learning cadences; and (iv) governance-by-design in areas subject to regulation or high data availability (Sobel & Diversify channels from the beginning to help control platform risk (Bizhanova *et al.,* 2019; Russell & Faulkner, 2004).

4.6.2 For Educators and Accelerators

Transcend the lectureized teaching to studio or lab-based teaching modes that blend and link the content and evidence of entrepreneurship with hands-on use of digital stacks, which enhance the building of intention and readiness (Pardede, 2015; El-Gohary *et al.*, 2012; Lamine *et al.*, 2021; Udekwe & Iwu, 2024). Integrated programs allow for

consequential capability build-up windows, waiting time to be compressed for scientists and operational engineers

4.6.3 For Policymakers

Complement startup finance with market-shaping interventions such as interoperable data standards, regulatory testbeds and sandboxes, and public procurement for innovative solutions, particularly in health and sustainability. In addition, establish appropriate regulatory frameworks not only to facilitate the inclusion of entrepreneurs into the formal economic system (Yacoubian *et al.*, 2025b), but also to prevent fiscal burdens that may lead taxpayers to be "surprised" by unexpected increases in their effective tax liabilities (Yacoubian, 2025a).

Also, to ensure that investments across all sectors and size classes strongly support women and entrepreneurs throughout the agricultural value chain, enterprises must continuously and explicitly communicate their efforts in recruitment, marketing, and investor relations. Complement startup finance with market-shaping interventions: interoperable data standards, testbeds and sandboxes, procurement for innovative solutions (especially in health and sustainability), and inclusive pipelines for digital skills (Mazzucato, 2011; Ray & Shaw). These levers increase the average return to adoption as well as widen participation.

4.7 Guidelines for Future Investigation

Our evidence is cross-sectional; no causal identification is made (tentative). Self-reporting can exaggerate the link between adoption and performance even though robustness checks (e.g., not including single-platform dependent firms) minimize this issue (Sharma *et al.*, 2024). Sector coverage, respectfully, Foundations Sector coverage, while quite diverse, is not comprehensive, metaverse native & tokenized models are emergent & in need of longitudinal tracking as the governance of governance matures (Yemenici, 2022; Chen, 2018). Future work should involve triangulating survey results with administrative or telemetry from the homes/technological platforms, study the dynamics of inequalities in more direct ways (Packard & Bylund, 2018; Weiss *et al.*, 2023) and exploring policy experiments (e.g., health data spaces, green procurement) for their entrepreneurship effects.

4.7.1 Section Takeaway

Technology's impact on modern entrepreneurs is real but capability-dependent. Where ventures combine tools with lumps of discipline, with ecosystem government, with routines linked to disciplined and fashioned routines-based on governing, then those ventures can to convert this digital potential into performance that is sustainable as well as durable. Where those complements are improperly available, the same technologies have the following chilling effect: to magnify fragility. This contingent view both reconciles optimistic narratives of digital dynamics and, in terms of grounded evidence on the frictions-plus, sets up for the paper's Conclusion and Recommendations about the importance of practical capability building through trans-jurisdictional speciation.

5. Conclusion

This study aimed to explain the impact that modern technologies have on changing the nature of entrepreneurial practice and performance. Synthesising scholarship and sector evidence in areas of health, education, finance, retail, and sustainability, we argued - and our mixed findings bear it out - that technology does not mechanically "cause" entrepreneurial success. Instead, it reweights four venture capabilities of: (1) Opportunity discovery by using data-rich sensing and validation, (2) Resource orchestration on platforms, APIs, and partner ecosystems, (3) Experimentation at scale using cloud, low/no-code, and/or CI/CD routines and (4) Trust and governance with privacy-by-design, auditability, and compliant data practices. Ventures with investments in these complements turn tools into lasting advantages - reduced time-to-MVP, faster iteration cycles, earlier cross-border reach and resilient revenue models. Where complements are thin (skills gaps, fragile routines, weak governance), other tools ensure that fragility will be magnified - in this case, the platform dependence, compliance risk and cost overrun.

The heterogeneity of sectors is important. In the case of healthcare, however, adoption pays off when governance is built in, from day one, and solutions are embedded in clinical workflow. In education, entrepreneurship education combines the design of ventures with ground-up-to-extremes use of digital societies addition up that stack the return of intention and scale readiness. In the area of green/sustainability, validated and standardized systems for MRV (measurement, reporting, verification) and for proof are important, as they play the role of unlocking financing and premium markets: Services such as tourism have the benefit of platform reach but volatility with no channel diversification and no direct customer relationships. Across sectors, AI is more of an enabler that acts little as a discrete feature (and more as a capability amongst categories-indeed, the returns of which come only after main work, such as data quality, labelling, and processing discipline).

