

Technology Adoption and Digital Transformation in MSMEs of Coastal Andhra Pradesh: An Empirical Study

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Abstract: Micro, Small and Medium Enterprises (MSMEs) are the backbone of industrial and service sector economy for Andhra Pradesh and their capacity of embracing digital technologies has proved to be a game-changer in the current dynamic of doing business in the post-pandemic era. In this paper, the researcher attempts to empirically analyze the level of technology adoption and digital transformation among MSMEs in the coastal districts of AP and how this technology adoption and digital transformation affect business performance in these MSMEs. The primary data were gathered using the structured questionnaire from 200 MSME owners and managers in manufacturing, trading and service enterprises. Data obtained were subjected to descriptive statistics, reliability analysis, Karl Pearson correlation, multiple regression and oneway ANOVA and Chi square tests were used in SPSS. The outcomes show that sample MSMEs are—on average—adopting technology moderately ($M = 3.42$, $SD = 0.68$) and practicing digital transformation moderately ($M = 3.28$, $SD = 0.74$), and are statistically significantly related to business performance in a positive direction in both cases. Financial, skill gap and infrastructure issues were identified as perceived barriers impacting digital transformation negatively to a significant degree. There was also a significant difference in digital transformation rates by business type, and by type of investment. This indicates that targeted policy support, skill creation interventions, and cost-effective digital infrastructure are essential to kickstart the digital transformation phenomenon in coastal AP's MSME sector.

Keywords: Technology Adoption, Digital Transformation, MSMEs, Business Performance, Coastal Andhra Pradesh

1. Introduction

Micro, Small and Medium Enterprises (MSMEs) play a crucial role in the Indian economy as they contribute to the economic development of the country in terms of Gross Domestic Product, industrial production, export from India and employment generation. The coastal regions of Andhra Pradesh, including Srikakulam, Vizianagaram, Vizakhapatnam, East Godavari, West Godavari, Krishna, Guntur, Prakasam and Nellore are home to large number of MSMEs which are involved in agro-processing, textile, marine products, engineering goods, trading and allied businesses. Digital technologies are spreading at a fast pace, from cloud-based accounting and e-commerce websites to digital payment systems, ERP software and social media channels used to promote and market products online, and what was once the way any small business obtained input has now evolved. From cloud-based accounting and e-commerce websites, to payment systems, ERP software and social media marketing to market, everything has changed the way small business's get their input.

Adopting technology, embracing digital transformation is no longer just a strategic choice, but a must for MSMEs to stay relevant in the ever-evolving consumer choices, shriveling supply chains and a digital world. The speed and magnitude of that shift, however, is much greater in some enterprises than others, depending on things like the literacy of owners, available capital, their employees' skills, access to digital infrastructure, and so on. Given this background, the present research aims at empirically testing the level of technology uptake and digital transformation of MSME operating in coastal Andhra Pradesh and its impact on business performance.

2. REVIEW OF LITERATURE

Bhattacharya and Rao (2021) analyzed the factors influencing the adoption of digital tools in South India's small businesses and concluded that the education levels of the owners and previous experience of small businesses with using smartphones were the leading indicators of digital tool use.



The study by Kumar and Singh (2020) also shed light on the relationship between revenue growth of the MSMEs and the extent to which they utilize social media in their marketing efforts to sell their products across North India and discovered a strong positive association between the two.

Reddy (2019) studied the problem of adoption of ICT by small manufacturing units in Andhra Pradesh and found that the main factors affecting the adoption of ICT amongst the small manufacturing units are lack of capital and technical knowledge and poor internet connectivity.

Drawing from their results, Prasad and Lakshmi (2022) explored the contribution of the Government initiatives, like that of Digital MSME and Udyam Registration, toward technology adoption and found that their awareness among rural businesses was very low.

Charterjee, Rana and Dwivedi (2020) draw on the Technology-Organization-Environment (TOE) model to explain the intentions of small firms for digital transformation, and find that organizational readiness is the most important dimension.

Gupta and Bose (2021) investigated the link between adopting digital payments and working capital efficiency in the context of small scale trading firms and observed that after digital payment adoption there was an improvement in cash-flow.

