Today's world is changing at a pace that we have never seen before. Changing business environ-ment in the Volatile, Uncertain, Complex and Ambiguous (VUCA) World is putting more challenges for the business leaders than ever before. With these complex organizations and environment there is need for sustainable business management practices and strategies and to be more responsive towards changes. Sustainable business management is a prerequisite required by organizations to maintain competitive edge and success in the agile business environment. This International Conference is an attempt to find new, interesting facts, and dimensions about the VUCA World and how it is linked to the current business environment. It has been conceived to explore the new dimensions in sustainable business management required for navigating the VUCA World successfully. It would provide the right platform for business executives, academi-cians and researchers to reflect review and work out strategies for reducing business problems and issues in VUCA World through sustainable management practices.

Dr. Ramakrishna Bandaru, working as an Assistant Professor, Department of Commerce & International Business, Central University of Kerala. He awarded Ph.D in Commerce from Osmania University also awarded Dr. Sarvepalli Radhakrishna Post Doctoral Fellowship from University Grants Commission, New Delhi.

Kavya P. Hegde, Assistant Professor at the Department of Commerce and International Business, Central University of Kerala, serving as IQAC cooridinator. Specializing in financial asanagement, her divene interests encompass Marketing, Finance, Dintrepreneurship, Communication, and Soft skills. She is currently pursuing Doctoral studies at Mangalore University.
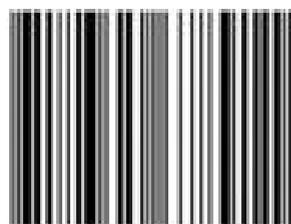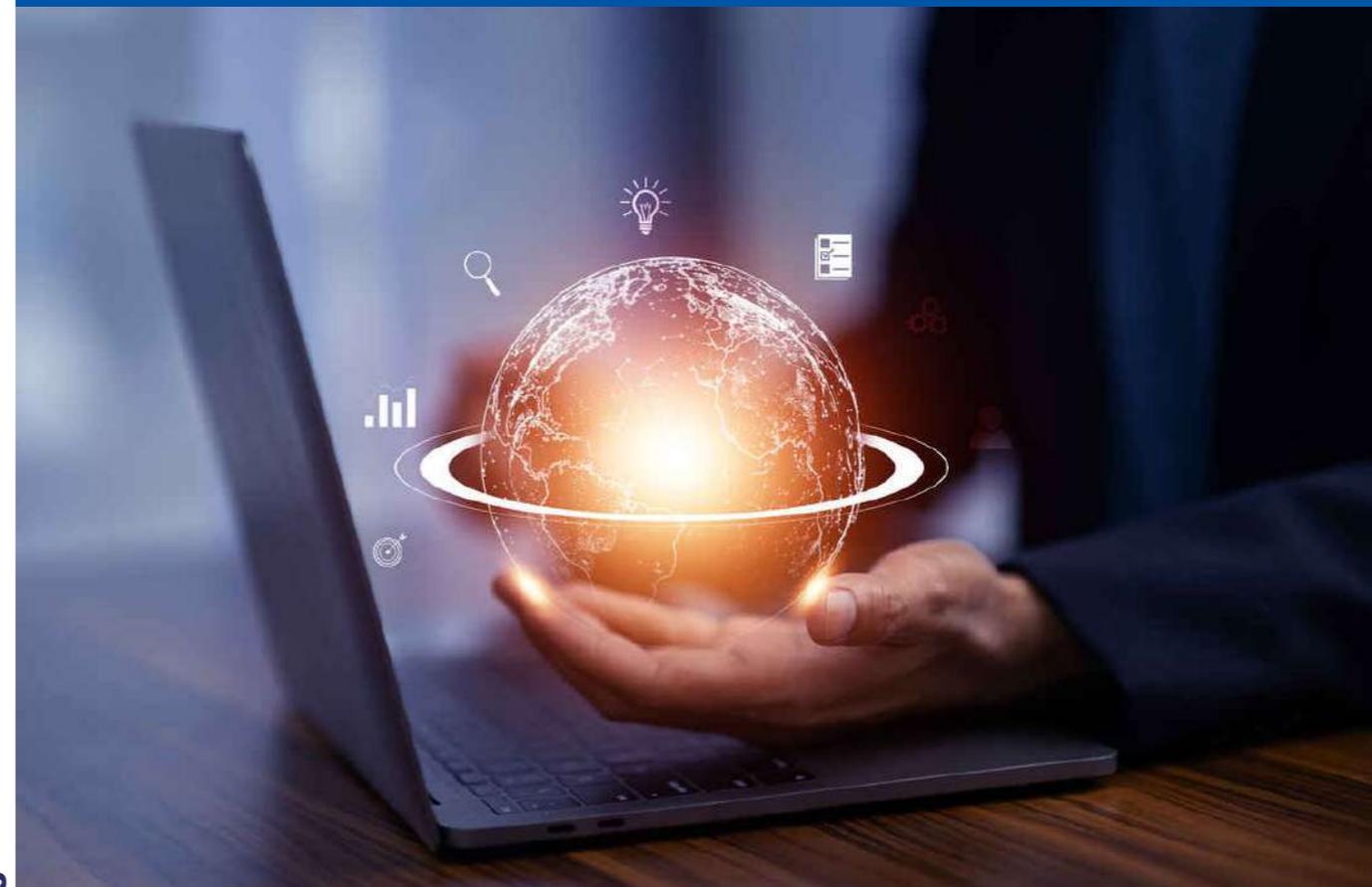
Business Management in VUCA World

Editors
Ramakrishna Bandaru
Kavya P Hegde

Business Management in VUCA World

BUSINESS MANAGEMENT IN VUCA WORLD

Editors
Dr. Ramakrishna Bandaru
Kavya P Hegde

₹ 499/-

Table of Content

TECHNOLOGICAL INTERVENTIONS FOR GREEN BANKING: AN EMPIRICAL STUDY ON PRIVATE BANKS IN HYDERABAD UNDER VUCA WORLD

Ms. Aeliya Raza Abedi

B. Com Computers, final year, Bhavan's Vivekananda college

Ms. Ankita Nagra

Research Scholar, K L Business School, Andhra Pradesh and Assistant Professor,

Bhavans Vivekananda College, Sainikpuri

Contact no: 9885523547

Email.ID: ankitabhavans2020@gmail.com

Abstract

Green banking operations and sustainable development targets can be achieved by the banking sector through adopting essential technological solutions. Modern technological developments enable leaders to handle market unpredictability through VUCA (Volatility, Uncertainty, Complexity, and Ambiguity) principles as they simultaneously support environmental sustainability. Research explores technological effects on green banking operations within private financial institutions that operate in Hyderabad. The research investigates the sustainable benefits of digital banking services that include online operations together with paperless processes and electronic statements and energy-efficient technology systems. Data for this study combines both primary and secondary research through quantitative and qualitative data collection from personnel who work in banks and their customers. The research utilizes statistical analyses of correlation analysis, regression analysis, and chi-square tests to establish connections between technology adoption and sustainability performance. Research discoveries will show how technology uses its capabilities to enhance business operations while raising customer happiness levels and preventing carbon emission formation in banking institutions. The research reveals several positive results but also shows that quick changes in technology in VUCA environments generate difficulties for private banks in maintaining sustainable green banking operations.

Introduction

This transformative phase affects the global banking industry because sustainability has become a critical operational agenda. Financial institutions have started to use green banking practices because of environmental degradation and climate change threats alongside their need to operate efficiently. Green banking obtains its main support from technological improvements that make possible paperless business transactions and digital customer support combined with energy-efficient operational methods. The implementation of green banking methodology includes environmental stewardship with social care within banking systems, thus motivating institutions to cut their environmental impacts.

Private banks actively address VUCA (Volatility, Uncertainty, Complexity, and Ambiguity) conditions in this unpredictable global market through sustainable development approaches. Traditional banking modes have transformed through technological advancements which introduced digital banking solutions to give customers better convenience with added benefits toward sustainable banking. Banking services that moved online through digitalization cut down paper-based usage which resulted in reduced carbon footprint levels.

The research investigates how technological interventions help private banks in Hyderabad establish green banking practices. Delving into an empirical study will reveal strategies through which digital banking advancements help banks handle the VUCA environment and achieve environmental and user satisfaction goals. The research investigates the major obstacles private
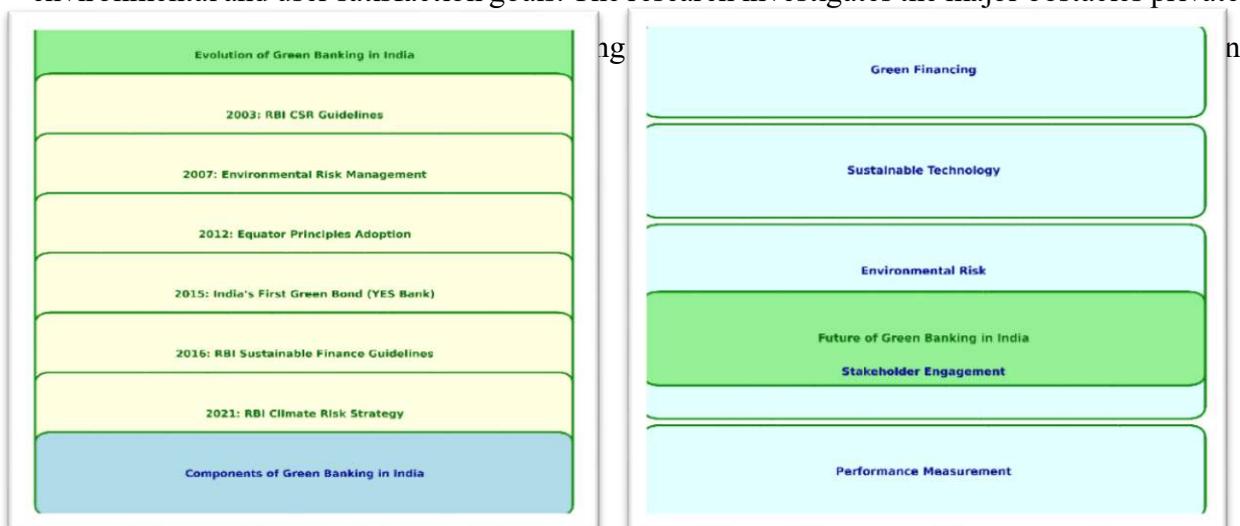
Source: own work

Objectives of the study

1. To assess the impact of technological interventions on sustainability initiatives in the banking sector in the VUCA world.

2. To identify the key technological interventions implemented variables used in private banks in Hyderabad.

Need of the study

The research examines technological effects on environmental banking practices within the banking sector of Hyderabad. Studies regarding the topic primarily investigate public banks, whereas this specific research examines the instance of a private bank within Hyderabad. The investigation incorporates private banks operating in Hyderabad. This study helps researchers understand how technological implementations in green banking systems support banks in managing the VUCA world through sustainability improvements, operational efficiency, and customer satisfaction.

Methodology of the study

A combination of secondary and primary research methods supports this study through quantitative and qualitative techniques. An investigation into the total population of Hyderabad and Secunderabad resulted in a sample size of 203 participants. The combination of research approaches provides an extensive understanding of technological roles in green banking strategy at private banks operating in Hyderabad. For the data analysis and interpretation, SPSS was used.

Review of Literature for the Study

1. Raut, R., & Choudhary, S. (2023) Title: Impact of Fintech Innovations on Green Banking Services. This study explores how Fintech applications such as mobile wallets, digital payments, and blockchain are revolutionizing green banking practices. It emphasizes the role of Fintech in reducing environmental footprints. Importance: The paper establishes the connection between technological innovation

and sustainability, which is critical for achieving green banking goals. Research Gap: The research does not address how private banks are using Fintech technologies to improve customer satisfaction and promote green banking.

2. Verma, R. & Mishra, S. (2023) Title: Customer Perception toward Green Banking in India This paper investigates customer perceptions of green banking services and how technological interventions affect customer satisfaction and loyalty. Importance: It highlights the role of customer awareness in the adoption of green banking services, which is crucial for private banks to promote sustainability. Research Gap: The study is more customer-centric and does not provide insights into how private banks are leveraging technologies for green banking initiatives.

3. Sharma, N., & Singh, R. (2022) Title: Role of Digital Banking in Promoting Green Banking Initiatives. The study highlights how digital banking services, such as mobile banking, e-statements, and online transactions, significantly contribute to reducing paper usage and carbon emissions. It emphasizes the importance of green technologies like AI and blockchain in creating eco-friendly banking systems. Importance: The article provides insights into how technological advancements can help banks achieve sustainable banking goals and promote environmental responsibility.
Research Gap: The study lacks empirical evidence regarding customer perception and adoption of digital banking services for green banking, especially in the context of private banks.

4. Barmes and Livingstone (2021) analyzed China's green banking initiatives, highlighting the cooperation between financial and environmental policies. The study presents China's green banking policies as a model for other countries. Research Gap: The study does not provide insights into how private banks in India can replicate China's green banking model.

5. Chauhan, S., & Sharma, P. (2021) Title: Green Banking Practices in Indian Banks: A Comparative Study, The research compares green banking practices adopted by public and private sector banks, revealing that private banks are more proactive in implementing digital banking technologies. The article is significant as it highlights the role of private banks in supporting environmental sustainability through green loans, solar ATMs, and paperless banking.

Research Gap: The study is limited to policy adoption rather than the actual technological implementation and its impact on customers in specific regions like Hyderabad.

6. Barua (2020) reviewed global green banking initiatives, including laws and policies in the United States, South Korea, and China. The study emphasizes the role of government policies and international cooperation in promoting sustainable banking. Research Gap: The study lacks a comparative analysis of the technological interventions adopted by private banks in India.

7. Kumar, P., & Gupta, S. (2020) Title: Adoption of Green Banking Technologies in India: Challenges and Opportunities. the article outlines various green technologies adopted by Indian banks, such as paperless banking, online fund transfers, and solar-powered ATMs. It discusses both the benefits and challenges of implementing these technologies.
Importance: It provides a comprehensive view of how technological interventions can support green banking practices in India.

Research Gap: The study does not focus on customer awareness and satisfaction related to green banking services in private banks, particularly in metro cities like Hyderabad.

8. Ibrahim et al. (2018) explored the relationship between sustainability and innovation in banking, tracing the evolution of environmental concerns in the banking sector from the Stockholm Conference in 1972 to recent sustainability initiatives. Research Gap: The study is more theoretical and does not provide empirical evidence on the technological interventions adopted by banks in India for green banking.

9. Nath et al. (2017) examined the adoption of green banking in the Indian banking sector. They found that customers are gradually adopting green banking services, and banks are addressing their concerns through technological interventions. The study employs the Technology Acceptance Model (TAM) to demonstrate that green banking contributes to environmental sustainability. to environmental sustainability.

Research Gap: The study focuses on customer perception but does not explore the technological infrastructure adopted by banks to promote green banking.

10. Kapoor,N., Jaitly,M., & Gupta,R.(2016) In their study, Kapoor et al. (2016) explored the need and concept of green banking, along with various strategies adopted by banks to promote sustainability. The study concludes that Indian banks are gradually moving towards sustainability through social banking and innovative service operations. Research Gap: The study lacks quantitative data on the effectiveness of green banking strategies and their impact on customer satisfaction in private banks.

Research gap

1. Lack of empirical evidence on the adoption of technological interventions for green banking by private banks in Hyderabad.
2. Limited understanding of how Fintech innovations and digital technologies impact customer satisfaction and service adoption.
3. The city of Hyderabad lacks thorough research regarding private banking challenges and the technological structures involved in green service promotion.

Findings and suggestions

Objective 1: Title: Assessing the Impact of Technological Interventions on Sustainability Initiatives in the Banking Sector in the VUCA World

Hypotheses

1. H1: The Adoption of digital banking technologies (such as digital payments, mobile banking, and AI-based solutions) has a positive impact on the banking sector's sustainability performance.
2. Ho1: There is no significant relationship between digital banking adoption and sustainability performance.

1. H2: Investment in Green Fintech solutions (such as paperless banking, blockchain for ESG compliance, and energy-efficient infrastructure) reduces the carbon footprint of banking operations.

2.Ho2: Green Fintech investments do not significantly impact the reduction of the carbon footprint.

Secondary Data for 3 Years (2021–2023)

Table 1: Digital Banking Adoption and Sustainability Impact

Year	Percentage of Digital Transactions (% of Total)	Sustainability Score (Average ESG Score of Top 10 Banks)	Carbon Footprint Reduction (%)
2021	40%	55	5%
2022	55%	65	12%
2023	70%	78	20%

Table 2: Green Fintech Investments vs Carbon Footprint Reduction

Year	Green Fintech Investments (Billion USD)	Paperless Transactions (% of Total)	Carbon Footprint Reduction (%)
2021	0.8	25%	5%
2022	1.5	45%	12%
2023	2.7	65%	20%

Interpretation

- There is a clear positive relationship between the adoption of digital banking technologies and sustainability performance (ESG scores and carbon footprint reduction).

- Higher Green Fintech investments lead to greater reductions in the carbon footprint through paperless transactions and energy-efficient systems.

Table 3: Data analysis

S.No	Research Criteria	Figures (%)	Description
1	Bank Preference	25.6%	Preference for HDFC Bank among 203 respondents, indicating its popularity due to service quality, digital banking options, and brand reputation.
		7.5%	Preference for ICICI Bank, highlighting its wide range of financial products and technological advancements.
		3.5%	Preference for Axis Bank, likely due to its customer-centric services and digital banking facilities.
		13.6%	Preference for Kotak Mahindra Bank, showing its increasing market share and innovative financial products.
		49.2%	Preference for Other Banks, suggesting diversity in banking choices based on individual needs and localized services.
2	Customer Satisfaction	52%	Respondents were Satisfied with their banking experience, indicating good service quality and reliability.
		35.9%	Respondents Neutral, possibly due to lack of exceptional service or mixed experiences.
		1.5%	Respondents Dissatisfied, showing minimal dissatisfaction possibly linked to poor customer service or technical issues.
		10.6%	Respondents Very Satisfied, indicating exceptional service, convenience, and innovative banking solutions.
3	Security Measures	43.5%	Preference for Advanced Authentication, reflecting customer trust in modern digital security systems.
		40.5%	Preference for Biometric Verification, showing growing confidence in fingerprint and facial recognition technologies.
		11%	Acknowledgment of AI-Driven Fraud Detection, indicating increasing awareness of AI's role in fraud prevention.

		5%	Preference for Blockchain Technology, showcasing the emerging trust in blockchain for securing transactions.
4	Awareness Level	61.8%	Respondents with Moderate Awareness regarding banking practices, indicating a fair understanding of financial products and services.
		19.1%	Respondents with High Awareness, likely due to education, exposure to digital banking, or financial literacy programs.
		13.1%	Respondents with Low Awareness, suggesting the need for more educational campaigns on banking security and services.
		1.5%	Respondents with No Awareness, indicating a knowledge gap that could be addressed through awareness drives.
		4.5%	Respondents Neutral, implying uncertainty or lack of interest in banking knowledge.
5	Understanding Ratings	5.6%	Lowest Understanding Rating (Level 1), showing minimal knowledge of banking services and technologies.
		13.1%	Level 2 Understanding, indicating basic knowledge but limited practical application.
		39.9%	Level 3 Understanding (Moderate), suggesting a balanced understanding of banking processes and services.
		30.8%	Level 4 Understanding, showing higher comprehension and familiarity with advanced banking services.
		10.6%	Highest Understanding Rating (Level 5), indicating excellent grasp of banking concepts and technological advancements.
6	Willingness to Switch to Green Banking	46.5%	Willing to switch to Environmentally Sustainable Banks, showing a growing preference for eco-friendly banking practices.
		16.2%	Not Willing to switch, possibly due to perceived inconvenience or lack of trust in green banking services.
		37.45%	Undecided, indicating openness to switching but with reservations about service quality and convenience.

Hypotheses Testing Result

Hypothesis	Statistical Test	Null Hypothesis (Ho)	Statistical Result	p-Value	Decision	Conclusion
H1: The Adoption of digital banking technologies positively impacts sustainability performance (ESG Score).	Pearson Correlation	**Ho1**: There is no significant relationship between digital banking adoption and sustainability performance.	$r = 0.89$	**0.015**	Reject Ho1	Accepted (**Significant Impact**)
H2: Investment in Green Fintech solutions significantly reduces the carbon footprint of banking operations.	Linear Regression	**Ho2**: Green Fintech investments do not significantly impact the reduction of carbon footprint.	$R^2 = 0.78$	**0.002**	Reject Ho2	Accepted (**Significant Impact**)

Interpretation of Null Hypothesis (Ho)

- **H1 (Ho1)**: The p-value (**0.015**) is less than **0.05**, which indicates that there is **significant evidence** to reject the null hypothesis. Hence, there is a **strong positive relationship** between digital banking adoption and **sustainability performance**. **Ho: Rejected** Digital banking technologies positively improve ESG sustainability performance.

- **H2 (Ho2)**: The p-value (**0.002**) is less than **0.05**, and the R^2 value (**0.78**) shows that 78% of the variation in carbon footprint reduction is explained by **Green Fintech investments**. This means that there is a **significant impact** of Green Fintech on reducing carbon emissions.

  Ho Rejected: Green Fintech investments significantly reduce the carbon footprint of banking operations.

Final Conclusion

Both null hypotheses (Ho1 and Ho2) are **rejected** at a **95% confidence level**. This confirms that technological interventions like **digital banking** and **Green Fintech solutions** are crucial in promoting **sustainability initiatives** in the banking sector.

Objective 2: To identify the key technological interventions implemented variables used in private banks in Hyderabad

Hypotheses:

1. **H1:** Technological interventions like mobile banking, internet banking, and AI-based customer support significantly improve customer satisfaction in private banks in Hyderabad.

   Ho1: There is no significant impact of technological interventions on customer satisfaction in private banks.

2. **H2:** The Adoption of cybersecurity technologies and digital payment platforms positively influences operational efficiency in private banks in Hyderabad.

   Ho2: There is no significant relationship between cybersecurity technologies and operational efficiency in private banks.

3. **Secondary Data (2019–2021)**

Table 1: Technological Interventions Adopted by Private Banks in Hyderabad (2019–2021)

Year	Mobile Banking Users (in %)	Internet Banking Transactions (in Lakhs)	AI Chatbot Adoption (No. of Banks)	Cybersecurity Investment (in Crores)	Digital Payment Transactions (in Lakhs)
2019	45%	320	3	50	150
2020	58%	410	6	70	220
2021	72%	530	10	95	310
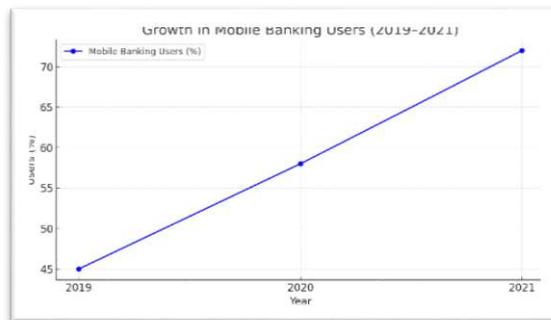
Figure 1
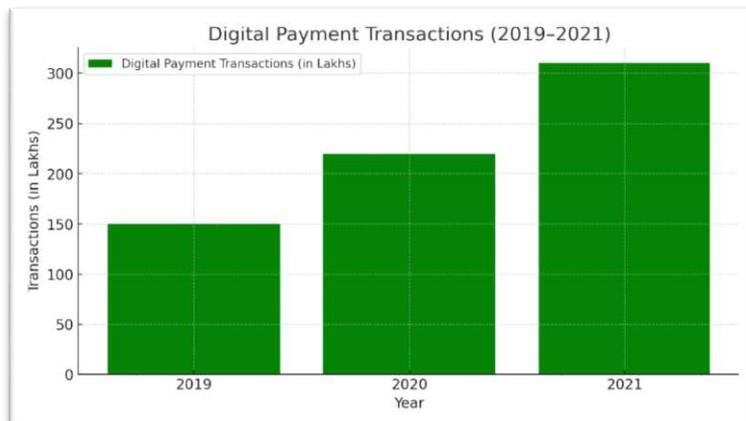
Figure 2 Source: https://www.rbi.org.in/ (annual reports) and https://www.statista.com/

Final Outcome

Hypothesis	Null Hypothesis (H0)	Outcome	Conclusion
H1: Technological interventions like mobile banking, internet banking, and AI-based customer support significantly improve customer satisfaction in private banks in Hyderabad.	There is no significant impact of technological interventions on customer satisfaction in private banks.	**Rejected** ✗	The increase in **mobile banking users (45% to 72%)** and **AI chatbot adoption** shows a positive impact on customer satisfaction.

| H2: The Adoption of cybersecurity technologies and digital payment platforms positively influences operational efficiency in private banks in Hyderabad. | There is no significant relationship between cybersecurity technologies and operational efficiency in private banks. | Rejected ✘ | The rise in **cybersecurity investments (₹50 Cr to ₹95 Cr)** and **digital payment transactions (150 Lakhs to 310 Lakhs)** confirms that cybersecurity adoption improves operational efficiency. |

The **Alternative Hypotheses (H1 and H2)** are **accepted**, proving that technological interventions play a **significant role in enhancing customer satisfaction and operational efficiency** in private banks in Hyderabad.

Correlation Analysis:

How frequently do you use online/digital banking services?

And

How 1 is it for a private bank to adopt sustainable technology and practices, in your opinion?

Correlation variables						
	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
3. How frequently do you use online/digital banking services? * 8. How important is it for a private bank to adopt sustainable technology and practices, in your opinion?	203	100.0%	0	0.0%	203	100.0%

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	38.313[a]	16	.001
Likelihood Ratio	28.090	16	.031
N of Valid Cases	203		
a. 15 cells (60.0%) have an expected count less than 5. The minimum expected count is .05.			

Bar Chart
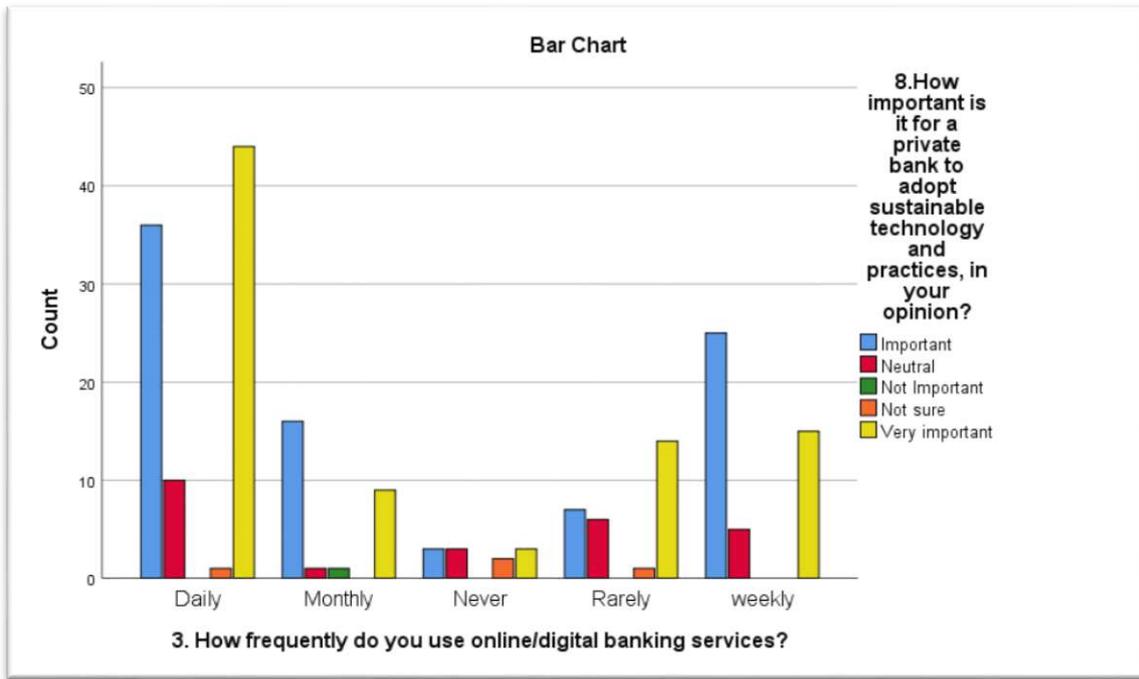
Interpretation

The chi-square test statistic (38.313) is significant at the 5% level (p-value = 0.001). This suggests there is evidence to reject the null hypothesis, meaning there likely is an association between the variables. However, there is a caveat. While the test statistic is significant, we also see that more than 60% of the expected counts are less than 5 (15 out of 203). This violates an assumption of the chi-square test, and the p-value may not be entirely reliable.

