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Reimagining entrepreneurship in the digital era: An analysis of innovation, technology adoption, and sustainable practices in driving business resilience and growth

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Abstract
Innovation, technology adoption, and sustainable business strategies are now prioritised in entrepreneurial practices, which have been significantly altered by the emergence of digital technologies. This study examines the ways in which big data and artificial intelligence (ai) might promote sustainable entrepreneurship in india, with an emphasis on the social, environmental, and economic effects. A structured survey of 420 entrepreneurs from a variety of industries yielded primary data that was used to measure the use of ai and big data, operational effectiveness, economic performance, environmental practices, and social impact. The findings were contextualised by utilising complementary secondary data sourced from government databases, industry publications, and scholarly literature. A 5-point likert scale survey, semi-structured interviews about adoption strategies and barriers, and case studies of best practices in ai/big data implementation were the main methods used to collect data. Backward descriptive statistics, reliability and validity calculations, and relation testing with structural equation modelling (sem) were the main quantitative approaches. As mentioned, a qualitative thematic analysis was also carried out. The claim that the use of digital technologies enhances a company's operational efficiency and economic growth in tandem with the sustainability of the environment and societal equity is supported by results showing differences in practices within technology and sustainability adoption. This study advances the field of sustainable entrepreneurship by providing practitioners and policymakers with more information to support the more realistic implementation of resilient and responsible business growth using ai and big data.

Keywords: Artificial intelligence, big data, sustainable entrepreneurship, technology adoption, business resilience

Introduction

The emergence of big data technology, artificial intelligence, and sustainable business practices are some of the developments in indian entrepreneurship. The country must recognise the value of preserving and fostering entrepreneurship, which will inevitably be impacted by the latest technological developments, particularly in the fields of artificial intelligence (ai) and the spread of big data, particularly given the current economy's growing significance.

Studies on the data economy show that investments in ai frequently use technology that makes many business operations and processes more complex and unclear. A similar example as pointed by maheshwari, gautam & jaggi, (2021) highlights the potential of big data in increased customer value and increased business.

According to grepper et al., more specific challenges face companies attempting to use to integrate ai into their workflows. A complex web of regulations, difficulty in finding qualified workers, and the expense of training or employing them. Most systems still employing people are beset with complexities due to the lack of streamlined organization (bhalerao et al., 2024; tirumalsety & gurtoo, 2021). Unified efforts are rarely made, and their absence continues to stagnate tremendous potential to enhance these business projects. Such integrations are complex, especially with the new elusive,

flexible, and sustainable technological blocks of the banking industry, the relevant action most often is broken. Having previously existed on the periphery of business strategy, in the last couple of decades, sustainability has been on the rise to become a foundational component of business strategy. Goyal et al. (2025) explain that the lack of certain forms of sustainable practices directly reduces a business's carbon footprint, a positive development amid the continuously more stringent demands of consumers and regulators. Their research underscores the importance of the adoption of 'green' technologies and the sustainable management of resources for enduring business resilience.

India has seen rapid growth in the field of artificial intelligence and big data. For example, 23% of indian businesses are already utilizing ai, and 73% of businesses plan to adopt it over the next 2 years (cpa australia / assocham report). In addition, 77% of indian start-ups are integrating ai with machine learning, the internet of things, and blockchain to enhance operational productivity. The national strategy for artificial intelligence aims to increase productivity and global competitiveness through equitable cross sector adoption. Accordantly, the literature on sustainable entrepreneurship emphasizes the importance of innovative business models that embrace the triple bottom line (del giudice et al, 2022).

Integrating advancements and creativity in business with technology, finance and even entrepreneurial exercises, along with sustainable practices, is difficult, yet appealing. The complexities of heterogeneity, geography, infrastructure, skills and governance, make the problem deeper. Within the indian context, la rocca et al (2024) mentions, sustainable entrepreneurship, the geo socio political context balance of regulatory, stakeholder and resource system paradigm construct is still formative or uncharted. The paradox of green finance within the indian context illustrates this paradox, on one side, there is a considerable number of ventures on which green finance fails to make a dent and on the other side, there sustainable and financially (khokhawala & iyer, 2022) sustainability objectives are very difficult to achieve.

The obstacles to the wireless attainment of digital technologies and the fostering of such ventures are what vatamanu & tofan (2025) identify. The aggressiveness of these technologies, softer elements of the engineering and technology disciplines, costs, and the mobility of resources (including people) lies within the holistic framework.

Bag, srivastava, cherrafi, ali & singh (2024) have explained the application of predictive analytics functionality in social sustainability across agricultural supply chain systems.

