

NAVIGATING THE FUTURE : UNVEILING THE DYNAMICS OF INDUSTRY 5.0

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THE DYNAMICS OF INDUSTRY 5.0

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PREFACE

In an era marked by technological revolutions, the concept of Industry 5.0 stands at the forefront, promising a paradigm shift in the way industries operate. As we navigate the ever-evolving landscape unravel the intricacies and possibilities that Industry 5.0 holds. “Navigating the Future” invites all attendees to be active contributors to the ongoing dialogue that shapes the future on industries, fostering a community of forward – thinkers and innovators who are well – equipped to drive positive change in the world of Industry 5.0

Industry 5.0 is regarded as a fifth industrial revolution in which consumers could satisfy their individual requirements as per the tastes and expectations. Although the repetitive tasks are done by robots in Industry 4.0 which is at the mass customization level, Industry 5.0 aims to perform mass personalization with help of Artificial Intelligence.

Industry 5.0 is expected to revolutionize the production process with higher autonomy to collaborative robots. Industry 5.0 is the futuristic industrial revolution which is expected to bring in more creativity and innovation in the products by allowing robots to perform repetitive tasks. It is expected to utilize the creative intellectual capability of human optimally. Moving from mass production to custom manufacturing techniques and production system digitization and intelligentization.

In the lines if above, the PG & Research Department of Commerce has organized two days Conference on the theme “Navigating the Future: Unveiling the Dynamics of Industry 5.0” with the following objectives, to understand and gain knowledge on the functional areas of Industry 5.0; to provide a holistic understanding of the multifaceted dynamics of Industry 5.0 and to enhance the research aptitude among the academicians, scholars towards dynamic changing environment.

To get more insights on the above theme, research articles were invited for presentation and publication. The Department has received fifty (50) articles on various sub-themes from Professors and research scholars of various colleges in Tamil Nadu, Kerala and Karnataka. The Editorial Board has reviewed and edited all the papers scrupulously and meticulously with plagiarism check.

The Editorial Board has recommended and forwarded all the articles in the form of Edited Book with ISBN Publication Number for disseminating the knowledge to all the stakeholders of Higher Education Institutions and Industry concerned.

This book is a comprehensive guide for understanding and utilizing on various themes to generate indepth knowledge on it and suitable for research scholars as well as corporates. We hope that you will find this book informative and inquisitive as much as we learnt it.

Editorial Board.

CONTENTS

S.No	Title	Page No.
1	UNLOCKING INNOVATION IN MSMES THROUGH TECHNOLOGY ADOPTION S. Natanagopal & Dr.A. Mayil Murugan	1
2	FARMER PRODUCERS ORGANISATION - A NEW ERA OF INCLUSIVE GROWTH Ms.P. Gajalakshmi & Dr. A. Mayilmurugan	12
3	ROLE OF GREEN MARKETING IN SKILL DEVELOPMENT V.Preethi & Dr. M. Chandrasekaran	21
4	APPLYING KAIZEN AND LEAN PRINCIPLES TO MARKETING: A CONCEPTUAL FRAMEWORK Dr. S. Selvakumar & A.Suguna	31
5	A STUDY ON IMPLEMENTATION AND UPGRADATION OF STRATEGIC COST MANAGEMENT FOR INDUSTRY 5.0 J. Kenmai Selvam	37
6	IMPLICATION OF ARTIFICIAL INTELLIGENCE IN BANKING SECTOR Dr. K. Hemamalini & P.Sindhu	42
7	ROBO-ADVISORY SERVICES IN MSMES Roopa D & Dr Chaya R	48
8	DIGITAL MARKETING TRANSFORMATION IN THE DIGITAL PAYMENT INDUSTRY Ms.M.Anitha & Dr.S.Chandrasekar	57
9	A STUDY ON EFFECT OF INDUSTRY 5.0 IN STUDENTS – CHALLENGES AND SOLUTIONS Dr.D.Samundeeswari & Yughandra	63
10	A STUDY ON FOREIGN DIRECT INVESTMENT INFLOWS IN DEVELOPMENT OF ENTERPRISES AND SERVICES HUB (DESH) IN TAMILNADU WITH AN UNVEILING THE DYNAMICS OF INDUSTRY 5.0 S.Lakshmi Bharathi & Dr. R.Vennila	68
11	INSURTECH IN INDUSTRY 5.0 V.Nithya & Dr.A.Karuppusamy	81
12	HUMAN RESOURCES ANALYTICS Mr. S.Jeevananthan & Mr.M. Aravind	84
13	UNVEILING THE IMPACT OF INDUSTRY 5.0 TECHNOLOGIES ON CONSUMER CHOICES IN THE ORGANIC FOOD SECTOR J. ArunPriya & Dr A. MayilMurugan	92

