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Digital Intensity and Financial Performance of Indian Listed MSMI Evidence from an Observable Digital Maturity Index

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Abstract
Digital transformation is increasingly becoming a strategic imperative for small-firm competitiveness, but there is little evidence on whether observable digital maturity translates into improved accounting-based performance among listed micro, small and medium enterprises (MSMEs) in emerging-market contexts. This study develops and applies a Digital Intensity Index (DII) to examine whether Indian listed MSMEs with high digital presence and digital engagement are reporting better financial performance than firms with weak or moderate digital maturity. The DII is made up of five publicly observable indicators: the existence of an official website, social media activity, LinkedIn/professional visibility, the ability to engage customers online and digital content or campaign activity. A final cleaned sample of 38 listed MSMEs is classified in the groups of low/non-digital (ND-MSME), moderately digital (MD-MSME) and highly digital (HD-MSME). The financial performance is assessed by sales growth, return on assets, return on equity and net profit margin. The empirical strategy comprises descriptive statistics, one-way ANOVA, Tukey post-hoc comparisons, Pearson correlation, linear regression, sector-wise analysis and additional PLS-SEM validation for digital adoption mechanisms. The results show that HD-MSMEs out-perform ND-MSMEs and MD-MSMEs on all the four financial indicators. The significant inter-group differences are proved by the ANOVA and the regression shows that DII explains 37.4% of sales growth, 46.8% of return on assets, 41.1% of return on equity and 35.2% of net profit margin . The results suggest that digital maturity is a measurable strategic capability linked to growth, efficiency, profitability and shareholder return in listed MSMEs. The study presents a replicable evidence-based digital classification framework and offers policy and managerial implications for the digital upgrading of MSMEs in emerging economies.

Keywords: Digital intensity; MSME performance; digital maturity; financial performance; Indian listed SMEs; digital transformation; dynamic capabilities.

JEL Classification: L25; L26; M15; O33

1. Introduction

Micro, small and medium enterprises (MSMEs) hold a pivotal position in the Indian economy because they combine employment generation, entrepreneurship, local production capability and export participation. Recently the Government of India in its official communication has stated that the sector accounts for approximately 30% of the national GDP, over 45% of the exports and remains the second largest employer after agriculture. Such macroeconomic significance makes the performance of MSMEs no less a policy issue than a firm-level management issue. The environment for smaller enterprises is also changing rapidly. Digital platforms, online customer interfaces, social media communication, data-enabled visibility and digitally mediated supply chains have transformed how companies create value, reach customers and maintain a presence in the marketplace. Digital transformation has therefore shifted from a technology function to a core strategic capability that determines firm-level competitiveness (Bharadwaj et al., 2013; Verhoef et al., 2021).

This challenge is particularly relevant for listed MSMEs as public listing creates higher expectations of disclosure, credibility and scalable growth. Stakeholders can compare not only financial outcomes but also digital visibility, so digital maturity becomes part of the firm's external strategic profile. A weak digital footprint may not directly prove weak capability, but it can hinder discoverability and stakeholder confidence in an increasingly digital business environment.

In the literature on digital transformation a distinction is made between simple digitization, broader digitalization and strategic digital transformation. Digitization is the process of converting analogue information into digital form while digitalization is the use of digital technologies to improve business processes, communication and value delivery. Digital transformation is deeper and changes the firm's value proposition, value creation logic, operating model and performance architecture (Vial, 2019; Verhoef et al., 2021). These processes are especially important for smaller firms as MSMEs often face challenges of limited resources, limited access to market, weak brand visibility and limited managerial bandwidth. Digital tools can partly alleviate these constraints by increasing reach, reducing search costs, improving customer interaction and allowing smaller enterprises to create market visibility beyond their physical locations (Bouwman et al., 2019; Matarazzo et al., 2021).

However, the empirical relationship between digital maturity and financial performance is underdeveloped in the context of Indian listed MSME. Much of the literature is based on survey-based measures of digital adoption, managerial perceptions, or broad digital finance indicators. There are advantages to these methods, yet there are disadvantages, such as self-reporting, inflated assessments of digital capability, and a lack of comparability in the measurement of each firm. Since we can utilise the audited financial statements that MSMEs file with government agencies and since MSMEs have publicly visible digital footprints, the current research has an advantage over previous studies that use MSMEs to provide empirical data for a new method to classify firms' digital maturity. After classifying firms by their level of digital maturity, we will determine how financial results differ across these levels. The objective of the present study is to use this opportunity and create a Digital Intensity Index (DII), which is comprised of five observable measures (website presence, social media usage, professional visibility via LinkedIn, ability to engage customers through the web and campaigns/content developed and disseminated digitally) to identify the degree of digital maturity.

We use the Resource-Based View (RBV) and Dynamic Capabilities View (DCV) theories to guide our theoretical framework. According to RBV theory, the value of organisational resources is determined by their contribution to market visibility, customer access, operational efficiency and competitive differentiation. When viewed through the lens of DCV, digitally mature firms should have greater abilities to sense new market opportunities, exploit emerging channels to reach customers and reconfigure internal operations in response to changes in their environment (Teece et al., 1997; Teece, 2007; Warner & Wäger, 2019). Therefore, digital maturity should be regarded not only as a technological characteristic but also as an external set of observable capabilities that influence growth, profitability, and operational efficiency.

The empirical question that drives the paper is straightforward: do Indian listed MSMEs with higher observable digital maturity exhibit stronger financial performance than firms with lower digital maturity? In order to answer this question, the paper classifies 38 listed MSMEs into ND-MSMEs, MD-MSMEs and HD-MSMEs based on the DII framework, and then compares the performance differences in sales growth, return on assets, return on equity and net profit margin. The study uses ANOVA and Tukey post hoc analysis to test for differences between groups and correlation and regression models to estimate the directional association between digital intensity and performance. Supplementary PLS-SEM validation is used to explain the mechanism of how digital leadership support, infrastructure capability, employee digital competency, and customer engagement may affect digital marketing adoption and market performance. This paper contributes to the literature in four ways. First, it suggests a transparent and replicable DII framework relying on

observable public evidence rather than managerial self-reporting. Second, it adds emerging-market evidence from listed Indian MSMEs that have been less studied than large listed firms or informal unlisted microenterprises. Third, it relates digital maturity to multiple performance measures based on accounting data, rather than a single outcome measure. Fourth, it combines group-based and continuous approaches, thus showing both if digital maturity categories differ and if the DII score itself predicts performance. These contributions are relevant for scholars studying digital transformation, policy makers supporting MSME formalization and digital upgrading and managers trying to translate digital presence into measurable financial value.