Literature review

The study of entrepreneurship in india and its digital transformation still sits at the heart of research. This is particularly due to the growing complexity of the country's economy. Researchers have thoroughly analyzed the role of business innovation, the adoption of new technology, and the implementation of new sustainable practices in the enhancement of business continuity and growth.

Studies by sharma, singh, and singhal (2021) concentrated on ai-driven analytics with the goal of identifying the tactics that would optimise business results. They looked at what additional benefits ai might offer in their analysis. There remains an overwhelming number of unsolved mysteries within entrepreneurship. As already iterated in and continues to persist in the marketing practices that are more incorporating, more innovative approaches need to be taken to address the plethora of gaps and opportunities in stemming the marketing advancement of small and medium sized businesses in india. In the same manner, sustainable innovations in entrepreneurship, which are on the high increase, still pose the need for more rational and thorough practical research to address the domain's challenges (yogananthan et al. 2024).

The digital adoption in businesses is on the rise in india and is believed to more positively impact the business environment. Gehlot and rajharia (2024) focused their studies the ever-rising phenomenon of digital transformation in businesses of the country, illustrating the outcomes from the case study method. In the same line of thinking, malpani and the co-author (2023) outline overall sustainable

recovery, pinpointing enablers, setters, challenges and solutions to the domain of possessed digital entrepreneurship of peripherally shared resources. Also, mahapatra & baral (2021) noted that some newer businesses in india integrating modern circular economy and business models can achieve simultaneous benefit and turnover.

The importance of sustainable entrepreneurship is illustrated in practice in the works of sonar and ghag (2025) who study sustainable entrepreneurship practices among smes in india proposing a strategic framework incorporating fuzzy delphi and the best worst methods for increasing entrepreneurial vertices in sustainability. Also, mer (2023) touches upon the role of ai in human resources and its ability to promote sustainable practices within organizations.

The connection between and among innovation, technology, and the practice of sustainability enhances the resilience and growth of a business. Juneja, & saraswat, (2025) speaks on practices and the resilience of business regarding innovation ecosystems and sustaining technologies. Sindhwani, et al. (2023) discusses the growth of business regarding the use of sustainable digital technologies in industry 4.0.

Research gap

The literature examines the impacts of innovation, the adoption of technology, and the sustainable practices individually, but little work has been done on analyzing the impacts of all three factors concurrently on the resilience and the growth of a business in the context of entrepreneurship in india. For instance, the impact of innovation on business adaptability and competitiveness is described by kamkankaew, et al. (2022). On the other hand, afolayan& de la harpe. (2020) consider the adoption of technology and its influence on operational efficiency and decision-making. In most cases, these studies do not attempt to analyze these factors in conjunction with one another.

The adoption of sustainable practices is becoming increasingly accepted as a prerequisite for the enduring success of a business. In the context of india, however, this is still a developing area of study. The work of das & dutta (2020) does study sustainable practices in the context of indian businesses, but focuses mostly on large businesses, thereby creating a gap in the analysis of small and medium enterprises (smes). In addition, studies such as kiran & reddy's (2019) which focus on the barriers to technology adoption in indian smes, analyze the barriers as independent factors without the consideration of the imperative to innovate and the adoption of sustainable practices. This gap in literature regarding indigen entrepreneurship in india has been ignored and left behind discussing absent innovativeness, adoption of new technologies, and the non-practice of sustainable ways of doing business in the context of disruption and growth.

Research objectives

1. To examine the impact of innovation on business performance and adaptability in indian entrepreneurial ventures.
2. To assess the role of technology adoption, particularly ai and big data, in enhancing operational efficiency, decision-making, and competitive advantage.
3. To study how sustainable entrepreneurship practices contribute to long-term business resilience and growth in indian enterprises.

Null hypotheses

H_{01}: Innovation has no significant impact on business performance and adaptability among indian entrepreneurs.

H_{02}: Adoption of ai and big data does not significantly enhance operational efficiency, decision-making, or competitive advantage in indian enterprises.

H_{03}: Sustainable entrepreneurship practices do not have a significant effect on long-term business resilience and growth in indian enterprises.

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Research methodology

The current study uses a mixed-method approach, combining qualitative and quantitative techniques to study how indian business owners deal with the quickly changing digital environment. Understanding the twin methods of innovation, technology adaption, and sustainability-driven practices that promote corporate success and resilience in the digital age is the main goal of the study. Participants of the study were entrepreneurs from all the major cross sectors in india, namely: Information technology, manufacturing, retail and services. The researcher accessed each stratum with a random sampling approach, assigning appropriate samples with respect to each industry, business weight and area of operation. The targeted sample consisted of 420 entrepreneurs who provided rich and dense answers, which were appropriate for qualitative and quantitative analysis. The entrepreneurs were stratified for the type of industry, size of the organization and area of operation to provide heterogeneity and relevance to the analysis.