14	ECO-EMPOWERMENT: SUSTAINABLE STRATEGIES FOR FMCG SUCCESS IN THE GREEN MARKET A.T.LogaRubini & Dr.K.Hema Malini	96
15	A STUDY ON REVOLUTION OF INDUSTRY 5.0 AND DEVELOPMENT OF FINTECH IN INDIA P. Banu Priya	104
16	EXPLORING THE GIG ECONOMY IN INDIA: OPPORTUNITIES AND CHALLENGES Mr.S.Praveenkumar & Dr.S.Chandarsekar	109
17	TECHNOPRENEURSHIP IN INDUSTRY 5.0 J.Gayathri & Dr.A.MayilMurugan	113
18	STRATEGIC COST MANAGEMENT TO NAVIGATE THE FUTURE: UNVEILING THE DYNAMICS OF INDUSTRY 5.0" Bhargavi R & Dr. Hema Malini	116
19	GREEN MARKETING - A WAY TO SUSTAINABLE DEVELOPMENT G.Mullainathan & A.Shakhil Reginald	125
20	INTRODUCTION OF ARTIFICIAL INTELLIGENCE IN HUMAN RESOURCE M.Muthukumar & S. Edward Gideon	132
21	INDUSTRY 5.0 IMPLEMENTATION: OPPORTUNITIES AND CHALLENGES Dr.K.Hema Malini & S.Bavani	140
22	SUSTAINABILITY IN MANUFACTURING; THE ROLE OF ARTIFICIAL INTELLIGENCE FOR ECO FRIENDLY PRACTICES IN INDUSTRY 5.0 Reshma.K. V & Dr. V. Selvam	145
23	IMPACT OF FINANCIAL INCLUSION ON THE GROWTH OF INDIAN ECONOMY P. Jayalakshmi & Dr. M. Ganesan	151
24	A STUDY ON UNRAVELING HUMAN CHALLENGES AND ITS SOLUTIONS IN THE WORKPLACE EVOLUTION OF INDUSTRY 5.0 Rubiserlin J	160
25	CYBER SECURITY CHALLENGES IN BANKING SECTOR S.Suba & Dr.A.Mayil Murugan	166
26	EXPLORING THE IMPACT OF CRM STRATEGIES ON CUSTOMER LOYALTY WITH THE MEDIATING ROLE OF RELATIONSHIP QUALITY R. Madhanagopal & R. M. Sowmiya Devi	172
27	A STUDY ON SUSTAINABLE INNOVATION FRAMEWORK OF LEAN SIX SIGMA IN INDUSTRY 5.0 A.Sahaya Stella	192
28	MANUFACTURING'S FUTURE REVOLUTION: EMBRACING INDUSTRY 5.0 Dr.G.Sindhu	200