2 Literature review and hypothesis development

Digital Transformation is becoming a major focus across Information Systems, Strategy, Entrepreneurship, and Marketing. Vial (2019) describes the digital transformation as "the process through which organisations employ digital technology to implement new strategies and alter the ways they create value." Verhoef et al. (2021) have identified that the effects of digital transformation extend far beyond customer behaviour; they also affect how market structures evolve, what types of organisational designs emerge, and how companies measure their success. These perspectives should be relevant to MSMEs because many small businesses do not have the same level of physical space or budget to promote themselves as larger companies. The digital interface allows them to establish a more effective form of communication, demonstrate credibility, and connect with customers beyond their original local network. There is a large body of literature on digital business strategy indicating that digital technologies are being incorporated into overall business strategy rather than serving as a supplementary tool. Bharadwaj et al. (2013) define digital business strategy as "an organisation's strategy that is developed and executed by using digital resources to generate differential value." For MSMEs, having a digital presence, engaging in online activities and developing platforms for customer interaction will serve as additional strategic tools. These tools allow MSMEs to signal their legitimacy, reduce information asymmetries, build relationships with customers and expand their networks. Furthermore, since all stakeholders, such as customers, suppliers, investors, and regulators, can view the financial reports of publicly traded MSMEs along with their public digital behaviours, there is particular relevance to digital strategy for listed MSMEs.

Finally, digital strategy is particularly important due to the nature of digital signals. For example, a website serves as a starting point for demonstrating legitimacy, while ongoing social media engagement demonstrates consistency in communication; building visibility through professional networking creates credibility for your business; developing engagement systems reduces barriers to customer interaction; and creating content generates continued awareness of your company within competitive markets. The collective impact of these factors provides a stronger indication of an organisation's readiness than any single factor. It is this cumulative logic that underlies the DII framework presented in this study.

The literature also warns that digital transformation is not only technological. The value of digital tool use depends on the organizational culture, managerial commitment, employee skills and process redesign. This is why digital maturity must be understood as a configuration of capabilities. Digital technologies have the potential to create financial benefits, but only by embedding them in customer relationships and operating routines, rather than superficial adoption; superficial digital technology adoption by firms does not translate into financial benefits.

Dynamic capabilities theory is a useful lens to explain the potential impact of digital maturity on performance. According to Teece et al. (1997), dynamic capabilities are the firms' ability to integrate, build and reconfigure internal and external competences to address rapidly changing environments. Later, Teece (2007) identifies sensing, seizing and transforming as micro foundations of dynamic capability. Digital maturity can enable all of these functions. A digitally visible firm may detect market signals through online interaction, capture opportunities through customer engagement and reconfigure communication routines through digital campaigns and platform-based systems. Warner and Wäger (2019) extend this reasoning by showing that digital transformation is a continuous process of strategic renewal that requires dynamic capabilities, as opposed to one-off technology adoption. The literature on SMEs suggests that digital transformation can enhance customer value creation, business model innovation and performance. Matarazzo et al. (2021) use evidence from SMEs in Italy to show that digital transformation supports customer value creation when firms develop dynamic capabilities. Bouwman et al. (2019) demonstrate that SMEs performance can be improved through digitalization of business model innovation practices and strategic implementation. The studies support the argument that digital maturity should be assessed not only by technology ownership but also by observable engagement and communication systems. A MSME with a website but no channel for customer engagement may be less digitally mature than a company with a website, social media, professional visibility and regular content activity. Recent empirical evidence from emerging and developing markets also indicates that stronger small-firm outcomes are linked to digital adoption. Frimpong et al. (2022) have established an association between

SMEs' access to digital finance and their performance in Ghana. Valdez-Juárez et al. (2024) report that digital transformation and innovation capabilities positively affect the financial performance of Mexican SMEs. In their study using World Bank Enterprise Survey data from India, Verma et al. (2024) found relationships between MSME performance indicators and digital finance. Together, these findings illustrate that digitalisation can alleviate resource constraints and improve performance. However, each also suggests the need for additional research focusing on specific firm-level issues, including observable digital maturity and audited financial indicators.

In the Indian MSME context, digital performance is becoming increasingly important, as many small firms are undergoing a transition to formality. As they adopt digital payment systems, online procurement, platform-based selling, electronic documentation and investor-facing disclosure, the strategic importance of publicly available digital information increases. Not all forms of digital adoption will be equivalent. One firm could exist digitally but act passively as a result of the digital space. At the same time, another uses digital channels as an active tool for acquiring new customers, building credibility and creating two-way communication. Accordingly, this paper views digital maturity as a continuous, measurable capability rather than a binary measure of whether the firm exists digitally or not. The second challenge is measurement. Research on digital transformation has primarily relied on survey data collected from managers who assess the perceived levels of digital readiness, digital orientation, or technological usage. While these metrics provide insight into a firm's internal capabilities, they lack comparability because individual respondents view digital maturity differently. Indicators of publicly observable performance provide a complementary perspective to assessments of internal capabilities. They indicate whether the firm has developed a visible digital identity, engages with stakeholders through social platforms, maintains professional visibility, permits customers to engage digitally with the firm and produces content digitally. Given the nature of listed MSMEs, these indicators are particularly relevant because external market participants also observe them. Third is the multi-dimensional nature of performance. Growth, efficiency and profitability are correlated but distinct constructs. An organisation can rapidly grow revenue at the expense of profit margins, or maintain its profit margins while failing to grow sales revenue. ROA is a metric used to evaluate the efficiency with which assets are utilised; ROE evaluates the returns generated by an organisation for shareholders; and NPM is a metric used to assess an organisation's ability to generate profits. By considering all four metrics collectively, this paper avoids constraining its definition of performance and offers a broader evaluation of whether digital maturity is associated with meaningful outcomes.