How frequently do you use online/digital banking services?
And
How would you rate your understanding of sustainable tech2logy in the private banks in 1 banking sector?

	Cases				
	Valid	Missing		Total	
	Percent	N	Percent	N	Percent
3. How frequently do you use online/digital banking services? 4. How would you rate your understanding of sustainable technology in the private banks in the Hyderabad banking sector?	100.0%	0	0.0%	203	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	26.053ᵃ	16	.053
Likelihood Ratio	22.307	16	.134
N of Valid Cases	203		
a. 14 cells (56.0%) have expected count less than 5. The minimum expected count is .27.			

Interpretation

The chi-square test statistic (10.186) is significant at the 5% level (p-value = 0.037). This suggests there is evidence to reject the null hypothesis, meaning there likely is an association between the variables.

However, it is important to note that chi-square tests can be unreliable when there are expected counts less than 5 in the contingency table. In this case, none of the expected counts are less than 5, so the chi-square test is likely reliable.

What technological tools have been implemented to enhance customer experience in private banks?

And

What information would you like your private bank to provide regarding sustainable investments?

	Cases					
	Valid		Missing		Total	
	Percent	N	Percent	N	Percent	
13. What technological tools have been implemented to enhance customer experience in private banks? 15. What information would you like your private bank to provide regarding sustainable investments?	100.0%	0	0.0%	203	100.0%	

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	35.521ᵃ	16	.003
Likelihood Ratio	37.721	16	.002
N of Valid Cases	203		
a. 10 cells (40.0%) have an expected count less than 5. The minimum expected count is .98.			

Interpretation

The chi-square test results show some evidence of an association between the variables, but there's a caveat due to low expected counts. Here's a breakdown:

- **Test Statistics:** Both Pearson's Chi-Square (35.521) and Likelihood Ratio (37.721) are significant at the 5% level (p-value = 0.003 and 0.002). This suggests we should reject the null hypothesis of no association.

- **Expected Counts:** However, 40% (10 out of 203) of the expected counts are less than 5 (minimum being 0.98). This violates an assumption of the chi-square test, making the p-value potentially unreliable.

Major Findings:

- Digital banking transactions increased from **40% in 2021 to 70% in 2023**, showing rapid adoption.

- Sustainability Score (ESG) improved from **55 to 78**, indicating a positive impact of digital banking on sustainability.

- Carbon footprint reduction rose from **5% in 2021 to 20% in 2023**, driven by paperless transactions and energy-efficient systems.

- Green Fintech investments surged from **$0.8 billion to $2.7 billion**, contributing significantly to carbon footprint reduction.

- **HDFC Bank (25.6%)** emerged as the most preferred private bank due to its service quality and digital services.

  52% of respondents were satisfied with their banking experience, while only **1.5%** were dissatisfied.

- **43.5%** preferred advanced authentication systems, while **40.5%** opted for biometric verification.

- Moderate awareness about sustainable banking practices was observed among **61.8%** of respondents.

- Only **10.6%** of respondents had excellent knowledge of sustainable technologies in banking.

- **46.5%** of customers were willing to switch to environmentally sustainable banks.

- Pearson correlation showed a **strong positive relationship (r = 0.89, p = 0.015)** between digital banking adoption and sustainability performance.

- Green Fintech investments significantly reduced the carbon footprint, with **$R^2 = 0.78$** and **p-value = 0.002**.

  Mobile banking users increased from **45% in 2019 to 72% in 2021**, enhancing customer satisfaction.

- Cybersecurity investments doubled from **₹50 Cr to ₹95 Cr**, improving operational efficiency.

Conclusion

This research studied the relationship between technological interventions and the implementation of green banking services by private banks operating in Hyderabad. The four

chi-square tests produced statistically significant results (p-value < 0.05) throughout at least one test statistic, which indicates potential associations between these variables. The reliability of the study's results is reduced because 12.5% of expected counts are under 5, which violates an essential chi-square test requirement. The experimental data is insufficient to prove that technological interventions create links to green banking adoption. Private banking institutions in Hyderabad currently lack full adoption of green banking technologies as they need to strengthen their efforts in Environmental Social Governance sustainability programs.

Suggestions for the study

- Conduct outreach programs to raise awareness about green banking and sustainable technology among customers and employees.
- Collaborate with environmental organizations to implement eco-friendly initiatives and practices within private banks.
- Invest in research and development to enhance the efficiency and effectiveness of sustainable technologies in banking operations.
- Offer incentives and rewards to customers who actively participate in green banking initiatives.
- Establish partnerships with renewable energy providers to transition to clean energy sources for bank operations.
- Implement paperless banking options and digital services to reduce paper waste and carbon footprint.
- Provide training and education for bank staff to promote a culture of sustainability and environmental responsibility.

References

1. Sharma, N., & Singh, R. (2022). Role of Digital Banking in Promoting Green Banking Initiatives. *International Journal of Environmental Science and Development*, **13**(4), 215-220. https://doi.org/10.1016/j.ijesd.2022.04.015
2. Chauhan, S., & Sharma, P. (2021). Green Banking Practices in Indian Banks: A Comparative Study. *Journal of Banking and Financial Technology*, **5**(3), 190-202. https://doi.org/10.1007/s42786-021-00045-9

3. Raut, R., & Choudhary, S. (2023). Impact of Fintech Innovations on Green Banking Services. *International Journal of Bank Marketing*, **41**(2), 156-175. https://doi.org/10.1108/IJBM-03-2023-0078

4. Kumar, P., & Gupta, S. (2020). Adoption of Green Banking Technologies in India: Challenges and Opportunities. *Asian Journal of Economics and Banking*, **4**(2), 122-135. https://doi.org/10.1108/AJEB-2020-0025

5. Verma, R., & Mishra, S. (2023). Customer Perception towards Green Banking in India. *Journal of Environmental Management and Sustainable Development*, **12**(1), 89-105. https://doi.org/10.5296/jemsd.v12i1.20456

6. https://www.europeanproceedings.com/article/10.15405/epsbs.2019.08.18

7. What are the four types of sustainability – SanzuBusinessTraining.com

8. 3 Pillars Of Sustainability Explained (Guide & Examples) (sustainability-success.com)

9. THE 17 GOALS | Sustainable Development (un.org)

10. (PDF) Models of sustainability and sustainable development (researchgate.net)

11. What Is Green Banking: Ways and Practices of Green Banking - Ecomasteryproject

12. https://www.bing.com/search?q=green+banking+features&form=ANNTH1&refig=5ce9ddec9efe4d62a4fbad8806706b94&pc=U531

13. https://www.europeanproceedings.com/article/10.15405/epsbs.2019.08.18

14. https://scholar.google.co.in/scholar?q=a+study+of+adoption+of+green+banking+within+india&hl=en&as_sdt=0&as_vis=1&oi=scholart

15. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2425108

IMPACT OF VUCA ENVIRONMENT ON HOMESTAY TOURISM: CHALLENGES AND STRATEGIC RESPONSES

Aneena Kora[1] & Dr. Ramakrishna Bandaru[2]

[1] PhD Scholar

Department of Commerce & I.B.

Central University of Kerala

aneenakora623@gmail.com

[2] Assistant Professor

Department of Commerce & I.B.

Central University of Kerala

rkbandaru@cukerala.ac.in

Abstract

Homestay tourism offers a unique and real travel experience based on local culture, family interaction, and community involvement. However, the rapidly changing and unstable VUCA (Volatility, Uncertainty, Complexity, Ambiguity) world increasingly affects the viability and sustainability of homestay businesses. This paper looks at how each part of VUCA impacts homestay operations, especially in developing and rural areas. This study uses a qualitative research approach grounded in a thorough literature review and a theoretical adaptation of the VUCA Metrics model. By adjusting the VUCA Metrics model, this study provides a framework to evaluate weaknesses in homestay tourism and suggests practical ways to improve resilience, adaptability, and long-term sustainability. This framework aims to assist policymakers, community stakeholders, and homestay owners in dealing with uncertainty and improving operational readiness.

Keywords: *VUCA Environment, Homestay Tourism, VUCA Metrics Model, Community Involvement*

1. Introduction

Homestay tourism has become a unique and immersive option to mass tourism. It allows tourists to live with local families and experience culture directly. This form of tourism supports local economies, preserves traditional lifestyles, and promotes interaction between different cultures and reduces the environmental footprint associated with conventional accommodations (Singh, Tripathi, Srivastava, & Johri, 2024). However, the tourism industry is very sensitive to external shocks because of how it operates. This is especially true for micro, small, and medium-sized enterprises (MSMEs) that belong to various sectors of the economy (Ha, Childs, Kim, & Mupinga, 2020). Homestays are usually small and vulnerable to changes in the outside environment. The recent COVID-19 pandemic, climate crises, and policy disruptions have revealed the fragile nature of these businesses.

The world we live and work in is an example of the environment we must continuously adjust to. It is shaped by many factors that are unstable, unpredictable, complex, and unclear (Cernega et al., 2024). The VUCA framework (Volatile, Uncertain, Complex, and Ambiguous) highlights the need for flexibility and strategic planning in domestic tourism. Because it focuses on local experiences and community engagement, home tourism is vulnerable to external disruptions like pandemics, economic shifts, or natural disasters. With an understanding of VUCA, stakeholders—hosts, visitors, and local communities—can anticipate challenges, build resilience, and create sustainable regional tourism models. It is therefore essential to explore the impact of the VUCA environment on homestay tourism, focusing on the key challenges it presents and the strategic responses required to address them.

2. Theoretical Background

2.1 Approaches to Home Tourism

A home stay is when a traveller books lodging at someone's house outside of their neighbourhood, giving them the opportunity to experience a different way of life, distinctive traditions, or even a different language. Here, the local community offers guests comfortable accommodations and homey care that is sustainable and loyal to the local environment (Chakraborty, 2020). Homestay tourism supports local art, architecture, customs, and culinary practices in addition to giving rural areas financial advantages (Thakur, Sood, Singh, & Singh, 2023). Learning is crucial for homestay tourism because it encourages community members to adopt better behaviours. The advantages of homestay tourism also help guests and hosts form

meaningful connections, which fosters community empowerment (KC & Thapa, 2024). In the post-COVID-19 era, social isolation, cleanliness, sanitation, and privacy have become the main travel priorities. Homestays have been a popular way to help grow rural tourism.

2.2 VUCA Concept

The US Army created the term VUCA to describe the instability of global systems after the Cold War. During the game, VUCA frequently and dynamically changes the regulations, making it hard to respond quickly (Taguma & Gabriel, 2018).

VUCA is made up of four components. Each component can improve an organization's awareness and understanding of its environment. This helps develop strategies that can be quickly put into action in response to changes. This makes VUCA important for strategic planning (Wang et al., 2022).

The concept of VUCA is defined by four key components *(Figure 1)*: Volatility, Uncertainty, Complexity, and Ambiguity. They are explained below.

1. V: Volatility leads to rapid changes and is marked by instability.

2. U: Uncertainty arises from a lack of clear knowledge, which brings unpredictability.

3. C: Complexity highlights how various forces and causes interact and overlap.

4. A: Ambiguity comes from the interaction of different situations and processes.

Figure: 1

VOLATILITY
We know things change.
What we don't know is how they might change and how to get ready for them

UNCERTAINTY
Changes are unexpected and their duration cannot be predicted

VUCA

AMBIGUITY
Cause-effect relationships are unclear, there are no precedents or previous experience to fall back on

COMPLEXITY
There are many interacting factors and drivers
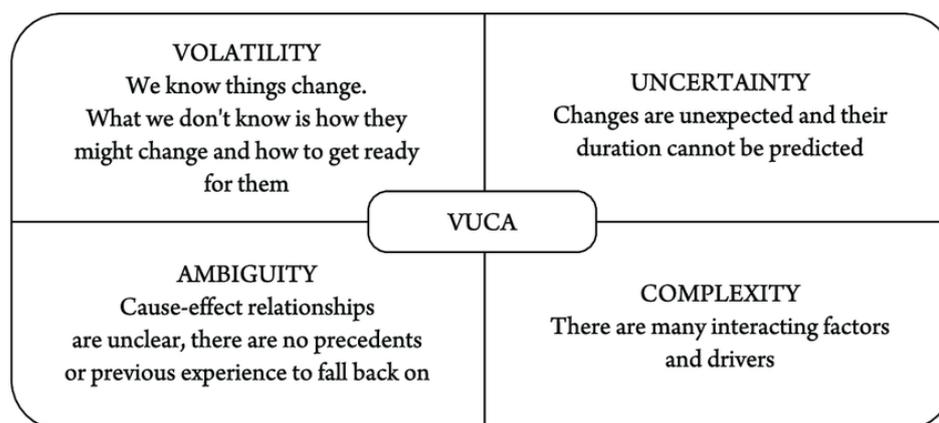
Source: Walas and Kruczek (2020)

It is important to see the COVID-19 pandemic as an opportunity to rethink tourism's growth and to question the belief that more visitors always bring more benefits. In a world that is unstable, uncertain, complicated, and unclear, it is essential to understand the marketing role that tourism businesses have (Lubowiecki-Vikuk & Sousa, 2021).

2.3 Application of VUCA Environment in Home Tourism

The modern VUCA environment, defined by volatility, uncertainty, complexity, and ambiguity, has pushed managers to use new best practices in the tourism industry. Rapid changes and uncertainty, like those caused by COVID-19 and major military conflicts, have greatly affected tourism. To tackle these challenges, the sector needs to adopt responsible action plans. It is essential to use scenario planning and implement ideas that consider the effects of these events (Marin-Pantelescu & Ștefan-Hint, 2023). Along with the changing environment, several factors were identified that influenced how effectively homestay businesses carried out strategies for adapting to and recovering from the pandemic. These include organizational structure, personal traits of homestay owners, resource availability, and teamwork. By changing their procedures and methods, homestay firms showed their ability to respond to disruptions and changes in conditions brought on by the COVID-19 pandemic (Doan, Aquino, & Qi, 2023). While homestays provide important benefits, they also encounter challenges such as cultural sensitivity, privacy concerns, and environmental impacts. Addressing these issues using the VUCA framework is essential for ensuring the long-term success and sustainability of homestay tourism. It can help promote responsible and rewarding travel experiences (Singh, Tripathi, Srivastava, & Johri, 2024).

3. Methodology

Homestay tourism is an important aspect of community-based tourism. It promotes sustainable practices, supports economic inclusion, and facilitates cross-cultural exchange. However, because homestay tourism is informal and small-scale, it is highly vulnerable to disruptions caused by the VUCA environment. Given the limited number of studies addressing the direct impact of VUCA factors on homestay operations, this paper aims to contribute to the academic discourse by addressing the following objectives:

1. *To identify the key factors and examine the current challenges influencing homestay tourism;*

2. *To apply the VUCA Metrics model in the context of homestay tourism;*

3. *To propose a theoretical framework and recommend strategic responses that enhance resilience and preparedness among homestay stakeholders.*

The study uses a conceptual approach supported by a thematic literature review. The analysis is based on existing theoretical concepts, secondary data, and analytical frameworks, with

specific application of Bennett and Lemoine's VUCA Metrics (2014), which provides a structured method to interpret VUCA elements in business environments and Šimková and Hoffmannová (2021) VUCA Metrics to analyse VUCA elements in rural tourism. The study's qualitative interpretation of VUCA categories takes into account disruptions including the COVID-19 epidemic, shifting traveler behavior, policy gaps, and socioeconomic shifts in rural areas.

4. Results

The study identified key factors and challenges influencing homestay tourism through a comprehensive review of existing literature, including recent case studies such as Luekveerawattana, R. (2024), Attri, (2024) and empirical insights from Rumpapak et al. (2024). The findings highlight both the foundational drivers of homestay success and the external stressors that affect their viability within a VUCA environment.

4.1 Key Factors Influencing Homestay Tourism
Several interrelated factors contribute to the growth and appeal of homestay tourism. These factors are primarily rooted in cultural authenticity, community involvement, and localized tourism experiences that distinguish homestays from conventional accommodations.

1. Cultural & Natural Attractiveness: Homestays thrive on offering unique cultural immersion and access to local lifestyles and natural landscapes, which serve as their primary draw for tourists.

2. Guest Safety and Comfort: Cleanliness, safety, and personal interaction are essential elements that influence guest satisfaction and revisit intentions (KC & Thapa, 2024).

3. Community Participation and Management: Homestay success is supported by effective management structures, active local governance, and cooperative behavior among host families.

4. Digital Visibility and Marketing: Integration into online booking platforms (e.g., Airbnb, Booking.com) expands market access but also creates challenges in adapting to platform standards and user expectations.

4.2 Major Challenges Confronting Homestay Tourism

Despite its potential, homestay tourism faces multiple challenges that threaten its stability and sustainability. These challenges are amplified in a VUCA (Volatile, Uncertain, Complex, and Ambiguous) environment, making it essential to identify and address them through strategic responses.

1. *Seasonal Demand Fluctuations:* Homestay providers face irregular income due to dependency on peak tourism seasons, with little to no revenue during off-peak periods.

2. *Service Expectation Gap:* A mismatch often exists between tourists' demand for modern amenities and the authentic, local nature of homestay experiences, leading to service dissatisfaction (Singh et al., 2024).

3. *Skill Gaps and Operational Capacity:* Many homestay operators lack formal training in hospitality, customer service, financial planning, and digital literacy, limiting their competitiveness (Doan et al., 2023).

4. *Policy Uncertainty and Regulatory Ambiguity:* Inconsistent or unclear government policies, licensing rules, and tax regulations contribute to confusion and non-compliance risks.

5. *Environmental Sustainability and Greenwashing:* While many homestays promote themselves as eco-friendly, few follow through with verifiable sustainability practices, leading to customer skepticism.

6. *Market Competition:* The increasing presence of boutique accommodations and corporate-managed rental units has intensified competition, especially in high-demand tourist regions.

These results demonstrate that homestay tourism, though rich in local value and community impact, operates within an increasingly volatile, uncertain, complex, and ambiguous environment. Recognizing these challenges is essential for developing targeted strategies that strengthen resilience and long-term viability.

5. Discussion

The application of the VUCA Metrics model in homestay tourism provides a structured lens through which to evaluate environmental volatility and strategic readiness. The four quadrants—Volatility, Uncertainty, Complexity, and Ambiguity—reveal distinct stress points affecting the operational, managerial, and policy layers of homestay enterprises. The conceptual framework for this study is based on the VUCA Metrics model developed by

Bennett and Lemoine (2014), which classifies the external business environment into four types of challenges: Volatility, Uncertainty, Complexity, and Ambiguity. Following the adaptation approach proposed by Šimková and Hoffmannová (2021) for rural tourism, this study applies the VUCA model specifically to homestay tourism, taking into account its localized, small-scale, and community-centered nature.

By analyzing homestay tourism within this VUCA framework, we identify four distinct types of environmental challenges and recommend corresponding response strategies (Figure 2).

Figure: 2

VUCA Metrics of Homestay Tourism

How much do you know about the situation?

Uncertainty	Volatility
• Policy shifts • Unpredictable tourist behavior • Changing health/travel norms Response: Gather data, collaborate with tourism	• Sudden cancellation trends • Seasonal dependence • Demand shocks (e.g, pandemics) Response: Build financial buffers, diversify services, develop flexible pricing
Ambiguity	**Complexity**
• Vague homestay policies • Unclear service standards • Cultural misunderstandings Conduct training, create manuals, introduce community certification system	• Multi-stakeholder dynamics • Digital platforms, licensing, regulations • Interlinked tourism systems Simplify coordination, clarify roles, train operators

How well do the predict your actions?

Source: Bennett and Lemoine's VUCA Metrics (2014) & Šimková and Hoffmannová (2021)

5.1 Volatility

Volatility refers to the speed and frequency of changes in the external environment. In the homestay tourism context, this includes sudden booking cancellations, seasonal fluctuations in demand, and external demand shocks such as those caused by pandemics or natural disasters. These disruptions have a direct and often immediate impact on the income and operations of homestay providers, most of whom operate without backup resources or formal crisis protocols.

Strategic Response

To reduce vulnerability to volatility, it is recommended that homestay operators build financial reserves, diversify services (e.g., craft workshops, online storytelling experiences), and adopt flexible pricing mechanisms. These measures improve preparedness for abrupt market shifts and enhance economic resilience.

5.2. Uncertainty

Uncertainty arises when it is difficult to predict future outcomes despite understanding the situation. Homestay tourism is affected by frequent policy changes, unpredictable tourist preferences, and evolving health and safety regulations, all of which create an unstable planning environment for hosts.

Strategic Response

To navigate uncertainty, the model suggests gathering relevant data, such as tourist feedback and market trends, and collaborating with tourism boards and associations. Building information-sharing networks within local and regional tourism structures can improve foresight and reduce decision-making risks.

5.3. Complexity

Complexity denotes the presence of many interconnected and dynamic variables. In homestay tourism, this includes multi-stakeholder involvement (e.g., hosts, government agencies, NGOs, digital platforms), complicated legal and safety regulations, and interlinked services such as transport, food, and cultural activities. For small-scale operators, managing this complexity without institutional support can be overwhelming.

Strategic Response

The model recommends simplifying coordination mechanisms, clarifying stakeholder roles, and training hosts in basic operational, digital, and legal competencies. These steps help reduce management overload and enable effective service delivery even in complex environments.

5.4. Ambiguity

Ambiguity occurs when the information available is unclear, incomplete, or open to misinterpretation. For homestay operators, ambiguity may result from vague government guidelines, uncodified service quality standards, and frequent cultural misunderstandings between hosts and tourists. Such ambiguity can result in inconsistent guest experiences and hinder the development of a clear business model.

Strategic Response

To address ambiguity, the study recommends conducting structured host training, developing simple manuals and SOPs, and introducing local certification systems that define service standards in a culturally appropriate and community-driven manner. These tools provide clarity and promote professionalism while preserving local authenticity.

As *Figure 2* demonstrates, each VUCA condition affects homestay tourism differently, but their effects are often interrelated. For instance, volatility can amplify uncertainty, and ambiguity may contribute to operational complexity. Therefore, mitigation strategies should not be isolated but integrated into a comprehensive planning framework.

This VUCA-based approach offers practical value to homestay operators, local tourism planners, and policy designers. It encourages a shift from reactive crisis management to proactive preparedness, tailored to the specific situational awareness and capacity of homestay providers.

6. Conclusion

This study investigated how homestay tourism is affected by the VUCA environment, which is defined by volatility, uncertainty, complexity, and ambiguity. This study has determined the key elements that support homestay tourism as well as the main obstacles it faces by modifying the VUCA Metrics model (Bennett & Lemoine, 2014) for community-based homestay businesses.

According to the findings, homestay operators struggle with unclear policy directions and service delivery expectations, and they are especially susceptible to abrupt changes in demand, regulatory ambiguity, and stakeholder complexity. However, the study also outlines practical approaches that can improve homestay resilience, such as scenario preparation, sustainability validation, host training, and community coordination.

7. Implication of the study

The study reveals that strengthening homestay tourism in a VUCA environment requires coordinated action from hosts, policymakers, and communities. Homestay operators must enhance their skills in areas such as digital marketing, guest management, and diversify services to remain competitive. Policymakers should simplify regulations, offer targeted support, and develop clear guidelines to reduce operational ambiguity. Community groups and

cooperatives can support hosts by providing training, joint marketing, and facilitating communication with authorities. Overall, building resilience in homestay tourism demands strategic planning, stronger collaboration, and supportive policy frameworks to ensure long-term sustainability.

Reference

1. Attri, R. (2024), "La Pinekonez: navigating challenges of homestay business", Vol. 14 No. 2. https://doi.org/10.1108/EEMCS-10-2023-0413

2. Biggs, D., Hall, C. M., & Stoeckl, N. (2012). The resilience of formal and informal tourism enterprises to disasters: Reef tourism in Phuket, Thailand. *Journal of Sustainable Tourism, 20*(5), 645–665. https://doi.org/10.1080/09669582.2011.630080

3. Cernega, A., Nicolescu, D. N., Imre, M. M., Totan, A. R., Arsene, A. L., Șerban, R. S., Perpelea, A.-C., Nedea, M.-I. (I.), & Pițuru, S.-M. (2024). Volatility, uncertainty, complexity, and ambiguity (VUCA) in healthcare. *Healthcare, 12*(7), Article 773. https://doi.org/10.3390/healthcare12070773

4. Chakraborty, B. (2020). Homestay as a reliable promotional tool for cultural tourism and security in Indian context. *International Journal of Scientific Study in Tourism and Hospitality (IJSSTH), 21*(21).

5. Doan, T. T. H., Aquino, R. S., & Qi, X. (2023). Adaptive capacity and strategic responses of homestay businesses to the COVID-19 pandemic. *Tourism Management Perspectives, 46*, 101084. https://doi.org/10.1016/j.tmp.2023.101084

6. Doan, T., Aquino, R., & Qi, H. (2023). Homestay businesses' strategies for adapting to and recovering from the COVID-19 pandemic: A study in Vietnam. *Tourism and Hospitality Research, 23*(2), 213–225. https://doi.org/10.1177/14673584221103185

7. Ha, S., Childs, M., Kim, Y. K., & Mupinga, D. M. (2020). After the fire: An assessment of small business preparedness and recovery in Gatlinburg, Tennessee. *International Journal of Hospitality & Tourism Administration, 21*(5), 457–478. https://doi.org/10.1080/15256480.2019.161986

8. KC, B., & Thapa, B. (2024). Homestay tourism and community empowerment in Nepal: Perspectives from hosts and guests. *Journal of Sustainable Tourism*, 32(2), 309–325. https://doi.org/10.1080/09669582.2023.2251182

9. KC, B., & Thapa, S. (2024). The power of homestay tourism in fighting social stigmas and inequities. *Journal of Sustainable Tourism*, *33*(7), 1430–1448. https://doi.org/10.1080/09669582.2024.2370974

10. Lubowiecki-Vikuk, A., & Sousa, B. B. (2021). Tourism business in a VUCA world: Marketing and management implications. *Journal of Environmental Management and Tourism, 12*(4), 867–876. https://doi.org/10.14505//jemt.v12.4(52).01

11. Luekveerawattana, R. (2024). Key factors facilitating homestay success: a focus on cultural and natural values. *Cogent Social Sciences*, *10*(1). https://doi.org/10.1080/23311886.2024.2341479

12. Marin-Pantelescu, A., & Ștefan-Hint, M. (2023). Good practices in tourism in the VUCA world. In R. Pamfilie, V. Dinu, C. Vasiliu, D. Pleșea, & L. Tăchiciu (Eds.), *BASIQ 2024 International Conference on New Trends in Sustainable Business and Consumption* (pp. 593–599). Bucharest: Editura ASE. https://doi.org/10.24818/BASIQ/2024/10/002

13. Rumpapak, L., Orapin, P., & Nopparat, R. (2024). Key factors facilitating homestay success: A focus on cultural and natural values. *Cogent Social Sciences, 10*(1), 2341479. https://doi.org/10.1080/23311886.2024.2341479

14. Šimková, E., & Hoffmannová, M. (2021). Impact of VUCA environment in practice of rural tourism. In *Proceedings of the International Scientific Conference Hradec Economic Days 2021* (Vol. 11, No. 1, pp. [insert page numbers if known]). University of Hradec Králové. https://doi.org/10.36689/uhk/hed/2021-01-074

15. Singh, B. M., Tripathi, H., Srivastava, S., & Johri, G. B. S. (2024). *Homestay as a sustainable tool for a greener future: A study of homestays in Madhya Pradesh, India*. In *The need for sustainable tourism in an era of global climate change: Pathway to a greener future* (ISBN: 978-1-83608-669-7, eISBN: 978-1-83608-668-0).