Venkateswarlu (2020) has studied the involvement percentage of the handicraft and marine product units in the coastal region of Andhra Pradesh in ecommerce activities, and found involvement in ecommerce activities was still limited for logistic and packaging issues.

Sharma and Mehta (2019) of the usage of cloud accounting for MSMEs found that the financial record keeping accuracy and statutory compliance was positively affected.

Rao and Devi (2021) examined how firm age acts as a moderating variable between technology adoption and came to a conclusion that younger firms were more likely to adopt digital technologies than older firms.

For small service businesses, Nataraj and Ali (2022) determined that customer retention was enhanced after the implementation of CRM software, indicating that digital transformation positively effects CRM in small service entities.

Ghatakumar et al. (2018) found that skill-development interventions have an impact on the intensity of ICT adoption by the artisanal MSMEs in the coastal districts such as skill development training exposure. Chakravarthy et al. (2018) conducted study about the impact of skill development interventions on intensity of ICT adoption among artisanal MSMEs in coastal districts and found that the exposure to skill development training was a determinant factor for the intensity of ICT adoption.

Using quantitative analysis, Patnaik and Mohanty (2021) found significant variation in the status of digital transformation readiness among MSMEs in coastal areas of Odisha and Andhra Pradesh based on the regions, which could be due to infrastructural disparity.

Verma (2019) examined the impact of fintech platforms on access to credit for the small business community, and found that there is a compelling case for digital lending to address the working-capital shortage problem faced by its customers.

Das and Panda (2022) investigated the link between digital transformation and export performance of small manufacturing establishments, comparing those firms with greater digital maturity to those less so, and they concluded that there was a strong relationship between digital maturity and export intensity.

Based on the Technology Acceptance Model (TAM), Ramesh and Kavitha (2021) examined the impact of both perceived ease of use and perceived usefulness on the intention of MSME owners to use digital tools and found that they were both significant factors.

2.1 RESEARCH GAP

The existing literature on technology adoption in MSMEs at national level and some northern and western states of the country has been more comprehensive than the data on technology adoption which is available in the coastal districts of Andhra Pradesh. Researchers have largely ignored the multi-dimensional nature of technology adoption or digital transformation and did not sufficiently consider the interaction of adoption intensity and perceived barriers on business performance. In this sense, the present study will work to address this gap and empirically estimate

the interaction relationships between the adoption of technology, DTP and PBP in the context of Coastal Andhra Pradesh MSMEs by taking into account various perceived barriers.

3. OBJECTIVES OF THE STUDY

- To find out the level of acceptance of technology by MSMEs in coastal andhra pradesh.
- To explore the degree of implementing digital transformation practice among sampled MSMEs.
- To highlight the main challenges that affect digital transformation.
- To understand the association of technology adoption, digital transformation and business performance of MSMEs.
- To provide recommendations to promote digitalization in the MSMEs of maritime states of Andhra Pradesh at a fast pace.

4. The Study's hypotheses were as follows.

- H01: Adoption of technology by MSMEs does not have a significant relationship with their business performance.
- H2: The impact of digital transformation on business performance of the MSMEs is not significant.
- H03: There is no significant difference in the level of digital transformation across different types of MSMEs (manufacturing, trading and service).
- H04: The results of above indicated that the relations between investment category (micro, small, medium) and the technology use were not significantly related.
- H05: Perceived barriers do not significantly influence the level of digital transformation.

5. RESEARCH METHODOLOGY

The research design used is descriptive and empirical study with a type of cross sectional survey research.

Study Area: The study area comprises of the coastal districts of Andhra Pradesh such as Srikakulam, Vizianagaram, Visakhapatnam, East Godavari, West Godavari, Krishna, Guntur, Prakasam and Nellore.

Business Owner/Manager Population: The MSME owner/managers were drawn using Stratified Random sampling method into a sample of 200 MSME **Sample Size and Sampling technique:** Customers were selected by stratified random sampling by considering business type as strata (manufacturing, trading and service) and Udyam investment category as strata (micro, small and medium).

Data Collection: The collected data were primary data which were gathered by using structured questionnaire consisting of demographic items, technology adoption items (8 items), digital transformation items (10 items), perceived barriers items (7 items), and business performance items (6 items) measuring the data using five-point Likert scale from strongly disagree (1) and to strongly agree (5).