The primary means by which digital maturity can drive sales growth include website visibility and social media activity, both of which can increase a firm's discoverability and lower customer search costs by facilitating brand communication. Establishing legitimacy with customers, investors, and potential employees through a LinkedIn presence can help build trust with potential clients. Online engagement systems can enable rapid customer responses and increase the likelihood of converting prospects into paying customers. Producing digital content can inform current customers about your products, services, promotions, and updates. Each mechanism described above aligns with prior research demonstrating a relationship between digital platforms, analytical tools, digital innovation and access to better-performing markets (Wamba et al., 2017; Nambisan, 2017). Therefore, digitally mature MSMEs will exhibit higher sales growth than less digitally mature firms. Digital maturity may also impact return on assets (ROA). ROA is a metric used to assess the efficiency with which organisations utilise their assets in generating earnings. Digital communication systems can improve the utilisation of existing resources, enabling organisations to coordinate efforts more effectively, experience fewer delays in processing customer requests and sell more goods without expanding their physical assets. Organisations utilising large amounts of big data analytics and other digital capabilities may also achieve greater process-oriented capabilities and subsequently improve organisational performance (Akter et al., 2016; Wamba et al., 2017). Basic digital platforms providing customer communication, inquiry management, and market responsiveness capabilities can also enhance MSME efficiency. Hence, we expect to identify an association between higher asset utilisation and higher DII scores. The return on equity can be affected by digital maturity via growth, efficiency and market reputation effects. Digitally mature firms can deliver better shareholder returns when their digital capabilities help increase revenues, control costs and improve profitability. The financial effect does not have to be automatic; digital initiatives can also cost money and demand managerial discipline. However, the dynamic capabilities perspective suggests that firms that are able to align digital routines with strategic objectives can convert digital maturity into superior performance. This expectation is consistent with Valdez-Juárez et al. (2024) who relate digital transformation and innovation capabilities to the financial performance of SMEs.

Digital maturity can help improve net profit margin by reducing marketing costs, improving customer retention, supporting direct communication and

increasing operational responsiveness through digital channels. But the margin effects are likely more complex than the growth effects, since profitability also depends on input costs, pricing power, sector structure and competitive intensity. Hence, the expected relationship is positive but may be weaker than the relationship between DII and ROA or sales growth. Instead of assuming that digital presence automatically leads to profitability, the present study investigates this relationship directly.

Based on this literature, two sets of hypotheses are formulated. The first set is comparative and tests the hypothesis if ND-MSMEs, MD-MSMEs and HD-MSMEs are significantly different in financial performance. The second set is relational and examines whether DII is positively related to each financial indicator. H1: There is a lot of variation in sales growth across the digital maturity categories. H2: ROA varies widely across digital maturity categories. H3: ROE differs significantly across digital maturity. H4: NPM differs significantly among digital maturity categories. H5: DII is positively related to the sales growth. H6: DII has a positive relationship with ROA. H7: DII is positively related with ROE. H8: DII has a positive association with NPM.

3 Research methodology

The study uses an explanatory quantitative research design and Indian MSMEs listed as the empirical setting. The research goal is comparative and relational: it tests whether firms with different levels of observable digital maturity differ in financial performance and whether a continuous digital intensity score is a predictor of performance outcomes. However, the design is not perception-based but rather combines publicly available digital indicators with measures of financial performance obtained from publicly available disclosures at the company level. This approach improves comparability since all firms are assessed using the same digital criteria and standard financial indicators.

The initial sample included 45 listed MSMEs from the NSE SME and BSE SME ecosystem and associated listed SME-type companies in the areas of information technology services, logistics, industrial manufacturing, engineering products, renewable energy, packaging, textiles, financial services, education, irrigation systems and industrial materials. Firms were eligible if they had publicly available financial data, observable digital indicators, operational continuity during the study period, company-level disclosures, and suitable for inter-firm comparison. The final cleaned data set consisted of 38 firms after the extraction and validation of the financial data. Firms were dropped if they had incomplete financial histories, lack multi-year observations, had inconsistent financial structures, or were extraction incompatible. The main independent variable is the Digital Intensity Index. The DII is an additive index built on five binary dimensions: presence of an official website, activity in social media, visibility on LinkedIn/professional networks, capacity for online customer engagement and activity in digital content/campaign. If verified evidence exists, each dimension is scored 1, if the indicator is missing, inactive, not working or not evidenced sufficiently, it is scored 0. Total score is in the range of 0 to 5. Firms scoring 0-1 are termed as ND-MSMEs, firms scoring 2-3 are termed as MD-MSMEs and firms scoring 4-5 are termed as HD-MSMEs. This scoring structure intentionally prioritizes replicability and transparency over subjective weighting.

Table 1 Digital Intensity Index scoring parameters

Digital dimension	Operational definition	Scoring basis
Official website presence	Functional and professionally maintained official website	1 = available; 0 = absent/non-functional
Social media activity	Active organizational communication through social platforms	1 = active; 0 = absent/inactive
LinkedIn/professional visibility	Professional digital identity and organizational visibility	1 = visible; 0 = absent
Online customer engagement	Enquiry forms, interaction modules or lead systems	1 = available; 0 = absent
Digital content/campaign activity	Blogs, campaigns, digital updates or promotional content	1 = available; 0 = absent

Table 2 Digital maturity classification

Score range	Classification	Interpretation
0-1	ND-MSMEs	Basic or weak digital presence
2-3	MD-MSMEs	Moderate digital integration
4-5	HD-MSMEs	Strong multi-platform digital maturity

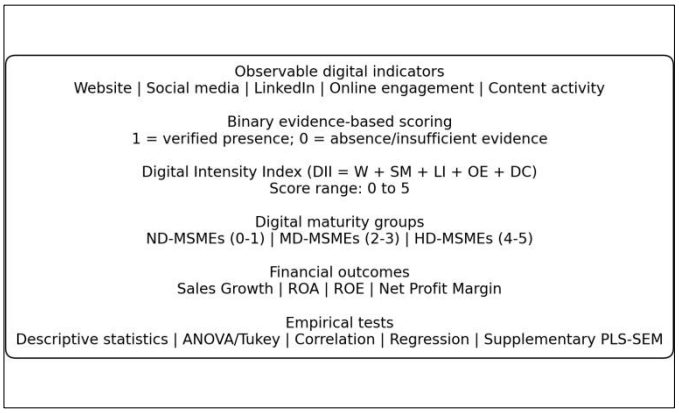

Figure 1 Conceptual and analytical framework

Financial performance is evaluated using four dependent variables. Sales growth captures revenue expansion capability and market responsiveness. Return on assets measures operating efficiency and asset utilization. Return on equity captures shareholder return generation. Net profit margin captures profitability efficiency relative to sales. Using multiple outcomes reduces the risk of overinterpreting a single performance metric and enables a more nuanced assessment of growth, efficiency and profitability. Sector classification is used for descriptive interpretation and to understand whether digital maturity differs across industry groups.