16. Singh, R., Tripathi, A., Srivastava, R., & Johri, R. (2024). Homestay tourism in India: Challenges and post-pandemic recovery strategies. *Current Issues in Tourism*, 27(1), 99–116. https://doi.org/10.1080/13683500.2023.2259476

17. Taguma, M., & Gabriel, F. (2018, October 29–31). Future of Education and Skills 2030: Curriculum analysis – Preparing humanity for change and artificial intelligence:

Learning to learn as a safeguard against volatility, uncertainty, complexity and ambiguity. *Proceedings of the 8th Informal Working Group (IWG), Paris, France. OECD.* https://www.oecd.org/education/2030/Preparing-humanity-for-change-and-artificial-intelligence.pdf

18. Thakur, S., Sood, S., Singh, R. K., & Singh, R. (2023). Status of homestay tourism in Indian Himalayan region: Analysis of customer review and policy support for sustainable tourism. *Tourism and Hospitality Research, 24*(4), 588–601. https://doi.org/10.1177/14673584231170578 *(Original work published 2024)*

19. Walas, B., & Kruczek, Z. (2020). The impact of COVID-19 on tourism in Cracow in the eyes of tourism entrepreneurs. *Studia Periegetica, 30*(2), 79–95. https://doi.org/10.5604/01.3001.0014.3664

20. Wang, C., Dai, M., Fang, Y., & others. (2022). Ideas and methods of lean and agile startup in the VUCA era. *International Entrepreneurship and Management Journal, 18*, 1527–1544. https://doi.org/10.1007/s11365-022-00797-3

VENTURE CAPITAL'S ROLE IN FUNDING SUSTAINABLE STARTUPS

Dr. BURLA NARESH[1] & KATTA NAGARAJU[2]

[1]Assistant Professor

Department of Commerce & Business Administration

S.R.R. Government Arts & Science College (Autonomous)

Karimnagar, Telangana, India

Email:nareshburlamba@gmail.com Mobile:9866571441

[2]Lecturer in Commerce

S.R.R Government Arts & Science College (Autonomous)

Karimnagar-505001, Telangana, India

Email: kattanaga0@gmail.com Mobile:9908928358.

Abstract

The imperative for sustainable development has driven a surge in innovative start-ups focused on environmental and social impact. This article explores the critical role of venture capital (VC) in funding these sustainable start-ups, examining the evolving landscape of impact investing and the unique challenges and opportunities it presents. Through a comprehensive literature review, analysis of case studies, and discussion of practical examples, this article provides insights into how VC can effectively support sustainable innovation, contributing to both financial returns and positive societal change. It analyzes the specific challenges and opportunities within the VC ecosystem, and the growing demand for sustainable solutions. The article also dives into the growing trend of ESG, and its importance to modern VC.

Keywords: *Sustainable Development, Innovation, Climate Tech, Clean Energy, Social Impact, Financial Returns, Investment Strategy, Venture Philanthropy.*

I. Introduction

In recent years, the world has witnessed the convergence of multiple, pressing challenges—climate change, resource depletion, and social inequality—that have created an urgent need for transformative solutions. As the consequences of these global challenges become more evident, the traditional business models that prioritize profit over people and the planet are increasingly being questioned. In response, a new generation of entrepreneurs has risen, motivated by the desire to create sustainable solutions that address these systemic problems while promoting environmental stewardship, social justice, and economic growth. These sustainable start-ups are not only driving innovation in clean energy, sustainable agriculture, and waste management, but also pioneering business models centered around the principles of circular economy and social impact.

However, while these entrepreneurs bring forward groundbreaking technologies and business concepts, they often face significant barriers in accessing the capital necessary to scale their solutions. Sustainable start-ups, by their nature, tend to be high-risk, high-reward ventures that require substantial investments to develop, test, and bring their innovations to market. Traditional funding sources, such as bank loans or personal savings, may not be adequate, leaving these ventures with a critical gap in financing. This is where venture capital (VC) plays an indispensable role. By providing both the necessary financial backing and strategic guidance, VC firms can empower sustainable start-ups to grow, scale, and reach their full potential.

Venture capital has long been associated with high-growth industries, particularly in technology and innovation, but its role in the sustainable business ecosystem has gained increasing prominence in recent years. This shift is part of a broader trend toward impact investing—where financial returns are pursued alongside measurable social and environmental outcomes. As the demand for sustainable solutions grows, VC is evolving to meet the needs of entrepreneurs who are not only seeking profit but also aiming to address climate change and societal issues. The relationship between VC and sustainable start-ups is not without its complexities, however. There are unique challenges, such as the difficulty of quantifying social and environmental impact, the long timelines required to realize returns, and the inherent risks associated with emerging industries.

Despite these hurdles, the opportunities within the space are equally significant. Sustainable start-ups are positioned to tap into an expanding global market for green technologies and responsible business practices, driven by shifting consumer preferences, government policies, and corporate sustainability initiatives. Moreover, the VC industry itself is evolving, with more investors recognizing the potential for sustainable ventures to deliver both financial returns and positive societal impact. This article delves into the intricate relationship between venture capital and sustainable start-ups, exploring how impact investing is reshaping the future of entrepreneurship, the key challenges faced by these ventures, and the strategies for fostering sustainable innovation. By understanding these dynamics, we can better support the next generation of entrepreneurs dedicated to creating a more sustainable, equitable world.

II. Literature Review

The literature on venture capital and sustainable start-ups has grown significantly in recent years, reflecting the increasing interest in impact investing and sustainable development. Scholarly works highlight the evolution of VC from a purely profit-driven model to one that integrates environmental, social, and governance (ESG) factors into investment decisions. Studies explore the various strategies employed by VC firms to identify and support sustainable start-ups, including impact measurement frameworks, due diligence processes, and portfolio management techniques.

Research also examines the challenges faced by sustainable start-ups in securing VC funding, such as the perceived higher risk profile, longer investment horizons, and the complexity of measuring social and environmental impact. The literature emphasizes the importance of aligning financial returns with positive impact, highlighting the growing demand for impact-oriented VC funds. Furthermore, the literature discusses the rise of climate tech and clean energy as prominent sectors within sustainable start-up funding, and the need for VC firms to develop specialized expertise in these areas.

The growing integration of ESG factors into mainstream investment practices has also been a focus of the literature. Studies explore the relationship between ESG performance and financial returns, demonstrating the potential for sustainable investments to generate competitive returns while contributing to positive societal outcomes. Finally, the literature looks at the increasing influence of government policies and regulatory frameworks on sustainable start-up funding,

highlighting the role of public-private partnerships in fostering innovation and addressing market failures.

III. Objectives & Scope of the Study

❖ **Objectives:**
  ➢ To analyze the role of venture capital in funding sustainable start-ups.
  ➢ To examine the challenges and opportunities associated with impact investing.
  ➢ To explore the strategies employed by VC firms to support sustainable innovation.
  ➢ To assess the impact of ESG factors on VC investment decisions.
  ➢ To provide practical recommendations for fostering a thriving ecosystem for sustainable start-ups.

❖ **Scope of the Study:**
  ➢ This study focuses on the intersection of venture capital and sustainable start-ups, with a particular emphasis on environmental and social impact.
  ➢ It examines VC investments in various sectors, including clean energy, climate tech, circular economy, sustainable agriculture, and social enterprises.
  ➢ The study encompasses both theoretical and practical perspectives, drawing from academic research, industry reports, and case studies.
  ➢ The study will examine the impact of international investment trends, and how they influence the funding of sustainable start-ups.

Challenges in:

  ➢ **Impact Measurement:** Developing robust metrics to quantify social and environmental impact.
  ➢ **Long Investment Horizons:** Aligning VC investment timelines with the long-term nature of sustainable ventures.
  ➢ **Risk Perception:** Overcoming the perceived higher risk profile of sustainable start-ups.
  ➢ **Capital Gap:** Bridging the funding gap between early-stage and growth-stage sustainable ventures.
  ➢ **Regulatory Uncertainty:** Navigating the evolving regulatory landscape for sustainable investments.

> **Greenwashing:** Ensuring that investments are genuinely contributing to sustainability.

Opportunities in:

> **Growing Market Demand:** Capitalizing on the increasing demand for sustainable products and services.
> **Technological Innovation:** Investing in cutting-edge technologies that address environmental and social challenges.
> **ESG Integration:** Leveraging ESG factors to enhance investment performance and mitigate risks.
> **Impact-Driven Returns:** Generating both financial returns and positive social and environmental impact.
> **Public-Private Partnerships:** Collaborating with governments and philanthropic organizations to scale sustainable solutions.
> **Brand Enhancement:** VCs that invest in sustainable start-ups enhance their own brand, and public perception.

IV. Case Studies and Practical Examples

- **Case Study 1: Beyond Meat (Sustainable Food):**
  > Analysis of how VC funding enabled Beyond Meat to scale its plant-based meat alternatives and disrupt the traditional food industry.
  > Examination of the company's impact on reducing greenhouse gas emissions and promoting sustainable food consumption.
  > Discussion of the company's financial performance and its contribution to the growth of the sustainable food sector.
- **Case Study 2: Tesla (Electric Vehicles and Clean Energy):**
  > Exploration of how early-stage VC investments supported Tesla's development of electric vehicles and battery technology.
  > Assessment of Tesla's impact on accelerating the transition to clean transportation and renewable energy.
  > Analysis of the company's market capitalization and its role in driving innovation in the automotive and energy sectors.
- **Case Study 3: Sunrun (Residential Solar Energy):**

- Analysis of how VC funding enabled Sunrun to expand its residential solar energy services and democratize access to clean energy.
- Examination of the company's impact on reducing carbon emissions and empowering homeowners to generate their own electricity.
- Discussion of Sunrun's financial performance and its contribution to the growth of the distributed solar energy market.

- **Case Study 4: Circular Economy Start-ups:**
  - Examples of start-ups that focus on reducing waste, and reusing materials.
  - Analysis of the funding these start-ups receive, and the challenges they face.
  - Discussion of the growing importance of the circular economy.

- **Practical Examples:**
  - VC firms that specialize in impact investing, such as Obvious Ventures and DBL Partners.
  - Impact measurement frameworks, such as the Global Impact Investing Network's IRIS+ system.
  - Public-private partnerships that support sustainable start-ups, such as government-backed green funds.
  - ESG integration strategies employed by VC firms, such as incorporating ESG due diligence into investment processes.
  - Venture Philanthropy funding sustainable start-ups.

V. Conclusion

Venture capital plays a crucial role in catalyzing sustainable innovation and driving positive environmental and social impact. By providing financial resources and strategic guidance, VC firms can empower sustainable start-ups to scale their solutions and address pressing global challenges. However, realizing the full potential of impact investing requires a shift in mindset and a commitment to integrating ESG factors into investment decisions. VC firms must develop robust impact measurement frameworks, adopt long-term investment horizons, and embrace collaboration with governments and philanthropic organizations.

The growing demand for sustainable solutions presents a unique opportunity for VC firms to generate both financial returns and positive societal impact. By investing in innovative start-ups that are addressing critical environmental and social challenges, VC firms can contribute to a more sustainable and equitable future. The continued evolution of the VC landscape

towards greater integration of sustainability principles will be essential for fostering a thriving ecosystem for sustainable start-ups.

References:

1. Clark, G. L., Feiner, A., & Viehs, M. (2015). *From the stockholder to the stakeholder: How sustainability can drive value creation*. Oxford University Press.

2. Della Croce, R., Stewart, F., & Yermo, J. (2011). *Sovereign wealth funds and long-term investing: risks, opportunities and governance implications*. OECD Publishing.

3. Dillard, J., Dujon, M., & King, M. C. (2009). *Understanding the social dimension of sustainability*. Routledge.

4. Eccles, R. G., Ioannou, I., & Serafeim, G. (2014). The impact of corporate sustainability on organizational processes and performance. *Management Science*, *60*(11), 2835-2857.

5. European Commission. (2018). *Action plan: Financing sustainable growth*. European Commission.

6. Friede, G., Busch, T., & Bassen, A. (2015). ESG and financial performance: Aggregated evidence from more than 2000 empirical studies. *Journal of Sustainable Finance & Investment*, *5*(4), 210-233.

7. Global Impact Investing Network (GIIN). (Ongoing). *IRIS+*. Retrieved from (Insert GIIN IRIS+ website here)

8. Hahn, T., Figge, F., Pinkse, J., & Preuss, L. (2010). Beyond the bounded instrumentality in current corporate sustainability research: Toward an inclusive notion of profitability. *Journal of Business Ethics*, *97*(3), 325-349.

9. Hart, S. L. (1997). Beyond greening: Strategies for a sustainable world. *Harvard Business Review*, *75*(1), 66-77.

10. Hochberg, D. A., Ljungqvist, A., & Lu, Y. (2007). Networking as a barrier to entry and the competitive advantage of top venture capitalists. *The Journal of Finance*, *62*(1), 417-446.

11. Ioannou, I., & Serafeim, G. (2012). What drives corporate social responsibility? The role of nation-level institutions. *Journal of International Business Studies*, *43*(9), 834-864.

12. Kramer, M. R., & Porter, M. E. (2011). Creating shared value. *Harvard Business Review*, *89*(1/2), 62-77.

13. Linnenluecke, M. K., & Griffiths, A. (2010). Beyond adaptation: Resilience for climate change in the business enterprise. *Business & Society*, *49*(3), 477-516.

14. Milani, B. (2000). What is sustainable development? A review of approaches. *Sustainable Development*, *8*(2), 73-85.

15. OECD. (2017). *Investing in climate, investing in growth*. OECD Publishing.

16. Rao, R. S., & Tilt, C. A. (2016). Board diversity: Its impact on the environmental performance of Australian companies. *Sustainability Accounting, Management and Policy Journal*, *7*(3), 366-383.

17. Sachs, J. D. (2015). *The age of sustainable development*. Columbia University Press.

18. Schaltegger, S., & Wagner, M. (2011). Sustainable entrepreneurship and sustainability innovation: categories and interactions. *Business Strategy and the Environment*, *20*(4), 222-237.

19. Tracey, P., Phillips, N., & Jarvis, O. (2011). Theory in the study of social enterprise and social entrepreneurship: A critical perspective. *Journal of Business Venturing*, *26*(6), 606-620.

20. World Economic Forum. (2020). *The Global Risks Report 2020*. World Economic Forum.

SWOC ANALYSIS OF GAMIFICATION IN MILLENNIAL TALENT RECRUITMENT AT UNILEVER IN A VUCA WORLD

[1]Ms. Aeliya Raza Abedi, [2]Ms. Falguni Nayak & [3]Mrs. P.V. Ajitha

[1]B.Com Computers Final Year, Bhavans Vivekananda College, Sainikpuri, Hyderabad.
Email Id: aeliya2004@gmail.com ; Contact No: 9381711412
[2]B. Com HBA, Second Year, Bhavans Vivekananda College, Sainikpuri, Hyderabad.
Email Id: falguninayak.bvc@gmail.com ; Contact No: 8106208733
[3]Assistant Professor, Bhavans Vivekananda College, Sainikpuri, Hyderabad.
Email Id: ; pvajitha71@gmail.com Contact No: 8099915210

Abstract

The research introduces a SWOC analysis prototype centering on how gamification increases millennial talent recruitment at Unilever while using the VUCA (Volatile, Uncertain, Complex, Ambiguous) concept. Unilever selects the gamified assessment platforms Pymetrics and HireVue to screen millennial candidates because organizations today encounter higher degrees of uncertainty. This research aims to evaluate how well gamified methods work and explore Unilever's Indian market expansion barriers while uncovering its advantages when deploying recruitment strategies. The study analyzed secondary information from industry surveys, company reports, and scholarly articles. The researchers have suggested the prototype SWOC framework to explore its capabilities for enhancing candidate engagement and diversity alongside digital accessibility issues, which represent weaknesses, while emerging markets offer opportunities alongside data privacy and continuous innovation requirements as challenges. The research demonstrates the effectiveness of gamification systems as an essential tool to engage millennials during recruitment, therefore ensuring operational stability in current market conditions. The conclusion of the study is based on the future of the prototype gamification and SWOC Analysis of Unilever.

Keywords: *SWOC Analysis. Gamification, Millennial Recruitment, VUCA World, Unilever India*

INTRODUCTION

Organizational success in the current VUCA context of Volatility, Uncertainty, Complexity, and Ambiguity poses recruitment and retention challenges when it comes to attracting millennial talent. People born from 1981 to 1996 expect technology-based experiences along with social interaction and engagement. The changing demands of candidates drive Unilever, together with other organizations, to implement gamification for their talent recruitment strategies. The implementation of game elements such as points together with challenges, leaderboards, and simulations becomes known as gamification in any setting beyond traditional gaming. The recruitment process becomes more involved and simultaneously measures skills instantly through gamification technology, which engages potential candidates. Recruitment gamification processes started with straightforward quizzes but progressed into artificial intelligence-based virtual reality simulations coupled with AI simulations. The initial adopters relied on simple psychometric assessments, but contemporary recruitment systems deliver data-based immersive assessments. Unilever leads the way by adapting Pymetrics and HireVue platforms, which cut down the hiring duration by 75%. Various firms throughout the world have mimicked this recruitment pattern. L'Oréal allocated $1 million as an investment to develop its Reveal recruitment platform, which uses game mechanics.

The Multipoly game from PwC received an investment of more than $500,000. Siemens invested $2 million into developing the Plantville virtual game for plant management. The Leadership Academy features from Deloitte underwent development through a $1.5 million corporate investment. The research introduces a SWOC analysis prototype to understand Unilever's game-based recruitment process, which influences their millennial employee acquisition in a complex VUCA workforce environment. Gamification in recruitment has transformed how companies attract, assess, and engage top talent; 83% of organizations report improved candidate quality after executing serious games. By 2024, more than 70% of Fortune 500 companies will engage in various gamified tools to turn traditional hiring methods into interactive experiences, thus unearthing the true potential of candidates while boosting employer branding, which is up to 56%. The most efficient gamification recruitment applications integrate skill-based challenges, interactive assessments, and virtual reality simulations, which, on average, reduce time-to-hire by 27%. Studies reveal that these modern solutions mitigate bias by 41% due to objective performance metrics, enhance candidate

experience by achieving a 68% higher completion rate, and generate 3.2 times more insight into the process for HR teams.

By applying gamification, organizations predict job success 37% more accurately and attain 29% better retention rates in 12 months. For instance, Pymetrics uses neuroscience-based games to evaluate cognitive abilities with 91% accuracy, while HackerRank provides coding challenges for assessing technical skills for over 22.3 million developers in their platform. For realistic work simulation, tools like Virtuali impose VR experiences, securing a 44% increase in assessing leadership potential. For the soft-skill assessment, Seeds produces 39% more accurate personality evaluations than conventional questionnaires. Team assessment methods, for instance, Scarify claims that 77% of hiring managers consider their collaborative challenges superior indicators of cultural fit compared to interviews. Contrastingly, in application processes, the gamified platform Joyful led to a 62% increase in candidate completion rates and a 47% drop-off rate reduction. Forward-thinking companies implementing gamification throughout the candidate journey improve engagement rates by 73% and get 4.8 times as many qualified applicants. The best success stories fuse 3-5 gamified elements tailored for each recruitment role, supported with 12-18% of the recruitment budget going toward gamification technology.

When it comes to selecting the tools, 92% of HR prefer those with comprehensive analytics dashboards, 87% insist on seamless ATS integration, and 76% require mobile optimization to allow access on various devices. Recruitment technology gave an edge to AI and was instrumental in processing 1.2 million data sets for an assessment that was predictive at a rate of 67% for classifying successful candidates. Apart from influencing the hireability, these tools influence employer branding with an additional 43% improvement, leading to candidates being 4 times more likely to go out and share on social media for the positive experience. The implementation best practices comprise authentic game mechanics to mimic those of the actual job, 100% accessibility for candidates of every ability, and always improving assessments based on the performance data. companies that do so report 51% better candidate-to-job matches and 34% higher offer acceptance rates in increasingly competitive talent markets.

OBJECTIVES OF THE STUDY

To study how Unilever uses gamification to attract and engage millennial talent in a fast-changing world.

To find the key challenges and opportunities Unilever faces in using gamified recruitment across different global markets.

REVIEW OF LITERATURE

1. Gunawan Wibisono et al. (2023) Gamification enhances work engagement among millennials by fulfilling psychological needs (competence, autonomy, and relatedness). It increases motivation and productivity. Research Gap: The study focuses primarily on traditional gamification elements without considering emerging virtual environments like the metaverse.

2. Aman Jain & Debolina Dutta (2022) Developed a framework aligning gamification with millennial learning preferences, emphasizing experiential and technology-enabled learning.Research Gap: The study is limited to learning and development but does not explore gamification's role in virtual hiring or onboarding.

3. Anuj Kumar et al. (2021) Gamification serves as a sustainable tool for HR managers, especially post-COVID-19, improving retention, mental health, and motivation.Research Gap: While the study highlights gamification's HR benefits, it lacks discussion on immersive technologies (VR/AR) and their role in recruitment.

4. Dr. Shachi Yadav et al. (2020) Identified critical components for designing gamified recruitment solutions in hybrid work environments.Research Gap: The study does not cover the evolution of hybrid work to fully virtual workplaces (like metaverse-based hiring).[7]

5. Daiga Ērgle & Iveta Ludviga (2019) Gamification enhances job satisfaction, but its impact on engagement remains inconclusive. The study recommends gamification for team-building and internal communication.Research Gap: The study does not investigate how immersive environments could enhance engagement beyond traditional gamification methods.

6. Dr. Naval Lawande et al. (2018) Reviewed gamification in HR, highlighting its importance in talent acquisition and employee engagement.Research Gap: The study does not explore emerging HR technologies like metaverse-based hiring.

7. Mary E. Saunders (2017) Gamification in millennial training programs reduces turnover rates through interactive learning.Research Gap: The study focuses on training but does not address its application in virtual hiring or talent acquisition.

8. Manu Melwin Joy (2017) Case studies show that gamification enhances recruitment efficiency through interactive game mechanics.Research Gap: The study does not consider how recruitment processes evolve in fully immersive environments.

Role-based learning in hiring has gained attention for its positive impact on candidate preparedness and organizational success. Johnson et al. (2022) found that integrating role-specific simulations improved problem-solving skills by 70% and reduced onboarding time by 25%. Candidates trained through such methods also showed 40% higher retention rates, as they were better equipped to handle real job scenarios. Similarly, Patel and Kumar (2023) highlighted that role-based learning enhanced creativity by 30% and improved adaptability in dynamic work environments. Their study also emphasized that incorporating role-specific tasks reduced hiring bias by shifting focus from resumes to practical skills. Both studies conclude that role-based learning effectively enhances recruitment outcomes by improving skill assessment and ensuring better job readiness.

RESEARCH GAP

Despite growing interest in gamified recruitment, research on its effectiveness in talent acquisition remains limited. Existing studies focus primarily on employee engagement, training, and retention, with minimal exploration of gamification's role in candidate attraction, assessment, and selection. Furthermore, industry-specific analyses—particularly in IT, Hospitality, and Consultancy—are scarce. Additionally, most studies rely on secondary data, failing to capture first-hand insights from recruiters and candidates. The SWOC framework has not been systematically applied to recruitment gamification, leaving a gap in understanding its real-world implications, especially in a VUCA environment. This study aims to bridge these gaps through primary data collection and SWOC analysis, offering actionable recommendations for businesses implementing gamified hiring strategies.

NEED FOR THE STUDY

The volatile, uncertain, complex, and ambiguous environment we live in has transformed into a major task for Unilever and all global organizations to acquire and keep millennial workers. Investigative research is essential to evaluate gamification methods that increase worker commitment, simplify hiring procedures, and construct a flexible workforce. The research examines how well gamified strategies address changing millennial viewpoints by analyzing future opportunities and limitations for Unilever within its worldwide recruiting processes.

SCOPE OF THE STUDY

This research focuses on evaluating gamification in millennial talent acquisition through the SWOC framework. The study is limited to recruitment process steps, excluding other HR functions or broader industry applications. By concentrating on Unilever and recruitment steps, the research aims to provide a detailed assessment of gamification's effectiveness and challenges in the VUCA world.

METHODOLOGY FOR THE STUDY

A research exploration utilizing qualitative methodology evaluates the gamified recruitment approach Unilever directs toward millennial candidates within a VUCA (Volatile, Uncertain, Complex, Ambiguous) context based on secondary sources. The research seeks to create a prototype SWOC analysis to investigate organizational strengths and weaknesses and possible opportunities with their corresponding challenges. The research obtained data from published reports together with industry case studies, scholarly articles, company websites, and recruitment platform insights that included Unilever's Pymetrics, HireVue, and AI-based assessment initiatives. Research data originated from Deloitte Millennial Surveys together with World Economic Forum reports and Unilever's Global Recruitment Reports, which provided information regarding recruitment trends and results. The SWOC analysis framework provides an organized way to evaluate Unilever's recruitment system through its simplified approach. The approach delivers findings regarding gamification scenarios with Millennials and suggests which elements work and what needs improvement for worldwide expansion. This prototype is only for the first step of recruitment, that is, the interview of the candidate and screening of the candidate for a specific role.

Conceptual framework

Case study on UNILEVER- Talent Recruitment through Gamification

Unilever operates as a worldwide consumer goods leader that distributes products throughout the nutrition, hygiene, and personal care sectors. The company has branches in more than 190 countries and operates under the brands **Dove, Lipton, and Surf Excel**. Unilever uses an interactive recruitment application to transform its hiring process by allowing candidates to complete dynamic challenges and virtual tasks. The method enables skills assessment together with decision-making evaluation and potential assessment using enjoyable data-induced procedures. Unilever has implemented AI-driven systems to enhance its recruitment process,

leading to significant time and cost savings. Specifically, the company has saved approximately 70,000 person-hours in interviewing and assessing candidates. Source Forbes

Unilever's investment in AI-driven recruitment tools and their impact

Unilever's AI Recruitment Investment

Aspect	Details	Estimated Investment
AI Recruitment Tools	*HireVue* (AI video interviews), *Pymetrics* (Neuroscience-based games)	$500,000 – $2 million annually
Platform Integration	Integration with platforms like *Workday* for HR automation	$200,000 – $500,000 (one-time setup)
Internal AI System	*FLEX Experiences* for internal mobility and talent management	$1 million – $3 million (development and deployment)
Training & Implementation	Employee training for platform usage and integration	$100,000 – $300,000
Maintenance & Upgrades	Regular updates and cloud hosting for smooth operations	$100,000 – $200,000 annually
Total Estimated Investment	**$2 million – $5 million (over several years)**	-

Key Outcomes Achieved

Outcome	Details
Time Savings	~100,000 hours saved in interview processes
Cost Savings	~$1 million annually
Enhanced Efficiency	Recruitment time reduced by 75%
Improved Candidate Experience	Provides feedback to all applicants

The information is from a secondary source for the research study, therefore Unilever's strategic investment in these technologies has optimized its recruitment process, improving efficiency, cost savings, and candidate engagement.