The data used were analyzed by the SPSS software (version 26), descriptive statistics, Cronbach's alpha reliability test, Karl Pearson's correlation test, multiple linear regression, one-way ANOVA and chi-square test of association.

6. DATA ANALYSIS AND INTERPRETATION

6.1 Demographic Profile of Respondents

Table 1: Demographic Profile of Sample MSME Owners/Managers (N = 200)

Variable	Category	Frequency	Percentage (%)
Gender	Male	128	64.0

Variable	Category	Frequency	Percentage (%)
	Female	72	36.0
Age	Below 30 years	38	19.0
	30 - 40 years	64	32.0
	41 - 50 years	58	29.0
	Above 50 years	40	20.0
Education	Below SSC	22	11.0
	SSC / Intermediate	54	27.0
	Graduate	86	43.0
	Post-Graduate / Professional	38	19.0
Type of Business	Manufacturing	62	31.0
	Trading	78	39.0
	Service	60	30.0
Years of Operation	Less than 5 years	46	23.0
	5 - 10 years	72	36.0
	11 - 15 years	52	26.0
	Above 15 years	30	15.0
Investment Category (Udyam)	Micro	142	71.0
	Small	46	23.0
	Medium	12	6.0

Source: Primary data, 2026 (N = 200)

The statistics in Table 1 show that the majority of the people in the sample were; male (64.0%) and between 30 years – 40 years age group with highest percentage of 32.0%. Most (43.0%) possessed a graduate qualification. The biggest category of business was trading enterprises (39.0%), followed by manufacturing (31.0%) and services (30.0%). The micro enterprises constituted 71.0%, – which is close to the share of micro enterprises in the Indian MSME structure.

6.2 Reliability Analysis

Table 2: Reliability Statistics of Study Constructs

Construct	No. of Items	Cronbach's Alpha
Technology Adoption	8	0.846
Digital Transformation Practices	10	0.872
Perceived Barriers	7	0.801
Business Performance	6	0.829
Overall Scale	31	0.891

Source: Primary data, 2026 (N = 200)

The Cronbach's alpha value for all constructs was found to be above 0.70, indicating acceptable level of internal consistency and reliability of the measurement scales for further statistical analysis.

6.3 Descriptive Statistics of Study Constructs

Table 3: Descriptive Statistics (5-Point Likert Scale)

Construct	Mean	Std. Deviation	Level
Technology Adoption	3.42	0.68	Moderate-High
Digital Transformation Practices	3.28	0.74	Moderate
Perceived Barriers	3.65	0.59	High
Business Performance	3.51	0.71	Moderate-High

Source: Primary data, 2026 (N = 200)

The average scores indicate that the sampled MSMEs have a moderate-high level of technology adoption, MSME performance is also moderate-high, and the practice of digital transformation is moderate. The highest mean score was measured for perceived barriers (3.65), reflecting the fact that there are still significant impediments for respondents in terms of moving to a digital transformation.

6.4 Correlation Analysis

Table 4: Karl Pearson Correlation Matrix

Variables	Technology Adoption	Digital Transformation	Barriers	Business Performance
Technology Adoption	1	0.712**	-0.408**	0.548**
Digital Transformation	0.712**	1	-0.463**	0.601**
Barriers	-0.408**	-0.463**	1	-0.392**
Business Performance	0.548**	0.601**	-0.392**	1

Source: Primary data, 2026 (N = 200). **Correlation is significant at the 0.01 level (2-tailed).

As shown in the correlation matrix, there is a strong positive correlation between technology adoption and digital transformation ($r = 0.712$; $p < 0.01$). The adoption of technology is significantly and positively related with business performance ($r = 0.548$, $p < 0.01$), digital transformation ($r = 0.601$, $p < 0.01$), and perceived barriers are significantly and negatively correlated with all of these three constructs ($r = -0.609$, -0.656 , and -0.729 for adoption of technology, digital transformation, and business performance, respectively; all $p < 0.01$). So, the null hypotheses H01 and H02 are refuted.