Table 3 Operationalization of variables

Variable	Symbol	Measurement/role
Digital Intensity Index	DII	Composite digital maturity score from 0 to 5
Sales growth	SG	Revenue expansion indicator
Return on assets	ROA	Operational efficiency and asset utilization
Return on equity	ROE	Shareholder return generation
Net profit margin	NPM	Profitability efficiency relative to sales
Digital cluster	DC	ND-MSME, MD-MSME, HD-MSME classification
Sector category	SEC	Industry-wise descriptive classification

The empirics proceed in six steps. In step one, we present summary statistics for DII and for the relevant financial variables. In step two, we report how many firms fall into each of the five digital maturity levels. In step three, we compare group-wise means for ND-MSMEs, MD-MSMEs and HD-MSMEs. In step four, we apply an F-test (one-way ANOVA) to determine whether there is a a statistically significant difference in mean performance among the three groups. In step five, when the overall F-statistic indicates a significant mean difference, we use Tukey's HSD (Honestly Significant Difference) test to identify which specific pair(s) of the three groups have statistically significantly different means. Finally, in step six, we report the results of Pearson correlations and simple linear regressions estimating the relationship between DII and each performance metric. We perform separate regressions for sales growth, ROA, ROE and NPM. The regression equation is: Performance_i = alpha + beta (DII_i) + epsilon_i

We also include a supplementary analysis based on a PLS-SEM validation (with respect to some constructs representing digital adoption mechanisms): digital leadership support, digital infrastructure capability, employee digital competence, digital customer engagement, digital marketing adoption and market performance. This supplementary analysis is meant to provide evidence at the level of constructs that digital inputs can affect both adoption and market outcomes. For this purpose, we present measurement reliability, discriminant validity, path coefficients, R-square, f-square, VIF, bootstrapping and model fit statistics in addition to the above-mentioned listed-firm financial analysis. Normality and other necessary diagnostics were carried out prior to performing any inferential tests. Values of skewness ranged from 0.11 to 1.28 and kurtosis values ranged from -1.18 to 2.41; thus all distributional assumptions necessary for applied financial research seem to be met. The data set was also examined for missing values or inconsistent observations during data cleaning. In the supplementary model, the VIF values were lower than the common threshold values, so there is no serious collinearity problem. These diagnostics support the appropriateness of our chosen analytical procedures.

4 Empirical results

The final sample contains balanced representation across the three digital maturity categories. HD-MSMEs account for 15 firms, representing 39.47% of the sample. MD-MSMEs account for 12 firms, representing 31.58%.

ND-MSMEs account for 11 firms, representing 28.95%. This distribution is analytically useful because it avoids excessive concentration in a single category and enables meaningful inter-group comparison. The average DII score is 2.89, with a median of 3.00 and standard deviation of 1.46, indicating that the sample is positioned around moderate digital maturity while still displaying substantial variation

Table 4 Distribution of firms across digital maturity categories

Digital category	Number of firms	Percentage
HD-MSMEs	15	39.47%
MD-MSMEs	12	31.58%
ND-MSMEs	11	28.95%
Total	38	100.00%

The descriptive statistics reveal considerable heterogeneity in financial outcomes. Average sales growth is 14.82%, with a standard deviation of 18.64 and a range from -22.40% to 78.65%. This wide dispersion indicates that revenue expansion differs sharply across MSMEs. Average ROA is 8.96%, with a standard deviation of 6.41, while average ROE is 15.47%, with a standard deviation of 11.92. Net profit margin averages 7.58%, with lower dispersion than sales growth and ROE. The positive skewness of the financial variables indicates the presence of high-performing firms, but the distributional diagnostics remain acceptable for the selected tests.

Table 5 Descriptive statistics of financial performance variables

Variable	Mean	Median	Std. Dev.	Min.	Max.	Skew.	Kurt.
Sales Growth (SG)	14.82	11.35	18.64	-22.40	78.65	1.28	2.41
Return on Assets (ROA)	8.96	7.82	6.41	-4.12	24.73	0.74	0.88
Return on Equity (ROE)	15.47	13.28	11.92	-8.34	46.15	0.96	1.37
Net Profit Margin (NPM)	7.58	6.44	5.27	-3.25	21.84	0.69	0.54
Digital Intensity Index (DII)	2.89	3.00	1.46	1.00	5.00	0.11	-1.18

Group-wise mean comparison provides the first direct evidence of performance differences across digital maturity categories. ND-MSMEs report average sales growth of 7.84%, MD-MSMEs 13.92%, and HD-MSMEs 22.61%. The same progression is visible for ROA, where ND-MSMEs average 5.13%, MD-MSMEs 8.74%, and HD-MSMEs 13.28%. ROE increases from 9.46% for ND-MSMEs to 14.88% for MD-MSMEs and 22.93% for HD-MSMEs. NPM rises from 4.92% to 7.36% and then to 11.47%. The pattern is consistent: the highly digital group records the strongest performance across every indicator.

Table 6 Group-wise mean financial performance across digital maturity categories

Financial indicator	ND-MSMEs	MD-MSMEs	HD-MSMEs
Sales Growth (%)	7.84	13.92	22.61
Return on Assets (%)	5.13	8.74	13.28
Return on Equity (%)	9.46	14.88	22.93
Net Profit Margin (%)	4.92	7.36	11.47

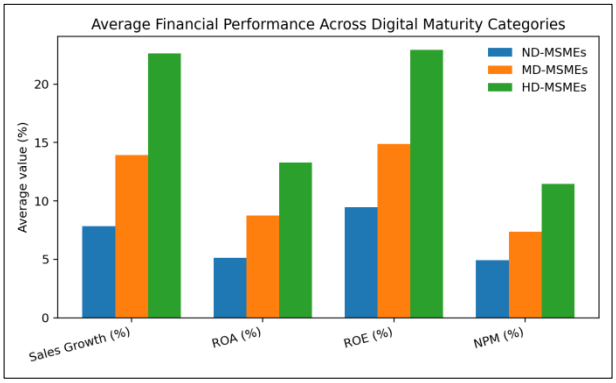

Figure 2 Average financial performance across digital maturity categories

ANOVA results confirm that the observed group differences are statistically meaningful. Sales growth differs significantly across digital maturity groups, with an F-statistic of 6.84 and p-value of 0.003. ROA also differs significantly, with F = 8.91 and p = 0.001. ROE shows significant inter-group variation, with F = 7.76 and p = 0.002. NPM is significant as well, with F = 5.94 and p = 0.006. These results support H1, H2, H3 and H4, indicating

that digital maturity classification is associated with meaningful differences in growth, efficiency and profitability.