The administering of the primary data included the usage of meticulously designed survey questionnaires as well as direct interviews. The survey was designed to collect the data related to innovation, technology integration, resilient sustainable business practices, and growth. The survey questionnaires were tested to ensure reliability and validity and amendments were made according to the feedback provided. To obtain detailed qualitative data, 30 entrepreneurs were selected and to them, barriers to and ways of achieving business sustainability and digital transformation were posed during the semi-structured interviews.

The secondary data was collected from different authoritative sources like government documents, industry studies, and academic sources. Most relevant sources of data include reports from ministry of msme, national sample survey office (nsso) publications, cii industry reports, and peer-reviewed articles featured in the journal of business venturing, and the journal of small business management. Such sources were relevant in providing context and comparative data to enhance the primary findings.

Descriptive and inferential statistics were conducted with spss, and qualitative reports from the interview process were scrutinized with varied but specific thematic approaches. This encompasses theme and pattern recognition, sorting thematic frameworks, research focus, and distilling data insights.

Data analysis

Table 1 analyzes the sample of 420 entrepreneurs to study the impact of age, gender, education, experience, enterprise type, sector, revenue, and region on the use of innovation, technology, and sustainable practices in indian entrepreneurship. Most entrepreneurs were between the age of 31 and 40 years (33.3%), which is usually a thinking age when people are willing to take strategic risks and are open to digitalized technology. Younger entrepreneurs (20-30 years; 26.2%) are more active in using ai and big data, while older (51+ years; 14.3%) people usually tend to practice conventional business approaches. This is in line with studies showing that technology adoption varies with age (sharma et al., 2021).

In terms of the distribution, male entrepreneurs (61.9%) are more numerous, but entrepreneurs (38.1%) females showed stronger support for sustainable and community-oriented practices which is in line with research that women-led firms are more likely to practice responsible and inclusive innovation (la rocca et al., 2024). Another factor that distinguished the entrepreneurs was education: Postgraduate (47.6%) and doctoral (23.8%) entrepreneurs were more likely to integrate advanced digital technology with sustainable practices. This is in line with the notion that higher education improves the ability to acquire new technologies (bag et al., 2023).

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Adoption patterns are also influenced by the experience and size of the firm. Entrepreneurs with 6 - 10 years of experience (35.7%) who incorporated digital platforms were the most proactive and had a good balance between practical market knowledge and youthful experimentation.

Table no. 1 demographic analysis

Demographic variable	Categories	Frequency	Percentage (%)
Age	20–30	110	26.2
	31–40	140	33.3
	41–50	110	26.2
	51+	60	14.3
Gender	Male	260	61.9
	Female	160	38.1
Educational qualification	Undergraduate	120	28.6
	Postgraduate	200	47.6
	Doctorate	100	23.8
Years of experience	0–5	80	19
	6–10	150	35.7
	11–20	120	28.6
	21+	70	16.7
Enterprise type	Micro	90	21.4
	Small	180	42.9
	Medium	150	35.7
Industry sector	Manufacturing	140	33.3
	Services	160	38.1
	It & digital	80	19
	Others	40	9.5
Annual revenue (inr)	< 50 lakhs	100	23.8
	50 lakh – 1 crore	120	28.6
	1 – 5 crores	130	31
	>5 crore	70	16.7
Region	North india	130	31
	South india	100	23.8
	West india	90	21.4
	East & ne india	100	23.8

Source: Generated by the author based on primary data

Within micro (21.4%) and small (42.9%) firms, medium sized businesses (35.7%) were more ai-enabled in process optimization which is still a deficit when compared to the market due to lacking financial and infrastructural resources (tirumalsety & gurtoo, 2021). Service firms (38.1%) dominate in the adoption of digital innovations particularly in customer analytics and as platform providers compared to the ever-disdained manufacturing sector (33.3%) which still concentrates on the disinvestment in automation and resource use that offers little value. The digital native begins operating with a business model that incorporates ai and big data alongside sustainability in their formative stages, a pattern identified in global research on the capacity of digital natives to transform a business (del giudice et al., 2022).

Additional evidence of disparity exists in revenue and its geographic differences. Firms that have a turnover of greater than 5 crore and comprise 16.7% of surveyed entrepreneurs and above claimed that they benefitted the most from ai, predictive analytic technologies, and innovation aimed at

sustainability and profitability. Therefore, they gained economies of scale. On the other hand, micro-enterprises as well as those that have a revenue of less than and up to 50 lakh and comprise 23.8% of surveyed entrepreneurs were only able to adopt basic digital technologies such as digital payments. This demonstrates the low cost and low absorptive capacity echoed in sharma et al 2021 and khokhawala and iyer 2022. Regionally, north india and south india 31% and 23.8% respectively, had higher adoption rates of digital technology because of greater and more robust ecosystems as well as policy frameworks. In contrast, east and northeast india 23.8% had responding infrastructure and skill constraints and tended to idealise low cost, localized innovation as a response to that, as shown by la rocca and dal moon in 2024.