29	A STUDY ON EXPLORING THE INTERSECTION OF SUSTAINABILITY AND INDUSTRY 5.0: TOWARDS HUMAN-CENTRIC AND ECO-FRIENDLY MANUFACTURING Dr.S.Saranya	206
30	RETAILERS PERCEPTION TOWARDS ONLINE RETAILING OF CHILDREN CLOTHES IN MADURAI DISTRICT P.Antony Raj & Dr.R.Mary Sophia Chitra	212
31	ISSUES AND CHALLENGES OF INTERNET OF THINGS Dr.D.Umamaheswari & Dr. R.Dharani	216
32	INTERNET OF THINGS CONCEPT AND APPLICATIONS: A REVIEW Dr. A. Nalli	218
33	STRENGTHS AND WEAKNESS OF FREELANCER SERVICES IN INDIA Dr. K. Surendran	221
34	A STUDY ON THE IMPACT OF ARTIFICIAL INTELLIGENCE IN EDUCATION AND TEACHING Dr. B. Shanmugapriya & Dr. S. Gurupriya	227
35	NAVIGATING THE UNORGANIZED SECTOR THROUGH DIGITALIZATION IN INSURANCE INDUSTRY B.Srividhya & Dr.A.Mayilmurugan	234
36	A STUDY ON THE TRENDS IMPLEMENTED IN THE DEVELOPMENT OF MARKETING IN THE DIGITAL ERA Dr. S. Selvakumar & Ms. K.S. Keerthiga	240
37	A SYSTEMATIC ANALYSIS ON AWARENESS OF MICROFINANCE IN INDIA AND ITS IMPACT R Vaishnavi & Dr. Y. Natarajan	246
38	AN INVESTIGATION INTO THE IMPACT OF E-COMMERCE ON FOSTERING SUSTAINABLE BUSINESS DEVELOPMENT G. Sreedevi	254
39	A STUDY ON CUSTOMER PREFERENCE TOWARDS INTERNET OF THINGS (IOT) IN BANKING SECTOR WITH SPECIAL REFERENCE TO MADURAI CITY Ms. K. Anandha Jothi Jeyalakshmi	262
40	INDUSTRY 5.0 APPLICATIONS FOR SUSTAINABILITY: A SYSTEMATIC REVIEW AND FUTURE RESEARCH DIRECTIONS K.Naganandhini	272
41	CYBER SECURITY AND INDUSTRY 5.0 S. Geetha	277

42	EXPLORING DIGITAL FINANCIAL LITERACY AMONG GEN - Y WOMEN WORK FORCE IN MADURAI CITY N.Uma Devi & Dr.S.Benita	281
43	DIFFICULTIES AND OPPORTUNITIES OF ARTIFICIAL INTELLIGENCE IN EDUCATION SYSTEMS Dr. S. Ramachandran	293

UNLOCKING INNOVATION IN MSMEs THROUGH TECHNOLOGY ADOPTION

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Abstract

The study explores the adoption of innovative technology in Micro, Small, and Medium Enterprises (MSMEs) in India, examining its impact on operational efficiency and identifying challenges encountered. Findings reveal a positive correlation between organizational culture factors and technology adoption, emphasizing the importance of leadership, policies, and flexibility. While technology adoption significantly enhances customer satisfaction, challenges such as compatibility issues and financial constraints persist. Suggestions include tailored training programs, technology adoption grants, and industry-academia partnerships to facilitate smoother integration. Practical solutions are proposed to address these challenges and foster a conducive environment for MSMEs to embrace innovation. Overall, the study provides insights into the transformative potential of technology adoption in MSMEs and offers actionable recommendations for stakeholders.

Keywords: MSMEs, Technology Adoption, Organizational Culture, Operational Efficiency, Challenges, Solutions, India, Innovation, Leadership, Policies.

Introduction

In the vibrant tapestry of India's economic landscape, the Micro, Small, and Medium Enterprises (MSMEs) sector stands as a dynamic force, not only as the second-largest job creator but also as a catalyst for regional balance and industrialization in rural areas (Financial Express, 2020). However, the orchestration of this sector is evolving, guided by the transformative melodies of cutting-edge technologies like AI, data analytics, and machine learning (ML) (IBEF, 2021). This symphony of innovation not only introduces novel business models, such as aggregator frameworks connecting creditors, borrowers, and enablers but also offers a lifeline for MSMEs seeking to simplify and automate their operations, thereby enhancing productivity (IBEF, 2021).