Table 7 One-way ANOVA results

Variable	F-statistic	p-value	Result
Sales Growth	6.84	0.003	Significant
Return on Assets	8.91	0.001	Significant
Return on Equity	7.76	0.002	Significant
Net Profit Margin	5.94	0.006	Significant

Tukey post-hoc analysis indicates that the strongest performance gaps occur between ND-MSMEs and HD-MSMEs. HD-MSMEs outperform ND-MSMEs across sales growth, ROA, ROE and NPM. Differences between ND-MSMEs and MD-MSMEs are also significant across the indicators, implying that even moderate digital integration is associated with improved financial outcomes relative to weak digital presence. Comparisons between MD-MSMEs and HD-MSMEs remain significant for ROA and ROE, while sales growth and NPM display moderate differences. This suggests that the transition from moderate to high digital maturity may yield incremental rather than abrupt performance gains for certain financial outcomes.

Table 8 Tukey post-hoc comparison results

Comparison	Sales Growth	ROA	ROE	NPM
ND-MSMEs vs MD-MSMEs	Significant	Significant	Significant	Significant
ND-MSMEs vs HD-MSMEs	Significant	Significant	Significant	Significant
MD-MSMEs vs HD-MSMEs	Moderate difference	Significant	Significant	Moderate difference

Pearson correlation analysis further supports the positive association between digital maturity and performance. DII is positively correlated with sales growth (r = 0.612), ROA (r = 0.684), ROE (r = 0.641), and NPM (r = 0.593), with all coefficients statistically significant at the 5% level. ROA has the strongest relationship with DII, suggesting that digital maturity may particularly influence operating efficiency and asset utilization. The positive correlations among the financial variables also indicate that growth, profitability and efficiency tend to move together within the sampled MSMEs.

Table 9 Pearson correlation matrix

Variables	DII	SG	ROA	ROE	NPM
DII	1.000	0.612**	0.684**	0.641**	0.593**
SG	0.612**	1.000	0.572**	0.546**	0.481**
ROA	0.684**	0.572**	1.000	0.731**	0.655**
ROE	0.641**	0.546**	0.731**	1.000	0.603**
NPM	0.593**	0.481**	0.655**	0.603**	1.000

Regression analysis confirms the predictive relevance of DII. The standardized beta coefficient for sales growth is 0.612, with t = 4.82, p < 0.001 and R-square = 0.374. The ROA model produces the strongest explanatory power, with beta = 0.684, t = 5.46, p < 0.001 and R-square = 0.468. The ROE model reports beta = 0.641, t = 5.02, p < 0.001 and R-square = 0.411. The NPM model reports beta = 0.593, t = 4.37, p = 0.001 and R-square = 0.352. These results support H5, H6, H7 and H8. The explanatory power is meaningful for a single-index model, particularly given that financial performance is influenced by many non-digital factors such as sector, firm age, cost structure, scale and managerial capability.

Table 10 Regression results: effect of digital intensity on financial performance

Dependent variable	Beta	t-value	p-value	R^2	Result
Sales Growth	0.612	4.82	0.000	0.374	Significant
Return on Assets	0.684	5.46	0.000	0.468	Significant
Return on Equity	0.641	5.02	0.000	0.411	Significant
Net Profit Margin	0.593	4.37	0.001	0.352	Significant

Further insight is there in sector-wise analysis. The highest average DII score of 4.63 belongs to Information Technology and Digital Services firms, which also lead the sample in sales growth, ROA, ROE and NPM. The following are the firms in Renewable Energy and Engineering sector with an average DII of 3.74 and fairly strong performance. Logistics and Transportation companies have moderate digital intensity and moderate-to-strong performance, likely due to the importance of coordination, tracking and communication technologies. Manufacturing and Industrial Products have a lower average DII of 2.31 and weaker performance than the technology intensive groups. The lowest average DII of 1.88 and the lowest financial indicators are in Packaging and Industrial Materials. The patterns do not establish sectoral causality but do suggest a certain alignment of digital maturity with financial outcomes across the major sector groups.

Table 11 Sector-wise average digital intensity and financial performance

Sector	Avg. DII	Sales Growth	ROA	ROE	NPM
Information Technology & Digital Services	4.63	24.73	14.26	25.48	12.74
Renewable Energy & Engineering	3.74	19.35	11.47	20.13	9.82
Logistics & Transportation	3.41	16.62	9.14	16.28	7.61
Financial & Business Services	3.28	15.21	8.92	15.74	7.44
Education & Miscellaneous Services	2.96	12.56	7.48	13.63	6.91
Manufacturing & Industrial Products	2.31	10.82	6.31	11.26	5.28
Packaging & Industrial Materials	1.88	8.43	4.82	9.14	4.35

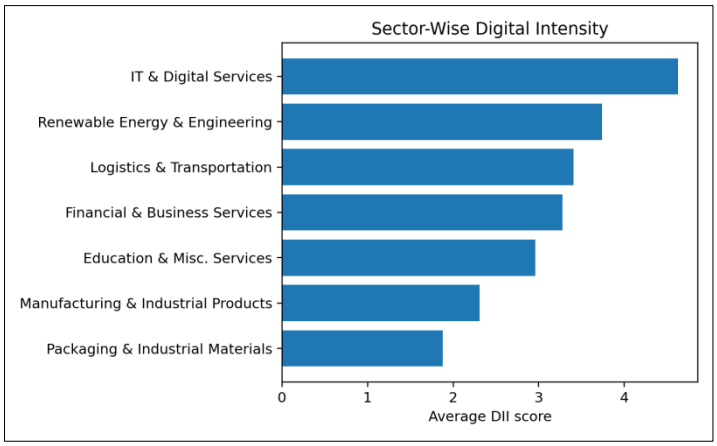

Figure 3 Sector-wise digital intensity

The sectoral pattern also highlights the importance of avoiding a one-size-fits-all digital policy. Technology and digital service firms may require advanced analytics, automation and platform integration, whereas manufacturing MSMEs may first need stronger product catalogues, enquiry systems, distributor communication tools and business-to-business visibility. Renewable energy and engineering firms may benefit from project visibility, technical documentation and professional networks. Logistics firms may benefit from tracking, customer communication and operational coordination. Thus, the financial relevance of digital maturity depends on whether digital tools are aligned with the value drivers of the sector.