Entrepreneurs' perception of ai and big data adoption among 420 surveyed entrepreneurs is detailed in table no. 2. Though the overall results suggest a positive disposition among indian enterprises towards digital transformation, the level of adoption remains patchy. Ai adoption for operational efficiency received the highest mean score (m = 4.25, sd = 0.68) and 45% reported full adoption. This illustrates the growing recognition of ai as an important driver of productivity and process simplification, supporting previous studies which show that automation of the digital layer greatly diminishes operational bottlenecks (brynjolfsson, rock and syverson 2017).

Table no. 2 technology adoption table (ai & big data)

Statement	Mean	Sd	Adoption frequency (%)	Interpretation
Ai adoption improves operational efficiency	4.25	0.68	Full: 45, partial: 40, none: 15	Strongly agree
Big data adoption enhances decision-making	4.18	0.72	Full: 40, partial: 45, none: 15	Agree
Ai contributes to competitive advantage	4.05	0.75	Full: 38, partial: 42, none: 20	Agree
Big data improves customer insights	4.1	0.7	Full: 42, partial: 40, none: 18	Agree

Source: Generated by the author based on primary data

Big data for decision making also received a high score (m = 4.18, sd = 0.72) with 85% of the entrepreneurs indicating at least partial adoption. This demonstrates the prevailing data driven decision making culture among indian entrepreneurs, corroborating previous findings that big data improves responsiveness and competitive positioning in the market (chen et al., 2012). Its adoption, however, is still more partial than full and in the case of smaller enterprises, is likely to be the result of infrastructure and skills gaps (gupta and george, 2016).

Ai's contribution to competitive advantage (m = 4.05, sd = 0.75) and big data's role in customer perceptions (m = 4.10, sd = 0.70) show about the same levels of optimism diffusion. These micro and small enterprises' lower levels of adoption and use of ai and analytics compared to larger, technology-focused companies support the structural problems in the digital ecosystems (dwivedi et. Al. 2021). Adoption and use of the digital technologies also depend on the age of the leaders, with younger ones favoring more the radical paradigm shifting digital technologies than the older ones (nambisan 2017). Hence the more so favorable evidence suggest that operational efficiency, ai, is adopted to use and accessed in more direct ways than big data, which appears to be more in broad ways, strategic, and remote aligned with the primary focus of the operational and customer insight goals. Both technologies, while advancing outcomes in resilience and growth, favor of ai having more full adoption (45%) than big data (40%), points to the emphasis entrepreneurs place on the use of efficiency analytics rather than advanced re-advanced analytics. Similar to what evidence points to, in the global context, the fundamental primary goal of adopting ai technologies is to streamline

processes, and than to move towards predictive and advanced analytics, towards innovative frameworks (wamba et al, 2020).

Differences with respect to sectors and size are equally visible. The untended consequences of service-oriented business practices in comparison with the partial business-attainment of smaller manufacturing organizations, stems from technological adoption to implementation gaps, as well as financial investments. On the contrary, firms in metro regions perceived ai and big data much more thoroughly than those in semi-urban and rural areas, where ai and big data adoption was slower. Thus, context-specific digital readiness is important (mishra et al. 2023).

The results from table 3 indicate that indian entrepreneurs are increasingly incorporating sustainability into the core value of their business. Out of all the entrepreneurs, the one that rated "sustainable practices improve business resilience" The most was that (m = 4.3, sd = 0.65) 50% adoption. This, indeed, marks a significant change in the underlying perception of business operations, to support and implement sustainability at the business core. This change will, in turn, improve the business's resilience to shocks and uncertainties in the market, reinforcing the idea of scholars who pointed out that one of the major outcomes of the integration of sustainability is business resilience (lozano, 2015).

Table no. 3 adoption of sustainable entrepreneurship practices

Statement	Mean	Sd	Adoption frequency (%)	Interpretation
Sustainable practices improve business resilience	4.3	0.65	Full: 50, partial: 35, none: 15	Strongly agree
Sustainable practices enhance long-term profitability	4.2	0.7	Full: 45, partial: 40, none: 15	Agree
Green innovation adoption linked to market competitiveness	4.15	0.72	Full: 40, partial: 42, none: 18	Agree

Source: Generated by the author based on primary data

The statement "sustainable practices enhance long-term profitability" Also performed relatively well (m = 4.2, sd = 0.70) since 85% of the entrepreneurs selected at least some level of adoption. In this case, the argument about business sustainability lowering risks and improving reputation and trust among stakeholders which leads to better financial positioning in the long run (porter & kramer, 2011; dangelico & vocalelli, 2017) seems to hold. Furthermore, it is interesting to note the difference in rating resilience and profitability, suggesting to some extent that the entrepreneurs value the capacity to endure and adapt in the approach to sustainability more than the money.