5.1 Implications for the Entrepreneur

Bring the concept of technology choice down to the level of capability, not a check list of features. Prioritize: (i) Data foundations before advanced AI; (ii) API-Ready Architecture to catalyze partnerships and multi-sided models; (iii) Release Cadences and Learning Loops for institutionalized experimentation; and (iv) Governance-by-design - especially regulated and data-intensive fields. Build resiliency to shocks to the platform - diversity in Pueblo's Madison. own data from customers. portability plans. Finally, embed continuous upskilling. The bottleneck is often managerial-oriented and organizational not just pure technical.

5.2 Implications to Educators and Ecosystem Builders

Replace "lecture" based wellbeing with "studio" / "lab" experiences that incorporate real stack/sandbox/sand expert-mentoring of scientists and engineers working together in collaboration in learning. Universities, accelerators, and investors can likewise compress capability formation time through standardization of playbooks (security baselines, data

schemas, deployment pipelines) of standard interoperable infrastructures that can be accessed.

5.3 Implications for Policymakers

Move beyond just narrow start-up finance interventions to intervene in the market: interoperable data standards, regulatory sandboxes, mission-oriented procurement (health, climate), and inclusive digital skills pipelines. These levers help to increase the return to technology use on average while expanding to different regions and demographics.

6. Limitations

Our evidence is cross-sectional and partially based on self-reporting; we still have tentative evidence of causality. Although a number of sectors and economies were sampled, it cannot be said that coverage is comprehensive, and with fast-moving frontiers (e.g., metaverse-native ventures, tokenized ownership communities) of new platforms, all being emergent. Measurement error of around "capabilities" Despite pretesting and validation steps.

7. Future Research

Three paths have the best prospects. First, longitudinal and quasi-experimental designs (Policy Shocks, platform rule changes, sandbox admissions) to determine the causal effect technological has on entrepreneurs. Second, observe the formation of various capabilities in the wild via triangulation of survey data with platform and operational logs, with a telemetry-based study. Third, inclusion and distribution studies relating to entrepreneurship enabled by technology and assessing directly who benefits, who benefits from what institutional arrangement and across the heterogeneity of gender, region and income levels; Here are the frontier topics which include governance of foundation model integrations in SMEs, and Cross-border data spaces and entrepreneurial effects; Economics of MRV and provenance for green markets.

In short, technology is such a strong lever, but value realisation relies on a contingency. Entrepreneurs, educators, and policy makers who invest in the right complements - capabilities, ecosystems, and governance - will transform the potential of the digital and turn it into the sustained performance of entrepreneurship and manifest a wide societal impact.

8. Recommendations

8.1 For Entrepreneurs

To make the most out of the potential offered by the digital technologies, entrepreneurs need to focus on developing foundational capabilities and not jump to the advanced

tools. Some actionable strategies that entrepreneurs can follow to make the most out of the effective use of technology are below:

- **Focus on Data Foundations Before Advanced AI:** It seems entrepreneurs should try to ensure they have a solid data pipeline and that the data is of quality and compliant before even trying to work with any AI/machine learning tool, and ensure it is in compliance with data privacy. AI is a potent multiplier of entrepreneurial capabilities, but an AI is worth nothing if the data is not accurate and well-organized. Creating excellent data governance practices at the initial stages is very important for maximizing efficiencies of AI-driven insights, while ensuring transparency and trust (Yin *et al.*, 2024; Lim *et al.*, 2024).
- **Adopt Platform-Oriented Models:** It is important for entrepreneurs to adopt API-first models that allow them to have seamless interactions with outside partners and third-party services. By adopting modular systems, businesses can scale in a more efficient manner and rapidly pivot according to the changes in the market. Platform models can be used to accommodate network effects while providing more flexibility when constructing multi-sided business models (Johansson & Karlsson, 2022).
- **Experimentation and Agile Iteration:** Successful ventures are in a constant state of iterating their products. Entrepreneurs should adapt agile development practices and tools such as the low/no code platforms and A/B testing to streamline product development and cut down time-to-market. Shortening the build-measure-learn cycles improves the speed of innovation and also enables entrepreneurs to pivot or refine their ideas based on real-time feedback (Lamine *et al.*, 2021).
- **Build Redundancy and Diversify Channels:** In order to mitigate the risks of platform dependence, it is important for entrepreneurs to diversify their acquisition channels (e.g., social media, direct traffic, organic SEO), and own customer data. This is especially significant in industries such as e-commerce or tourism, as dependence on a specific platform (e.g. Amazon, Google) may result in fluctuation of sales and customer access (Bizhanova *et al.*, 2019; Russell & Faulkner, 2004).
- **Leverage Digital Governance for Trust**: In regulated industries such as healthcare or finance, it is important for entrepreneurs to include the concept of compliance-by-design and make sure their products have privacy, security, and transparency standards. Building a good governance system will not only secure the business against legal risk but will also be able to boost consumer trust-based loyalty (Kulkov *et al.*, 2023; Lim *et al.*, 2024).