The recent cadence of change, accelerated by the COVID-19 pandemic, has compelled businesses to embrace technology and innovation for growth and survival (Fernando, José & José, 2020). Against this backdrop, the proactive integration of innovative cultures within organizations becomes imperative, setting the stage for a comprehensive exploration of the role of technology in MSMEs' resilience and prosperity.

A snapshot of this transformative journey is revealed by the insights garnered from a

poll of 250 small business owners conducted by Dun & Bradstreet in 2020. The findings illuminate the tangible benefits of digitization, with 54% of respondents claiming reduced operating expenses through the digitization of routine tasks, and 51% asserting an enhanced competitive positioning (Kaka et al., 2019). As the technological dawn unfolds, those who embrace innovation early are better poised to seize the opportunities within the Indian market. The study delves into the heart of India's economic engine—the MSME sector—where approximately 6.3 crores enterprises collectively generate 30% of the nation's GDP, 48% of annual exports, and sustain a workforce that represents the second-largest employment pool (IBEF, 2021). Within this expansive canvas, the intricate dance between traditional craftsmanship and technological evolution unfolds, showcasing the sector's critical role in India's economic narrative.

As MSMEs navigate this landscape, the study aims to unravel the intricate interplay between technology adoption and business growth, offering insights into how digital transformation can propel MSMEs towards a future where innovation is not just an option but a prerequisite for success. Join us as we explore the technological heartbeat pulsating through the veins of MSMEs, sculpting a narrative of resilience, adaptation, and innovation.

Innovative Technology Adopted by MSMEs

Digitalization of Processes: MSMEs are increasingly digitizing their operations, including inventory management, sales, and customer relationship management. This involves the adoption of software solutions such as Enterprise Resource Planning (ERP) systems, Customer Relationship Management (CRM) software, and Point-of-Sale (POS) systems.

E-commerce and Online Marketplaces: MSMEs are leveraging e-commerce platforms and online marketplaces to reach a broader customer base and expand their market reach. This includes setting up online storefronts, participating in online marketplaces like Amazon, eBay, or Etsy, and utilizing digital marketing strategies to promote their products and services.

Cloud Computing: Cloud computing technologies enable MSMEs to access computing resources, storage, and software applications over the internet on a pay-as-you-go basis. This allows MSMEs to scale their IT infrastructure efficiently, reduce infrastructure costs, and improve flexibility and agility in their operations.

Data Analytics and Business Intelligence: MSMEs are utilizing data analytics and business intelligence tools to gain valuable insights from their data, such as customer preferences, market trends, and operational performance. This enables MSMEs to make data-driven decisions, optimize processes, and identify new business opportunities.

Internet of Things (IoT): IoT technologies enable MSMEs to connect and remotely monitor physical devices and assets, such as machinery, equipment, and vehicles, in real-time. This enhances operational efficiency, reduces downtime, and enables predictive maintenance, leading to cost savings and improved productivity.

Artificial Intelligence (AI) and Machine Learning (ML): AI and ML technologies are

being increasingly adopted by MSMEs to automate repetitive tasks, improve decision-making processes, and personalize customer experiences. This includes applications such as chatbots, predictive analytics, and recommendation engines.

Renewable Energy Technologies: MSMEs are embracing renewable energy technologies such as solar panels, wind turbines, and energy-efficient appliances to reduce energy costs, lower their carbon footprint, and enhance sustainability.

TReDS (Trade Receivables Discounting System): MSMEs leverage TReDS platforms, digitally discounting invoices to access immediate funds against trade receivables. This innovative approach enhances cash flow management, working capital, and financial liquidity, empowering MSMEs for sustained growth and operational resilience. By streamlining invoice discounting processes through digital platforms, TReDS optimizes efficiency, accelerates cash flows, and mitigates financial constraints inherent in traditional financing methods.

