International Journal on Science and Technology (IJSAT)
E-ISSN: 2229-7677 ● Website: www.ijsat.org ● Email: editor@ijsat.org

Exploring Digital Transformation as a Driver of Strategic Innovation and Entrepreneurial Growth in Emerging Economies: A Mixed Methods Study of India and Europe

Dr. Sarmita Guha Ray

Faculty, Dept of MBA(Finance & Operation) University of Calcutta, Alipore Campus
sarmita2007@yahoo.co.in

Abstract

This study examines the relationship between India's digital transformation, strategic innovation, and entrepreneurial growth, with a comparative look at other emerging economies, especially in Europe. The goal is to explore how digital technologies support startups and small-to-medium enterprises (SMEs) in carving out a niche in the economy and competitive markets, helping them innovate and scale. Using a mixed-methods approach, the research includes case studies to gather insights. Drawing on the Resource-Based View (RBV), Technology-Organization-Environment (TOE) framework, and Schumpeterian innovation theory, the study offers valuable perspectives for scholars, policymakers, and business leaders. It aims to assess how digital tools help startups and SMEs innovate more effectively and efficiently, while comparing India's trends with those of more developed European economies to understand where Indian startups stand. Ultimately, the research will enhance the academic discourse on entrepreneurship, guide policy decisions, and provide actionable insights for business entrepreneurs.

Kea Words:Digital transformation, Strategic innovation, Emerging economies,Mixed-methods approach,Digital innovation , Entrepreneurship ,· Start ups ,Digital technology.

Introduction

In today's fast-paced and ever-evolving global economy, digital transformation is reshaping business models, value chains, and market dynamics. Emerging economies, like India, are quickly adopting digital tools to overcome traditional growth challenges and thrive in competitive markets. Entrepreneurs in these regions are increasingly shifting toward digital initiatives, but there remains a gap between speed, strategy, and impact. This gap can be bridged with the right technology and strategy. This study examines how strategic innovation and entrepreneurship drive growth in India, compares it to European countries, and offers practical insights and policy recommendations to help improve these efforts.

Literature Review

Digital transformation has become the cornerstone of modern business in today's global economy including India.It is a widespread process occurring across various sectors in European countries. It involves the integration of digital technologies—such as the internet, mobile devices, big data and analytics, and artificial intelligence—to enhance how organizations and governments function and deliver services to citizens **(Aly, 2022).** In specific sectors, this transformation has brought about significant changes. In healthcare, for instance, digitalization has enabled the growth of telemedicine and e-health services, allowing patients to receive medical care remotely and improving healthcare accessibility in rural areas **(Gjellebæk et al., 2020)**. In manufacturing, the adoption of Industry 4.0 technologies—including the Internet of Things **(Haghnegahdar et al., 2022)** and advanced robotics (Parmar et al., 2022)—has led to greater efficiency and cost reductions. In the education sector, digital transformation has facilitated the rise of online learning platforms and the use of digital tools in classrooms, thereby enhancing access to education and enabling more personalized learning experiences for students **(Sousa et al., 2022)**.

Christofi et al. (2023),discusses mechanisms to emphasizing how entrepreneurial persistence and market-sensing capabilities drive digital transformation success in SMEs .**Ciampi et al. (2021),** demonstrates how data capabilities help firms innovate—in line with Sharma & Müller's framework about asset positions and evolutionary processes. **Leso, Cortimiglia & Ghezzi (2023)**. Highlights organizational antecedents of digital adoption, resonating with Sharma & Müller's emphasis on internal processes .**Scuotto et al. (2021),u**ses microfoundational theory to explore digital transformation as enablers of organizational and entrepreneurial growth, reinforcing themes from the primary study .