Eighty-two percent of entrepreneurs noted its importance, as reflected in the mean score of 4.15 (sd=0.72) on the statement 'green innovation adoption linked to market competitiveness.' schaltegger & wagner (2011) and garcía-granero et al. (2018) noted how eco-innovation has been studied as a way to practice environmental and product differentiation, as well as brand positioning, and entrepreneurs affirm the statement's competitive advantages. The average lower score points to resource constraints, limited regulatory frameworks, and potential non-adoption, especially among smaller firms which suggest that competitive benefits of eco-innovations will be limited.

Resilience, profitability, and competitiveness are ranked in order of strongest to weakest in the value chain, with quarterly profitability accruing significantly more value than quarterly competitively configured units, even after cost pooling. It hints that geography with the variety of resources, more dominant in the service/it sector, favors larger firms while smaller firms and those in the manufacturing sector tend to lag in adoption. It suggests that the absence of policies to promote and

support sustainable business practices is inconsistent with the level of interest in indian entrepreneurship.

The fourth table of the findings presents a summary of the information which is more than simply barriers and motivators to the adoption of new technologies and sustainable practices in the indian entrepreneurial ecosystem. As it pertains to the motivators, the ranked barriers m = 4.10, sd = 0.70, and wis = 82, indicate innovation in organizational culture is the strongest. It can be understood that businesses that prioritize innovation are more likely to increase the adoption of advanced technologies with sustainable practices. Prior studies confirm that innovation-oriented cultures foster resilience and adaptability, enabling firms to better manage technological transitions and environmental commitments (damanpour & aravind, 2012; crossan & apaydin, 2010). Similarly, supportive government policies (m = 4.05, sd = 0.68, wis = 81) rank closely, reflecting the pivotal role of regulatory and institutional frameworks in enabling entrepreneurial growth. The indian government's emphasis on initiatives such as digital india and startup india further illustrates how targeted policies can reduce barriers and accelerate adoption of digital and sustainable solutions (prasad & junni, 2017).

One of the most important facilitating factors is advanced infrastructure (m = 4.00, sd = 0.72, wis = 80), which indicates the importance of technological, logistical, and energy infrastructure in the deployment of new technologies. Without such infrastructure, even an innovation-oriented company can expect delays and poor efficiencies in implementation. Other studies also show that infrastructure is a factor of innovation-driven competitive advantage, especially for developing countries where differences in regional access can enable or inhibit entrepreneurial activity (singh & gaur, 2018; zahra, wright & abdelgawad, 2014).

The barriers as depicted do in fact point to less serious but persistent difficulties. Funding gaps versus implementation cost chunks (m = 3.90, sd = 0.75, wis = 78) continue to be the main obstacles for small and medium-sized businesses (smes) with limited resources to adopt ai, big data, or green technologies horizontally. According to the literature, cost-related barriers in the digital economy tend to be more detrimental to smaller businesses and put them at a greater disadvantage than larger businesses (chen et al., 2010 vial, 2019).

This also holds true for the shortage of skilled workers (m = 3.85, sd = 0.80, wis = 76). Particularly in the expanding fields of artificial intelligence, big data analytics, and sustainable innovations, there is still an untapped potential that could help close the entrepreneurial skill gaps in india. Research has demonstrated that a significant obstacle to businesses' advanced use of technology is a lack of skills and competency (brynjolfsson and mcafee, 2014, shankar and gopalkrishnan, 2020).

The information in table 4 illustrates the intricacies of the factors that promote and hinder the integration of sustainability and technology in india's entrepreneurial ecosystem. The existence of an innovative organisational culture is the most important of the supports. This indicates that these businesses are more likely to adopt sustainability practices and embrace new technologies. Previous research has examined how resilient and adaptable businesses are to swift changes in the environment and in technology. Institutional context and government policies that encourage innovation are important for fostering entrepreneurial growth (m = 4.05, sd = 0.68, wis = 81). Illustrating this point, the indian government's digital india and startup india initiatives highlight how policies can reduce barriers and accelerate the adoption of digital technologies and sustainable practices (prasad & junni, 2017).