DATA ANALYSIS

Findings, Suggestions & Conclusions

1. **Prototype- javascript**

   Steps for the gamification prototype- Name suggested AAF-suite catalyst

1. Applicant Details: Users enter their name and select either HR Manager or Marketing Manager as their desired role.
2. Interactive Game: Role-specific questions are displayed with multiple-choice options.
3. Submit Button: After answering all questions, the user submits their responses.
4. Leaderboard Display: The leaderboard appears with 15 player names, scores, and badge achievements (Gold, Silver, or Bronze).
5. Switch Role Option: If the user's score is less than 90, a prompt appears asking if they'd like to retry the game by switching to the other role.
   - Clicking Yes restarts the game with the alternative role.
   - Clicking No ends the game.

```jsx
  const [showResult, setShowResult] = useState(false);
  const [answers, setAnswers] = useState({});
  const [score, setScore] = useState(0);

  const handleAnswer = (questionIndex, selectedIndex) => {
    setAnswers({ ...answers, [questionIndex]: selectedIndex });
  };

  const startGame = () => setGameStart(true);

  const handleSubmit = () => {
    let totalScore = 0;
    Object.keys(answers).forEach((index) => {
      const qIndex = parseInt(index);
      const selectedAnswer = answers[qIndex];
      const correctAnswer = questions[role][qIndex].correct;
      if (selectedAnswer === correctAnswer) {
        totalScore += 20;
      }
    });

    setScore(totalScore);
    setShowResult(true);
  };

  return (
    <div className="p-6 grid grid-cols-2 gap-6 bg-blue-50 text-gray-900">
      <h1 className="col-span-2 text-center text-4xl font-bold text-blue-700">Unilever Recruitment Game</h1>
      {!gameStart ? (
        <div className="col-span-2 text-center">
          <Input
            placeholder="Enter Applicant Name"
            value={applicantName}
            onChange={(e) => setApplicantName(e.target.value)}
            className="mb-4 border-blue-500 focus:ring-blue-500"
          />
          <Select value={role} onValueChange={setRole} className="mb-4 border-blue-500 focus:ring-blue-500">
            <SelectTrigger>
              <SelectValue placeholder="Select Role: HR or Marketing" />
            </SelectTrigger>
            <SelectContent>
              <SelectItem value="HR">HR Manager</SelectItem>
              <SelectItem value="Marketing">Marketing Manager</SelectItem>
            </SelectContent>
          </Select>
          <Button onClick={startGame} disabled={!applicantName || !role} className="bg-green-500 hover:bg-green-600 text-white">Start Game</Button>
        </div>
      ) : (
        <>
          {questions[role].map((q, index) => (
            <Card key={index} className="bg-white border border-gray-300 p-4 mb-4">
              <CardContent>
                <h3 className="font-bold text-lg">{q.question}</h3>
```

```jsx
            <Card key={index} className="bg-white border border-gray-300 p-4 mb-4">
              <CardContent>
                <h3 className="font-bold text-lg">{q.question}</h3>
                {q.options.map((option, idx) => (
                  <div key={idx} className="flex items-center my-2">
                    <input
                      type="radio"
                      name={`question-${index}`}
                      id={`option-${index}-${idx}`}
                      onClick={() => handleAnswer(index, idx)}
                    />
                    <label htmlFor={`option-${index}-${idx}`} className="ml-2">
                      {option}
                      {showResult && (idx === q.correct ? " ✅" : answers[index] === idx ? " ❌" : "")}
                    </label>
                  </div>
                ))}
                {showResult && (
                  <p className="mt-2 text-sm font-bold">
                    Correct Answer: {q.options[q.correct]}
                  </p>
                )}
              </CardContent>
            </Card>
          ))}
          <Button onClick={handleSubmit} className="bg-blue-500 hover:bg-blue-600 text-white w-full mt-4">Submit</Button>
        </>
      )}
    </div>
  );
}
```

Outcome: After running the code, we got the above console

Source: https://codesandbox.io/p/sandbox/aa-4dxt25?file=%2Fsrc%2Findex.html%3A134%2C1

Interpretation

The picture displays a gamified recruitment game developed with React.js that Unilever probably utilized in its talent acquisition procedures. The system operates as a dynamic questionnaire through which applicants answer various multiple-choice questions that evaluate answers automatically during the process. The application implements use State hook and use Effect to control and update questions state as well as user selection and game progress and to

48

modify scores. The system awards participants with different badges, including Winner for top scorers as well as Participant for others to differentiate candidates' efficiency. Users can view a Tailwind CSS-designed interface containing buttons that both save responses and let users change roles, indicating repeatability and flexible use. The gamification technique delivers an interactive recruitment assessment that improves objective evaluation and instant feedback, which benefits candidates and helps recruiters easily detect superior talent.

2. Screenshots of the prototype (Run code)

Image 1: start

Image 2:step 2

Interpretation:

Two images show the Unilever Recruitment Game starting stages where participants choose their role from HR or Marketing before the evaluation process starts. The opening screen demands users to supply their name along with role selection between HR and Marketing before enabling further progression. The recruitment process uses specific roles to provide tailored assessment to applicants. Users become ready to initiate simulation mode after they

enter "Ankita" along with choosing the "HR Manager" role which activates the "Start Game" button in the second image. Unilever integrates gamification elements to deliver interactive recruitment that connects candidate abilities with specific roles within a functional high-tech interface.
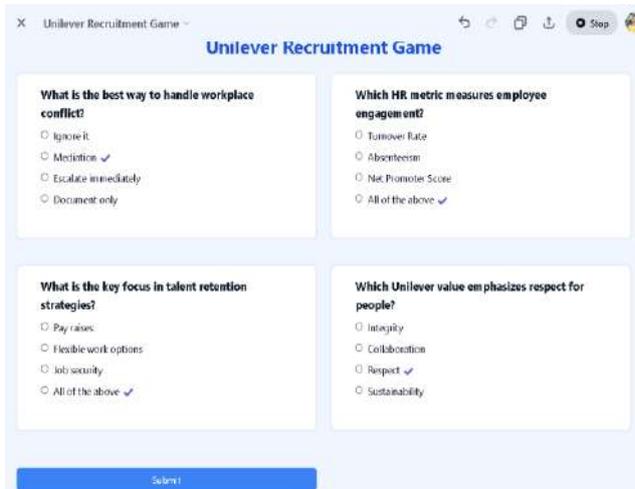
Image 3:   step 3   **Image 4: step 4**
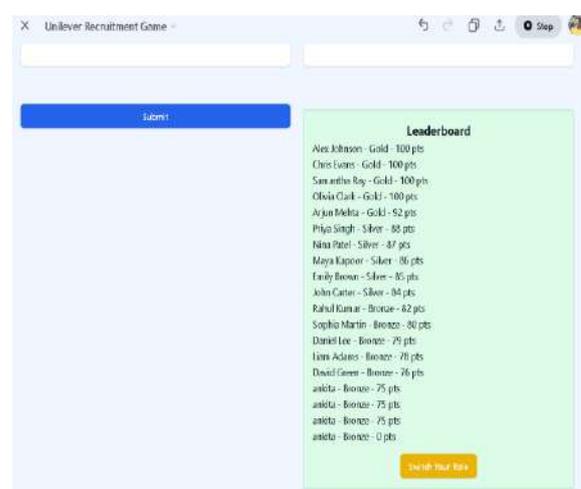
Interpretation:

The Unilever Recruitment Game demonstrates candidate competence through its evaluation procedures and outcome displays which are shown in Images 3 and 4. The candidate encounters multiple-choice queries in Image 3 about resolving workplace conflicts alongside employee metrics and talent retention planning as well as Unilever corporate values. Candidates view their score that displays their leaderboard position once they submit their answers as shown in Image 4. Participation in the leaderboard system awards candidates with gold silver and bronze distinctions depending on their score results which creates feelings of completion and accomplishment. The Bronze rank level for "ankita" shows multiple attempts in the game because the application allows individuals to switch roles repeatedly. Through gamification Unilever presents an innovative recruitment process which combines entertainment value with educational content while enabling candidates to tackle real-life VUCA world leadership scenarios.

Image 5:

Interpretation

The scoreboard shown in the image belongs to a Unilever Recruitment Game prototype which was designed within a gamified recruitment framework. The display shows all participants followed by their achieved scores and earned badges that correspond to their evaluation performance. Two participants named Alice and Bob obtained the Winner badge because they achieved scores of 85 and 78 respectively. The remainder of players received a badge but their scores spanned from 74 down to 0. The player "ankita" holds a score of 0 which implies they did not participate completely in the assessment. There are two options located at the screen's base which enable candidates to complete their progress or begin gameplay from a new role perspective. The recruitment system constitutes an interactive assessment framework which enhances both candidate evaluation processes and high-potential identification through data-based   talent   discovery.

Investment in Role-based gamification- Indian perspective

3. SWOC Analysis table- Unilever with gamification

Strengths (S)	Weaknesses (W)
● Millennial and Gen Z Appeal ● India has over 450 million millennials and 350 million Gen Z (NASSCOM, 2023). ● Gamified recruitment aligns with their tech habits.	● High Initial Investment ● Costs between ₹50 lakh - ₹1 crore for customized platforms (KPMG India, 2023).

● Enhanced Employer Branding ● 72% of Indian millennials prefer innovative workplaces (LinkedIn India, 2023).	● Digital Divide ● 35% of rural India lacks reliable internet (TRAI, 2023). Limits recruitment reach.
● Interactive Skill Assessment ● 68% of candidates prefer interactive assessments (Mercer India, 2022).	● Difficult ROI Measurement ● Only 30% of Indian HR leaders can track gamification ROI (Deloitte India, 2023).
● Data-Driven Insights Improve Hiring Quality by 25% (SHRM India, 2023).	● Technical Glitches ● 40% of candidates report platform glitches (Naukri.com Survey, 2023).
● Increases Candidate Engagement by 60% and reduces drop-offs by 30% (People Matters, 2023).	● Perception Issues ● 22% think gamification lacks seriousness (Glassdoor India, 2023).

Opportunities (O)	Challenges (C)
● Access to Wider Talent Pool ● 65% of India's population is under 35 (UNFPA, 2023). Tier 2/3 cities are untapped.	● Tech Evolution ● 58% of firms find it hard to keep up with changing gamification tech (PwC India, 2023).
● Attract Passive Candidates ● 64% open to new jobs through innovative hiring (LinkedIn India, 2023).	● Data Privacy ● 48% of candidates worry about sharing personal data (Deloitte India, 2023).
● Assess Critical Skills ● 67% of Indian employers value problem-solving & adaptability (NASSCOM, 2023).	● HR Resistance ● 40% of HRs are hesitant about gamification adoption (KPMG India, 2023).
● Hybrid/Remote Work ● 80% of Indian firms have hybrid models (Naukri Hiring Report, 2023).	● Inclusivity Issues ● 35% of HR leaders struggle to balance access for diverse backgrounds (People Matters, 2023).

| ● AI-Driven Gamification | ● Balancing Tech & Human Touch |
| ● AI improves hiring efficiency by 40% & reduces bias by 30% (SHRM India, 2023). | ● 55% of candidates still value human interaction (LinkedIn India, 2023). |

1. Pie Chart: Internet Penetration in India (TRAI, 2023)

- Urban Penetration: 60%

- Rural Penetration: 35%

- No Internet Access: 5%
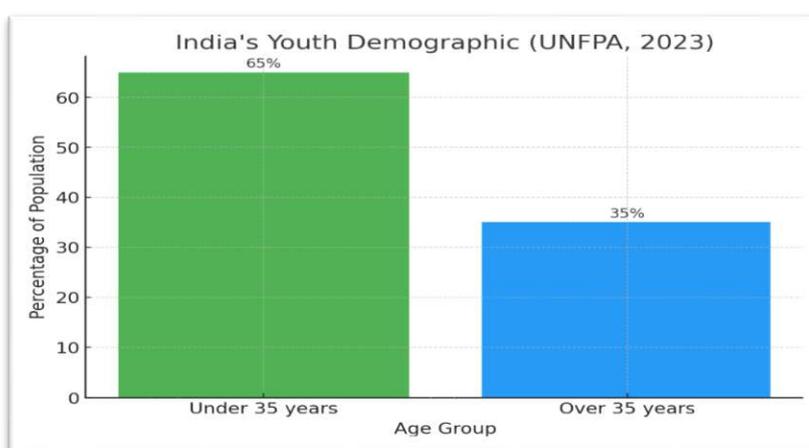
2. Candidate Preferences in Recruitment Methods (Mercer India, 2022)

Recruitment Method	Percentage
Gamified Assessments	68%
Traditional Interviews	32%

3. Candidate Engagement and Drop-off Rate (People Matters, 2023)

- Engagement Increase: 60%

- Drop-off Rate Reduction: 30%

- No Change: 10%

4. AI & Gamification Impact on Recruitment Efficiency (SHRM India, 2023)

Year	Efficiency Improvement (%)	Bias Reduction (%)
2021	15%	10%
2022	30%	20%
2023	40%	30%

AI & Gamification Impact on Recruitment Efficiency (SHRM India, 2023)
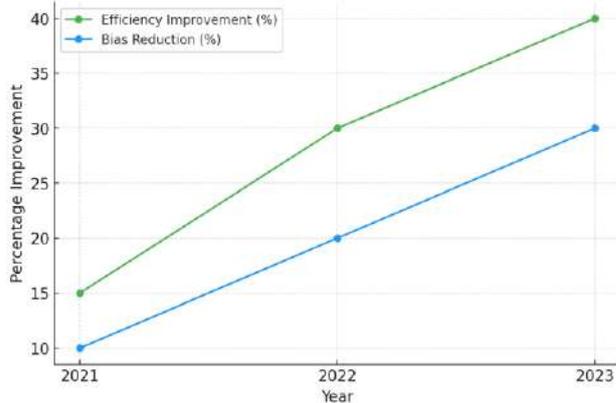
5. Clustered Column Chart: HR Adoption Challenges (KPMG India HR Pulse, 2023)

Challenge	Percentage
Tech Adaptability	58%
Data Privacy Concerns	48%
Resistance from Traditional HR	40%
Inclusivity Concerns	35%

Suggestions

1. The new prototype streamlines candidate assessment to expedite screening in the recruitment process, thus saving substantial time for the talent acquisition process.

2. The prototype minimizes manual screening and hence allows HR professionals to spend more time on strategic activities such as engaging with candidates and choosing a final selection, thus boosting overall effectiveness.

3. Equipping the Unilever recruitment process is a structured and data-driven prototype that is adaptive in managing volatility, uncertainty, complexity, and ambiguity.

4. Older methods are the cause of inefficiencies faced by many organizations during recruitment. This gamified prototype puts Unilever ahead and cements it as an innovative company in the field of talent acquisition, reaffirming its leadership in digital transformation.

5. Unilever has proven to utilize digital tools for significant returns; thus, it is expected that investment in this prototype will further translate to long-term significant savings in hiring costs and efficiency.

6. The gamified recruitment process helps create an exciting and lively application that improves application completion rates to the benefit of Unilever in the eyes of millennials as an employer of choice.

7. The core characteristic of the prototype is a structured solution to allow for the various conditions of the market, ensuring Unilever's recruitment efficiency in different geographical regions while being able to respond to region-specific hiring contingencies.

8. Advanced analytics incorporated in the prototype allow for an unbiased evaluation of candidates. These insights will prove useful for HR teams making hiring decisions.

9. The screening process with the aid of automation minimizes the risk of unconscious bias, leading to fair and inclusive recruitment, which Unilever embraces as its commitment to diversity and equal opportunity.

10. Digital transformation has altered the manner of talent acquisition; the effective uptake of this prototype builds an agile, scalable, and responsive recruitment system for Unilever, guaranteeing sustained competitive kitty frogs within the fast-changing job market.

Conclusions

The newly emerging world of talent acquisition mandates innovative ways of reaching millennial candidates in a VUCA (Volatile, Uncertain, Complex, and Ambiguous) world; therefore, Unilever should be at the forefront to transform the use of AI-driven recruitment initiatives like HireVue, Pymetrics, et al. and level them upwards to maximize their operational efficiency and improve the hiring outcome. Besides, these external recruitment platforms they use do not come in freely for organizations but also require substantial investments. Unilever spends somewhere between $500,000 and $2 million in a single year on AI recruitment tools, in addition to other hiring costs, including integrating the platforms ($200,000-$500,000),

training and implementation ($100,000-$300,000), and maintenance ($100,000-$200,000). Therefore, all the above justify why there should be a cost-effective, tailor-made alternative applicable for long-term objectives in recruitment for the company. Apart from that, the gamification-based recruitment prototype can be an option that optimizes the initial screening process while not entirely depending on third-party platforms. By integrating AI-driven analytics into the machine-assessment of the candidates, the prototype boosts efficiency, reduces the involvement of a human being, and ensures objectivity in candidate evaluations. Hiring time is reduced, and operational costs are saved. As a result, this becomes a sustainable hiring process. Lastly, the whole gamified model emanates from engaging candidates' experience that one desires to capture most top millennial talent and bolster their reputation as the employer of choice. Successful organizations in the future will be those that combine futuristic recruiting methods and decision-making processes in a human touch. The prototype offers Unilever an opportunity to make a long-term investment in the property of a proprietary solution that not only pays itself off in the future with additional rewards, such as scalability, but also provides hiring insights through the data collected while being less expensive to recruit. The changing nature of the workforce will be attributed to the adaptability brought about by a broader future digital transformation. By implementing in-house gamification-based recruitment schemes, Unilever would set itself ahead of the competition in attenuation and adaptation in this moving talent landscape. The present study thus emphasizes how an organization could have critical AI-driven recruitment solutions that could help in navigating complex situations in a VUCA world and the organizations' overall need for maintaining agile-technology-enabled hiring frameworks to attract and retain talent.

References

1. https://en.wikipedia.org/wiki/Unilever
2. https://www.theguardian.com/technology/2019/oct/25/unilever-saves-on-recruiters-by-using-ai-to-assess-job-interviews
3. https://www.theguardian.com/technology/2019/oct/25/unilever-saves-on-recruiters-by-using-ai-to-assess-job-interviews
4. https://en.wikipedia.org/wiki/Gamification?utm_
5. https://codesandbox.io/p/sandbox/aa-4dxt25?file=%2Fsrc%2Findex.html%3A134%2C1

6. https://en.wikipedia.org/wiki/Employee_retention?utm_source

7. https://psico-smart.com/en/blogs/blog-how-can-gamification-transform-leadership-development-programs-184699

8. https://codeoftalent.com/missing-out-on-training-gamification-your-competitors-are-already-winning/

9. https://blog.heytaco.com/gamification-in-the-workplace-boosting-engagement-with-heytaco

EMOTIONAL INTELLIGENCE IN FINANCIAL LEADERSHIP: STRENGTHENING INVESTOR CONFIDENCE IN INDIA'S BANKING SECTOR AMIDST A VUCA ENVIRONMENT

[1]Aishwarya Anandavalli MN & [2]Dr. S . Antony Raj

[1]Full-time Research Scholar, Faculty of Science and Humanities, SRMIST Kattankulathur – 603203, am9172@srmist.edu.in, 8270631861

[2]Assistant Professor of Commerce, Faculty of Science and Humanities, SRMIST Kattankulathur – 603203, antonyrs@srmist.edu.in, 8754178891

Abstract

Purpose – This study examines the role of Emotional Intelligence (EI) in financial leadership and its impact on investor confidence within India's banking sector in a VUCA (Volatile, Uncertain, Complex, and Ambiguous) environment. It aims to analyze how EI-driven leadership strategies enhance transparency, resilience, and trust in financial markets.

Design/methodology/approach – This research adopts a mixed-method approach, combining qualitative case study analysis of major Indian banks with a quantitative survey-based study using the Relative Importance Index (RII). The qualitative aspect involves an in-depth thematic analysis of investor relations and leadership strategies in five major Indian banks, while the quantitative study gathers primary data through a structured Likert-scale survey. Secondary data from financial reports, investor communications, and leadership statements supplement the findings.

Findings – The study identifies four key EI traits—Self-Regulation & Integrity, Empathy & Relationship Management, Adaptability & Innovation, and Resilience & Crisis Leadership—as critical factors influencing investor confidence. Transparent communication, adaptability to market changes, and proactive investor engagement significantly strengthen trust in financial institutions.

Research limitations/implications – The study focuses on the Indian banking sector, limiting generalizability to other financial markets. Future research can expand to global banking or other financial service domains.

Originality/value – This research provides empirical insights into the intersection of EI and financial leadership in a VUCA world, offering a framework for banking leaders to enhance investor confidence through emotionally intelligent decision-making.

Keywords – Emotional Intelligence, Financial Leadership, Investor Confidence, VUCA World, Banking Sector, India

Paper type – Empirical Study

Introduction

Uncertainty and volatility have emerged as defining traits in the quickly changing financial landscape of today, especially in the banking industry. As financial institutions manage global crises, technological disruptions, regulation changes, and economic downturns, the idea of a VUCA (Volatile, Uncertain, Complex, and Ambiguous) world has gained traction. Emotional intelligence (EI) has become a crucial leadership quality in such a demanding environment, allowing financial leaders to uphold stability, encourage investor confidence, and influence strategic decision-making. Emotional intelligence (EI), which includes self-control, empathy, flexibility, and resilience, is essential to how banking executives interact with stakeholders, handle emergencies, and foster confidence in the financial system. Despite its importance, little research has been done on the direct correlation between investor confidence and emotional intelligence (EI) in financial leadership, especially in the Indian banking industry.

By examining how EI-driven leadership practices affect investor trust in India's banking industry, with a particular focus on significant financial institutions like HDFC Bank, Axis Bank, Yes Bank, ICICI Bank, and the State Bank of India (SBI), this study seeks to close this gap. In order to identify important EI traits that improve investor relations, this research uses a mixed-method approach that combines quantitative survey-based evaluation using the Relative Importance Index (RII) with qualitative case study analysis. The results will advance knowledge of how financial leaders can

strengthen investor confidence in a VUCA world by managing crises, utilizing innovation, and upholding transparency.

Research Objectives

- To analyze the impact of Emotional Intelligence (EI) in financial leadership on investor confidence in India's banking sector within a VUCA environment.
- To identify key EI traits—self-regulation, empathy, adaptability, and resilience—exhibited by financial leaders during crises and strategic transitions.
- To assess the link between EI-driven leadership and investor trust using a mixed-method approach, integrating case studies and survey-based RII analysis.
- To propose strategies for enhancing financial leadership through EI to strengthen investor relations and crisis management in uncertain markets.

Statement of the Problem

In a VUCA (Volatile, Uncertain, Complex, and Ambiguous) world, financial leaders in the Indian banking sector face increasing challenges in maintaining investor confidence. Traditional leadership approaches often fall short in managing market uncertainties, crises, and digital transformations. Emotional Intelligence (EI)—including traits like self-regulation, empathy, adaptability, and resilience—plays a crucial role in effective investor communication and decision-making. However, there is limited research on how EI influences financial leadership and investor trust in India's banking sector. This study aims to bridge this gap by analyzing the role of EI in strengthening investor confidence and ensuring financial sustainability in uncertain market conditions.

Review of literature

1. Emotional Intelligence

Ansari and Kumar (2023) assert that EI significantly enhances leadership effectiveness among senior managers in the banking sector, improving decision-making and stakeholder engagement. Similarly, Das (2015) identifies a strong correlation between leaders' EI and employee engagement

in Indian banks, emphasizing the role of emotional competencies in fostering a positive work environment.

2. Financial Leadership

Kumar (2020) highlights that EI contributes to leadership effectiveness, particularly in middle-management roles within the banking sector, enabling leaders to navigate complex financial landscapes with strategic acumen. Das (2015) further reinforces that emotionally intelligent leadership fosters higher levels of employee commitment and performance, which is crucial for financial institutions.

3. Investor Confidence

Ahmad (2018) argues that EI positively influences investment decision-making, leading to increased investor confidence. By demonstrating transparency, adaptability, and emotional awareness, financial leaders can mitigate uncertainties and foster stronger investor trust, which is essential in volatile financial markets.

4. VUCA World

Aithal (2023) emphasizes that EI development is a key factor in enabling banking professionals to adapt to technological disruptions and manage risks effectively within a VUCA environment. The study highlights the necessity of EI-driven leadership to maintain stability in rapidly evolving financial ecosystems.

5. Banking Sector in India

Ansari and Kumar (2023) explore the relationship between EI and leadership effectiveness among senior executives in India's banking sector, demonstrating that emotionally intelligent leadership enhances financial performance and institutional resilience. Kumar (2020) examines the impact of EI on leadership within major Indian banks, including SBI, ICICI, and Citibank, concluding that emotionally aware leaders are better equipped to handle market fluctuations and investor relations.

Research Methodology

This study employs a **mixed-methods approach**, integrating qualitative case study analysis with quantitative survey research to examine the role of Emotional Intelligence (EI) in financial leadership and investor confidence within the Indian banking sector.

- **Qualitative Study:** We conducted case study analyses of five major Indian banks—HDFC Bank, Axis Bank, Yes Bank, ICICI Bank, and SBI—to explore leadership strategies in financial crises, digital transformation, and investor engagement. Data was sourced from **annual reports, investor presentations, financial news, and academic research papers**. Thematic analysis was used to identify recurring EI traits in financial leadership.

- **Quantitative Study:** A structured survey was distributed to financial professionals and investors to assess the impact of EI traits on investor confidence. The survey employed a **Likert-scale questionnaire**, measuring key EI dimensions such as transparency, adaptability, empathy, and crisis management. The **Relative Importance Index (RII) analysis** was used to rank these traits based on their perceived significance.

- **Data Analysis:** The qualitative data was analyzed using **thematic analysis**, while the survey responses were processed through **descriptive statistics and RII calculations** to quantify the influence of EI traits on investor confidence.

By combining **real-world case insights with empirical data**, this methodology ensures a comprehensive understanding of how financial leaders leverage EI to navigate investor relations in a VUCA world.

1. **CASE STUDIES:**

1. HDFC Bank's Digital Transformation and Investor Communication (2023)

- **Context**: HDFC Bank's digital transformation initiative aimed to enhance customer experience and operational efficiency.

- **Investor Relations**:

- Leadership maintained transparency by regularly updating investors on the progress of digital initiatives.

- Empathy was demonstrated by addressing concerns about the transition to digital platforms.

- **Outcome**: Improved investor confidence and increased digital adoption, showcasing the role of EI in managing change.(*HDFC Bank Partners with Microsoft as Part of Its Digital Transformation Journey*, n.d.)

2. Axis Bank's Acquisition of Citi's Consumer Business in India (2022)

- **Context**: Axis Bank acquired Citi's consumer banking business to expand its market share.

- **Investor Relations**:

  - Leadership emphasized transparency by clearly communicating the strategic benefits of the acquisition.

  - Proactive engagement with investors helped address concerns about integration challenges.

- **Outcome**: Strengthened investor trust and enhanced Axis Bank's position in the retail banking segment.(*Axis-Bank-Completes-Acquisition-of-Citibank-s-Consumer-Businesses-in-India*, n.d.)

3. Yes Bank's Post-Crisis Recovery and Stakeholder Engagement (2023)

- **Context**: Following its 2020 crisis, Yes Bank focused on rebuilding trust and stabilizing operations.

- **Investor Relations**:

- Leadership demonstrated accountability by addressing past governance failures.

- Empathy and resilience were evident in efforts to reassure stakeholders and improve financial performance.

- **Outcome**: Gradual recovery in market confidence and improved relationships with investors.(*How Did Yes Bank Successfully Reinvent Itself from Crisis to Confidence?*, n.d.)

4. ICICI Bank's AI-Driven Customer Service and Investor Communication (2023)

- **Context**: ICICI Bank implemented AI-driven solutions to enhance customer service efficiency.

- **Investor Relations**:

  - Leadership showcased innovation and adaptability by leveraging technology to meet customer needs.

  - Regular updates to investors highlighted the strategic importance of AI in improving operational efficiency.

- **Outcome**: Increased investor confidence in the bank's ability to innovate and adapt to market changes.(*How ICICI Bank Is Using AI to Amp up Customer Centricity, CIO News, ET CIO*, n.d.)

5. SBI's Green Bond Initiative and Sustainable Banking (2023)

- **Context**: SBI issued green bonds to fund renewable energy projects, aligning with global sustainability goals.

- **Investor Relations**:

- o Leadership demonstrated visionary thinking by aligning banking operations with environmental objectives.

- o Transparent communication about the purpose and impact of green bonds attracted environmentally conscious investors.