Objectives of the Study

- To assess the innovative technologies adopted by MSMEs.
- To investigate the integration of innovation into the organizational culture of MSMEs and technology adoption.
- To analyze the effect of technology adoption on day-to-day operational efficiency in MSMEs.
- To identify the challenges encountered by MSMEs during the adoption of innovative technology.

Statement of the Problem

In the dynamic realm of Micro, Small, and Medium Enterprises (MSMEs) in India, the emergence of cutting-edge technologies brings both promise and challenge. While technology adoption holds the potential to revolutionize operations, foster growth, and enhance competitiveness, the journey towards digital transformation is not without hurdles. The multifaceted challenges faced by MSMEs in adopting new technologies include a lack of awareness about suitable digital solutions tailored to their unique organizational structures (Industrial Automation Magazine, 2021). Moreover, limited resources, both financial and human, pose significant barriers to the seamless integration of technology within MSMEs. The fear of falling behind the rapid pace of technological advancements, coupled with concerns about data security and the associated costs, further compounds the reluctance of MSMEs to embrace digital innovation (Industrial Automation Magazine, 2021). In light of the pivotal role MSMEs play in India's economic landscape, addressing these challenges becomes imperative for sustained growth, improved efficiency, and resilience against future disruptions. Therefore, the study aims to comprehensively investigate the obstacles hindering technology adoption among MSMEs, analyze their implications, and propose strategic solutions to facilitate a smoother integration of innovative technologies into their operational frameworks.

Scope of the Study

The study focuses on understanding the nuances of technology adoption within the MSME sector in India, with a particular emphasis on the challenges faced by enterprises during this transformative journey. The research will encompass various dimensions of technology adoption, ranging from digitization of routine tasks to the implementation of advanced technologies such as artificial intelligence, machine learning, and the Internet of Things. The scope also extends to different sectors within MSMEs, including manufacturing, trade, and other services, providing a holistic view of technology integration across diverse business domains. Additionally, the study will explore the role of digital platforms and initiatives launched by e-commerce giants to support MSMEs in their technology adoption endeavours. Insights into the current technology environment, challenges faced by MSMEs, and potential solutions will contribute to a nuanced understanding of the intricacies surrounding technology adoption in this critical sector. By delving into the intricacies of MSMEs' technology adoption challenges, the study aspires to provide actionable recommendations for policymakers, industry stakeholders, and MSMEs themselves, fostering an environment conducive to innovation, growth, and sustainability within this vital sector.

Research Design and Methodology

The study employed a Descriptive Research methodology, utilizing surveys and fact-finding inquiries. Descriptive Research aimed to provide a snapshot of the current state of affairs. Structured interview schedule method was used to gather information about the MSMEs in Madurai District, technological adoption, operational efficiency, challenges in technology adoption.

In accordance with the information available, the research methodology for the study will be designed based on the total population size of Micro, Small, and Medium Enterprises (MSMEs) in Madurai District, which is reported to be 32,546 units.¹

Population and Sample Design:

The total population under study was the MSME sector in Madurai District, consisting of 32,546 units. The sample frame consisted of structured MSME companies in the district, including various industries such as food, textiles, hosiery, wood, paper, leather, rubber, chemical, metal, machinery, and others. Stratified random sampling method was employed, to ensure representation from different sectors.

Sample Size Calculation

Considering the finite population, Slovin's formula was applied to determine the sample size. With a confidence level of 95% and a margin of error of 5%,

The calculated sample size: The sample size (with finite population correction) is equal to 380² to increase the accuracy of the output 400 samples collected, with 100 samples

¹ Madurai District Administration. (n.d.). Industries & Commerce. Retrieved from <https://madurai.nic.in/industries-commerce/>

² Good Calculators. (n.d.). Sample Size Calculator. Retrieved from <https://goodcalculators.com/sample-size-calculator/>

selected from each 4 cluster that is Food and food-based industries, Cotton textiles, Hosiery & readymade, Wood and wood-based industries.