Table 12 Supplementary PLS-SEM structural results

Path	Beta	t-value	p-value	Decision
DLS -> DMA	0.136	2.410	0.0165	Supported
DIC -> DMA	0.152	2.570	0.0106	Supported
EDC -> DMA	0.154	2.819	0.0051	Supported
DCE -> DMA	0.181	3.158	0.0017	Supported
DMA -> MP	0.363	6.848	0.0000	Supported

Table 13 Hypothesis-wise summary

Hypothesis	Statistical technique	Decision
H1: Sales growth differs across digital categories	One-way ANOVA	Supported
H2: ROA differs across digital categories	One-way ANOVA	Supported
H3: ROE differs across digital categories	One-way ANOVA	Supported
H4: NPM differs across digital categories	One-way ANOVA	Supported
H5: DII is positively associated with sales growth	Correlation and regression	Supported
H6: DII is positively associated with ROA	Correlation and regression	Supported
H7: DII is positively associated with ROE	Correlation and regression	Supported
H8: DII is positively associated with NPM	Correlation and regression	Supported

The supplementary PLS-SEM results support the mechanism through which digital enablers may translate into market outcomes. Reliability statistics are acceptable, with Cronbach alpha values ranging from 0.727 to 0.801 and composite reliability values from 0.821 to 0.864. The structural paths from digital leadership support, digital infrastructure capability, employee digital competency and digital customer engagement to digital marketing adoption are positive and significant. The path from digital marketing adoption to market performance is also

positive and significant (beta = 0.363, t = 6.848, p < 0.001). Bootstrapping confirms the stability of the supported paths, and model fit indicators are acceptable, with SRMR = 0.069 and NFI = 0.901. The PLS-SEM evidence complements the listed-firm analysis by showing that digital adoption mechanisms operate through leadership, infrastructure, skills and engagement.

5 Discussion

Supporting evidence suggests that the level of visible digital maturity is positively associated with the degree of financial success experienced by Indian listed MSMEs. Results have been supportive across group-comparison studies, ANOVA, post hoc testing, correlation analysis, regression modelling, and sector-based studies. The most robust association was observed between DII and ROA. Therefore, there is a theoretical basis to believe that increased levels of digital maturity could enhance a company's ability to utilise its assets and improve its operational efficiency. As such, digital systems provide an opportunity to improve coordination within organisations, decrease response times for both internal and external stakeholders, enhance communication with customers, and increase the value created by each asset utilised within a company.

Results on sales growth indicated that digitally mature MSMEs experience greater revenue growth. These findings further support the notion that enhanced digital visibility increases discoverability and access to new markets. Companies that possess active digital platforms or social media accounts can easily share information about products, services, capabilities and upcoming events with potential customers more quickly than those with little to no digital footprint. Similarly, businesses competing in B2B environments or providing professional services can use their LinkedIn profiles and/or professional online identities to demonstrate credibility to current customers, suppliers, investors and prospective employees. Therefore, the existence of a digital footprint provides much more than simply a means for a company to communicate. A digital presence can also serve as an entry point into the market.

This study found stronger shareholder returns for digitally mature MSMEs than for less mature firms, indicating that digital maturity is positively associated with shareholder returns. However, the fact that digitalisation generates shareholder value per se is not implied by these findings. Rather, digital maturity enables firms to more effectively integrate digital visibility, customer interaction, organisational responsiveness, and managerially enabled capability than do less mature firms. Dynamic Capability Theory can aid in understanding how digital tools enhance performance when used in conjunction with routines that enable firms to identify opportunities, act on them and generate and implement new operating practices (Teece, 2007; Warner & Wäger, 2019).

Positive NPM results were obtained, although somewhat lower than ROA and ROE. This outcome represents a meaningful pattern since it does not exaggerate. Several factors, including input prices, competitive forces, supplier/customer/buyer bargaining power, product, service offerings and financial discipline, influence NPM. While digital systems can support margin expansion through reduced communication costs and improved customer relationships, they can also entail expenses for content development, platform administration and technology maintenance. Therefore, the significance but moderate magnitude of the NPM relationship appears reasonable.

In terms of sectoral differences, technology-related industries are significantly more digitally mature and financially successful than traditional industrial sectors. However, this research should not be misinterpreted as implying that only technology companies will derive benefits from digital maturity. The study suggests that even MSMEs engaged in manufacturing/industrial activities can achieve performance improvements through stronger digital communication, customer inquiry systems, product visibility and professional digital identity. An important strategy lesson, therefore, is to match a company's digital maturity profile to the characteristics of its sector. For example, while a software company may require a digital maturity model similar to that of a web retailer, a packaging firm would likely require different attributes (e.g., a credible website presence, functionality for customer engagement, professional visibility, frequent communication) depending on its unique operations and requirements.

The paper's DII framework adds value because it is simple, replicable and evidence-based. Many digital transformation studies use complex survey scales that are appropriate for perception research but difficult to replicate across listed firms. The DII uses publicly observable indicators and can therefore be repeated by other researchers, investors, policymakers and practitioners. Its simplicity is also a limitation because it does not capture depth of technology integration, digital spending, analytics capability or back-end automation. Nevertheless, as an external maturity screen, it performs well and explains meaningful variation in performance.

The findings align with international evidence that digitalization improves SME performance through customer value creation, business model innovation, digital finance and dynamic capabilities (Bouwman et al., 2019; Frimpong et al., 2022; Matarazzo et al., 2021; Valdez-Juárez et al., 2024; Verma et al., 2024). The contribution of the present paper lies in applying this argument to listed Indian MSMEs using a transparent digital maturity index and accounting-

based performance indicators. The results therefore extend digital transformation research into an important emerging-market segment.

A further contribution is that the results create a bridge between strategic digital transformation theory and practical MSME assessment. The DII does not require confidential internal data, managerial interviews or proprietary technology expenditure information. It can be applied by researchers, lenders, incubators and policymakers using verifiable public evidence. This makes the framework especially useful in emerging economies where access to private firm-level technology data is often limited. The framework can also be periodically repeated, allowing observers to track whether MSMEs move from low to moderate or high digital maturity over time.

The findings should also be read as evidence of complementarity. Digital maturity is unlikely to generate superior performance unless it is combined with product quality, managerial discipline, financial prudence and sectoral opportunity. The positive coefficients therefore indicate that digital maturity is an enabling capability, not a substitute for sound business fundamentals. This interpretation is consistent with dynamic capabilities theory, where technology becomes valuable when embedded in organizational routines and strategic renewal processes rather than when adopted in isolation.

For journal positioning, the study speaks to three debates. The first is the digital transformation-performance debate, where scholars continue to examine when and how digital technologies produce measurable returns. The second is the SME capability debate, where resource-constrained firms must convert limited resources into competitive advantage. The third is the emerging-market formalization debate, where listed MSMEs occupy an intermediate space between informal microenterprises and large corporations. By studying listed MSMEs, the paper captures firms that are small enough to face MSME constraints but formal enough to provide comparable public evidence.