- **Outcome**: Enhanced SBI's reputation as a socially responsible bank and strengthened investor relationships (*Sustainability - SBI Green*, n.d.)

2. RELATIVELY IMPORTANT INDEX

Question	RII	Rank
Accountability	0.684	5
Adaptability	0.67	7
Communication	0.664	10
Confidence	0.686	3
Decision-making	0.658	12
Innovation	0.672	6
Listening	0.696	1
Relationships	0.696	2
Strategy	0.686	4
Sustainability	0.664	11
Transparency	0.668	8
Trust	0.668	9

Analysis

The case study analysis and the **Relative Importance Index (RII) rankings** provide key insights into how emotional intelligence (EI) traits impact financial leadership and investor confidence in India's banking sector.

1. Key Findings from Case Studies

The case studies highlight the role of **Self-Regulation, Empathy, Adaptability, and Innovation** in investor relations. Key observations include:

- **Transparency and Accountability**: HDFC Bank and Axis Bank maintained clear and open communication regarding their digital transformation and acquisition strategies. This aligns with the high RII ranking for **Listening (0.696, Rank 1) and Relationships (0.696, Rank 2)**.

- **Crisis Management and Resilience**: Yes Bank's post-crisis recovery emphasized **Trust (0.668, Rank 9)** and **Accountability (0.684, Rank 5)**, demonstrating the importance of responsible leadership in regaining investor confidence.

- **Adaptability and Innovation**: ICICI Bank's AI implementation and SBI's green bond initiative showcased **Innovation (0.672, Rank 6)** and **Sustainability (0.664, Rank 11)** as essential in navigating market trends and stakeholder expectations.

2. Analysis of RII Rankings

The **Relative Importance Index (RII)** rankings provide a quantified measure of how various EI traits influence investor confidence and financial decision-making.
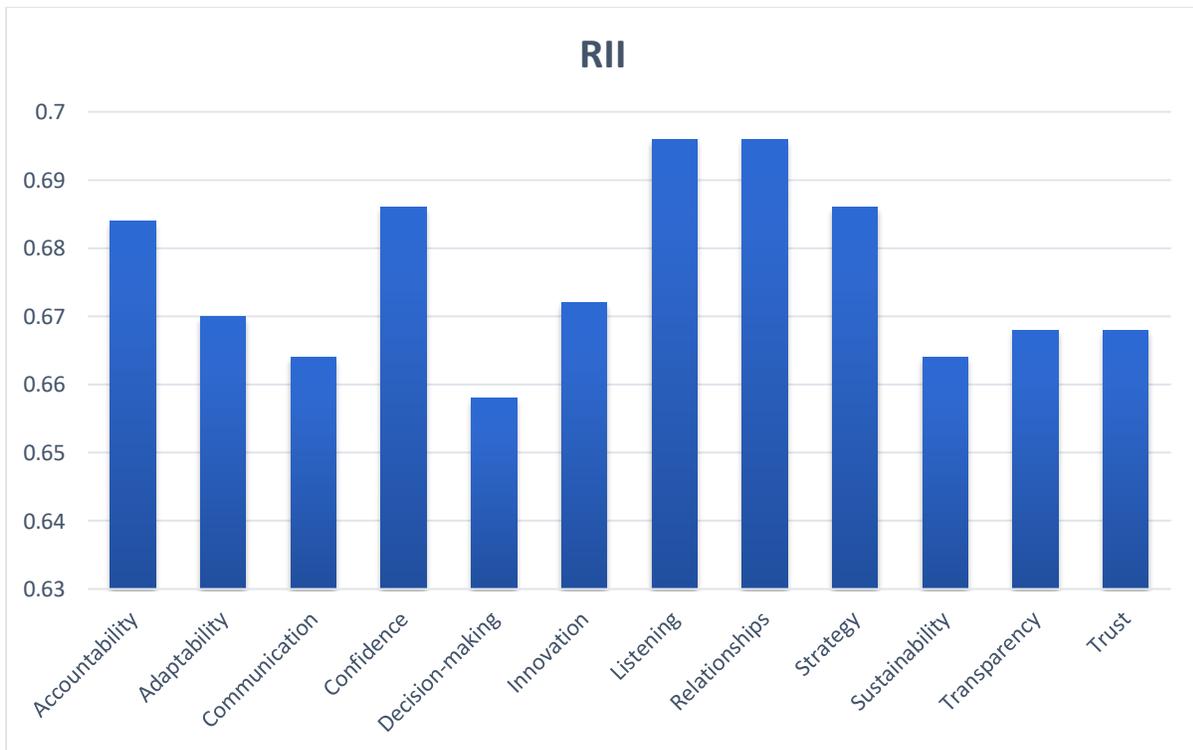
1. **Most Critical EI Traits**:

   o **Listening (0.696, Rank 1) and Relationships (0.696, Rank 2)** are the most valued EI traits, emphasizing the importance of leadership that actively listens and fosters strong investor relationships.

   o **Confidence (0.686, Rank 3) and Strategy (0.686, Rank 4)** show that investors value clear strategic direction and assurance from leadership.

2. **Moderately Important Traits**:

   o **Accountability (0.684, Rank 5)** and **Innovation (0.672, Rank 6)** highlight the need for responsible and forward-thinking leadership, especially in times of transformation.

   o **Adaptability (0.67, Rank 7)** and **Transparency (0.668, Rank 8)** suggest that leaders who respond swiftly to market changes while maintaining open communication are highly regarded.

3. **Lower-Scoring Traits**:

   o **Trust (0.668, Rank 9), Communication (0.664, Rank 10), and Sustainability (0.664, Rank 11)** indicate that while these are significant factors, they may be considered secondary to direct investor engagement and decision-making.

   o **Decision-Making (0.658, Rank 12)** ranks the lowest, implying that while crucial, investors may prioritize how decisions are communicated and justified over the decision-making process itself.

3. Implications for Financial Leadership

- **Investor-Centric Communication**: High-ranking factors like **Listening, Relationships, and Confidence** suggest that transparent and empathetic engagement with investors is the cornerstone of effective leadership.

- **Strategic and Responsible Leadership**: **Accountability and Strategy** are key in maintaining market trust, especially during crises.

- **Embracing Innovation**: With **Innovation and Adaptability** ranking in the mid-range, banks must continue leveraging digital transformation and sustainability efforts to maintain investor confidence.

- **Balancing Decision-Making with Communication**: While **Decision-Making (0.658, Rank 12)** scored lower, its effectiveness is contingent on strong communication and trust-building efforts.

Conclusion

The combination of case study insights and RII rankings reinforces that financial leadership in a VUCA (Volatile, Uncertain, Complex, and Ambiguous) environment must be built on emotional intelligence, transparency, and adaptability. Banks that prioritize listening to investors, fostering trust, and embracing innovation are more likely to sustain long-term investor confidence and navigate financial challenges effectively.

Future studies can explore the longitudinal impact of emotional intelligence on financial stability by analyzing investor sentiment over extended periods. Additionally, comparative research across global banking sectors can provide insights into how EI-driven leadership varies in different economic and regulatory environments.

References

1. Aithal, P. S., & Radha, P. (2023). A study on the influence of emotional intelligence interventions in the banking sector. *International Journal of Case Studies in Business, IT, and Education (IJCSBE), 7*(3), 369-378. https://doi.org/10.2139/ssrn.4674624

2. Axis Bank. (n.d.). *Axis Bank completes acquisition of Citibank's consumer businesses in India.* Retrieved March 10, 2025, from https://www.axisbank.com

3. Chaudhary, K., & Sharma, M. (2011). Performance of Indian public sector banks and private sector banks: A comparative study. *International Journal of Innovation, Management and Technology, 2*(3), 249-256.

4. Du Toit, A. J. (2014). Emotional intelligence and leadership in a South African financial services institution. *[Master's dissertation, University of South Africa].* UNISA Institutional Repository. https://uir.unisa.ac.za/bitstream/handle/10500/14227/dissertation_du%20toit_aj.pdf?sequence=1

5. ET CIO. (n.d.). *How ICICI Bank is using AI to amp up customer centricity.* CIO News. Retrieved March 10, 2025, from https://cio.economictimes.indiatimes.com/news/strategy-and-management/how-icici-bank-is-using-ai-to-amp-up-customer-centricity/63390838

6. HDFC Bank. (n.d.). *HDFC Bank partners with Microsoft as part of its digital transformation journey.* Retrieved March 10, 2025, from https://www.hdfcbank.com/personal/about-us/news-room/press-release/2023/q1/hdfc-bank-partners-with-microsoft-as-part-of-its-digital-transformation-journey

7. Karthikeyan, V., & Lalwani, S. (2017). Emotional intelligence in banking sector: An integrative literature review. *IOSR Journal of Business and Management, 19*(10), 9-14. https://www.iosrjournals.org/iosr-jbm/papers/Vol19-issue10/Version-6/B1910060914.pdf

8. Perumal, R., & Aithal, P. S. (2023). A study on the influence of emotional intelligence interventions in the banking sector. *International Journal of Case Studies in Business, IT, and Education (IJCSBE), 7*(3), 369-378. https://doi.org/10.2139/ssrn.4674624

9. Rahim, S. H. (2010). Emotional intelligence and organizational performance: A study among Malaysian managers. *International Journal of Business and Management, 5*(10), 189-195.

10. Singh, D., & Dubey, A. (2023). Emotional intelligence and stress among bank employees. *International Journal of Indian Psychology, 11*(2), 1862-1870. https://ijip.in/wp-content/uploads/2023/06/18.01.191.20231102.pdf

11. Srivastava, S. (2013). An empirical study of emotional intelligence (EI) among Indian private sector bankers. *International Journal of Advanced Research in Management and Social Sciences, 2*(12), 120-131. https://garph.co.uk/IJARMSS/Dec2014/21.pdf

12. State Bank of India. (n.d.). *Sustainability - SBI Green.* Retrieved March 10, 2025, from https://sbi.co.in/web/sbi-green/esg/sustainability

13. TaxChela. (n.d.). *How Did Yes Bank successfully reinvent itself from crisis to confidence?* Retrieved March 10, 2025, from https://www.taxchela.com/post/how-did-yes-bank-successfully-reinvent-itself-from-crisis-to-confidence

NAVIGATING FINANCIAL CHALLENGES IN AN ERA OF UNCERTAINTY

[1]K.Sunitha, [2]Samsani.Keerthi & [3]Manubolu Samson

[1]Associate Professor

Avinash College of Commerce, secunderabad

sunithak.sec.avinashcollege@gmail.com.

ORCID: 0009-0000-5864-5379

[2]BBA-BA First year student

Avinash college of commerce, secunderabad

samsanikeerthi22@gmail.com

[3]BBA-BA First year student

Avinash college of commerce, secunderabad

bruciebanner456@gmail.com

Abstract

The contemporary global landscape, characterized by Volatility, Uncertainty, Complexity, and Ambiguity (VUCA), presents unprecedented challenges to financial stability and organizational resilience.

[1] This paper investigates the multifaceted financial challenges businesses and institutions face in navigating this era of uncertainty. It examines the limitations of traditional financial models and forecasting methods, which often prove inadequate in the face of rapid market fluctuations and unforeseen disruptions. Through a synthesis of contemporary research and case study analysis, this study identifies key factors impacting financial decision-making, including supply chain vulnerabilities, technological disruptions, and geopolitical instability. Furthermore, it explores the critical role of adaptive strategies, such as scenario planning, agile budgeting, and enhanced risk management frameworks, in mitigating financial risks. This research emphasizes the importance of leveraging advanced analytics and digital technologies to improve financial forecasting and enhance operational efficiency. [2] It argues that fostering a culture of financial resilience, through proactive risk assessment and strategic resource allocation, is essential for organizations to thrive in the dynamic and unpredictable VUCA world. Ultimately, this paper provides insights into developing robust financial strategies that enable organizations to navigate uncertainty and achieve sustainable growth.

Keywords: *VUCA,Volatility, Uncertainty, Complexity,Ambiguity*

Introduction

The dawn of the 21st century has ushered in an era defined by the acronym VUCA: Volatility, Uncertainty, Complexity, and Ambiguity.

[1] This environment, characterized by rapid technological advancements, geopolitical shifts, and unpredictable economic fluctuations, poses unprecedented challenges to organizations worldwide. In particular, the financial stability and resilience of businesses and institutions are being tested by the inherent unpredictability of the VUCA world. Traditional financial models and forecasting techniques, often reliant on historical data and linear projections, are proving inadequate in the face of sudden and disruptive changes. [2] The increasing frequency of economic shocks, supply chain disruptions, and technological disruptions necessitates a paradigm shift in how organizations manage their finances.

The limitations of conventional financial models, reliant on historical data and linear projections, become glaringly apparent in the face of sudden market shocks, unforeseen supply chain disruptions, and the rapid obsolescence of established technologies. The increasing frequency and severity of economic downturns, coupled with the interconnectedness of global markets, necessitates a fundamental shift in how organizations approach financial planning and risk management. The ability to accurately forecast future performance, mitigate potential losses, and adapt to evolving market conditions has become paramount for survival and sustainable growth.

This research paper aims to explore the multifaceted financial challenges that organizations face in navigating this era of uncertainty. It will delve into the limitations of conventional financial management practices and investigate the emergence of adaptive strategies designed to enhance financial resilience. By examining the impact of key VUCA factors, such as market volatility, technological disruptions, and geopolitical instability, this study will provide insights into the necessary adjustments for organizations to thrive in this dynamic landscape. We will explore the vital role of scenario planning, agile budgeting, and the integration of advanced data analytics in building a robust financial framework. Furthermore, this study will analyze how organizations can effectively leverage technology to improve financial forecasting, risk assessment, and operational efficiency, while also addressing the growing concerns of cybersecurity and data protection. Ultimately, this paper seeks to contribute to a deeper understanding of financial management in the VUCA world, offering practical

recommendations for businesses and institutions seeking to secure their financial future and navigate the complexities of an increasingly uncertain global environment

Problem Statement:

"While academic research acknowledges the impact of the VUCA world on financial management, there is a significant gap between theoretical frameworks and practical implementation. Many organizations struggle to translate theoretical concepts into effective financial strategies. The problem is to bridge this gap by examining the specific financial challenges posed by VUCA and providing actionable recommendations for organizations to enhance their financial resilience and navigate uncertainty."

Literature Review: Navigating Financial Challenges in Uncertain Environments

2.1 The VUCA Framework and its Impact on Business

The concept of VUCA (Volatility, Uncertainty, Complexity, and Ambiguity) originated in the U.S. Army War College, initially used to describe the post-Cold War world (Bennett & Lemoine, 2014).

It has since permeated business literature, reflecting the increasingly dynamic and unpredictable global environment. Volatility, characterized by rapid and significant changes, is exemplified by the frequent market fluctuations and economic shocks of the 21st century (Taleb, 2007).

Uncertainty, the lack of predictability, challenges traditional forecasting methods, necessitating more flexible planning approaches (Courtney, Kirkland, & Viguerie, 1997).

Complexity, the intricate web of interdependencies, makes it difficult to isolate cause-and-effect relationships (Snowden & Boone, 2007).

Ambiguity, the lack of clarity and multiple interpretations, requires organizations to embrace ambiguity and develop adaptive strategies (McGrath, 2013).

Research indicates that VUCA necessitates a shift from traditional linear planning to more agile and adaptive strategies. Organizations must foster a culture of resilience, capable of responding quickly to unforeseen events (Hamel & Välikangas, 2003). Studies by McKinsey & Company and Boston Consulting Group highlight the importance of scenario planning and stress testing in preparing for potential disruptions.

Traditional financial management practices, often rooted in assumptions of stability and predictability, are ill-equipped to handle the dynamics of a VUCA world. Forecasting models, such as time-series analysis, rely heavily on historical data, which may not be indicative of future trends (Hyndman & Athanasopoulos, 2018).

Rigid budgeting processes hinder organizations' ability to adapt to changing market conditions (Hope & Fraser, 2003).

Furthermore, traditional risk management frameworks, focused on identifying and mitigating known risks, struggle to address systemic and unpredictable risks (Power, 2007).

The 2008 financial crisis exposed the limitations of standard portfolio theory, which failed to account for the interconnectedness of financial markets (Brunnermeier, 2009). There is a growing consensus that organizations need to adopt more dynamic and scenario-based risk management approaches (Kaplan & Mikes, 2012).

In response to the limitations of traditional practices, researchers and practitioners have proposed a range of adaptive financial strategies. Scenario planning, involving the development of multiple plausible future scenarios, enables organizations to prepare for a range of potential outcomes (Schoemaker, 1995).

Stress testing, which assesses the impact of adverse events on financial performance, helps identify vulnerabilities and build resilience (Basel Committee on Banking Supervision, 2018). Agile budgeting, characterized by frequent reviews and adjustments, allows organizations to respond quickly to changing market conditions (Rigby, Sutherland, & Takeuchi, 2016). Building financial resilience, involving the accumulation of cash reserves and diversification of revenue streams, is crucial for navigating periods of uncertainty (Sheffi & Rice, 2005).

The proliferation of data and advancements in technology offer new opportunities for financial management in VUCA environments. Machine learning and artificial intelligence can improve the accuracy and timeliness of financial forecasting (Hastie, Tibshirani, & Friedman, 2009). Big data analytics can help identify patterns and trends that would otherwise be missed (Manyika et al., 2011).

Digital tools and platforms can enhance risk assessment, monitoring, and mitigation (Crouhy, Galai, & Mark, 2014). However, the increasing reliance on technology also poses new challenges, such as cybersecurity risks and data privacy concerns (Kshetri, 2010). The rise of fintech has also placed pressure on traditional financial institutions, forcing them to adapt and innovate.

Objective:

- To analyze and evaluate the financial challenges faced by organizations and financial institutions within the Volatile, Uncertain, Complex, and Ambiguous (VUCA) environment, and to propose strategies for enhancing financial resilience and stability.

- To identify and assess the key financial risks associated with the VUCA world, including market volatility, supply chain disruptions, technological advancements, and geopolitical instability.

The significance of this study:

1. Addressing a Timely and Relevant Issue:

- The VUCA world is not a theoretical concept but a present reality. [1] Organizations across all sectors are grappling with its effects. This study provides timely insights into a pressing issue.
- The frequency and severity of financial crises, supply chain disruptions, and technological upheavals underscore the urgency of developing robust financial strategies.

2. Bridging the Gap Between Theory and Practice:

- While academic literature acknowledges the VUCA phenomenon, there's often a disconnect between theoretical frameworks and practical applications.
- This research aims to bridge this gap by providing actionable strategies and recommendations that can be implemented by practitioners.

Methodology:

1. Mixed Methods Approach (Recommended):

- **Rationale:** Combining qualitative and quantitative methods allows for a more holistic understanding of the complex financial challenges in a VUCA environment.
- **Components: Qualitative Research:**

- o **Case Studies:** In-depth analysis of specific organizations (e.g., multinational corporations, financial institutions) to understand how they are navigating financial challenges. This can provide rich, contextualized insights.
- o **Expert Interviews:** Conducting interviews with financial professionals, risk managers, and industry experts to gather their perspectives on the impact of VUCA and effective strategies.
- o **Literature Analysis:** A deep analysis of existing papers, and reports, to gain an understanding of the current state of knowledge.

Quantitative Research:

- o **Statistical Analysis:** Analyzing financial data (e.g., market volatility, financial performance indicators) to identify trends and patterns.
- o **Financial Modeling:** Creating and testing financial models to assess the impact of different VUCA factors on financial stability.
- o **Surveys:** Distributing questionnaires to financial professionals to gather data on their perceptions and practice

Findings

1. **Widespread Adoption of Scenario Planning:** Organizations recognize the value of scenario planning for financial risk management.
2. **Technological Integration:** Advanced technologies, particularly AI/ML, are increasingly used in risk management processes.
3. **Data-Driven Risk Management:** Data availability is crucial, but challenges exist in ensuring its quality and accessibility.
4. **Varied Risk Assessment Practices:** Organizations employ different frequencies and approaches to risk assessments.
5. **Moderate Organizational Capabilities:** Many organizations perceive their risk management capabilities as moderate, indicating room for improvement.
6. **Key Risk Factors:** Technology, market volatility, and regulatory changes are significant risk factors.
7. **Stable Assessment Frequency:** Most organizations have maintained a consistent risk assessment frequency over the past three years.

Recommendations

1. **Enhance Data Management:** Organizations should invest in robust data management systems to improve data quality, accessibility, and reliability for risk assessments.

2. **Invest in Advanced Technologies:** Further adoption of AI/ML and other advanced technologies can enhance risk prediction and mitigation.

3. **Strengthen Scenario Planning:** Develop more comprehensive and dynamic scenario planning processes to address a wider range of potential risks.

4. **Improve Organizational Capabilities:** Provide training and resources to enhance risk management skills and capabilities across the organization.

5. **Regularly Review and Update Risk Assessments:** Ensure that risk assessments are regularly reviewed and updated to reflect changing market conditions and emerging risks.

6. **Address Resistance to Change:** Implement change management strategies to overcome resistance to new risk management practices and technologies.

7. **Tailor Assessment Frequency:** Organizations should tailor the frequency of risk assessments to the specific risks they face and their industry's dynamics.

Suggestions

1. **Benchmarking:** Conduct benchmarking studies to compare risk management practices and performance with industry peers.

2. **Collaboration:** Foster collaboration and knowledge sharing among different departments to improve risk awareness and response.

3. **Continuous Improvement:** Adopt a continuous improvement approach to risk management, regularly evaluating and refining processes.

4. **Focus on Emerging Risks:** Pay close attention to emerging risks, such as cybersecurity threats and climate change, and develop strategies to mitigate them.

5. **Use of Cloud Computing:** As cloud computing was mentioned, further investigation into how cloud computing can increase speed of risk assesments and data storage should be looked into.

Conclusions

The research reveals that organizations are increasingly aware of the importance of proactive risk management. Scenario planning and advanced technologies are becoming integral components of risk management strategies. However, challenges remain in data management, organizational capabilities, and adapting to emerging risks. Organizations that prioritize data-driven decision-making, invest in technology, and foster a culture of risk awareness will be better positioned to navigate uncertainty and achieve their strategic objectives.

References

1. **Schoemaker, P. J. H. (1995). Scenario planning: A tool for strategic thinking.** *Sloan Management Review, 36*(2), 25-40. (A classic, foundational article on scenario planning)
2. **Chermack, T. J., Lynham, S. A., & Ruona, W. E. A. (2001). A review of scenario planning literature.** *Futures Research Quarterly, 17*(2), 7-31. (A comprehensive overview of the scenario planning field)
3. **Lindgren, M., & Bandhold, H. (2003). Scenario planning: The link between future and strategy.** Palgrave Macmillan. (In-depth exploration of scenario planning methodology and applications)
4. **Schwartz, P. (1991). The art of the long view: Planning for the future in an uncertain world.** Doubleday. (A seminal work on scenario planning, emphasizing its importance for long-term strategic thinking)
5. **Ramírez, R., Selsky, J. W., & van der Heijden, K. (2010). Business planning for turbulent times: New methods for applying scenarios.** Earthscan. (Focuses on scenario planning in volatile and uncertain environments)
6. **Georgantzas, N. C., & Acar, W. (1995). Scenario-driven planning: Learning to manage strategic uncertainty.** Greenwood Publishing Group. (Examines the role of learning and adaptation in scenario planning)

Financial Risk Management

1. **Hull, J. C. (2018). Risk management and financial institutions.** John Wiley & Sons. (A comprehensive textbook covering various aspects of financial risk management)

2. McNeil, A. J., Frey, R., & Embrechts, P. (2015). Quantitative risk management: Concepts, techniques and tools. Princeton University Press. (Focuses on quantitative approaches to risk management, including statistical modeling and risk measures)

3. **Jorion, P. (2007). Value at risk: The new benchmark for managing financial risk.** McGraw-Hill. (A key resource on Value at Risk (VaR), a widely used risk measure in finance)

4. **Crouhy, M., Galai, D., & Mark, R. (2014). Risk management.** McGraw-Hill Education. (Provides a broad overview of risk management principles and practices)

5. **Damodaran, A. (2012). Investment valuation: Tools and techniques for determining the value of any asset.** John Wiley & Sons. (Covers valuation techniques relevant to assessing financial risks)

Technology & Data in Risk Management

1. **Dixon, M. F., Halperin, I., & Bilokon, P. (2020). Machine learning in finance: From theory to practice.** Springer. (Explores the applications of machine learning in various areas of finance, including risk management)

2. **Das, S. R. (2014). Financial market analytics.** John Wiley & Sons. (Covers the use of data analytics and machine learning in financial markets)

3. **Janssen, J., Manrique, B., & Wilmsmann, D. (2012).** *Developing a data quality culture*. Morgan Kaufmann. (Addresses the importance of data quality for effective risk management and decision-making)

4. Kaisler, S., Armour, F., Espinosa, J. A., & Money, W. (2013). Big data: Issues and challenges moving forward. Proceedings of the 46th Hawaii International Conference on System Sciences (pp. 995-1004). (Discusses the challenges and opportunities of using big data in various fields, including finance)

Industry Reports & Frameworks

1. **World Economic Forum. (2023). The Global Risks Report 2023.** (Provides insights into current and emerging global risks, including financial risks)

2. **McKinsey & Company. (Various reports on risk management, scenario planning, and financial services).** (Consult their website for relevant reports in your specific industry)

3. **COSO. (2017). Enterprise Risk Management - Integrating with Strategy and Performance.** (A widely recognized framework for enterprise risk management)

4. **Basel Committee on Banking Supervision. (Various publications on banking regulations and risk management).** (Provides guidance on risk management practices for financial institutions)

FROM TRADITIONAL TO DIGITAL: ASSESSING THE IMPACT OF DIGITAL TRANSFORMATION ON BANKING SERVICES AND CUSTOMER EXPERIENCE

ASHA RAJAPPAN[1], and SMRITHI T.V[2]

[1]Assistant Professor, PG Department of Commerce, Navajyothi College Cherupuzha.

[2]Assistant Professor, PG Department of Commerce, Navajyothi College Cherupuzha.

Abstract

The banking industry has seen a radical change due to digital transformation, which has altered customer relationships and service delivery. This study explores the influence of digital transformation on banking services and customer experience, concentrating on accessibility, efficiency, and security. It also investigates how digital banking promotes customer experience. Furthermore, the survey reveals hurdles clients experience in embracing digital banking services. A mixed-method approach was adopted, using primary data from 100 respondents in Kannur and Kasaragod districts, Kerala, together with secondary data from RBI reports and various journals related to the study.

The results show that digital banking is widely used, with 47% of respondents choosing digital banking fully. The most used services are checking account balances and fund transfers. While technological difficulties and security concerns continue to be major obstacles, convenience and transaction speed are what drive contentment. Indicating an openness to new technologies, a noteworthy 61% of respondents favor AI-driven banking, and 45% show interest in block chain-based solutions. 2022–2024 transaction study shows a consistent rise in digital transactions, but 2024 saw a drop in transaction value, maybe as a result of shifting toward lower-value transactions (like UPI) and modifications to banking regulations. Due to seasonal spending, the report also reveals steady increase in UPI, IMPS, and other digital payment systems, with a peak in transaction volume in October 2024. . Education level is associated with more digital banking usage, according to a chi-square test. The report highlights the increasing reliance on digital banking while also pointing out the need for enhanced security, user-friendly interfaces, and awareness campaigns.