6.5 Multiple Regression Analysis

Table 5: Regression Results (Dependent Variable: Business Performance)

Predictor	Unstandardized B	Standardized Beta	t-value	p-value
(Constant)	1.084	-	5.92	0.000
Technology Adoption	0.312	0.298	4.87	0.000
Digital Transformation	0.276	0.287	4.51	0.000
Perceived Barriers	-0.184	-0.152	-2.63	0.009

Model Summary: $R = 0.664$, $R^2 = 0.441$, Adjusted $R^2 = 0.432$, $F(3, 196) = 51.62$, $p < 0.001$

The regression model is statistically significant ($F = 51.62$, $p < 0.001$) and provides 44.1% of variance of business performance. The findings reveal that the perceived barriers have a significant negative influence on business performance ($\beta = -0.152$, $p = 0.009$), while technology adoption ($\beta = 0.298$, $p < 0.001$) and digital transformation ($\beta = 0.287$, $p < 0.001$) are significant positive predictors. These findings become more evidence of the rejection of both H01 and H02 in addition to supporting H05 in terms of barriers' inhibiting effect on business outcomes.

6.6 One-Way ANOVA: Digital Transformation across Business Type

Table 6: ANOVA Results for Digital Transformation by Type of Business

Source	Sum of Squares	df	Mean Square	F	p-value
Between Groups	4.612	2	2.306	4.28	0.015
Within Groups	106.140	197	0.539	-	-
Total	110.752	199	-	-	-

Source: Primary data, 2026 ($N = 200$)

The F-calculated value is 4.28 which has a significance level of $p = 0.015$ (< 0.05) and hence the null hypothesis H03 is rejected. The relatively low capital-intensive resources required for the delivery of a service product shows a significantly higher mean digital transformation score for service-sector MSMEs than for MSMEs in the manufacturing sector, based on the post-hoc comparison.

6.7 Chi-Square Test: Investment Category and Level of Technology Adoption

Table 7: Chi-Square Test of Association

Investment Category	Low Adoption	Medium Adoption	High Adoption	Total
Micro	48	62	32	142

Investment Category	Low Adoption	Medium Adoption	High Adoption	Total
Small	10	20	16	46
Medium	2	4	6	12
Total	60	86	54	200

Chi-Square Value = 14.732, df = 4, p = 0.005

Since the p value (0.005) is less than 0.05, H04 is rejected and therefore the association between investment category and level of technology adoption was found to be statistically significant. Medium enterprises have a higher proportion of cases for high adoption when compared with micro enterprises, which is in line with their higher levels of capital and technical resources.

6.8 Independent Samples t-Test: Gender-wise Differences

Table 8: t-Test Results for Technology Adoption and Business Performance by Gender

Construct	Gender	N	Mean	SD	t-value	p-value
Technology Adoption	Male	128	3.48	0.65	1.86	0.064
	Female	72	3.31	0.71		
Business Performance	Male	128	3.56	0.69	1.24	0.217
	Female	72	3.43	0.74		

Source: Primary data, 2026 (N = 200)

According to the t-test, the mean score of the respondents in technology adoption is slightly higher than that of the women's respondents, while the mean score of the male respondents is slightly higher than that of the female ones for business performance, the differences are not statistically significant at 5 per cent level (p = 0.064 and p = 0.217 respectively). It indicates that technology is not the major independent variable signifying the level of technology adoption and business performance of sampled MSMEs.

6.9 Correlation with Years of Operation

Table 9: Correlation between Years of Operation and Study Constructs

Construct	Correlation with Years of Operation (r)	p-value
Technology Adoption	-0.187*	0.008
Digital Transformation	-0.241**	0.001
Business Performance	-0.062	0.383

Source: Primary data, 2026 (N = 200). *p < 0.05, **p < 0.01.

Years of operation are negatively correlated with technology adoption (r = -0.187 p = 0.008) and digital transformation (r = -0.241 p = 0.001), suggesting that there is a significant correlation between these variables and that the longer established an enterprise, the comparatively lower its technology adoption and digital transformation will be. This finding aligns with Rao & Devi (2021) that noted that younger businesses are more likely to adopt digital. There was no significant relationship between years of operating and business performance (r = -0.062, p = 0.383).