Data Collection

Both primary and secondary data were utilized in the study to comprehensively investigate the status of digital transformation, challenges faced, and the impact on MSMEs in Madurai District. Primary data collection was conducted through a structured interview scheduled methods and utilizing an interval scale to assess the current state of affairs. Secondary data were gathered from various sources, including online journals, research reports, articles, and reports published by management consultants.

Framework of Analysis

The framework for analysis comprises percentage analysis, multiple regression, paired sample t-test, and descriptive statistics. Percentage analysis assesses proportional distribution, multiple regression examines relationships between variables, paired sample t-test compares means of related groups, and descriptive statistics summarize dataset characteristics.

An Analysis of Technological Adoption

Technological adoption among Micro, Small, and Medium Enterprises (MSMEs) across different dimensions. These dimensions include adoption rate, investment in technology, training programs, integration of technology into operations, and collaboration with tech providers. The table categorizes the level of technological adoption into five categories: Very High, High, Average, Low, and Very Low. The following table presents frequencies and percentages within each category provide insights into the distribution of MSMEs based on their technological adoption levels.

Table 1 Technological Adoption (Percentage Analysis)

Dimensions		Very High	High	Average	Low	Very Low
Adoption rate	Frequency	110	210	20	30	30
	Percentage	27	53	5	7	8
Investment in technology	Frequency	110	212	22	29	27
	Percentage	27	53	5	7	6
Training programs	Frequency	105	229	44	22	0
	Percentage	26	57	11	6	0
Integration of technology into operations	Frequency	123	239	4	34	0
	Percentage	30	60	1	9	0
Collaboration with tech providers	Frequency	107	245	35	13	0
	Percentage	27	61	9	3	0

Source: Primary Data & Computed

Table 1 presents data on the adoption of technology across various dimensions in an organization or industry. The dimensions considered are the adoption rate, investment in technology, training programs, integration of technology into operations, and collaboration with technology providers.

In terms of the adoption rate, a majority of the respondents (53%) indicated a high level of adoption, while 27% reported a very high adoption rate. Notably, only a small percentage (7% and 8%) reported low and very low adoption rates, respectively.

A similar pattern is observed for investment in technology, with 53% of respondents indicating a high level of investment and 27% reporting very high investment. The percentages for low and very low investment levels are relatively small at 7% and 6%, respectively.

Regarding training programs, the data suggests a strong emphasis on this aspect, with 57% reporting high levels of training programs and 26% indicating very high levels. Only 11% reported an average level of training programs, while 6% reported low levels.

The integration of technology into operations also shows a positive trend, with 60% of respondents indicating high levels of integration and 30% reporting very high levels. Remarkably, only 1% reported an average level, and none reported low or very low levels of integration.

Collaboration with technology providers is another area where the data reflects a favourable scenario. A majority of respondents (61%) reported high levels of collaboration, while 27% indicated very high levels. Only 9% reported an average level of collaboration, and 3% reported low levels of collaboration.

Overall, the analysis reveals that the industry has a strong commitment to technological adoption, with high levels of investment, training, integration, and collaboration with technology providers. However, there are still some areas where further improvement may be needed, as indicated by the small percentages reporting low or very low levels in certain dimensions.

Organizational Culture Factors and Technology Adoption in MSMEs.

Organizational Culture Factors and Technology Adoption in MSMEs. The following table presents the findings of a multiple regression analysis investigating the relationship between organizational culture factors and technology adoption.

Null Hypothesis (H0): There is no significant relationship between organizational culture factors and technology adoption in MSMEs.

Alternative Hypothesis (H1): There is a significant positive relationship between organizational culture factors and technology adoption in MSMEs.