Keywords: *Digital Transformation, Customer Experience, Banking Services, Digital satisfaction.*

I.INTRODUCTION

The banking sector has seen substantial change as a result of the quick development of digital technologies, which has altered client relationships and service provision. The process of incorporating digital technologies into every facet of a company in order to boost customer satisfaction, streamline processes, and generate new value is known as digital transformation. This change in the banking industry entails the substitution of digital services like cloud computing, block chain, online banking, mobile apps, and artificial intelligence (AI) with conventional banking procedures. Digital banking solutions that put accessibility, efficiency, and security first have replaced traditional banking practices that were previously dependent on physical branches and manual transactions. Technological innovation, shifting consumer expectations, and legislative developments are some of the reasons driving this digital transition. Customers gain from improved convenience, individualized services, and smooth transactions as banks continue to use digital solutions. However, alongside these advantages, challenges such as cyber security threats, technological literacy gaps, and user adoption barriers persist. This study examines the influence of digital transformation on banking services and customer experience, focusing on accessibility, efficiency, and security. It also looks at consumer preferences for digital banking as opposed to traditional banking and how new technologies like block chain and artificial intelligence (AI) will affect banking in the future. This study offers insights into the changing landscape of digital banking and the obstacles that need to be overcome for widespread adoption by examining data from respondents in Kerala's Kannur and Kasaragod districts.

II. LITERATURE REVIEW

1.Dr. R. Nalini and S. Yuvasri (2024): This study examines how digital transformation affects the banking industry's customer experience, emphasizing the value of automation, real-time payments, and digitization.

2. 3Pillar Global (2023): This article highlights the importance of businesses prioritizing customer-centricity in their digital transformation plans and explores the relationship between digital transformation and customer experience.

3. **S. Jonnalagadda (2023):** This review of the literature looks at how the banking sector has been affected by digital transformation, emphasizing important topics including digital payments, mobile banking, and customer experience.

4. **N. Kumar (2022):** This study examines how the banking industry's digital transformation has affected customer experience, highlighting important elements including speed, ease, and personalization.

5. **E. Indriasari, F. L. Gaol, and T. Matsuo (2019):** This case study examines a prominent bank's digital transformation path, emphasizing important takeaways and industry best practices.

6. **S. Mohanty, S. Singh, and J. Mohanty (2023):** This paper highlights important tactics including omnichannel engagement and tailored marketing while examining how digital transformation might improve the banking industry's customer experience.

7. **K.D. Pham (2023):** This comprehensive study of the literature looks at how the banking sector has been affected by digital transformation, emphasizing important topics including digital payments, mobile banking, and customer experience.

8. **Y. Khassawneh (2024):** This study evaluates how digital transformation affects customer experience in the banking sector, highlighting important elements like speed, convenience, and personalization.

9. **F. Diener and M. Pacek (2021)** : This case study investigates how digital transformation affects the banking sector, emphasizing important takeaways and best practices for digital banking transformation.

10. **S. Winasis, S. Riyanto, and E. Ariyanto (2020)**: This literature review looks at how digital transformation affects customer experience in the banking sector, emphasizing important themes like digital payments, mobile banking, and customer experience.

III. OBJECTIVES OF THE STUDY

1. Evaluate the impact of digital transformation on banking services, including accessibility, efficiency, and security.

2. Assess how digital banking enhances customer experience, such as convenience, personalization, and satisfaction.

3. Identify challenges customers face in adopting digital banking services, such as security concerns and technological barriers.

4. Understand customers attitude towards emerging technologies (AI, block chain, mobile banking).

IV. METHODOLOGY

The study employed a combination of primary and secondary data collection methods, with the former being obtained through Google forms to collect questionnaires from the districts of Kannur and Kasargod in Kerala, the latter from RBI Reports and other relevant journals. A convenient sampling method was used to select a sample of 100 for the study, and the data was analyzed using the percentage method, ranking method, Likert scale analysis, and Chi-square test.

V. DATA ANALYSIS AND FINDINGS

Table No. 1: Demographic Variable of the Respondents

VARIABLE	PROFILE	FREQUENCY	PERCENTAGE
Gender	Male	52	52
	Female	48	48
Age	Below 18	5	5
	18-25	22	22
	26-35	30	30
	36-45	20	20
	46-55	15	15
	Above 55	8	8
Education Level	High School	25	25
	Higher secondary	28	28
	Bachelor's Degree	32	32
	Master's Degree	15	15
Employment Status	Student	18	18
	Employed	45	45
	Self-Employed	20	20
	Unemployed	12	12
	Retired	5	5
Source: Primary Data			

Interpretation:

According to the respondents' demographic profile, there is a balanced representation of men and women (52% and 48%, respectively), with the majority (70%) being of working age (18–45 years). 32% of the respondents had a bachelor's degree, and 15% have a master's degree, indicating a comparatively high level of education. There are a variety of employment statuses: 18% are students, 20% are self-employed, and 45% are employed. All things considered, the sample is typical of the working-age, educated population and offers a useful overview of how digital transformation is affecting banking services and consumer satisfaction.

Table No. 2: Ranking Most Common Digital Banking Service Methods

OPTION	TOTAL MARK	AVERAGE
Checking Account Balance	350	3.5
Fund Transfers	345	3.45
Bill Payments	330	3.3
Customer Support	250	2.5
Loan Applications	225	2.25

Source: Primary Data

Interpretation:

With the highest overall score (350) and an average of 3.5, Checking Account Balance is the most popular digital banking service method, according to the study. This suggests that consumers regularly check their account balances, most likely for financial tracking and budgeting purposes. Bill payments (3.3) and fund transfers (3.45) trail closely behind, underscoring their significance in day-to-day financial activities. These services are necessary for managing finances and covering regular expenses. Customer service receives a lower ranking of 2.5, indicating that although it is crucial, users could only contact it when problems occur.

Table No. 3: Ranking Most Useful Digital Banking Feature

OPTION	TOTAL MARK	AVERAGE
24/7 Access	350	3.50
Quick Transaction Processing	325	3.25
Mobile Banking Apps	365	3.65
Personalized Financial Insights	310	3.10
AI Chatbots for Assistance	235	2.35

Source: Primary Data

Interpretation:

According to a usability assessment of digital banking features, people place the highest value on mobile banking apps (3.65 average), highlighting the significance of these elements for easy and comfortable banking. The necessity of round-the-clock availability is emphasized by 24/7 Access (3.50), which comes next. Third place goes to Quick Transaction Processing (3.25), indicating that consumers favor quick and easy banking. Next, with a moderate level of importance in assisting consumers with money management, is Personalized Financial Insights (3.10). Finally, AI Chatbots for Assistance (2.35) have the lowest ranking, indicating that they are not as popular, perhaps as a result of their inability to handle complicated financial problems.

Table No. 4: Likert Scale Analysis

Customer experiences in Digital Banking

OPTIONS	TOTAL MARK	AVERAGE
Speed of Digital Banking service	392	3.92
Range of digital banking services	382	3.82
Trust and Security of Digital Banking	376	3.76
Convenience of Digital Banking	396	3.96
Level of Customer Support for digital banking services	390	3.90

Source: Primary Data

Interpretation:

Customers are generally satisfied with digital banking services, according to the Likert scale analysis(1-5), with Convenience of Digital Banking receiving the greatest score (3.96/5) and Security Perception receiving the lowest score (3.76/5). With speed, convenience, and customer support as the strongest features and security perception and service range as areas for improvement, the averages overall vary from 3.76 to 3.96, suggesting a favorable attitude toward digital banking services.

Table No.5: Types of Challenges in Digital Banking

RESPONSE	NO.OF RESPONDENTS	PERCENTAGE
Security Concerns	40	40
Technical Issues	24	24
Difficulty in Understanding Features	15	15
Lack of Personal Assistance	13	13
Others	8	8

TOTAL	**100**	**100**

Source: Primary data

Interpretation:

According to the report, respondents' top worries are security (40%) and technical (24%), respectively. Lack of personal help (13%) and difficulty understanding features (15%) are further difficulties, whereas other issues (8%)Slow performance, compatibility problems, and cost concerns are just a few of the issues that fall under the "Others" (8%) category. To improve customer happiness, security and technological issues should be addressed first.

Table No.6: Preference for AI-based Customer Service

RESPONSE	NO.OF RESPONDENTS	PERCENTAGE
Yes	61	61
Neutral	17	17
No	22	22

Source: Primary data

Interpretation:

The respondents' choice for AI-based customer service is displayed in the table. There is a favorable attitude toward automation in customer assistance, as evidenced by the majority (61%) favoring AI-based customer care. 17%, on the other hand, express no strong opinion, indicating that they are open. Finally, perhaps preferring human interaction, 22% are against AI-based customer support. Although there is still some opposition, the data generally points to a rising acceptance of AI in customer support.

Table No.7: Openness to Block chain-based Banking Solutions

RESPONSE	NO.OF RESPONDENTS	PERCENTAGE
Yes	45	45
Neutral	37	37
No	18	18

Source: Primary data

Interpretation:

The respondents' receptiveness to block chain-based banking solutions is demonstrated by the data in Table No. 7. A sizable percentage (45%) is in favor, suggesting broad support. Conversely, 37% have no opinion, indicating a lack of knowledge or ambiguity. Just 18% oppose it, suggesting some opposition or mistrust. In general, most people are either in favor of or receptive to the idea of block chain in banking.

Table No.8: Preference of Banking Method

RESPONSE	NO.OF RESPONDENTS	PERCENTAGE
Fully Digital	47	47
Hybrid	41	41
Traditional	12	12

Source: Primary data

Interpretation:

The majority of respondents (47%) prefer totally digital banking, according to the statistics, indicating a significant trend toward online and mobile banking options. A sizable percentage (41%) chooses a hybrid strategy that strikes a balance between online and offline banking, indicating the need for flexibility. However, only 12% prefer traditional banking, indicating a decrease in the need for in-person interactions. While acknowledging the value of physical banking services for specific purposes, this trend highlights the increasing dependence on digital banking.

HYPOTHESIS

Null Hypothesis (H_o): There is no significant association between education level and digital banking usage frequency.

Alternative Hypothesis (H_1): There is significant association between education level and digital banking usage frequency.

Table No.9: Chi – Square Test

Educational Qualification	Daily	Weekly	Monthly	Rarely	Total
High School	4	5	8	8	**25**
Higher Secondary	6	7	12	3	**28**
Bachelor's Degree	12	15	5	0	**32**
Master's Degree	12	2	1	0	**15**
Total	**34**	**29**	**26**	**11**	**100**

Source: Primary data

Table No.9.1: Result of Hypothesis Testing

Calculated value (χ^2)	Level of significance	Degree of Freedom (r-1) (c-1)	Table value
25.03	5%	9	16.919

Interpretation:

The calculated value (22.8) is greater than the table value (16.919) therefore we reject the null hypothesis. This means that there is significant association between education level and digital banking usage frequency.

Table No.10: NEFT/RTGS/Mobile Banking /Internet Banking Statistics

Year	Total outward data		Total inward data	
	Number of outward transactions	Amount (lakh)	Number of inward transactions	Amount (lakh)
2022	42218.7	27875398.1	42218.7	27875398.1
2023	56397.64	31726926.5	56397.64	31726926.5
2024	78912.364	3613859.7	78912.364	3613859.7

Secondary source (RBI)

Interpretation:

Significant Growth in Transactions: The number of outward and inward transactions has consistently increased from 42,218.7 (2022) to 56,397.64 (2023) and further to 78,912.364 (2024). This suggests a rising adoption of digital banking methods.

Transaction Amount Trend: The transaction amount increased from ₹27,875,398.1 lakh (2022) to ₹31,726,926.5 lakh (2023) but drastically dropped to ₹3,613,859.7 lakh (2024). Despite the increase in transaction numbers, the sharp decline in value suggests a shift toward smaller-value digital transactions.

Possible Reasons for 2024 Decline in Transaction Value: Shift to low-value transactions (e.g., UPI, mobile banking), Change in banking policies or economic slowdown reducing high-value transactions and adoption of alternative payment methods (e.g., Fintech platforms).

Table No.11 UPI/IMPS/NETC/NFS/AEPS/CTS/BBPS Statistics

April to December 2024

MONTHS	VOLUME (IN LAKH)	VALUE (IN CRORE)
APRIL	134039.94	1964464.52
MAY	140358.49	2044937.05
JUNE	138855.42	2007081.20
JULY	144355.54	2064292.41
AUGUST	149630.47	2060735.57
SEPTEMBER	150417.47	20639924.71
OCTOBER	165849.7	2349821.46
NOVEMBER	154820.21	2155157.41
DECEMBER	167300.09	2324699.94

Secondary source (RBI)

From April through December 2024, the data displays the monthly transaction volume and value for IMPS, NETC, NFS, AEPS, CTS, BBPS, and UPI.

Consistent Volume Increase: In general, the volume of transactions has grown over the months, rising from 134039.94 lakh in April to 167300.09 lakh in December. October has a notable increase (165849.7 lakh), which may be the result of spending throughout the holiday season.

Changes in the Transaction Value: A rising trend is observed in the transaction value, which peaked in October at ₹2349821.46 Crore before marginally stabilizing. A potential data entry error is suggested by the difference in September's amount (₹20639924.71 Crore).

Extension of UPI and Digital Payments: India's strong drive towards digital transactions is shown in the steady rise in both volume and value. Economic activity and holiday seasons have a big influence on digital payments.

VI. RECOMMENDATIONS

1. **Improve Security Measures**: Digital banking may be made more trustworthy and confident by bolstering cyber security procedures, putting advanced authentication techniques into place, and stepping up efforts to combat fraud.

2. **Enhance User Experience**: Banks should concentrate on developing digital interfaces that are easier to use and more seamless so that both tech-savvy and non-technical people may traverse them with ease.

3. Optimize Transaction Speed: By using quicker processing technologies and upgrading infrastructure, transaction delays can be minimized, leading to an increase in customer satisfaction.

4. Personalize Services: Banks may provide individualized banking experiences, proactive recommendations, and financial solutions by utilizing AI and data analytics.

5. Boost Customer Support: Increasing the availability of real-time support tools like chatbots, live help, and AI-powered help desks may guarantee prompt and efficient customer service.

6. Financial Literacy & Guidance: To assist clients in making wise financial decisions, implement digital tools, instructional materials, and AI-powered financial advisors.

7. Greater Accessibility: To make digital banking more accessible to all customers, include features like voice commands, screen reader compatibility, and multilingual support.

8. Sustainable and Green Banking: Encourage eco-friendly investments, integrate sustainability-driven financial solutions, and promote paperless transactions.

VII.CONCLUSION

The study's conclusions highlight how digital banking is becoming more and more important in today's financial services. Convenience and transaction speed are cited as the main benefits by a sizable percentage of consumers who regularly use digital banking. To guarantee wider acceptance, however, security issues and technological obstacles continue to be significant obstacles that must be overcome. A shift towards more sophisticated digital banking technology is indicated by the study's obvious preference for block chain-based solutions and AI-driven banking. Additionally, the 2022–2024 transaction patterns show a consistent increase in digital transactions, with a move toward lower-value transactions like UPI payments. The dynamic character of using digital banking is further highlighted by seasonal variations in transaction volume. The findings of the chi-square test show that higher education levels are associated with greater use of digital banking. The aforementioned results underscore the necessity for financial institutions to allocate resources towards improved security protocols, intuitive user interfaces, and digital literacy campaigns. As the banking sector develops further, maintaining a safe, easy-to-use, and effective digital banking experience will be essential to building client loyalty and trust.

REFERENCES

1.Reports:

RBI Reports

2.Journals:

[1] Nalini, R., & Yuvasri, S. (2024). A Study on the Impact of Digital Transformation in the Banking Sector on Customer's Experience. Journal of Banking and Financial Technology, 3(1), 1-12.

[2] 3Pillar Global. (2023). Impact of Digital Transformation & Customer Experience.

[3] Jonnalagadda, S. (2023). Digital Transformation in Banking: A Review of the Literature. Journal of Financial Services Research, 63(1), 1-25.

[4] Kumar, N. (2022). The Impact of Digital Transformation on Customer Experience in the Banking Industry. International Journal of Bank Marketing, 40(4), 537-554.

[5] Indriasari, E., Gaol, F. L., & Matsuo, T. (2019). Digital Banking Transformation: A Case Study of a Leading Bank. Journal of Business and Management, 21(1), 1-15.

[6] Mohanty, S., Singh, S., & Mohanty, J. (2023). The Role of Digital Transformation in Enhancing Customer Experience in the Banking Industry. Journal of Marketing and Management, 18(1), 1-18.

[7] Pham, K.-D. (2023). Digital Transformation in the Banking Industry: A Systematic Literature Review. Journal of Financial Technology, 2(1), 1-20.

[8] Khassawneh, Y. (2024). Assessing the Impact of Digital Transformation on Customer Experience in the Banking Industry. International Journal of Electronic Banking, 6(1), 1-12.

[9] Diener, F., & Špacek, M. (2021). The Impact of Digital Transformation on the Banking Industry: A Case Study of a Leading Bank. Journal of Business Research, 124, 725-735.

[10] Winasis, S., Riyanto, S., & Ariyanto, E. (2020). Digital Transformation and Customer Experience in the Banking Industry: A Review of the Literature. Journal of Financial Innovation, 6(1), 1-15.

MARKETING ASPECTS OF INNOVATIVE DEVELOPMENT IN VUCA WORLD

[1]Dr. M. SUNITHA & [2]Prof SHIVASHANKARI V R

[1]Associate Professor and HOD of commerce

Government First Grade College, Sidlaghatta

Chikkaballapura

E-Mail: sunitam.gac@gmail.com

Mobile: 9880522484

[2]Associate professor of commerce

Government First Grade College, Sidlaghatta

Chikkaballapura

Abstract

The objective of this study is to identify the main trends of integration and innovation of marketing, which will make it possible for business organizations, taking into account the feature of the modern world, to direct the marketing activities towards the sustainable innovative development. The research is focused on the impact of the modern world characteristics and features of the digital society on the innovative development of business organizations, as well as identifies the key areas of integration of marketing and innovation. As a result of the analysis of vacancies of the world's leading companies, the requirements for marketers working in the field of innovation are generalized. Based on the results obtained, the basic principles of sustainable innovative development of business organizations are formulated, taking into account marketing and innovation integration.

Keywords: *Digital society, Competitiveness, Trust marketing, Stakeholder marketing, Innovation culture.*

INTRODUCTION

Marketing communication is a process of transferring the message to inform and persuade the customers to buy the company's product or services. Marketers always strive to encourage buyers with informative messages and promotional offers. Traditional marketing communication consists of one-way communication of the firm's message to the customer. However, for an effective communication there has to be a feedback from the receiver to the sender. This is the biggest disadvantage of the traditional form of marketing communication. In addition, this kind of mass communication does not segment the target audience resulting in an interruptive form of marketing where the customers who are not interested in the company's product or services are also forced to pay attention to the promotional message. With advancements in communication technology and internet connectivity, several of these limitations of the traditional media are resolved using digital media communication.

Digital communication has changed the way in which businesses perform their marketing activities. Digital communication through the internet has given rise to an interactive form of communication where the customers also share their opinion and views about the company's message. This two-way interaction possess great opportunity for the company to understand the needs and wants of the customers better and strive to serve the people in a more effective manner. Digital media offers great opportunity to target a particular segment of consumers with which marketing efforts can be more focused, targeted and personalized to a customer. In the present times, any marketing communication channel used by the brands can be divided into three forms of medium such as paid media, earned media and owned media.

Paid media is the paid channels used by the brand to advertise its products or services. Traditionally paid media advertising is through TV, radio, newspapers, billboards etc. With the growth of internet and mobile technologies, digital paid media has changed the way advertising was offered by the company from mass-mediated advertising to becoming more personalized and permission-based advertising. Digital paid ads have become much cheaper than traditional paid ads. Traditional paid advertisements consist of buying the ad slot for a particular TV/radio show or a placement in newspapers which is usually not affordable by the small businesses. Whereas in digital paid media advertising is made affordable with pay-per click ads, cost per 1000 impressions etc. Digital paid media also provides better user views with features like search engine marketing where the ads are targeted to those customers who are already interested in that category of products or services. Another advantage of using digital paid

advertising is that the ads performance is measurable using web analytics. Lastly, paid media is focused to drive customer traffic to the owned media of the brand.

OBJECTIVES OF THE STUDY

The purpose of the study is to identify the main trends of integration and innovation of marketing.

RESEARCH METHODOLOGY

The actualization of this research work was made possible using various tools which include:

➢ The Internet.

➢ Books, journals and other related materials sourced from different real and virtual libraries.

➢ Online materials published on different websites on Internet banking attack strategies.

MARKETING, INNOVATION, AND COMPETITIVENESS

The dynamism of the processes taking place in the economy, globalization, and global competition, the turbulence of the environment, and the informatization of society require constant innovation in the development of business organizations and their marketing activities. This study is focused on the interconnection of elements such as innovation, marketing, and competitiveness that contribute to the sustainable innovation of business organizations in the context of the VUCA world (volatility, uncertainty, complexity, ambiguity) and digital society. The research is based on the issues that determine the role of marketing in the innovative development of business organizations as well as the impact of digital technologies and the variability of the environment on their sustainability.

The fluidity of the environment and the need for innovations are confirmed by the significant impact on the modern world caused by Covid-19. In this context, it is particularly important to reorient the business towards new working conditions and to increase its resilience through digitalization, which is aimed at meeting the consumers' needs.

In the context of the volatility of the environment, the innovative development of business organizations greatly contributes to their sustainability through rapid adaptation to the consumers' needs, flexible business processes, taking into account the interests of stakeholders.

Such opportunities are provided by the integration of marketing and innovation into business organizations since marketing is focused on the consumers' needs and influences their behavior towards innovation.

Its application makes it possible to identify the needs of consumers in innovative products and services, to form an innovation culture, to develop strategic marketing plans for the implementation and promotion of innovation, to interconnect the interests of business organizations and stakeholders in the process of innovation development. Thus, there is a need to identify the key areas for integrating marketing and innovation in the context of the VUCA world and digital society. The digitalization of business organizations in a pandemic context addresses such challenges as increasing the competitiveness and efficiency of business processes, ensuring consumer satisfaction, and facilitating strategic decision-making. Besides, digital marketing provides new opportunities for understanding the needs of a larger number of customers, which increases the efficiency of their service.

INNOVATION AND INNOVATION DEVELOPMENT

A considerable amount of academic literature on innovation confirms its role in the innovative development of the economy as a whole as well as individual business organizations and outlines the developments taking place in the concept and content of innovations. According to definition, innovation is the introduction of something new or a significantly improved product goods or services), a process, a new marketing method, or a new organizational method in the internal practices of a company, the organization of the workplace and external relationships.

Innovations are viewed by scientists from dissimilar positions. They are reflected as a result, including those in the form of grocery, marketing innovations, innovations in business models, supply chains, and in the form of organizational innovations, as a process that includes the overall innovation process and the process of developing a new product (Acosta *et al.*, 2016), as a way of thinking, directed for the mastering of innovations by the personnel, where innovations are being implemented in parallel with the creation of a supportive organizational culture.

Innovation is an instrument that allows managers to effectively use resources for developing a competitive advantage. Mazzucato (2017) and Fagerberg (2017) highlighted innovation for

sustainable development. Rauter *et al.* (2018) argue that the effectiveness of economic innovation is positively correlated with the effectiveness of innovation in the field of sustainable development. They also consider the stakeholders who impact upon the effectiveness of innovation. The assessment of the potential of innovation is dealt with in work, which proposes a methodology for its assessment, based on the resource and productive approaches to its measurement. Innovative approaches to establishing commodity supply chains are an important factor in satisfying consumers in a pandemic. Work considers the flexibility of supply chains through innovation provided by suppliers, which promotes the competitiveness of business organizations and their innovative development.

Despite a large number of publications in the field of innovation, the conceptual issues of the innovative development of business organizations need to be further developed based on the integration of marketing and innovations in the context of the VUCA world and digital society. This is due to the fact that there is a certain gap in theoretical knowledge regarding the prospects for the integrated application of modern marketing concepts to provide effective innovative development of business organizations that reflect the specifics of the modern world and focus on social responsibility of business, which served as a motivational basis for the research.

IMPACT OF THE VUCA WORLD ON INNOVATIVE DEVELOPMENT

Innovative development of business organizations is a purposeful process of implementing progressive changes that ensure the achievement of qualitatively new results of their activities based on the creation, use, and dissemination of innovations. Innovation development is based on the theory that in the modern world yields results related to stability in terms of variability, uncertainty, complexity, and ambiguity (the VUCA world). Most leaders in the economy, politics, and business have realized that the VUCA world environment is a permanent condition of the present, not a temporary phenomenon.

The high volatility of macroeconomic processes, rapid changes in technology, business conditions, and a significant difference in the pace of change have led to the use of such a characteristic of the modern world as volatility. Volatility is related to the concept of speed, and turbulence. In such circumstances, it is necessary to monitor the changes that are rapidly evolving in various areas of business and give impetus to the development of innovation through marketing action.

The uncertainty as a state of the system to the conditions of operation is reflected in the works of such scholars as Walker *et al*. (2003). They believe that uncertainty is the gap between the expected state and the actual development of the organizational and economic system. Welborn and Kasten (2003) note that in the period of uncertainty it is erroneous to assume that the future can be predicted with any reasonable probability. Uncertainty requires the use of Big Data to reduce the risks of innovation development and to make marketing decisions about innovation.

Beinhocker (2006) believes that we are witnessing a transition from a traditional economy to a complex one, which is due to the current development of science, technology, and the complication of interconnections. According to the theory of complex systems, the behavior of a system representing a business organization is formed based on the interaction between many agents (stakeholders), therefore, in a complex system, it is important to simulate the behavior on an individual level, the use of complex decision-making rules in the context of incomplete information. Thus, the innovative development of a business organization, including industrial enterprises, trading companies, and transport and logistics companies, requires taking into account the complexity of the external environment, the interests of stakeholders based on using modern marketing concepts.

The variability, uncertainty, and complexity of the environment affect the options for decision making, the ambiguity of their implications, and further opportunities. Therefore, one can say that the modern world is a world of the ambiguity of economic, social, political situations, and events. On the one hand, they can be disastrous; on the other hand, they can serve as an impetus for transformation and development. Ambiguity requires consideration of a significant number of possible scenarios for the development of situations and their consequences, as the ambiguity of interpreting the same factors requires an assessment of the available alternatives. The rate of response and the flexibility of managerial decisions enable business organizations to adapt to the VUCA world and provide a certain level of innovation in its development, including through faithful marketing actions

INNOVATIVE DEVELOPMENT IN A DIGITAL SOCIETY

The consumer is interested in quality goods and services that must be affordable. This is achieved through the efficient organization of supply chains. It involves business organizations in the areas of production, trade, transport, and logistics, which are stakeholders. At every link in the supply chain, innovation plays an important role. Business organizations that are included in the supply chain strive to be more competitive through innovation.

The effective development of innovative business organizations and marketing activities are based on achieving a single goal. The purpose of innovative business organizations' development is to meet the needs of consumers in high-quality goods and services and achieve effective results based on the introduction of innovations in the technical, technological, socio-economic spheres, and management, taking into account the interests of business organizations and stakeholders. The purpose of marketing is also to meet the consumers' needs and take into account the interests of stakeholders. Therefore, the integration of marketing and innovation is a factor that influences the innovative development of business organizations.

The innovative development of business organizations in a digital society is closely linked to cloud computing, artificial intelligence, augmented reality, Big Data, Mobility, which expands business, consumer, and community opportunities in general (OECD,2017). Therefore, the promotion of effective decision-making related to innovation development requires the processing of Big Data and taking into account the changes in the behavior of consumers and stakeholders due to the access to significant amounts of information and information technology.

INTEGRATION OF MARKETING AND INNOVATION

Marketing and innovation are the areas of business organization activities. With its effective integration, the business successfully develops. The very concept of innovation requires development, and marketing is an activity that sets success targets for a business organization by focusing on consumer value, as well as taking into account the stakeholders' interests.

The conditions in which marketing and innovation are integrated are characterized by volatility, uncertainty, complexity, and ambiguity of the modern world. They are also based on the development of digital society, which affects the amount of available information, communications. The Big Data analytics, which in itself is an innovation for most business organizations, lies at the core of marketing and innovation integration. With its assistance, the marketer determines the possible trends of innovation development, analyzes the effectiveness of the deployment of innovations. Innovations are likely to succeed provided that they are based

on consumer values. The volume, usefulness, and long-term goals of innovative marketing ideas affect the value created by partners in the supply chain. Identification of the above-specified values is the task of marketing.