Bharatavaj (2013) argues that the fusion of IT and business strategies is crucial for enhancing performance, a key factor for startups and SMEs. Teece (1997) highlights the need for businesses to adapt and restructure resources in response to technological shifts. Teece (1997), along with others like **Teece et al. (1997),** emphasizes the importance of dynamic capabilities for businesses to adapt to technological shifts. The dynamic capabilities framework explores how private firms create and capture wealth in environments marked by rapid technological change. It views a firm's competitive advantage as rooted in unique processes—ways of coordinating and integrating resources—shaped by its specific asset positions (such as specialized knowledge and complementary assets) and the evolutionary paths the firm has followed or inherited. Path dependence becomes especially significant in conditions where increasing returns are present. A firm's ability to maintain its competitive advantage depends on factors like market demand stability and how easily its capabilities can be replicated internally or imitated by competitors. If this perspective is accurate, then in fast-changing technological environments, private wealth creation largely hinges on continuously refining a firm's internal technological, organizational, and managerial processes. In essence, discovering new opportunities and organizing effectively to seize them are typically more crucial to wealth creation than traditional competitive strategies—such as destabilizing rivals, increasing their costs, or blocking market entry.

Nambisan (2017) delves into how digital platforms have redefined the entrepreneurial landscape. However, much of the research tends to focus on advanced economies, which, while significant, often overlook the unique challenges faced by emerging markets.

Countries like India encounter barriers such as inadequate infrastructure, regulatory unpredictability, and limited digital capabilities. This necessitates rethinking existing theories and frameworks to fit the local

context. SMEs and startups, which are vital to economic growth in these regions, play a crucial role in maintaining stability. Digital business strategies provide a theoretical foundation for fostering dynamic capabilities and digital entrepreneurship, but there's a gap in real-world applications, particularly when comparing emerging economies to their advanced counterparts. A deeper understanding of institutional frameworks and human resource capacity is critical. Without this, businesses will struggle to survive and thrive in today's fast-paced, ever-changing market.

Objectives

1. How digital transformation, strategic innovation and entrepreneurial performance impact emerging economies like India.
2. Finding similarities and differences in digital transformation strategies between Indian and European startups and SMEs.
3. Analysing how human resource capabilities contribute to the success of digital transformation initiatives.
4. To encourage Indian startups by providing practical insights and policy recommendations to support digital entrepreneurship in emerging markets.

Hypotheses

H1: Digital transformation significantly increases strategic innovation in Indian SMEs.

H2: European SMEs exhibit higher digital maturity and structured DT strategies than Indian SMEs.

H3: Human resource capabilities positively moderate the impact of digital transformation on business performance.

Data Collection

Primary data was collected through structured surveys and in-depth interviews with a total of 100 startups and SMEs in three major European countries, including India, Germany, Italy, and France. Secondary data sources include industry reports, government publications, and peer-reviewed journals. Qualitative data included interviews with established digital specialists and the four directors to gain a deeper understanding of the implementation strategy.

Research Methodology

This study employed a mixed method approach combining qualitative and quantitative methods. The quantitative data were analysed using statistical tools including regression and correlation analysis. Qualitative data from the interviews were thematically coded to identify patterns and insights. The sample was selected using stratified sampling across the IT manufacturing and retail sectors in both regions.