Table 2 Organizational Culture Factors and Technology Adoption in MSMEs (Multiple Regression)

R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics	ANOVA ^a	
				R Square Change	F	Sig.
.944 ^a	.890	.890	1.16359	.890	1071.955	.000 ^b
Coefficient						
(Constant)	t	Sig.				
Leadership	15.696	.000				
Policies	1.990	.047				
Flexibility	2.320	.021				

Source: Primary Data & Computed

Table 2 shows the comprehensive regression analysis results and it shows a strong positive relationship between organizational culture factors (leadership, policies, and flexibility) and technology adoption in micro, small, and medium-sized enterprises (MSMEs). The model explains 89% of the variation in technology adoption, with leadership being the most significant factor, followed by flexibility and policies. The analysis confirms that fostering an organizational culture characterized by strong leadership, supportive policies, and flexibility is crucial for promoting technology adoption in MSMEs.

Day-To-Day Operational Efficiency

Technological adoption on day-to-day operational efficiency, analysing variables like cost-effectiveness, quality, customer satisfaction, and workforce productivity. The following table shows the result of Paired Sample T-Test.

Null Hypothesis (H0): There is no significant difference in day-to-day operational efficiency through technological adoption.

Alternative Hypothesis (H1): There is a significant difference in day-to-day operational efficiency through technological adoption.

Table 3 Day-To-Day Operational Efficiency (Paired Sample T Test)

Operational Efficiency Variables	Mean Before Technology Adoption	Mean After Technology Adoption	Paired t-value	Significant Level
Cost-effectiveness	3.95	3.93	0.690	0.000
Quality	4.15	4.15		
Customer Satisfaction	1.85	4.15	-40.140	0.000
Workforce Productivity	4.15	4.18	-0.9530	0.000

Source: Primary Data & Computed

Table 3 displays findings from paired sample t-tests comparing operational efficiency variables before and after technology adoption, encompassing cost-effectiveness, quality, customer satisfaction, and workforce productivity. For cost-effectiveness, there's no significant difference observed between pre-adoption (mean = 3.95) and post-adoption (mean = 3.93) phases, as indicated by a non-significant paired t-value (0.690, p-value = 0.000). Similarly, quality remains unchanged with means of 4.15 before and after adoption. Notably, customer satisfaction significantly surged from 1.85 to 4.15 post-adoption, supported by a substantially negative paired t-value (-40.140, p-value = 0.000). Conversely, while workforce productivity showed a slight uptick from 4.15 to 4.18 post-adoption, the increase was relatively small compared to the significant boost in customer satisfaction.

In summary, the paired sample t-tests reveal that technology adoption did not significantly impact cost-effectiveness or quality. However, it led to a substantial increase in customer satisfaction and a slight improvement in workforce productivity. These results suggest that the primary benefit of technology adoption in this case was enhancing customer satisfaction, while operational efficiency variables like cost-effectiveness and quality remained largely unchanged.

Challenges Encountered by MSMEs During the Adoption of Innovative Technology

The challenges encountered by Micro, Small, and Medium Enterprises (MSMEs) during the adoption of innovative technology. The variables include resistance to change, financial constraints, lack of technical expertise, compatibility issues, and concerns regarding technology adoption. The Following table shows the result of Descriptive Statistics.

Table 4 Challenges Encountered by MSMEs During the Adoption of Innovative Technology (Descriptive Statistics)

Variables	Mean	Std. Deviation	Coefficient of Variation (CV)
Resistance to Change	4.15	0.66	15.78
Financial Constraint	4.20	0.68	16.14
Lack of Technical Expertise	4.20	0.68	16.17
Compatibility Issues	4.65	0.48	10.28
Security Concerns	4.20	0.67	15.95

Source: Primary Data & Computed

Table 4 provides insights into the mean, standard deviation, and coefficient of variation (CV) for various variables representing the challenges faced by micro, small, and medium-sized enterprises (MSMEs) during technology adoption. Resistance to Change, Financial Constraint, Lack of Technical Expertise, Compatibility Issues, and Security Concerns are examined.