6 Implications

Digital maturity can be considered strategically, rather than simply digitally. Thus, managers must move from merely having a static website to integrating their digital footprint across various business- and consumer-facing media (i.e., professional, social, and customer). Inquiry systems, current content, professional presence and ongoing communication with customers are particularly important. Managers should also relate their digital expenditures to their financial objectives. That means they should evaluate if the digital activities contribute to increases in sales, assets utilised, shareholder returns, and profit margins. The results provide some evidence supporting digital upgrade programs for MSMEs; however, those programs should include a focus on developing specific capabilities in MSMEs that policymakers can measure. Thus, policymakers' programs developed for the MSME community should enable them to engage in integrated digital communications, enhance their professional visibility through digital platforms, develop an understanding of how to interface with customers via digital channels, cultivate an analytical mindset to understand their own digital activity, and apply industry-specific digital use cases.

Policymakers should focus on traditionally manufactured and industrial firms, which represent lower levels of digital maturity within the MSME community, to address the digital divide.

The Digital Maturity Index (DII) provides an efficient method for banks, SME lenders, venture capital funders, public entities, and other parties interested in assessing the digital maturity of MSMEs to use as one factor when evaluating a firm's market readiness, managerial orientation toward innovation, and growth potential.

While the DII cannot replace a comprehensive financial analysis of an MSME, it does offer a complementary tool to assess the digital engagement levels of these firms at a reasonable cost and time. In doing so, this enables public entities to view all MSMEs on publicly traded exchanges (thereby increasing transparency) and increases investor confidence in MSMEs with higher digital maturity levels.

This study demonstrates the importance of using both observable digital indicators and audited financial performance data for researchers. The authors believe that future research utilising the model presented herein can expand upon the framework by including additional variables, such as panel models, sector fixed effects, lag structure, measures of digital expenditures, web analytics metrics, sentiment analysis, and machine-based rating schemes related to the quality of digital content.

7 Limitations and future research

Limitations of this study must be considered. The sample was limited to only 38 MSMEs. Larger datasets provide more generalisable results. Second, the DII measures only observable digital indicators (e.g., website quality) and does not measure digital processes within an organisation (e.g., ERP systems, cybersecurity maturity, digital investments or analytical capabilities). Third, the regression models were intentionally kept simple and did not include other potentially relevant variables (e.g., age, leverage, firm size, sector-specific fixed effects, or ownership type). Fourth, this study is correlational, and the relationship identified here should not be interpreted as causal.

The above limitations could be addressed through additional research using panel data and estimating fixed-effects or dynamic panel models. A longitudinal study would allow researchers to determine if increases in digital intensity precede increases in financial performance. Additional research could incorporate additional digital maturity measures, with a focus on weighted measures. For example, web quality, customer interface complexity, engagement frequency, and content consistency could each receive more detailed scoring. Additional areas of digitalisation that could be included in future research include digital finance usage, e-commerce integration, supply chain digitalisation, and/or automation intensity. These types of variables allow researchers to distinguish between front-end digital presence and operational digital transformation.

In addition, future research will examine differences in digital maturity across industries and firm types. As suggested by the current findings, it and digital services are more digitally mature than industrial sectors. However, there may be differences in the financial returns to digital maturity across industries. For example, manufacturing firms may derive greater value from supply chain digitalisation and b2b lead generation, while service firms may derive greater value from content creation, social media and customer engagement. Additionally, future research can explore how digital maturity affects a firm's ability to recover during crises when physical access to customers and traditional supply chains are interrupted.

Finally, future research may employ mixed-methods approaches to understand better the managerial decisions that influence digital maturity. While quantitative assessments demonstrate what is visible on the surface, qualitative methods can explain why managers choose particular digital channels over others. Therefore, such work would transform the DII from a classification tool to a more comprehensive theoretical understanding of MSME digital capability development.

Additionally, future research can connect digital maturity to market valuation indicators. Not only are public companies judged on their accounting results, but they are also evaluated on investors' perceptions regarding growth prospects, corporate governance, transparency, and narrative strategies. A strong online presence enables better communication with investors and reduces informational asymmetry; however, it also creates expectations that must be met by real operating performance.

8 Conclusion

This study transformed a firm-level digital classification and financial analysis into an empirical journal paper on Indian listed MSMEs. The study classified firms into ND-MSME, MD-MSME and HD-MSME groups using a Digital Intensity Index based on five observable indicators and examined whether digital maturity is associated with sales growth, ROA, ROE and NPM. The results are consistently emphasizing that digitally mature MSMEs outperform weakly and moderately digitally mature firms. The empirical results show that the HD-MSMEs have the highest average performance in all financial indicators. ANOVA confirms statistically significant differences across digital categories, and Tukey comparisons show the strongest gap between ND-MSMEs and HD-MSMEs. Correlation and regression analysis show that DII is positively and significantly associated with all four measures of performance with the most significant impact on ROA. Sector-wise analysis further shows that digitally intensive sectors tend to report stronger financial performance. Supplementary PLS-SEM evidence supports the mechanism that digital leadership, infrastructure, competency and customer engagement contribute to digital marketing adoption and market performance.

In summary, this article states that digital maturation is not simply about how an organisation communicates externally; digital maturation (as evidenced by its engagement) correlates with greater market reach, increased efficiency, improved profitability, and higher returns for shareholders of publicly traded micro-, small-, and medium-sized enterprises. The DII model proposed in this study represents a systematic, replicable, and evidence-based approach to measuring digital maturity in MSMEs. Future studies will continue to assess digital maturation using larger longitudinal datasets than those used in the current study and a broader range of digital metrics. However, the results of this study will help guide policymakers, investors, and researchers interested in assessing the financial performance implications of MSME digital maturation in developing countries.

In general, the authors demonstrate that even relatively simple measures of external digital maturation can identify significant variability in financial performance. This is particularly interesting since many small companies may not possess the resources required to execute comprehensive transformation programs, but can nonetheless develop credible and effective digital capabilities through discipline when creating high-quality public-facing digital systems. As such, MSME's from India looking to increase their growth rates or enhance investor confidence would view the development of digital maturation as a multi-stage process (i.e. create credibility of your digital identity, engage customers through integration of your digital platforms, maintain professionalism through consistent and timely updates on social media, generate relevant content that supports customer engagement and link all digital activities to measurable financial outcomes).

Appendix A: Company-wise digital intensity

classification

The following table reports the company-wise digital intensity scores used for classification. The final empirical analysis retained 38 firms after financial data cleaning; the full classification exercise originally covered 45 firms.