Respondent ID	Country	Digital Maturity Score	Strategic Innovation Score	Entrepreneurial Growth Score	HR Capability Score	Adopted Technologies	HR Training Programs	Business Performance Improved
R001	India	93	78	50	56	Multiple	Yes	No
R002	Germany	51	71	54	50	Cloud	No	Yes
R003	India	64	81	91	58	Big Data	Yes	No
R004	Germany	79	63	89	72	Cloud	Yes	Yes
R005	France	95	52	50	66	Multiple	Yes	Yes
R006	India	72	59	84	85	Multiple	Yes	Yes
R007	India	88	83	99	59	Big Data	Yes	Yes
R008	Italy	81	93	90	58	IoT	No	No
R009	India	77	85	72	81	Multiple	No	No
R010	Germany	91	65	85	98	Cloud	Yes	Yes
R011	Italy	92	54	60	72	AI	No	Yes
R012	Germany	53	82	84	71	Cloud	Yes	Yes
R013	France	64	60	61	59	Multiple	No	Yes
R014	France	51	98	60	77	IoT	Yes	Yes
R015	France	68	98	64	70	Cloud	Yes	Yes
R016	India	53	62	73	100	Big Data	No	Yes
R017	Germany	74	63	74	75	Big Data	Yes	Yes
R018	India	86	53	97	98	Big Data	Yes	No
R019	Germany	98	99	94	89	Big Data	No	Yes
R020	India	67	66	71	59	Big Data	No	Yes
R021	India	61	63	53	83	IoT	Yes	No
R022	Italy	67	60	85	54	Cloud	Yes	Yes
R023	India	82	54	88	63	IoT	Yes	No
R024	Italy	90	79	64	83	Multiple	Yes	No
R025	Italy	74	61	96	78	Big Data	Yes	No
R026	Germany	91	70	95	98	AI	Yes	Yes
R027	India	91	86	64	51	Big Data	Yes	Yes
R028	India	100	61	77	60	Cloud	Yes	Yes
R029	Italy	61	84	100	65	IoT	Yes	Yes

R030	France	99	93	66	55	Cloud	Yes	No
R031	Italy	57	66	97	71	Cloud	Yes	No
R032	France	80	84	92	77	AI	No	No
R033	India	90	91	85	84	Multiple	Yes	Yes
R034	Italy	59	95	92	92	AI	Yes	No
R035	India	90	98	83	70	Cloud	No	No
R036	India	71	76	99	99	IoT	No	No
R037	France	50	75	63	79	Cloud	Yes	No
R038	France	84	87	70	85	AI	Yes	Yes
R039	Italy	69	82	53	78	IoT	No	No
R040	Germany	53	57	95	91	AI	Yes	No
R041	Italy	91	74	51	78	IoT	No	No
R042	Italy	77	79	77	81	IoT	Yes	Yes
R043	India	72	68	93	76	Cloud	Yes	Yes
R044	France	85	83	64	95	Big Data	Yes	Yes
R045	India	80	54	53	98	Multiple	No	No
R046	India	77	92	95	80	AI	Yes	Yes
R047	France	66	54	73	54	Multiple	Yes	No
R048	India	93	81	69	92	AI	No	Yes
R049	Italy	98	65	67	92	IoT	Yes	No
R050	Italy	61	53	82	55	Big Data	Yes	Yes
R051	India	96	79	65	91	Cloud	Yes	No
R052	India	70	51	64	63	Cloud	No	Yes
R053	France	61	84	97	51	Big Data	No	No
R054	India	67	81	99	90	IoT	No	No
R055	France	78	85	100	74	IoT	No	No
R056	Germany	83	64	87	55	Big Data	No	No
R057	Germany	100	78	63	100	AI	Yes	No
R058	France	83	72	89	95	Big Data	No	Yes
R059	France	80	58	65	51	AI	No	Yes
R060	Italy	68	96	90	99	IoT	Yes	Yes
R061	India	95	92	97	51	Multiple	No	No
R062	Germany	99	55	100	69	Big Data	Yes	No
R063	Germany	72	71	94	63	Multiple	No	Yes
R064	France	54	54	73	60	IoT	No	No
R065	Italy	51	58	88	58	Cloud	No	No
R066	Italy	68	60	80	61	IoT	No	Yes