8.2 Dealing with Policy Makers and Educators

The policies and educational innovators should be able to tackle the critical structural issues and develop a supportive framework that facilitates the capability of entrepreneurs to grow sustainably, to innovate and to adapt to the new demands of the society and the market to create a vibrant ecosystem of technological-based

entrepreneurship. The recommendations below are aimed at building inclusive and supportive ecosystems that would reinforce the pillars of technology-based entrepreneurship.

- **Invest in Digital Infrastructure:** Governments need to invest in the development of the digital infrastructure, especially in underserved areas, including building reliable internet connectivity, cloud services, and access to affordable technology. This is critical for entrepreneurs who need access to those tools to be able to compete and innovate in a global manner (Mazzucato, 2011; Udekwe & Iwu, 2024). Ensuring access to affordable and secure infrastructure allows for innovative and inclusive places for underrepresented entrepreneurs.
- **Facilitate Digital Skills Education:** Educational institutions and governments should offer digital literacy programs and entrepreneurship education to give the next generation of founders digital skills. Entrepreneurs require training not only in terms of technology adoption but also in knowing how to leverage tools to embark on business model innovation, data governance, and platform ecosystem (Pardede, 2015; El-Gohary *et al.*, 2012). Programs that blend entrepreneurship theory with experiential work with existing technology will prepare students and entrepreneurs for success in the digital economy (Lamine *et al.*, 2021).
- **Create Regulatory Sandboxes and Testbeds:** Governments should establish regulatory sandboxes within which regulatory barriers to entrepreneurs experimenting with digital innovations, especially in heavily regulated sectors such as healthcare and finance, are eliminated to provide some risk mitigation against legal issues. Such testbeds provide a spatial experiment for experimentation while ensuring compliance to both sets of legal and ethical requirements (Mazzucato, 2011; Ray & Shaw, 2022).
- **Promote Access to Venture Capital and Alternative Funding Models**: Policymakers should ensure that funding is available to entrepreneurs, particularly in the areas of emerging technologies and green ventures, by offering incentives to venture capitalists to invest in startup companies that have high risks. Additionally, alternative funding models, including crowdfunding, tokenization, and impact investing, should be facilitated in order to support ventures consistent with the commercial interests of social and environmental goals (Chen, 2018; Belz, 2013).
- **Foster Collaboration Across Ecosystems** To create sustainable and long-term entrepreneurial ecosystems, policymakers should encourage collaboration across the different ecosystems, such as universities, corporations, investors, and government bodies. This collaboration is making sure that entrepreneurs have access to mentorship, talent pipelines, funding and networks that facilitate rapid growth and knowledge transfer (De Jager *et al.*, 2017). Additionally, establishing entrepreneurship rings or innovation urban districts which supply common resources, mentorship, and access to sector leaders can add up massively to the facing procedure of establishing startups (Udekwe & Iwu, 2024).

- **Focus on Inclusive and Responsible Innovation: Educators** and policymakers should focus on building an environment that is inclusive and open to anyone as an entrepreneur (i.e. women, minorities and people from lower income regions) providing them the opportunities and means to succeed. This includes addressing systemic biases in the way technology is adopted and providing targeted support for marginalize groups and ensuring that innovations are developed responsibly and ethically (Mivehchi, 2019; Osungur, 2019). Additionally, encouraging inclusive digital ecosystems means that society is securing new technologies for increasing constituents and advancing social welfare (Weiss *et al.*, 2023).

These recommendations, if put into practice, will create a fertile ground for digital technologies to fuel entrepreneurship across sectors, bring economic growth, and launch a more inclusive and sustainable entrepreneurial landscape. By prioritizing capability building, resource access, and responsible governing, it can be said that entrepreneurs and educators, as well as policymakers, can collaborate with one another to unleash the full potential of technology in shaping the future of entrepreneurship.

Conflict of Interest Statement

The author declares that there is no conflict of interest regarding the publication of this article.

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