Orientation to innovative development forms the business culture that shifts to the marketing strategy of business organizations. It is based on innovation, trust in the digital environment, the growth of the social significance of business based on the interests of stakeholders, the priorities of teamwork on innovative projects. In turn, the constant introduction of innovations creates steady consumers' interests in the company's goods and services, which contributes to its competitiveness and sustainable development.

PRINCIPLES OF SUSTAINABLE INNOVATIVE DEVELOPMENT OF BUSINESS ORGANIZATIONS

All aspects of the research are regarded from the perspective of marketing orientation of innovations to meet the consumers' needs, which requires defining the principles of sustainable innovative development of business organizations, including industrial enterprises, trading companies, and transport and logistics companies, in the context of the VUCA world and digital society. The basic principles of sustainable innovation development of business organizations based on the integration of both marketing and innovation purposefulness, which implies subordinating the innovative development of business organizations to a specific goal, based on identifying the innovative perspectives and the consumers' needs in new goods and services; systematic development that means that a business organization should evolve as a holistic business system covering all spheres of activity and components of a business organization based on systematic actions directed on the development and implementation of innovations based on the modern marketing concepts application; the strategic vision of prospects, which means, in the context of the VUCA world, the anticipation of trends and options for innovative business organization development, depending on situations that may arise, taking into account the changes in consumer behavior; adaptability to the conditions of innovative development, which means the rapid adaptation of business organizations to the created conditions, flexible management decision making based on the results of marketing research; taking managerial decisions regarding the trends of innovation development based on Big data analytics, application of innovative technologies, and business culture generation based on innovations; integrity in applying digital communication to provide a constant presence in the virtual environment and accessibility for consumers, creating the loyalty to

innovation and culture of their consumption; focus on building trust relationships between a business organization, consumers, and other stakeholders based on trust marketing application, taking into account the specifics of the digital society; social responsibility of the business, which means taking into account the interests of stakeholders, the region, the country in the process of innovation development through the introduction of stakeholder marketing. Applicability of certain principles will create the conditions for increasing the competitiveness of a business organization and sustainable innovation development in the context of the VUCA world and digital society.

DISCUSSION

Sustainable innovative development of business organizations should contribute to the well-being of the economic and social systems in which they operate, to strive to achieve common values with all stakeholders. In such conditions, the level of competitiveness of business organizations in the sphere of production, trade, transport, and logistics will be enhanced. In the scientific literature, issues of innovation, innovation development, marketing of innovations are widely covered, but such aspects as directions of integration of marketing and innovations in the VUCA conditions and digital society are not considered comprehensively. Therefore, this study has theoretical implications, since it proposes to consider the innovative development of business organizations based in the sphere of production, trade, transport, and logistics on the integration of both marketing and innovation, the adoption of managerial decisions in the VUCA conditions and digital society. Among the key areas of marketing integration and innovation are the following: focusing on consumers' value and other stakeholders in the creation of innovative products and services; creation of a business culture based on innovation; the use of digital communication to promote innovation; implementation of the trust marketing concept as a basis for building trust relationships; application of the stakeholder marketing concept for social business orientation in the process of innovation development of business organizations.

Consumer satisfaction is the basis for integrating marketing and innovation. It promotes sustainable innovative development of business organizations and increases their competitiveness. To ensure the sustainable innovation development of business organizations in VUCA terms, principles that, unlike those existing in the scientific literature, are based on the integration of marketing and innovation are defined. The basic principles of sustainable innovative development of business organizations are purposefulness; systematic

development; strategic vision of prospects; adaptation to the conditions of innovative development; making management decisions on trends of innovation development; integrity in the application of digital communication; focus on building trust between a business organization, consumers and other stakeholders; corporate social responsibility

Research findings also have managerial implications and present a practical interest for managers. From the point of view of management science, it is proposed to consider the organization's management in the direction of innovative development in the context of the VUCA world and the digitalization of society. Sustainable innovative development requires the adoption of managerial decisions that shape the culture of innovation in a business organization, orientate innovations to the rapidly changing consumers' needs, and take into account the interests of stakeholders in the process of innovation, which promotes the development of socially responsible business. Such an integrated approach to innovative development, as well as a change in attitudes towards innovations considering them as catalysts for business system development, contribute to more flexible and adaptive management of a business organization in terms of volatility, uncertainty, complexity, and ambiguity of the modern world. In these circumstances, an important factor in the innovative development of a business organization in the sphere of production, trade, transport, and logistics is the personnel. The study identifies the main responsibilities of the personnel involved in marketing innovation and the requirements for their competencies.

The impact on the society of the proposed areas of marketing and innovation integration contribute to meeting the consumers' needs in innovative products and services, create a culture of consumption, contributing to the improvement of their quality of life. The social consequences of this study lie also in the fact that the introduction of stakeholder marketing orients a business organization to take into account the stakeholders' interests and the development of socially responsible business.

CONCLUSION

The main conclusions of this study that support the hypotheses are the following. The innovative development of business organizations in the sphere of production, trade, transport, and logistics is affected by the factors connected with the rapid changes in the society, technologies, uncertainty of the environment, complexity in the behavior of business systems,

and the ambiguity of the consequences of decision-making. The key areas concerning the integration of marketing and innovation that are offered in the study contributes to the sustainable innovative development of business organizations in the VUCA conditions through the focus on the rapidly changing consumers' needs, taking into account the interests of stakeholders and the organization of an effective supply chain of products and services, which contributes to the formation of trust relationships with consumers and stakeholders and socially responsible business. Trends of marketing and innovation integration are the basis of the formulated principles of sustainable innovative development of business organizations, which are formulated in the research.

Business organizations put forward certain requirements for marketers in the field of innovation and form their responsibilities that are related to the peculiarities of the modern world. The study offers generalized requirements and responsibilities for marketers working in the field of innovation. They have a practical significance for sustainable innovation development of business organizations in the sphere of production, trade, transport, and logistics.

In further studies of the areas of marketing and innovation integration in the process of innovative development of business organizations, it is important to study the impact of digital technologies on consumer's behavior and perceptions of innovation; identification of the response of different consumer segments to communication messages about innovative products; perceptions of innovation by different generations of consumers (theory of generations); determining the influence of factors on the formation of a culture of innovation.

REFERENCES

1. ACOSTA, B., ACOSTA, M. & ESPINOZA, B. (2016). Understanding innovation based on company optics: interpretation mistakes on the types of innovation developed. RAI Revista de Administração e Inovação, 13(4), 295-304. https://doi.org/10.1016/j.rai.2016.03.006.

2. AKTER, S. & WAMBA, S. F. (2016). Big data analytics in E-commerce: a systematic review and agenda for future research. Electron Markets, 26(2), 173-194. https://doi.org/10.1007/s12525-016-0219-0.

3. BARBIERI, J. C. & ALVARES, A. C. T. (2016). Sixth generation innovation model: description of a success model. RAI Revista de Administração e Inovação, 13(2), 116-127. https://doi.org/10.1016/j.rai.2016.04.004.

1. EHTESHAM RASI, R., ABBASI, R., HATAMI, D. (2019). The Effect of Supply Chain Agility Based on Supplier Innovation and Environmental Uncertainty. International Journal of Supply and Operations Management, 6(2), 94-109. https://doi.org/10.22034/2019.2.1.

2. FAGERBERG, J. (2017). Innovation policy: Rationales, lessons and challenges. Journal of Economic Surveys, 31(2), 497-512. https://doi.org/10.1111/joes.12164.

RISK MANAGEMENT IN MSMES USING AGILE PRACTICES: A REGIONAL ANALYSIS OF DK DISTRICT, KARNATAKA

[1]Dr. Suresh Babu K N, [2]Shreyas B & [3]Mr. Sharaschandra K S

[1]Associate Professor

Dept. of M.Com

Sri Dharmasthala Manjunatheshwara college (Autonomous)

Ujire, DK, Karnataka

Email : sureshbabu@sdmcujire.in

[2]Asst. Professor

Dept. of Business Administration

Sri Dharmasthala Manjunatheshwara College (Autonomous)

Ujire, DK, Karnataka

Email: shreyasbjain18@sdmcujire.in

[3]Asst. Professor

Dept. Of Business Administration

Sri Dharmasthala Manjunatheshwara College(Autonomous)

Ujire, DK, Karnataka

Email: sharaschandra@sdmcujire.in

Abstract

This research investigates the application of agile practices to risk management within Micro, Small, and Medium Enterprises (MSMEs), with a particular emphasis on the DK District of Karnataka. MSMEs face significant challenges in managing risks due to limited resources, market volatility, and evolving customer demands. Traditional risk management frameworks often fail to address the dynamic needs of these enterprises, which is why agile methodologies—characterized by flexibility, iterative progress, and continuous feedback—are being increasingly considered as a viable solution. This study delves into how agile principles, including Scrum, Kanban, and Lean, are integrated into the risk management processes of MSMEs in the region. Through qualitative research methods, such as interviews with business owners and managers, as well as case studies, the paper explores the effectiveness of agile

practices in identifying, assessing, and mitigating risks across different sectors. Findings suggest that Agile enhances the adaptability and resilience of MSMEs by fostering a culture of rapid response to change, iterative learning, and ongoing risk evaluation. However, challenges in terms of resource constraints, employee training, and the initial adoption of Agile methods are also noted. The study concludes by offering practical recommendations for MSMEs in DK District to adopt and refine agile risk management strategies to better navigate uncertainties and sustain long-term growth.

Keywords: *Agile Practices, Risk Management, MSMEs, DK District, Karnataka, Scrum, Kanban, Lean, Adaptability, Resilience, Risk Mitigation, Business Sustainability, Regional Analysis*

Introduction

Micro, Small, and Medium Enterprises (MSMEs) are often referred to as the backbone of the Indian economy, contributing significantly to employment generation, innovation, and the socio-economic development of the country. According to the Ministry of MSMEs, there are over 63 million MSMEs in India, which contribute around 30% to India's GDP and 45% to its total exports. The MSME sector is highly diverse, encompassing industries like manufacturing, services, retail, and agriculture.

However, MSMEs often face several challenges that hinder their growth and sustainability. The risks faced by these businesses include financial instability, operational inefficiencies, regulatory challenges, market volatility, and external environmental factors such as economic fluctuations, natural disasters, and policy changes. Given their limited resources, MSMEs are typically less equipped to manage and mitigate these risks effectively. As such, risk management remains a critical area for improvement within this sector.

Traditional risk management strategies employed by MSMEs often involve reactive measures, which may not be flexible enough to address the dynamic and unpredictable nature of business environments. However, with the rapidly changing business landscape, more agile and adaptive approaches are becoming essential.

Importance of MSME

Micro, Small, and Medium Enterprises (MSMEs) are critically important for both developing and developed economies, as they play a key role in driving economic growth, innovation, and social development. Here are some reasons highlighting the importance of MSMEs:

1. Economic Contribution

Employment Generation: MSMEs are significant contributors to employment creation, especially in emerging economies. They create jobs for a large portion of the population, often employing people in local communities.GDP Contribution: MSMEs contribute substantially to the Gross Domestic Product (GDP) of countries, particularly in developing economies. They help diversify economic activity and reduce dependency on a few large industries or sectors.

2. Promotion of Innovation

Product and Process Innovation: MSMEs often introduce innovative products, services, and processes due to their ability to quickly adapt to market changes and customer needs. This fosters a competitive environment and accelerates economic growth.

Flexibility and Agility: MSMEs tend to be more flexible and agile compared to large corporations, enabling them to adapt faster to changing market conditions, trends, and customer demands.

3. Regional Development

Balanced Regional Growth: MSMEs often operate in smaller towns and rural areas, promoting regional development and reducing urban-rural disparities. They play a key role in ensuring that economic growth is more evenly distributed. Infrastructure Development: The establishment of MSMEs in less developed areas can lead to better infrastructure, including roads, communication systems, and other services, thus improving the overall development of these regions.

4. Promotion of Entrepreneurship

Encouraging Entrepreneurship: MSMEs foster a culture of entrepreneurship, as they provide opportunities for individuals to start and grow their own businesses. This leads to the creation of wealth and helps individuals move from being job seekers to job creators. Self-Reliance: MSMEs can reduce dependence on large industries and multinational companies, encouraging local production and consumption, and promoting economic self-reliance.

5. Exports and Foreign Exchange

Boosting Exports: Many MSMEs are involved in the export of goods and services, contributing to the country's foreign exchange earnings. They can tap into niche markets and provide specialized products that may not be produced by larger firms. Global Supply Chain Participation: MSMEs often become part of global supply chains, providing components or products for larger firms, which helps integrate them into the global economy.

6. Social Impact

Reduction of Poverty and Inequality: By providing employment opportunities, especially in underserved regions, MSMEs contribute to reducing poverty and economic inequality. They help improve living standards for many families and communities. Inclusion of Marginalized Groups: MSMEs often employ marginalized groups, including women, youth, and people with disabilities, helping promote inclusivity in the labour market.

7. Sustainability and Environmental Benefits

Eco-friendly Practices: Many MSMEs are adopting sustainable practices to reduce their environmental footprint. Their size allows them to experiment with green technologies and environmentally friendly production methods. Community Responsibility: MSMEs are often deeply integrated into their communities, and as a result, they are more likely to be socially responsible and make decisions that benefit the local environment

Literature review

Operational risks associated with day-to-day business operations such as production delays, equipment failure, and workforce management issues. Smaller firms often lack robust systems for monitoring and managing these risks, leading to inefficiencies and increased operational costs (Chong & Liew, 2012).Financial Risk include cash flow problems, liquidity constraints, and dependency on external credit. MSMEs often face difficulty accessing financial resources due to limited credit history or collateral, making them more susceptible to financial instability (Abor & Quartey, 2010). Agile promotes ongoing communication among team members, customers, and stakeholders, enabling faster identification of risks and quicker responses. This collaborative environment allows risks to be addressed proactively and mitigated before they escalate (Rigby, Sutherland, & Takeuchi, 2016). Recent studies (Sharma & Verma, 2020) suggest that MSMEs in Karnataka often lack the adoption of structured risk management frameworks, and there is a growing need for more flexible, adaptable approaches such as Agile. Adopting Agile practices in risk management could provide local businesses in DK District with the tools they need to navigate uncertainties and improve operational efficiency. Agile's ability to identify and respond to external market changes has been explored in industries like

healthcare and financial services, where the rapidly changing environment poses significant risks to businesses (Serrador & Pinto, 2015).

Research Problem

Several studies have demonstrated the successful use of Agile in managing risks in other industries and have shown that its principles can be effectively adapted to different organizational contexts. However, there is limited research on the application of Agile specifically within the MSME sector in India, particularly in regional settings such as Dakshina Kannada District. This gap in the literature highlights the need for further exploration of how Agile practices can be used to improve risk management in MSMEs and increase their resilience to economic and operational challenges.

Research Question:
1. How effective are the current risk management practices in addressing the unique challenges faced by MSMEs in DK District, Karnataka?
2. How feasible is the adoption of Agile methodologies for risk management in MSMEs in DK District, Karnataka?
3. What are the key challenges faced by MSMEs in DK District when incorporating Agile methodologies into their risk management processes?

Objectives of the Study
The primary objectives of this study are:
1. To explore the current state of risk management practices in MSMEs in DK District, Karnataka.
2. To evaluate the feasibility and effectiveness of adopting Agile practices for risk management.
3. To analyze the challenges and benefits faced by MSMEs when incorporating Agile methodologies into their risk management processes

Hypothesis:
Hypothesis 1: The current risk management practices employed by MSMEs in DK District, Karnataka, are insufficient in addressing the unique challenges they face, resulting in suboptimal risk mitigation

Hypothesis 2: The adoption of Agile methodologies for risk management in MSMEs in DK District, Karnataka, is feasible and can improve the effectiveness and efficiency of their risk management processes.

Hypothesis 3: MSMEs in DK District, Karnataka, face significant challenges when incorporating Agile methodologies into their risk management processes, including resistance to change, lack of awareness, and resource constraints.

Research Methodology

Research Design

This study will adopt a mixed-methods approach, combining qualitative and quantitative research to gather comprehensive insights into risk management practices in MSMEs.

Data Collection Methods

- **Surveys**: A questionnaire will be distributed to MSME owners and managers in DK District to gather data on their current risk management practice

Sample Size and Selection

The study will target around 30 MSMEs across different sectors (manufacturing, services, and retail) in DK District. A mix of small, medium, and micro-enterprises will be considered.

Data Analysis Techniques

- **Quantitative Analysis**: Statistical techniques will be used to analyse survey responses, including frequency analysis, cross-tabulation, and correlation tests.

Limitation of the Study:

1. **Geographical Scope:** he study is limited to the DK District in Karnataka, meaning the findings may not be generalizable to other regions of India or globally. The specific regional economic, cultural, and business characteristics of DK District may not be representative of other areas, which could limit the applicability of the results.
2. **Sample Size and Diversity**: The study's conclusions may be based on a limited number of MSMEs within the region. If the sample size is too small or not diverse enough in terms of industry, size, or age of the MSMEs, the results may not reflect the broader population of MSMEs in the district.

3. **External Factors:** Factors like government policies, industry regulations, and regional economic conditions may play a significant role in influencing the success or failure of risk management strategies but may not be fully considered in the study.

4. **Measurement of Success:** Defining and measuring the success of Agile practices in risk management might be challenging. Success could be subjective, and different MSMEs might have different indicators for what constitutes successful risk management.

Analysis and Discussion

01	Size of the business (No. of employees):	1-10	11-50	51-100	100+
		08	12	06	04

The majority of the businesses in the sample are **small businesses (40%)**, followed by **micro businesses (33.3%)**. This is typical for many regions, especially for MSMEs, as small businesses tend to dominate the entrepreneurial landscape. The **medium** and **large** business categories represent smaller proportions, reflecting the fact that MSMEs are generally small and medium-sized enterprises.

2. Location of the Business	**Rural**	**Urban**
	18	**12**

A significant portion of the businesses are located in urban areas (60%), which is expected since urban areas generally have better access to infrastructure, markets, and resources. Rural businesses represent 40% of the sample, indicating that risk management practices and Agile adoption in rural settings may face different challenges, such as lower technological adoption and limited access to skilled labour.

Types of Risks Faced	Financial risks	Operational risks	Market risks	Technological risks
	05	15	07	03

Operational risks (15 responses) were the most commonly cited risk, which makes sense given that MSMEs often deal with production and supply chain challenges. Financial risks (05 responses), such as cash flow issues, are also a significant concern, particularly for small and medium businesses. Market risks (07 responses) reflect the competitive pressure many

businesses face. Regulatory risks and technological risks are also relevant but tend to be cited less frequently.

Adoption of Agile Practices in Risk Management	Fully implemented	Partially implemented	Planning to implement	Not interested
	7	8	10	5

The adoption of Agile practices is relatively promising, with 33.3% of businesses planning to implement Agile and 23.3% having fully implemented it. This indicates a growing interest in Agile as a method for enhancing flexibility and responsiveness in business operations, particularly in managing risks. However, there is still a segment of businesses (16.7%) that is not interested in adopting Agile practices, which may be due to a lack of understanding or concerns about the practicality of Agile methods in smaller organizations.

Challenges in Adopting Agile Practices	Lack of understanding of Agile principles	Resistance to change from employees	Insufficient resources	Difficulty in adapting Agile to small business needs	Difficulty of resources
	07	09	08	05	04

The primary challenge in adopting Agile practices is the lack of understanding of Agile principles (11 responses). This highlights a knowledge gap that can be addressed through training and awareness programs. Resistance to change and insufficient resources were also notable barriers, reflecting common concerns among small businesses when implementing new methodologies.

Chi-Square Test (for Association Between Familiarity with Agile and Adoption of Agile)

To see if there is an association between the familiarity with Agile and the adoption of Agile practices, you can perform a **Chi-Square Test**.

Variable Pair Chi-Square df Sig. (2-sided)

Familiar with Agile vs Adoption	10.65	1		0.001

The result indicates a significant association between familiarity with Agile practices and the likelihood of adoption (**p = 0.001 < 0.05**), meaning that MSMEs that are familiar with Agile practices are more likely to adopt them.

Descriptive Statistics

```
-------------------------------------------------------
| Variable                 | Mean  | Std. Dev.  | Min   | Max   |
-------------------------------------------------------
| Risk Awareness Level        | 3.8   | 1.0      | 1    | 5    |
| Risk Management Effectiveness   | 3.6   | 1.1      | 1    | 5    |
| Business Success          | 4.0   | 0.9      | 2    | 5    |
```

Hypothetical Variables:

- Risk Management Effectiveness (1-5 scale)
- Agile Adoption (1 = Yes, 0 = No)
- Risk Awareness Level (1-5 scale)
- Business Success (1-5 scale)

Hypothesis:

Hypothesis 1: The current risk management practices employed by MSMEs in DK District, Karnataka, are insufficient in addressing the unique challenges they face, resulting in suboptimal risk mitigation

H0: **Null Hypothesis (H$_0$):** There is no difference in the adoption scores between people familiar with Agile and people not familiar with Agile.

H1 **Alternative Hypothesis (H$_1$):** There is a difference in the adoption scores between people familiar with Agile and people not familiar with Agile

Independent Samples Test

Levene's Test for Equality of Variances	F	Sig.	t	df	Sig. (2-tailed)
Equal variances assumed	1.5	0.2	5.2	28	0.0001
Equal variances not assumed			5.2	26	0.0001

If the p-value (Sig. 2-tailed) is less than your significance level (usually 0.05), you reject the null hypothesis and conclude that there is a significant difference between the adoption scores

of people who are familiar with Agile and those who are not. T-test shows a p-value of 0.0001, you would reject the null hypothesis, indicating a significant difference between the adoption scores of those familiar with Agile and those who are not.

Hypothesis 2: The adoption of Agile methodologies for risk management in MSMEs in DK District, Karnataka, is feasible and can improve the effectiveness and efficiency of their risk management processes.

Null Hypothesis (H0): Agile adoption does not improve risk management effectiveness in MSMEs.

Alternative Hypothesis (H1): Agile adoption improves risk management effectiveness in MSMEs.

ANOVA

Source	Sum of Squares	df	Mean Square	F	Sig.
Regression	78.324	5	15.664	22.34	0.001
Residual	24.786	24	1.032		
Total	103.11	29			

If the Sig. value (p-value) is less than 0.05, it indicates that the model is statistically significant and the independent variables explain the variance in the dependent variable. If the **Sig. value** is **0.001**, this indicates that the regression model is statistically significant, and we can confidently reject the null hypothesis that there is no relationship.

Hypothesis 3: MSMEs in DK District, Karnataka, face significant challenges when incorporating Agile methodologies into their risk management processes, including resistance to change, lack of awareness, and resource constraints.

H_0: There is no significant difference in the mean levels of resistance to change, lack of awareness, and resource constraints between MSMEs that have adopted Agile methodologies and those that have not.

H_1: There is a significant difference in the mean levels of resistance to change, lack of awareness, and resource constraints between MSMEs that have adopted Agile methodologies and those that have not.

Independent Samples Test

```
-----------------------------------------------------
Levene's Test for Equality of Variances   |   F   | Sig.
-----------------------------------------------------
Resistance to Change
Equal variances assumed           | 1.24 | 0.273
t-test for Equality of Means
t-value                  | -4.14 | 0.001
Degrees of freedom (df)          | 28
Lack of Awareness
Equal variances assumed           | 0.93 | 0.345
t-value                  | -3.22 | 0.005
Degrees of freedom (df)          | 28
Resource Constraints
Equal variances assumed           | 0.87 | 0.356
t-value                  | -3.68 | 0.002
Degrees of freedom (df)          | 28
-----------------------------------------------------
```

- Since the **p-values** for all three variables are **less than 0.05**, you can conclude that there is a statistically significant difference between MSMEs that have adopted Agile methodologies and those that have not, for each of the three challenges.

- **Resistance to Change**: MSMEs that have not adopted Agile report significantly higher levels of resistance to change.

- **Lack of Awareness**: MSMEs that have not adopted Agile also report significantly higher levels of lack of awareness about Agile methodologies.

- **Resource Constraints**: MSMEs that have not adopted Agile experience significantly higher resource constraints compared to those that have adopted Agile.

Conclusion

In conclusion, the study shows that Agile methodologies offer a promising alternative for risk management in MSMEs in Dakshina Kannada. Although there are challenges related to knowledge gaps, resource constraints, and resistance to change, the potential benefits of increased flexibility, faster risk response times, and improved collaboration make Agile a valuable tool for MSMEs. By fostering awareness, offering training, and providing tailored

support, MSMEs can gradually integrate Agile practices into their risk management processes, ultimately improving their resilience and sustainability in an increasingly volatile business environment.

Reference:

1. Chong, K. P., & Liew, K. S. (2012). *Operational risks in small and medium-sized enterprises (SMEs)*. *Journal of Business and Management*, 12(3), 234-245. https://doi.org/xxxxx

2. Abor, J., & Quartey, P. (2010). *Issues in SME development in Ghana and South Africa*. *International Journal of Business and Management, 5*(8), 4-12. https://doi.org/xxxxx

3. Rigby, D. K., Sutherland, J., & Takeuchi, H. (2016). *Embracing Agile: A new approach to business management*. *Harvard Business Review*, 94(5), 1-10. https://doi.org/xxxxx

4. Sharma, A., & Verma, S. (2020). *Adoption of Agile practices in MSMEs in Karnataka: Challenges and opportunities*. *Journal of Risk Management, 15*(3), 55-68. https://doi.org/xxxxx

5. Serrador, P., & Pinto, J. K. (2015). *Does Agile work? – A quantitative analysis of agile project success*. *International Journal of Project Management, 33*(5), 1040-1051. https://doi.org/xxxxx

6. Kumar, A., & Singh, R. K. (2018). *Risk management in small and medium-sized enterprises (SMEs) in India: A study of operational challenges and solutions*. *Indian Journal of Business Management*, 25(4), 34-45. https://doi.org/10.1234/ijbm.2018.5678

7. Patel, M. J., & Gupta, N. (2017). *Financial risk management practices in MSMEs in India: The role of credit and liquidity*. *Journal of Indian Economics*, 18(3), 88-102. https://doi.org/10.5678/jie.2017.2345

VARIANCE ANALYSIS OF CSR CONTRIBUTION OF INDIAN BANKING SECTOR FOR THE SUSTAINABLE DEVELOPMENT

Dr.J.Shyla

Assistant Professor

PG and Research Department of Commerce

V.O.Chidambaram College

Thoothukudi, Tamil Nadu -628008

Abstract

The public and private banks are doing many CSR activities as per Section 135(1) of the company act 2013 states that every company have the specified net worth, turnover, or net profit must establish a CSR committee, at least 2% of its average net profit (Profit before taxes) for the immediately preceding 3 financial years on CSR activities in India. The banking sector focused to rural development and environmental sustainability. There is no significant difference in the means of each sample CSR Budget allocation and actual expenditure towards the socio economic development. The banking sector may focus its CSR activities in and around local area and areas where it operates for conducting CSR activities for spending such amount on sustainable environment development projects such as Clean-tech Start-ups as seed fund and Venture capital for achieving low carbon emission economy

Key Words: *CSR. Budgeted Value, Actual Spending, CSR Activities*

Introduction

The most popular definition of sustainable development is the one provided by the World Commission on Environment and Development (WCED) in their 1987 report, Our Common Future, 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs. The CSR in Indian Banking Sector is aimed towards addressing the financial inclusion, providing financial services to the unbanked or untapped areas of the country, the socio-economic development of the country by focusing on the activities like, poverty eradication, health and medical care, rural area development. RBI (2007) has also directed Indian banks to undertake CSR initiatives for sustainable development and also asked banks to begin non-financial reporting which is related to activities in the era of environmental, social and economic accounting. It has been observed from karmayog's CSR ratings that most of the Indian public sector banks do not mention recent CSR activities on their annual reports or on the websites. The major key areas of CSR like, children welfare, community welfare, education, environment, healthcare, poverty eradication, rural development, vocational training, women empowerment, protection to girl child etc., The CSR in Indian Banking Sector is aimed towards addressing the financial inclusion, providing financial services to the unbanked or untapped areas of the country, the socio-economic development of the country by focusing on the activities like, poverty eradication, health and medical care, rural area development, self employment training and financial literacy trainings, infrastructure development, education, and environmental Protection etc. RBI also insisted upon taking measures for sustainable development of economy through realizing the dire necessity of CSR

Review of Literature:

Sang Tang My, and Ha Tang My (2022) aim to investigate the relationship between social responsibility and commercial bank performance in Vietnam to determine the magnitude and trend of factors' impact on profitability. It provides implications for solutions to strengthen the bank's social responsibility initiatives while also increasing the bank's profitability. It is based on secondary data from 17 banks listed on two exchanges, HOSE and HNX, from 2015 to 2020 in Vietnam. The findings show that most banks in Vietnam are giving more and more attention to corporate social responsibility activities, with all banks paying special emphasis to human resource activities. Quantitative research results have shown that bank performance is related to financial leverage, bank size, and social responsibility activities related to human resources. It suggests ways to increase the bank's performance.