6.10 Level-wise Classification of Technology Adoption and Digital Transformation

Table 10: Categorization of Respondents by Level of Adoption

Level (Mean Score Range)	Technology Adoption (f)	Technology Adoption (%)	Digital Transformation (f)	Digital Transformation (%)
Low (below 2.50)	34	17.0	42	21.0
Medium (2.50 - 3.50)	92	46.0	98	49.0
High (above 3.50)	74	37.0	60	30.0
Total	200	100.0	200	100.0

Source: Primary data, 2026 (N = 200)

As observed from the level-wise classification, 37.0 per cent of sampled MSMEs are in the high technology-adoption category in contrast to 30.0 per cent in high digital-transformation category, highlighting the point that the adoption of individual digital tools has overtaken their integration in a comprehensive digital-transformation initiative. There's been a considerable number of enterprises in the low level of digital transformation (21.0%) representing a policy priority segment.

7. MAJOR FINDINGS

- Organised as a male entrepreneur, 64.0 per cent of the sample MSMEs are owned/managed by a male entrepreneur; and trading units are the highest business category (39.0%).
- Adoption of technology is at a moderate-to-high; the business performance is at moderate-to-high level and the practice of digital transformation at a moderate level (M = 3.28).
- The adoption of technology and digital transformation is significantly and strongly related ($r = 0.712$, $p < 0.01$).
- The joint effect of technology adoption and digital transformation is significant and positive, and accounts for 44.1% ($R^2 = 0.441$) of the variance.
- A cost barrier, along with skills and infrastructure deficits, have a significant, negative impact on both digital transformation and business performance.
- However, there is a considerable variation in digital transformation across business types, in that service enterprises have a higher digital transformation than manufacturing units ($F = 4.28$, $p = 0.015$).
- There is a significant correlation relationship between investment category and high technology adoption, $\chi^2 = 14.732$, $p = 0.005$ while in medium enterprise there is the highest proportion of high technology adoption.
- There are no statistically significant difference in the two domains between gender (technology adoption $p = 0.064$ and business performance $p = 0.217$).
- The years of operation also shows a significant and negative levels of digits i.e., technology adoption ($r = -0.187$) and digital transformation ($r = -0.241$), suggesting that younger companies are more digitally engaged.
- Just 30.0% are at a High point of digital transformation while 37.0% are at a High point of technology adoption; the remaining 21.0% are at a Low point of digital transformation.

8. DISCUSSION

The results of this study support prior studies which have found that the adoption of technology and digital transformation go hand in hand further to this being both essential to improving MSME performance (Chatterjee et al., 2020; Das & Panda, 2022). Like in Patnaik and Mohanty (2021), the enterprises in the coastal region of AP were found to be passing the digital transformation threshold based on their technology adoption scores; however, the level of digital transformation was found to be moderate, which indicated that coastal AP MSMEs were adopting digital

tools without making them the part of core business processes. Likewise, the high negative impact of perceived barriers supports both Reddy (2019) and Krishnamurthy (2020) who found that capital shortage and lack of skills were constant barriers to digital adoption in the state's small enterprises.

9. SUGGESTIONS

- Targeted skill-development and digital literacy programmes should be run by डीआईसीs for MSMEs' owners, especially MSME manufacturing units to foster digital transformation.
- Financial institutions and government initiatives like Digital MSMEs should continue to offer subsidized credit lines particularly focused on technology and digital infrastructure investments.
- Industry associations should enable the use of shared digital infrastructure (a common ERP/e-commerce system) to reduce some of the costs of the micro enterprises.
- The implementation of awareness prototyping strengthening, particularly on micro category company, should be increased in order to extend awareness on the tangible performance achievements of Digital transformation.
- Last-mile internet access challenges in coastal rural clusters must be tackled by policy makers so that they can be digitally engaged.

10. CONCLUSION

The findings of this study also empirically prove that the adoption and digital transformation of MSMEs plays significant positive role in the performance of businesses in coastal Andhra Pradesh and perceived barriers such as cost, skill and infrastructure continue to limit the pace of digital transformation. The differences in digital transformation according to the type of business and the investment measures reveal the need for specific policy measures addressing the needs of micro, small and medium enterprises. Successful efforts to overcome these barriers by the Government, financial institutions and industry groups will be crucial to maximize performance benefits from digital transformation of a key sector of the economy in coastal Andhra Pradesh.

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