Table 4: Barriers and enablers in technology & sustainability adoption

Factor	Barrier / enabler	Mean	Sd	Weighted importance score	Remarks
Lack of skilled workforce	Barrier	3.85	0.8	76	Moderate barrier
High implementation cost	Barrier	3.9	0.75	78	Moderate barrier
Supportive government policies	Enabler	4.05	0.68	81	Strong enabler
Organizational culture promoting innovation	Enabler	4.1	0.7	82	Strong enabler
Availability of advanced infrastructure	Enabler	4	0.72	80	Strong enabler

Source: Generated by the author based on primary data

Sustained high technology use and access to leading industries are m = 4.00, sd = 0.72, wis =80) and attest spends advocates the supporting role of advanced digital, logistic as well as energy quilts to spate emerging technologies. If such supporting treats are not provided, the pipelines time even for the most innovative tech companies may be quite eroded i even falter. Prior shahrzad also for the argsuch and governed the competitiveness towards sped of novel and outdistanced the emerging market ‘s cores where the appropriate lopsided dissimilarity of region to region crossed access to the entrepreneurial fittings constraints sch singh & shahrzad gaur 2018 .6; 10 zahra wright & target 2014. On the other hand, the implementation challenges founded in the barriers to implementation are less serious with respect to the behaviors we studied but still are persistent. These are all costly, particularly for small and medium enterprises (m = 3.90, sd = 0.75, wis = 78) and is especially true as small and medium enterprises continuously are hampered by lack of financial resources for the large-scale adoption of ai, big data, and other greenhouse friendly technologies. Reports indicating that the inequitable digital divides remain cost barriers for small firms in fostering deep digital transformations more than for big firms also correlate with these studies (chen et al 2010, vial 2019). The shortage of skilled workers (m = 3.85, sd = 0.80, wis = 76) is another core league attempt to solve the problem. This problem of, is on the whole, is the least severe, but it is still, the most likely to resonate, the gap in the entrepreneurial skill set in india. This is even more true for the newer, and exciting areas like artificial intelligence, big data, and sustainable creative technologies. A number of works have argued that the absence of skills is one of the most critical reasons why firms are unable to use advanced technologies separated in value (brynjolfsson & mcafee 2014; shankar & gopalkrishnan 2020).

The disparity between convincing factors and restrictive factors is more positive and favorable towards convincing factors. In the context of the examined the enablers and barriers, the weighted importance scores of enablers (80-82) and barriers (76-78) suggest that indian enterprises work under positive environment for adoption, enablers being more supportive. This is inline with recent emerging market research focusing on entrepreneurship which points out that supportive mechanisms and cultural frameworks can expose the system to underdeveloped structural elements… More fiscal and more skilled (autio et al, 2014, tripathi and jha, 2022).

The analysis shows that the cost factors and the available workforce should be retained, but not given predominant attention. There is substantial opportunity created by the enablers (government, culture of innovation, and infrastructure) for the reimagining of entrepreneurship business practices in the context of digital disruption. Therefore, in the indian case, the barriers can be driven down and the momentum driven by the enablers can be increased by enhancing the accessibility to advanced and

improved training, encouraging the collaboration between the private and the public sector, and enhancing financing opportunities."

Table 5 outlines correlation analysis results which help in understanding the interrelationships of technology acceptance, sustainable entrepreneurship, enterprise dimensions, and resilience in indian entrepreneurship ecosystems. Findings illustrate that correlation among all the study variables are significant and positive suggesting the integrated nature of innovation, digitalization, and sustainability resulted in organizational growth.

While all the variables are substantially correlated, the most correlation is detected between business resilience and growth with the adopting of big data ($r = 0.70$, $p < 0.01$) closely followed by the relationship of artificial intelligence and business resilience ($r = 0.68$, $p < 0.01$). Hence, indicating that the digital transformation of a firm through ai and big data analytics is crucial in improving the firm's resilience and competitiveness. The results support the existing literature regarding the importance of data driven decision making and predictive analytics on organizational adaptability and flexibility (chen, chiang & storey, 2012; mariani & fosso wamba, 2020).

Table 5: Pearson correlation between key variables

Variables	1	2	3	4	5
1. Ai adoption	1	0.62**	0.55**	0.68**	0.48**
2. Big data adoption	0.62**	1	0.57**	0.70**	0.45**
3. Sustainable practices	0.55**	0.57**	1	0.66**	0.50**
4. Business resilience & growth	0.68**	0.70**	0.66**	1	0.52**
5. Enterprise size (employees)	0.48**	0.45**	0.50**	0.52**	1

Source: Generated by the author based on primary data

Given that there is a strong correlation between business resilience and sustained practice ($r = 0.66$, p 0.01), it is reasonable to conclude that integrating green innovations sustainability does contribute to the achievement of social and environmental goals as well as long-term resilience and profitability. The complexity of sustainable practices is higher than that of smaller businesses, as supported by dangelico and pujari (2010) and singh and el-kassar (2019), who found that larger firms have more resources and sophisticated sustainable frameworks to implement. Additionally, there is a positive correlation between business size and sustainability ($r = 0.50$, $p < 0.01$).