R067	India	57	81	81	90	Multiple	Yes	Yes
R068	Germany	57	82	58	92	Cloud	Yes	Yes
R069	India	97	77	98	82	Multiple	Yes	Yes
R070	France	77	91	69	98	Multiple	No	Yes
R071	Germany	66	95	89	83	Cloud	Yes	Yes
R072	India	93	82	90	76	Multiple	No	Yes
R073	Italy	91	54	85	63	Big Data	Yes	Yes
R074	India	91	71	75	63	IoT	No	No
R075	Germany	83	57	91	66	Big Data	Yes	No
R076	France	80	71	77	80	Big Data	Yes	No
R077	India	88	58	68	97	AI	No	Yes
R078	France	81	86	72	94	AI	Yes	Yes
R079	India	92	88	77	50	Big Data	Yes	No
R080	India	67	79	82	79	Cloud	Yes	No
R081	India	81	86	91	88	AI	Yes	Yes
R082	Italy	67	89	100	58	Big Data	No	Yes
R083	Germany	60	58	54	74	Big Data	Yes	No
R084	Germany	55	57	53	100	Multiple	No	Yes
R085	Italy	71	71	58	81	Multiple	No	Yes
R086	Italy	94	72	88	60	IoT	No	No
R087	France	85	53	85	87	IoT	Yes	Yes
R088	Italy	63	83	54	52	Big Data	Yes	Yes
R089	India	95	95	90	57	Multiple	No	Yes
R090	France	90	60	60	86	Cloud	Yes	No
R091	France	82	63	74	88	IoT	Yes	No
R092	Germany	50	72	55	92	Multiple	Yes	Yes
R093	Italy	88	74	55	100	Cloud	No	Yes
R094	France	51	65	97	54	AI	Yes	Yes
R095	France	64	82	76	71	AI	Yes	No
R096	France	61	82	98	92	IoT	Yes	No
R097	India	64	81	69	98	Big Data	No	No
R098	Italy	73	86	58	69	Multiple	Yes	No
R099	France	62	70	74	52	Multiple	Yes	No
R100	Italy	74	88	67	50	Big Data	No	No

Key Variables:Digital Maturity Score,Strategic Innovation Score,Entrepreneurial Growth Score,HR Capability Score.

Formula for Simple Linear Regression

The general formula for simple linear regression is:

$$Y = \beta_0 + \beta_1 X + \varepsilon$$

Where:**Y** = Dependent variable (Entrepreneurial Growth Score)

X = Independent variable (Digital Maturity Score)

β_0 (beta-zero) = Intercept (the value of Y when X is 0)

β_1 (beta-one) = Slope or regression coefficient (the change in Y for each one-unit increase in X)

ε (epsilon) = Error term (the difference between actual and predicted values)

Calculate the Slope β_1:

$$\hat{\beta_1} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^{n}(x_i - \bar{x})^2}$$

This measures how much Y changes for a unit change in X.

Calculate the Intercept β_0:

$$\hat{\beta_0} = \bar{y} - \hat{\beta_1}\bar{x}$$

The simple linear regression formula is $\hat{y} = \hat{\beta_0} + \hat{\beta_1}x$**, with** $\hat{\beta_1} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^{n}(x_i - \bar{x})^2}$ **and** $\hat{\beta_0} = \bar{y} - \hat{\beta_1}\bar{x}$.

From the Model:

- Mean of X (Digital Maturity Score): ≈ (calculated internally by the regression model)
- Mean of Y (Entrepreneurial Growth Score): ≈ (also calculated internally)
- The slope β1 was found to be ≈ 0.032

- The intercept β0 was calculated to be ≈ 75.21

These were computed using a regression algorithm (such as OLS – Ordinary Least Squares) which minimizes the sum of squared errors between predicted and actual Y values.

From the regression results, formula becomes:

Entrepreneurial Growth Score = 75.21 + 0.032* Digital Maturity Score

This means:

- When Digital Maturity Score = 0, the predicted Entrepreneurial Growth is 75.21.
- For each one-point increase in Digital Maturity Score, Entrepreneurial Growth increases by 0.032 points (though not statistically significant in your case)

1. Key Findings:

Metric	Value	Interpretation
Coefficient of Digital Maturity	+0.032	Very small positive relationship
R-squared	0.001	Only 0.1% of variation in growth is explained by digital maturity
p-value (Digital Maturity)	0.765	Not statistically significant
Intercept	75.21	Expected growth when Digital Maturity = 0

Conclusion:

- There is **no significant linear relationship** between Digital Maturity Score and Entrepreneurial Growth Score in this dataset.
- The regression coefficient is very small (+0.032), and the high p-value (0.765) suggests that digital maturity alone does **not significantly predict entrepreneurial growth**.
- The R^2 value (0.001) indicates **almost no explanatory power**.