Resistance to Change exhibits a moderate level of variation with a CV of 15.78%, indicating its significance as a challenge, despite a slightly lower mean of 4.15. Financial Constraint and Lack of Technical Expertise both present high mean values of 4.20,

suggesting their substantial impact, corroborated by CVs of 16.14% and 16.17%, respectively. Compatibility Issues, with the highest mean of 4.65, emerge as the most critical challenge, highlighted by a CV of 10.28%, indicating less variation in responses. Security Concerns, with a mean of 4.20 and a CV of 15.95%, underscore their notable influence on technology adoption. Overall, the table suggests that MSMEs face several challenges during the adoption of innovative technology, with compatibility issues being the most critical concern. Financial constraints, lack of technical expertise, and security concerns are also major challenges, while resistance to change is a relatively less severe challenge compared to others. The coefficients of variation indicate moderate levels of variation in the responses for most variables, except for compatibility issues, which has a lower level of variation, suggesting a consensus on its importance as a challenge.

Findings

The following are the key findings derived from the study examining the technological adoption among Micro, Small, and Medium Enterprises (MSMEs).

Technology Adoption Levels: The majority of MSMEs exhibit high to very high levels of technology adoption across various dimensions, including investment in technology, training programs, integration into operations, and collaboration with tech providers.

Organizational Culture Factors: Strong leadership, supportive policies, and flexibility within organizational culture significantly correlate with higher levels of technology adoption among MSMEs.

Operational Efficiency Impact: While technology adoption did not notably affect cost-effectiveness or quality, it led to a substantial increase in customer satisfaction and a slight improvement in workforce productivity.

Challenges in Technology Adoption: MSMEs face significant challenges during the adoption of innovative technology, including compatibility issues, financial constraints, lack of technical expertise, and security concerns.

Importance of Collaboration: Collaboration with technology providers emerges as a critical factor in facilitating technology adoption among MSMEs, indicating the importance of external partnerships and support networks.

Suggestions

Based on the study findings, the following suggestions are proposed to enhance technological adoption and innovation within Micro, Small, and Medium Enterprises (MSMEs).

Tailored Training Programs: Develop customized training for digital literacy and software usage.

Technology Adoption Grants: Offer government-backed grants for tech implementation. **Industry-Academia Partnerships:** Foster collaborations for tech transfer and R&D.

Digital Innovation Hubs: Establish centres for tech resources and guidance.

Peer-to-Peer Networks: Create platforms for MSMEs to share insights.

Technology Adoption Roadmaps: Provide step-by-step guidelines for tech adoption.

Innovation Challenges: Organize competitions to spur tech innovation.

Technology Adoption Assessments: Offer tools to evaluate readiness and identify gaps.

Conclusion

The study delves into the complexities of technology adoption within the MSME sector, highlighting both its opportunities and challenges. While acknowledging the significant progress made by MSMEs in embracing technology, it also unveils the persistent obstacles impeding this journey.

The study underscores the crucial role of organizational culture in shaping technology adoption, stressing the need for a supportive environment characterized by visionary leadership, adaptable policies, and a culture of innovation. Such an environment not only facilitates the integration of innovative technologies but also fosters long-term success.

Furthermore, the study showcases the concrete benefits of technology adoption on operational efficiency, particularly in improving customer satisfaction. Yet, it also underscores the necessity of addressing challenges such as compatibility issues, financial constraints, and resistance to change, which hinder progress.

As MSMEs navigate these challenges, collaboration between policymakers, industry stakeholders, and MSMEs themselves becomes essential. By tackling these obstacles head-on and seizing the opportunities presented by technology adoption, MSMEs can chart a path towards sustainable growth and enhanced competitiveness in the digital economy.

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