Because ai and big data analytics are two new technologies designed to work together to promote innovation and sustainability, there is also a significant correlation between them ($r = 0.62$, $p < 0.01$). Companies that make the most of these technologies are probably going to experience increased productivity, better customer intelligence, and higher predictive accuracy. This is particularly true in india, where digital startups prioritise the integration of ai/ml and big data to promote efficiency and quick growth (dwivedi et al., 2021).

The adoption of digital tools and the resource constraints of small businesses are demonstrated by the positive and significant correlations, which are weaker when it comes to firm size and technological adoption (ai: $R = 0.48$; big data: $R = 0.45$). This fact is particularly relevant in india, where cloud-driven analytics and "Cheap" Ai are used by micro and small businesses to level the playing field (prasad & junni, 2017; wamba et al, 2017).

Enterprise size is only a moderator in the relationship between business resilience in the digital age and the integration of ai and big data with the sustainability and of the entire value chain. This insight strengthens the case for integrating sustainability and digitalisation to create multiplier effects or synergies that would support resilient, inclusive, and competitive growth for indian businesses.

The table provides the reader with information about india's entrepreneurial environment in terms of enterprise size, adoption of green practices, and technology adoption. The claim is validated by the model's apparent robustness and the results from all predictors that statistically suggest a resilient

outcome and head above the 5% level of statistical significance. The predictors validate the malgarialauch business resilience. The digitally strengthened techniques that support the adoption of ai and big data, specifically 0.29 and 0.31, are then covered in detail. The impact of data-driven, ai-optimized systems in forecasting, streamlining operations, and decision support is also highlighted in supporting literature, especially for developing nations (wamba et al, 2017; mariani & fosso wamba, 2020).

Table 6: Regression analysis of factors affecting business resilience & growth

Predictor	B	Se	Beta	T-value	P-value	Vif
Ai adoption	0.33	0.07	0.29	4.71	0.001	1.8
Big data adoption	0.35	0.08	0.31	4.38	0.002	1.7
Sustainable practices	0.3	0.06	0.27	5	0.001	1.6
Enterprise size	0.12	0.05	0.1	2.4	0.018	1.2
Constant	0.42	0.09	-	4.67	0.001	-

Source: Generated by the author based on primary data

The most important sustainable practices which improve survivability and resiliency, notably, strengthen the supporting literature's claim of green and responsible sustainable profitability. The concept of economically rationally adopting profitable systems coherently supports the position of papers which advocate the dual advantage of internal market and cost competition (dangelico & pujari, 2010; singh & el-kassar, 2019).

The correlation between company size and resilience is still relevant, albeit an unreliable predictor ($\beta = 0.10$, $p = 0.018$). This indicates that larger companies are more efficient in implementing digital and sustainable strategies due to better resources, organization, and greater economies of scale. However, the small beta value indicates that small companies which lack advanced digital tools and other innovative products can still achieve resilience. This is the case in india where micro and small companies are still able to use low cost ai and cloud computing to remain competitive (prasad & junni, 2017; dwivedi et al., 2021).

The lack of calculated vif (variance inflation factors) below 2 of multicollinearity supports the validity of the regression model. Along with the preceding paragraphs, they illustrate that in the entrepreneurial ecosystem of india, the correlate with enterprise size attributes resilience as the greatest to the synergistic fusion of ai, big data, and sustainable practices. This value enhances the claim that interactions between digitalization and sustainability are interdependent. Each drives the other, which is crucial for digitized entrepreneurship.

In table 7, we see evidence that ai along with its sustainability principles faces the most pronounced challenge of adoption in its implementation, as investment focused ai adoption shows a deficit of 35.7% technology advanced of the frameworks on the green techno-forgers, and even less so in the case of green techno-forgers, which is especially in abundance at the small and medium enterprise case. And then, the lack of skilled manpower appropriately trained on the paradigms of sustainability and digital technology and its applications as solutions, which is at 31%, is the second most undue deficit challenge.

Challenges of technology integration (19%) are also strategically important and block the seamless ai adoption and its day-to-day operationalization along with the other day-to-day sustainability a d support activities. There is ai and its green techno-forger investment of resources, a, rest with the embedded techno-forger green initiatives and techno-forger digital and green goals within scant resources. There is the same for the change adoption reluctance and the policy zenith, which from the scant vantage points of decluttering and rationalization, are also much in the recess for development.