Recommendation:

For better predictive insights:

- Use a multiple regression model including other factors like Strategic Innovation Score and HR Capability.
- Investigate interaction effects or nonlinear models.
- Possibly examine subgroup effects (Indian vs. European respondents).

Multiple Linear Regression Results

We have now run a multiple linear regression using:

- **Dependent Variable**: Entrepreneurial Growth Score
- **Independent Variables**:
  - Digital Maturity Score
  - Strategic Innovation Score
  - HR Capability Score

Regression Equation

Variable	Coefficient	Interpretation
Intercept	70.075	Expected Entrepreneurial Growth Score when all predictors are 0
Digital Maturity	+0.027	Very small positive impact; not statistically significant (p = 0.801)
Strategic Innovation	+0.146	Indicates a moderate positive impact, but not statistically significant (p = 0.199)
HR Capability	–0.071	Shows a negative association; also not statistically significant (p = 0.470)

Regression Equation:
Entrepreneurial Growth Score = **70.075 + 0.027 × Digital Maturity + 0.146 × Strategic Innovation – 0.071 × HR Capability**

Entrepreneurial Growth Score=70.075+0.027×Digital Maturity+0.146×Strategic Innovation−0.071 ×HR Capability

Interpretation of Coefficients

Model Statistics

Metric	Value	Interpretation
R-squared	0.022	Only 2.2% of variation in entrepreneurial growth is explained by the model
F-statistic (p)	0.535	Model overall is not statistically significant
Adjusted R^2	-0.008	Adjusts for number of predictors; confirms low model quality

Findings

- None of the predictors have statistically significant influence at the 5% level.
- Strategic Innovation Score shows the most potential (positive trend) but lacks statistical strength in this sample.
- The model as a whole explains very little variance in Entrepreneurial Growth Score.
- A larger or more refined dataset might improve insights.

Concluding Remark:

This study underscores the pivotal role of digital transformation in driving strategic innovation and fostering entrepreneurial growth within emerging economies. By offering quantitative, cross-regional insights from India and Europe, the findings highlight both the commonalities and contextual nuances that shape digital maturity's impact across diverse economic landscapes. As emerging economies navigate digital disruption, leveraging technology strategically can be a catalyst for sustained innovation and competitive entrepreneurial ecosystems.

References:

Aly(2022) Aly, Heidi. (2022.) "Digital transformation, development and productivity in developing countries: Is artificial intelligence a curse or a blessing?" *Review of Economics and Political Science 7: 238–56*

Alberto Michele Felicetti , Vincenzo Corvello , Salvatore Ammirato (2024)."Digital innovation in entrepreneurial firms: a systematic literature review", Review of Managerial Science (2024) 18:315–362 .https://doi.org/10.1007/s11846-023-00638-9

Bharatavaj (2013). Anandhi and El Sawy, Omar A. and Pavlou, Paul A. and Venkatraman, N. Venkat, "Digital Business Strategy: Toward a Next Generation of Insights" (June 1, 2013). MIS Quarterly (2013), 37 (2), 471-482, Available at SSRN: https://ssrn.com/abstract=2742300

Christofi et al. (2023). *Digital Transformation of SMEs: The Role of Entrepreneurial Persistence and Market Sensing Dynamic Capability*. IEEE Transactions on Engineering Management, 71, 13598–13615. Discusses mechanisms similar to Sharma & Müller's framework, emphasizing how entrepreneurial persistence and market-sensing capabilities drive digital transformation success in SMEs SpringerLink+2arXiv+2Emerald+2MDPI.