Appendix Table A1 Company-wise DII scores and final digital category

Company	DII score	Final category
Vertoz Ltd	5	HD-MSME
SoftTech Engineers Ltd	5	HD-MSME
AVG Logistics Ltd	5	HD-MSME
Touchwood Entertainment Ltd	5	HD-MSME
Route Mobile Ltd	5	HD-MSME
Affle India Ltd	5	HD-MSME
Quick Heal Technologies Ltd	5	HD-MSME
Zaggle Prepaid Ocean Services Ltd	5	HD-MSME
Xelpmoc Design and Tech Ltd	5	HD-MSME
Intense Technologies Ltd	5	HD-MSME
Saksoft Ltd	5	HD-MSME
Silver Touch Technologies Ltd	4	HD-MSME
DigiSpice Technologies Ltd	4	HD-MSME
Solex Energy Ltd	4	HD-MSME
Zodiac Energy Ltd	4	HD-MSME
Dynamic Cables Ltd	4	HD-MSME
Captain Polyplast Ltd	4	HD-MSME
Cadsys (India) Ltd	3	MD-MSME
Spectrum Electrical Industries Ltd	3	MD-MSME
Worth Peripherals Ltd	3	MD-MSME
Banka BioLoo Ltd	3	MD-MSME
Total Transport Systems Ltd	3	MD-MSME
Shanti Educational Initiatives Ltd	3	MD-MSME
Texel Industries Ltd	3	MD-MSME
Uniinfo Telecom Services Ltd	2	MD-MSME
Wonder Fibromats Ltd	2	MD-MSME
Shree Vasu Logistics Ltd	2	MD-MSME
Rhetan TMT Ltd	2	MD-MSME
Macpower CNC Machines Ltd	2	MD-MSME
Aaron Industries Ltd	2	MD-MSME
Narmada Macplast Drip Irrigation Systems Ltd	2	MD-MSME
Sintercom India Ltd	1	ND-MSME
Veeram Securities Ltd	1	ND-MSME
Gujarat Hy-Spin Ltd	1	ND-MSME
Tirupati Forge Ltd	1	ND-MSME
Surani Steel Tubes Ltd	1	ND-MSME
Supreme Engineering Ltd	1	ND-MSME
United Polyfab Gujarat Ltd	1	ND-MSME
Aakash Exploration Services Ltd	1	ND-MSME
Salasar Exteriors and Contour Ltd	1	ND-MSME
Kesar India Ltd	1	ND-MSME
Bharat Agri Fert and Realty Ltd	1	ND-MSME
Ashapuri Gold Ornament Ltd	1	ND-MSME
Genus Paper and Boards Ltd	1	ND-MSME
Gujarat Craft Industries Ltd	1	ND-MSME

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Data availability: The analysis is based on publicly observable digital indicators and company-level financial disclosures compiled by the author(s). The cleaned analytical dataset can be made available on

reasonable request, subject to verification of source disclosures.

References

1. Akter, S., Wamba, S. F., Gunasekaran, A., Dubey, R., & Childe, S. J. (2016). How to improve firm performance using big data analytics capability and business strategy alignment? International Journal of Production Economics, 182, 113-131. https://doi.org/10.1016/j.ijpe.2016.08.018
2. Bharadwaj, A., El Sawy, O. A., Pavlou, P. A., & Venkatraman, N. V. (2013). Digital business strategy: Toward a next generation of insights. MIS Quarterly, 37(2), 471-482. https://doi.org/10.25300/MISQ/2013/37:2.3
3. Bouwman, H., Nikou, S., & de Reuver, M. (2019). Digitalization, business models, and SMEs: How do business model innovation practices improve performance of digitalizing SMEs? Telecommunications Policy, 43(9), Article 101828. https://doi.org/10.1016/j.telpol.2019.101828
4. Frimpong, S. E., Agyapong, G., & Agyapong, D. (2022). Financial literacy, access to digital finance and performance of SMEs: Evidence from Central Region of Ghana. Cogent Economics & Finance, 10(1), Article 2121356. https://doi.org/10.1080/23322039.2022.2121356
5. Matarazzo, M., Penco, L., Profumo, G., & Quaglia, R. (2021). Digital transformation and customer value creation in Made in Italy SMEs: A dynamic capabilities perspective. Journal of Business Research, 123, 642-656. https://doi.org/10.1016/j.jbusres.2020.10.033
6. Nambisan, S. (2017). Digital entrepreneurship: Toward a digital technology perspective of entrepreneurship. Entrepreneurship Theory and Practice, 41(6), 1029-1055. https://doi.org/10.1111/etap.12254
7. Teece, D. J. (2007). Explicating dynamic capabilities: The nature and microfoundations of sustainable enterprise performance. Strategic Management Journal, 28(13), 1319-1350. https://doi.org/10.1002/smj.640
8. Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. Strategic Management Journal, 18(7), 509-533. https://doi.org/10.1002/(SICI)1097-0266(199708)18:7<509::AID-SMJ882>3.0.CO;2-Z
9. Valdez-Juárez, L. E., Ramos-Escobar, E. A., Hernández-Ponce, O. E., & Ruiz-Zamora, J. A. (2024). Digital transformation and innovation, dynamic capabilities to strengthen the financial performance of Mexican SMEs: A sustainable approach. Cogent Business & Management, 11(1), Article 2318635. https://doi.org/10.1080/23311975.2024.2318635
10. Verhoef, P. C., Broekhuizen, T., Bart, Y., Bhattacharya, A., Qi, J., Fabian, N., & Haenlein, M. (2021). Digital transformation: A multidisciplinary reflection and research agenda. Journal of Business Research, 122, 889-901. https://doi.org/10.1016/j.jbusres.2019.09.022
11. Verma, A., Das, K. C., & Misra, P. (2024). Digital finance and MSME performance in India: Evidence from World Bank Enterprise Survey data. Journal of Economic Studies, 52(5), 887-903. https://doi.org/10.1108/JES-12-2023-0744
12. Vial, G. (2019). Understanding digital transformation: A review and a research agenda. Journal of Strategic Information Systems, 28(2), 118-144. https://doi.org/10.1016/j.jsis.2019.01.003
13. Wamba, S. F., Gunasekaran, A., Akter, S., Ren, S. J., Dubey, R., & Childe, S. J. (2017). Big data analytics and firm performance: Effects of dynamic capabilities. Journal of Business Research, 70, 356-365. https://doi.org/10.1016/j.jbusres.2016.08.009
14. Warner, K. S. R., & Wäger, M. (2019). Building dynamic capabilities for digital transformation: An ongoing process of strategic renewal. Long Range Planning, 52(3), 326-349. https://doi.org/10.1016/j.lrp.2018.12.001