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Table 7: Challenges in concurrent adoption of ai & sustainable practices

Challenge	Frequency	Percentage	Cumulative %	Rank
Financial constraints	150	35.7	35.7	1
Lack of skilled personnel	130	31	66.7	2
Technology integration issues	80	19	85.7	3
Resistance to change	40	9.5	95.2	4
Regulatory barriers	20	4.8	100	5

Source: Generated by the author based on primary data

The analysis results illuminating that while binded other constraining factors, regulatory ones are not regarded as the most dominant one. Adoption of digital-sustainability integration is profoundly influenced by financial and human capital restraints, and thus, integration is done at a very slow pace. The above observations call for targeted financing as well as policy supports, along with other supporting services to develop technical skills and sustainable financing to achieve the goals of simultaneous integration of ai with sustainable practices within the entrepreneurial eco system of india.

Discussion of findings

The study shows that the factors of ai adoption, big data, and sustainable practices are primary practices that determine the advancement and sustenance of the business, and these factors positively influence the level of business resilience and proficiency adoption in india. According to the regression outcomes big data ($\beta = 0.31$) and ai ($\beta = 0.29$) were the strongest predictors of. They were ai's operational efficiency, auto data driven decision making, and competitiveness. Sustainable practices ($\beta = 0.27$) positively contribute to resilience. This suggests that being environmentally responsible, or the eco-sustainable business practices, means being responsive to the expectations of the stakeholders in the business and being profitable in the long run.

The more the increase in the business size ($\beta = 0.10$) the more the reduced effect which means that there is an advantage that can be drawn from the technology and the effective application of the sustainability practices even for the smaller-sized firms.

The analysis of the challenges to adoption shows that the lack of finances (35.7%) and lack of people with the right skills (31%) are the most significant barriers to the digitization and sustainability processes which require a lot of resources. There are other challenges which are more operational and of the culture of the organization, such as (4, 0%) lack of technology (19%) and lack of willingness to change (9.5%) and the more external organization, the lag of regulation (4.8.%), lack of governing regulations the rest is of the culture of the organization. Supportive policies and the culture within the organization of innovation are the rest which are supportive.

According to the analysis, integrating innovation, technology, and sustainability can help indian businesses achieve resilience and growth. The study emphasises that closing gaps in skill-based and financial practices maximises benefits for all sectors. The study emphasises that the sustainable digital transformation is both strategically necessary and economically feasible for long-term competitiveness.

Conclusion

This study studies how sustainability, ai, and big data can support entrepreneurship as well as the resilience and expansion of indian businesses. Nonetheless, it was observed that there is a misconception in the field of entrepreneurship that technology is a magical instrument that improves the simplicity, speed, and accuracy of operations and maximises the calibre of decisions made. The firm's profitability and competitive position in the market are enhanced by the ongoing

implementation of sustainability. Companies that are sustainable and digitalised offer the best protection against market conditions and volatility. The study also found that the size of the company influences the degree of sustainability and technological sophistication, which emphasises the need to re-examine the long-standing issue of scale-appropriate technology for micro, small, and medium-sized businesses. Nevertheless, the study shows how sustainability and digitisation have shaped india's entrepreneurial environment.

Implications

By highlighting the integration of artificial intelligence (ai), big data, and sustainable practices, as well as their respective contributions to business resilience and gaps in the literature, this study expands the body of knowledge in the field of entrepreneurship. It targets the complex and frequently avoided topics of sustainability and technology adoption in addition to business expansion.

This study informs managers and entrepreneurs about the necessity of incorporating advanced sustainable digital technologies with sustainable business practices. Training programs, technology access, incentives for sustainable entrepreneurship, and resource provision are among the areas where the framework analysis is helpful to policymakers and industry associations. Also, the systematized strategies designed to facilitate effective use in the context, have shown to be useful. It is important to note the relevant and important gaps between sectors, and between individual enterprises.

Research limitations

Every research has its shortcomings; in this case they require observation. First, the study bases its intentions on the results of cross-sectional surveys taken by 420 people and does not seem to have any records of the intervals of technology adoption, the changes that accompanied the intervals and the sustainability practice intervals that were noted. Second, the study sets the metric of the so-called self-reporting results and in this way loses the chance of using multi metrics, which results in the surveys not adequately assessing the operational and financial returns. Finally, the research sample spanning across many sectors is still lacking; it excludes the informal as well as the rural entrepreneurial ecosystem which is ever so prevalent in india.

Future research agenda

Time-series studies should be used in future research to comprehend how sustainability and technology adoption have changed over time. Generalisability would be enhanced by further broadening the sample to include businesses in the rural, informal, and cross-regional sectors. Empirical validation is further strengthened by the inclusion of objective financial and environmental performance records. The dynamics of resilient and growth-oriented entrepreneurship may be better understood by investigating potential mediating and moderating factors like organisational culture, leadership, and supportive frameworks. The context of sustainable entrepreneurship will be better understood through comparative studies of developed and developing nations.

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