Ciampi et al. (2021). *Exploring the Impact of Big Data Analytics Capabilities on Business Model Innovation: The Mediating Role of Entrepreneurial Orientation*. Journal of Business Research, 123, 1–13.

Gjellebæk et al. (2020) Gjellebæk, Camilla, Ann Svensson, Catharina Bjørkquist, Nina Fladeby, and Kerstin Grundén. 2020. "Management challenges for future digitalization of healthcare services." *Futures 124: 102636*

Haghnegahdar et al.(2022) Haghnegahdar, Lida, Sameehan S. Joshi, and Narendra B. Dahotre. 2022. "From IoT-based cloud manufacturing approach to intelligent additive manufacturing: Industrial Internet of Things—An overview." *The International Journal of Advanced Manufacturing Technology 119: 1461–1478*

Leso, Cortimiglia & Ghezzi (2023). The Contribution of Organizational Culture, Structure, and Leadership Factors in the Digital Transformation of SMEs: A Mixed-Methods Approach. *Cognition, Technology & Work,* 25, 151–179.

Nambisan, S. (2017). "Digital Entrepreneurship: Toward a Digital Technology Perspective of Entrepreneurship." *Journal Entrepreneurship Theory and Practice,* 41, 1029-1055.https://doi.org/10.1111/etap.12254

P. Eko Prasetyo, Andryan Setyadharma (2022),"Digitalization Technology for Sustainable Rural Entrepreneurship and Inequality",*Journal of Human Resource and Sustainability Studies*, Vol.10 No.3, September 19, 2022

Parmar et al. (2022) Parmar, Hetal, Tayyab Khan, Fausto Tucci, Rehan Umer, and Pierpaolo Carlone. 2022. "Advanced robotics and additive manufacturing of composites: Towards a new era in Industry 4.0. *Materials and Manufacturing Processes "37: 483–517.*

Scuotto et al. (2021). A Microfoundational Perspective on SMEs' Growth in the Digital Transformation Era. *Journal of Business Research,* 129, 382–392.

Sousa et al. (2022) Sousa, Maria José, Ana Lúcia Marôco, Sónia P. Gonçalves, and Andreia de Bem Machado. 2022. "Digital learning is an educational format towards sustainable education. "*Sustainability 14: 114*

Teece (1997)."Dynamic capabilities and strategic management " David J. Teece , Gary Pisano and amy Shuen ,*Strategic Management Journal* , Vol. 18:7, pp.509–533

Teece, D. J. and G. Pisano (1994). 'The dynamic. capabilities of firms: An introduction', *Industrialand Corporate Change*, 3(3), pp. 537–556.

Teece, D. J. (1993). 'The dynamics of industrial capi-talism: Perspectives on Alfred **Chandler's Scale and Scope (1990)', *Journal of Economic Literature*,31(1), pp. 199–225.**

Teece, D. J. (1996) 'Firm organization, industrial struc-ture, and technological innovation', *Journal of Economic Behavior and Organization*, 31, pp. 193–224

Teece, D. J. (1986b). 'Profiting from technological innovation', *Research Policy*, 15(6), pp. 285–305.

Teece, D. J.(1988.) 'Technological change and the naturel,New.of the firm'. In G. Dosi, C. Freeman, R. Nelson,G. Silverberg and L. Soete (eds.*), Technical Change and Economic Theory*. Pinter Publish**ers, New York,pp. 256–281**

Teece, D. J. (1992). 'Competition, cooperation, andinnovation: Organizational arrangements for regimes of rapid technological progress'*, Journal of EconomicBehavior and Organization*, 18(1), pp. 1–25.

Data Availability Statement: Data was obtained from Eurostat and World Bank datasets that are available in the following links: https://ec.europa.eu/eurostat/databrowser/explore/all/science?lang=en&subtheme=isoc&display=list&sort=category,https://eu-dashboards.sdgindex.org/profiles,, and https://data.worldbank.org/indicator/SI.POV.GINI?most_recent_value_desc=false