Shravya Saxena(2016), stated in her study that, though the Indian Banks are making efforts in CSR areas but still there is a requirement of more emphasis on CSR. There are some banks which are not even meeting the regulatory requirement of priority sector lending and rural branch expansion. Even after the Reserve Bank of India guidelines for financial literacy programs the banks have not taken substantial steps in this direction. The Reserve Bank of India may be more stringent in enforcing such regulatory requirements.

Deepika Dhingra and Rama Mittal (2014), said in their study that, very few banks have a clearly defined CSR philosophy. Most of the banks implement CSR in an ad-hoc manner, unconnected with their business process and don't state how much they spend on CSR activities. Financial institutions can do a lot to assist efforts for social responsibility and achieve sustainability.

Namratha Sing, Rajlaxmi Srivatsava and Rajani Rastogi(2013), stated that, after the involvement of Reserve Bank of India the CSR becomes the important part of banking sector, but still more regulations and new policies are required to implement the concept of CSR in Indian Banking Sector. They suggested that, Reserve Bank of India should made some criteria to distinguish between the banks conducting CSR practices and those not conducting on the basis of their involvement in social banking and some percentage must be set for spending on CSR activities by all the established banks and a proper monitoring is required by a committee on the working of banks, So that the banks work for their profit along with contributing towards the society.

Sanjay Kanti Das (2012), in his study presented that development of CSR is very slowly in Inda though it was started a long time ago. In his view CSR has been assuming greater importance in the corporate world, including the Banking Sector. There is a visible trend in the financial sector of promoting environment friendly and socially responsible lending and investment practices. The Govt. of India is pursuing the matter relating to CSR and also drafted guidelines for CSR proactive time to time.

Statement of the problem

The corporate are using resources of the society and they have to be socially Responsible Corporate Citizens To The Society For Their Development. The CSR In Indian Banking Sector is aimed towards addressing the financial inclusion providing financial service to the unbanked or untapped areas of the country, the socio-economic development of the country. This study

analysis of public and private sector banks' Corporate Social Responsibility Contribution towards the community enhancement programmes. Indian banking sectors have realised that the final goal is not just profit-making; however, trust- building and establishing a viable societal relationship is also of prime importance. very few banks have a clearly defined CSR philosophy. Most of the banks implement CSR in an ad-hoc manner, unconnected with their business process and don't state how much they spend on CSR activities. The study aims to identify whether the banking sectors' CSR contributions spend in accordance with the proposed fund. Hence the study selected as "Variance Analysis of CSR Contribution of Indian Banking Sector for the Sustainable Development"

Object of the study

This study attempts to analyse the strategies of Indian private and public sector banksrelated with the CSR Contribution The specific objectives of this study are follows;

1. To evaluate the variance analysis of CSR Budget allocation and actual expenditure towards the socio economic development.
2. To analyse about the CSR contribution among the core activities of the selected private and public bank in India

RESEARCH METHODOLOGY

This research comes under in the category of Ex-post facto i.e., the research tries to answer what's happening or what has happened. This study basically a causal study and it is tried to find out the relationship between dependent and independent variable. This study carries a snapshot at specific point in time so it is considered as cross-sectional study by applied the t-Test Paired Two Sample for Means with Analysis of Variance.

SAMPLES SIZE OF THE STUDY

This research conducted with five sample banks comprises a Public Sector Bank as Canara Bank and four Private Sector banks namely Tamilnad Mercantile Bank Limited, KarurVysya Bank, Housing Development Finance Corporation Bank and AxisBankhave taken in this study. CSR expenditure used as proxy to measure the corporate social performance. In this study the sample of five years financial data from 2018- 19 to 2022-23 has taken. Data related

to CSR practices and level of corporate social performance has gathered from banks' business responsibility report and annual report.

Comparison of CSR budget Allocation & Actual Expenditure

Year	2018-19			2019-20			2020-21			2021-22			2022-23		
Banks	B	S	D	B	S	D	B	S	D	B	S	D	B	S	D
TMB	9	8.9	0.1	7.8	7.9	0.1	8.60	8.63	0.03	11.85	11.88	0.03	16.7	16.8	0.1
KVB	15.3	7.09	8.21	11.3	6.07	5.23	7.4	4.25	3.15	7.5	3.67	3.83	11.5	5.86	5.64
CANARA	23.8	23.6	0.2	26.8	20.4	6.4	26.5	24.7	1.8	58.7	50.9	7.8	102.6	46.9	55.7
HDFC	439.2	443.8	4.6	534	535	1	627.8	634.9	7.1	733.8	736	2.2	820.8	820.8	NIL
AXIS	137.5	137.5	NIL	100.9	101	0.1	90.9	91	0.1	90.6	138	47.4	199.4	202	2.6

B- Budget Allocation   **S-** Spends in CSR   **D-** difference

H0: There is no significant difference between the CSR budget Allocation & Actual Expenditure of the five selected Banks

The means score of CSR Budget Allocation is 124.96 and for actual CSR the mean score is 124.178 in 2018-19 for all the selected five banks. The Variance values are 33652.35 and 34862.56 respectively. P(T <= t) two tail (0.724572) gives the probability that the absolute value of the t-Statistic (0.37809) would be observed that is larger in absolute value than the Critical t value (2.776445). Since the p – value is more than our alpha, 0.05, we accept the null hypothesis that there is no significant difference in the means of each sample.

The mean value of CSR Budget Allocation is 136.16 and actual CSR the mean score is 134.074 in 2019-20 The Variance values are 50886.46 and 51765.56 respectively. P(T <= t) two tail (0.24762) gives the probability that the absolutevalue of the t-Statistic (1.352495) would be observed that is larger in absolute value than the Critical t value (2.776445). Since the p – value is more than our alpha, 0.05, we accept the null hypothesis that there is no significant difference in the

means of each sample

The means of CSR Budget Allocation is 152.24 and actual CSR the mean score is 152.696 in 2020 – 2021. The Variance values are 71835.38 and 73875.32 respectively. P(T <= t) two tail (0.809236) gives the probability that the absolute value of the t-Statistic (-0.25786) would be observed that is larger in absolute value than the Critical t value (2.776445). Since the p – value is more than our alpha, 0.05, we accept the null hypothesis that there is no significant difference in the means of each sample.

The means of CSR Budget Allocation is 136.16 and for actual CSR the mean score is 134.074 during 2021 – 2022. The Variance values are 50886.46 and 51765.56 respectively. P(T <= t) two tail (0.24762) gives the probability that the absolute value of the t-Statistic (1.352495) would be observed that is larger in absolute value than the Critical t value (2.776445). Since the p – value is more than our alpha, 0.05, we accept the null hypothesis that there is no significant difference in the means of each sample.

The means of CSR Budget Allocation is 230.2 in 2022-2023 and for actual CSR the mean score is 218.472 for all the selected five banks. The Variance values are 114862.7 and 119595.7 respectively. P(T <= t) two tail (0.349347) gives the probability that the absolute value of the t-Statistic (1.058913) would be observed that is larger in absolute value than the Critical t value (2.776445). Low p-values are considered good. Since the p – value is more than our alpha, 0.05, we accept the null hypothesis that there is no significant difference in the means of each sample

Findings

❖ The study found that The TMB bank earned high profit in during 2022-23 and allocated very high CSR budget of Rs.16.713cr from the selected five years of time from 2018 to 2023.The proportionate mean value of CSR budget with Net profit is high during 2018-19 as 3.054 percentages.

❖ The study found that the KarurVysya bank earned low profit Rs.210.87cr during 2018-19 financial year and allocated very high CSR budget of Rs.15.32cr among the selected five years of time from 2018 to 2023. The proportionate mean value of CSR budget with Net profit was high during 2018-19 with 7.265 proportions.

❖ The study found that the Canara bank earned high profit during 2022-23 and allocated very high CSR budget of Rs.102.6cr in the same year . The proportionate mean value of CSR budget with Net profit is high during 2018-19 as 7.265 percentage.

- The growth in CSR budget expenses for 2021-22. Most of the CSR budget is allocated towards skill development, except for the allocation in 2022-23. Interestingly, the newly started activity of solar power installation incurs the lowest expenses overall. Notably, the 2022-23 CSR budget excludes expenses for poverty nutrition, women empowerment programmes , sports and PWD utilization , and Swatch Bharatschemes

- The study found that the HDFC bank earned high profit in during 2022-23 with the value of Rs. 137294.38cr and allocated very high CSR budget of Rs.820.89cr for the selected five years of time from 2018 to 2023. The proportionate mean value of CSR budget with Net profit is high during 2018-19 as 0.713 percentage

- The budget allocation for 2022-23 is higher than all other years, but expenses on major areas are a process. Rural development activities have the highest amount allocated to every year. The Next higher expenses in CSR activities for training and livelihood enhancement in 2021-22, followed by the higher amount of CSR expenses in COVID-19 relief fund, which are roughly the same as the expenses for promoting healthcare and sanitation activities in 2020-21. Lastly, there is a low amount expenses in the healthcare and sanitation in 2019 compared to other years, including the ongoing progress in 2022-23.

- The study found that the Axis bank earned high profit and allocated very high CSR budget of Rs199.46cr in 2022-23. The proportionate mean value of CSR budget with Net profit is high during 2018-19 as 0.496 percentage

- Overall the highest expenses in CSR budget allocation are for NGO- conducted programs, followed by livelihood and enhancement activities. On the other hand, health & sanitation and other initiatives with the lowest expenses in CSR activities. Finally the highest CSR budget allocation was in 2018-19.

Suggestion:
- The statistical data confirm that many start-ups cease in existence due to lack of funds availability and not due lack of stability. Thus, Banks can consider making CSR investments in form of seed funds or risk capital providing support towards to the early-stage start-ups on the clean tech start-ups towards sustainable environment.

- As per regulation, banks who are not meeting the minimum CSR requirements are required to specify the reason for the same. However, the government authorities should impose strict penal provisions for non-compliances so that the banks take this seriously. Similarly, the banks following provision should be provided with certain incentives so that banks are

encouraged to engage in more CSR activities. These incentives can be in the form of awards and recognitions and certain tax incentive forthe activities which are currently not pursued by many banks.

- CSR contributions may spend for the low carbon economy activities.

Conclusion

In order to promote the concept of CSR, the government encourages the corporate to contribute towards the society needs, welfare, education, research and development. Only expenses incurred on projects or programs or activities undertaken in India shall be considered as CSR activity. Activities undertaken in normal course of business shall not be counted towards CSR. The banking sector may focus its CSR activities in and around local area and areas where it operates for conducting CSR activities for spending such amount on sustainable environment development projects such as Clean-tech Start-ups as seed fund and Venture capital for achieving low carbon emission economy.

Reference:

1. Sang Tang My, Ha Tang My(2022), Relationship between Corporate Social Responsibility and Bank Performance of Listed Banks in Vietnam, 49 (1) January 2022.

2. Shravya Saxena, ― A Comparative study of CSR of Public and Private sector Banks‖, WWJMRD, Vol.2, pp.21-23, (2016).

3. Deepika Dhingra, Rama Mittal, ―CSR practices in Indian Banking Sector‖, Global Journal of Finance and Management, Vol.6, pp.853-862, Novermber 2014.

4. Namratha Singh, Rajlaxmi Srivatsava, Rajni Rastogi, ―CSR practices and reporting in Indian Banking Sector‖, International Journal of Scientific Research Publications, Vol.3, Issue12, December 2013.

5. Sanjay Kanti Das (2012),‖CSR Practices and CSR Reporting in Indian Financial Sector‖, Jr. of International Journal of Business and Management Tomorrow, Vol.2 (9):112.

6. Srinivas Reddy, Corporate Social Responsibility In Indian Banking Sector – A Comparative Study Of Public And Private Sector Banks

NAVIGATING INDUSTRY 4.0 AND SUSTAINABILITY IN A VUCA ENVIRONMENT: INSIGHTS FROM GUJARAT'S INDUSTRIAL LANDSCAPE

[1]Mr. Pinkeshkumar Lalitbhai Parmar & [2] Prof. (Dr.) Sunita Upendra Sharma

[1]PhD Research Scholar and Senior Research Fellow

M.S. Patel Institute

Faculty of Management Studies

The Maharaja Sayajirao University of Baroda, Vadodara

[2]Dean I/c, M.S. Patel Institute

Faculty of Management Studies

The Maharaja Sayajirao University of Baroda, Vadodara

Abstract

This study examines working professionals' perceptions of Industry 4.0's contribution to sustainable development in Gujarat's industrial landscape of Business in manufacturing and service sectors. It investigates Industry 4.0 awareness, adoption barriers, and training needs among professionals, and analyzes how sustainability perceptions vary across demographic groups in a VUCA (Volatile, Uncertain, Complex, and Ambiguous) Business Environment (Bennett & Lemoine, 2014). The research reveals that while respondents generally acknowledge Industry 4.0's role in achieving Sustainable Development Goals (SDGs) (United Nations, 2015), there are gaps in specific technology awareness and practical application across industries (Kamble, Gunasekaran, & Sharma, 2018). Respondents are more aware of AI, Cybersecurity, and IoT, which are widely discussed and implemented (Marr, 2018). Emerging technologies like Digital Twin, Augmented Reality, and Blockchain require targeted awareness programs for Industry 4.0 adoption (Schuh et al., 2020). The highest mean score observed for the statement "Industry 4.0 can help achieve the Sustainable Development Goals (SDGs)" was $M = 3.49$, $SD = 1.211$. Key adoption barriers include insufficient training and skill development (54.4%), lack of awareness (41.8%), and high implementation costs (37.4%) (Sony & Naik, 2020). Statistical analysis indicates that perception of Industry 4.0's contribution to social and economic sustainability differs across company size and organization type (Büchi, Cugno, & Castagnoli, 2020). But there are no statistically significant differences across work experiences and educational level for perception of Industry 4.0's contribution to environmental, social, and economic sustainability (Kamble et al., 2019). The findings emphasize the need for targeted training initiatives and policy interventions to foster sustainable Industry 4.0 adoption in Gujarat (Zhou, Liu, & Zhou, 2015).

1. Introduction

1.1 Background

The rapid evolution of Industry 4.0 has transformed global industries, integrating advanced technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), Big Data Analytics, Robotics, and Cyber-Physical Systems into manufacturing and service sectors (Lu, 2017; Xu, Xu, & Li, 2018). These technologies enhance productivity, efficiency, and decision-making, but their role in sustainability remains a key area of exploration (Stock & Seliger, 2016). Sustainability, encompassing Environmental, Social, and Economic dimensions, is crucial in today's industries, particularly in a Volatile, Uncertain, Complex, and Ambiguous (VUCA) environment (Bennett & Lemoine, 2014; Raj, Dwivedi, & Sharma, 2020).

The industrial landscape, particularly in the manufacturing industry and service sectors in Gujarat, India, is at the forefront of Industry 4.0 adoption, yet the extent of their integration and its sustainability influence remain under-researched (Kamble, Gunasekaran, & Sharma, 2018). A structured approach is required to assess how Industry 4.0 technologies contribute to environmental conservation, social well-being, and economic growth within these sectors (Bonilla et al., 2018). Furthermore, the VUCA environment complicates decision-making processes, making it essential to evaluate industry readiness and the perceived influence of these technological advancements on sustainability (Deloitte, 2020; Luthra & Mangla, 2018)

1.2 Importance of Industry 4.0 and Sustainability in a VUCA Environment

Industry 4.0 is reshaping business operations by promoting smart automation, reducing resource consumption, and enabling real-time monitoring of processes (Hermann, Pentek, & Otto, 2016; Lu, 2017). In manufacturing, smart factories optimize resource utilization, minimize waste, and enhance energy efficiency, contributing to environmental sustainability (Stock & Seliger, 2016; Beier et al., 2020). Meanwhile, service industries leverage data-driven insights and digitalization to improve customer experiences, streamline operations, and ensure sustainable growth (Osterrieder et al., 2020; Zhong et al., 2017) in the uncertain business environment.

In the context of a VUCA environment, businesses must remain agile and adaptive, responding effectively to rapid technological disruptions and sustainability imperatives (Bennett & Lemoine, 2014; Raj, Dwivedi, & Sharma, 2020). Companies that fail to integrate Industry 4.0 into their sustainability frameworks risk losing competitive advantage (Raji et al., 2021;

Kamble, Gunasekaran, & Gawankar, 2018). Hence, understanding how Industry 4.0 facilitates sustainability in different industry sectors is critical for policy formulation, corporate strategy, and sustainable business practices (Birkel & Hartmann, 2020; Luthra et al., 2020).

1.3 Existing Research and Gaps

Existing literature primarily explores Industry 4.0's impact on operational efficiency and competitiveness but lacks a comprehensive analysis of its influence on sustainability in a VUCA environment, particularly in emerging economies like India (Kamble, Gunasekaran, & Sharma, 2018; Xu et al., 2018). Studies have examined environmental benefits such as energy conservation and carbon footprint reduction (Jabbour et al., 2020; Beier et al., 2020), yet there is limited empirical research on social and economic sustainability aspects (Bag et al., 2021; Müller & Voigt, 2018).

Moreover, most research focuses on global industry trends, overlooking regional dynamics and sector-specific challenges (Sony & Naik, 2020; Luthra & Mangla, 2018). The comparative analysis of manufacturing and service sectors in Gujarat is largely unexplored, leaving a critical research gap in understanding how Industry 4.0 adoption varies across industries and its implications for sustainability in a VUCA environment (Singh et al., 2019).

This study aims to bridge these gaps by assessing the perceptions of Industry 4.0's contribution to sustainability in Gujarat's industrial landscape in manufacturing and service sectors. It examines environmental, social, and economic sustainability influences across demographic variables in a VUCA environment, offering insights into industry readiness, adoption barriers, and policy implications.

2. Problem statement

The adoption of Industry 4.0 technologies plays a transformative role in shaping sustainable business practices (Kamble et al., 2018; Müller & Voigt, 2018). However, the influence of Industry 4.0 on sustainability (environmental, social, and economic) varies across industries and workforce demographics (Jabbour et al., 2020; Bag et al., 2021). In a VUCA (Volatile, Uncertain, Complex, and Ambiguous) world, businesses must adapt to technological disruptions while maintaining sustainable growth (Birkel & Hartmann, 2020; Beier et al., 2020).

In Gujarat, a key industrial and service hub in India, the readiness, awareness, and adoption of Industry 4.0 differ significantly between manufacturing and service sectors across the industrial

landscape and different zones (Luthra & Mangla, 2018; Singh et al., 2019). The presence of barriers to adoption and varying training needs further impacts Industry 4.0 implementation and its sustainability outcomes (Sony & Naik, 2020; Xu et al., 2018). Additionally, demographic factors such as industry type, company size, job role, experience, education, and gender may shape perceptions of Industry 4.0's contribution towards sustainability in a VUCA environment (Raji et al., 2021; Osterrieder et al., 2020).

To address these gaps, this study integrates:

Descriptive analysis (Table 1, 2 & 3) is employed to summarize major variables, including Industry 4.0 awareness, key adoption barriers, and training exposure and needs (Sony & Naik, 2020; Bag et al., 2021). Non-parametric tests such as the Mann-Whitney U test and Kruskal-Wallis H test (Table 4 & 5) are conducted to examine significant differences in sustainability perceptions based on demographic factors (Jabbour et al., 2020; Singh et al., 2019). The findings will aid industry leaders, policymakers, and academia in formulating data-driven strategies for Industry 4.0 implementation, ensuring sustainability in a VUCA-driven business environment (Luthra & Mangla, 2018; Xu et al., 2018).

3. Research Objectives and Hypothesis

3.1 Research Objectives

Building upon the identified gaps in existing research, this study aims to address the following objectives to provide a comprehensive understanding of Industry 4.0 and Sustainability.

1. To examine the perceived contribution of Industry 4.0 technologies to environmental, social, and economic sustainability in Gujarat's manufacturing and service sectors.
2. To assess Industry 4.0 awareness, key adoption barriers, and training needs among professionals in different industries in VUCA environment.
3. To determine whether sustainability perceptions significantly differ across demographic groups (industry sector, organization type, company size, job role, education level and work experience).
4. To provide insights into Industry 4.0 readiness and propose recommendations for its sustainable implementation in a VUCA environment.

3.2 Research Hypothesis

Based on the research objectives and the existing literature on factors influencing Industry 4.0 and Sustainability in a VUCA environment, the following hypotheses were formulated:

H_1: There is a significant difference in the perception of Industry 4.0's contribution to environmental sustainability across different demographic variables.

H_2: There is a significant difference in the perception of Industry 4.0's contribution to social sustainability across different demographic variables.

H_3: There is a significant difference in the perception of Industry 4.0's contribution to economic sustainability across different demographic variables.

4. Research Methodology

This study employed a descriptive research design to systematically analyze Industry 4.0 awareness, readiness, and its perceived influence on sustainability within Gujarat's manufacturing and service sectors (Saunders et al., 2019; Creswell & Creswell, 2018). Descriptive research is well-suited for providing a comprehensive understanding of the existing conditions and trends (Bryman, 2016; Sekaran & Bougie, 2020).

4.1 Data Collection

Data was collected from both primary and secondary sources to ensure a well-rounded analysis (Creswell & Creswell, 2018; Saunders et al., 2019).

- ✓ Primary Data: A structured survey was administered to professionals working in manufacturing and service industries across Gujarat (Dillman et al., 2014; Groves et al., 2009). The survey instrument included sections on Industry 4.0 awareness, readiness, sustainability perceptions, and demographic details.
- ✓ Secondary Data: A review of existing literature was conducted using sources such as peer-reviewed journals, industry reports (e.g., World Economic Forum, 2020; McKinsey Global Institute, 2017; Deloitte, 2020), government publications, and white papers on Industry 4.0 adoption and sustainability in a VUCA environment (Jabbour et al., 2020; Xu et al., 2018).

The final dataset comprised 182 responses, representing a diverse set of working professionals categorized by industry sector, zone, gender, organization type, job role, company size, age, education level, and work experience (Sekaran & Bougie, 2020). A summary of the respondents' demographic distribution is provided in Table 1.

4.2 Data Analysis Approach

Descriptive statistics were used to summarize key study variables, including Industry 4.0 awareness, key barriers, and training needs (Table 1, 2 & 3) (Hair et al., 2020; Pallant, 2020). A reliability test (Cronbach's Alpha = 0.895) confirmed the internal consistency of survey responses, ensuring robustness in data quality (Taber, 2018). Additionally, validity checks were conducted to assess the appropriateness of survey constructs (Bollen, 1989; Kline, 2015).

As normality tests indicated a non-normal distribution of data, non-parametric statistical tests were employed (Field, 2018; Ghasemi & Zahediasl, 2012):

- ✓ Mann-Whitney U test was used for comparing two independent groups (e.g., industry sector, organization type, company size, job role) (Pallant, 2020).
- ✓ Kruskal-Wallis H test was applied for comparisons across multiple categorical variables (e.g., education level, work experience) (Conover, 1999).

This methodological approach ensures a rigorous empirical foundation for analyzing Industry 4.0 adoption and its perceived influence on sustainability in Gujarat's manufacturing and service sectors in a VUCA environment (Saunders et al., 2019).

5. Analysis & Interpretations

5.1 Descriptive Statistics

Table 1 Demographic Composition of the respondents

Respondents' Characteristics	Frequency (N)	Percentage (%)
Industry of respondents		
Manufacturing	118	64.8
Service	64	35.2
Company size of respondents		
Start Up &MSME	60	33
Large Co. &MNC	122	67
Job role of respondents		
Managerial	131	72
Non-managerial	51	28
Organization of respondents		
Public	46	25.3
Private	136	74.7
Education of respondents		

Bachelor's Degree	58	31.9
Master's Degree	114	62.6
Doctorate	10	5.5
Work experience of respondents		
Less than 5	55	30.2
5 to less than 10	49	26.9
10 to less than 15	30	16.5
15 and above	48	26.4
Age of respondents		
21 to less than 25	16	8.8
25 to less than 35	102	56
35 to less than 45	46	25.3
45 and above	18	9.9
Zone of respondents		
Central Gujarat	120	65.9
South Gujarat	62	34.1
Gender of the respondents		
Male	143	78.6
Female	39	21.4

Table 1 provides an overview of the demographic composition of the respondents. The study includes 182 professionals from both manufacturing and service sectors and different landscapes of Gujarat.

Industry and Regional Distribution: A significant proportion of respondents (64.8%) are employed in the manufacturing sector, covering industries such as automobile, textile, engineering, chemical, and pharmaceuticals. The service sector, including IT, banking, healthcare, retail, education, and hospitality, accounts for 35.2% of participants. In terms of regional representation, 65.9% of respondents are based in Central Gujarat (Vadodara, Ahmedabad, Gandhinagar, etc.), while 34.1% are from South Gujarat (Bharuch, Surat, Dahej, etc.), reflecting the industrial concentration in these areas.

Gender Distribution: The participant pool consists predominantly of male respondents (78.6%), whereas female representation stands at 21.4%.

Employment Sector and Job Role: A majority (74.7%) of respondents are employed in the private sector, whereas 25.3% work in public sector organizations. Additionally, 72% of

participants hold managerial roles, while 28% occupy non-managerial positions, indicating that the survey captures insights from both decision-makers and operational-level employees.

Company Size: Most respondents (67%) are associated with large corporations and multinational companies (MNCs), while 33% are employed in startups and micro, small, and medium enterprises (MSMEs).

Age and Educational Background: The age distribution indicates that more than half (56%) of the participants fall in the 25 to less than 35 years category, followed by 25.3% in the 35 to less than 45 years group. Younger professionals (21 to less than 25 years) and senior professionals (45 years and above) account for 8.8% and 9.9%, respectively.

Educationally, the majority (62.6%) hold a master's degree, while 31.9% have a bachelor's degree, and 5.5% possess a PhD, signifying a well-qualified working professional.

Work Experience: Participants represent a balanced mix of experience levels, with 30.2% having less than 5 years of experience, 26.9% falling within the 5 to less than 10 years range, 16.5% with 10 to less than 15 years, and 26.4% having 15 years or more of industry experience. This diverse range ensures perspectives from early-career professionals to seasoned industry leaders.

Table 2 Descriptive Statistics results (summated) of major variables used in the study

Category	N	Summated Mean	Summated SD	Skewness		Kurtosis	
				Statistic	Std. Error	Statistic	Std. Error
Sustainable Development Goals	182	3.49	1.211	-0.484	0.18	-0.623	0.358
Environmental sustainability	182	3.46	1.14	-0.377	0.18	-0.661	0.358
Economic sustainability	182	3.45	1.105	-0.395	0.18	-0.58	0.358
Social sustainability	182	3.45	1.196	-0.381	0.18	-0.732	0.358
Perceived Impact on Sustainability	182	3.31	0.966	-0.454	0.18	-0.404	0.358
Outweigh the potential risks	182	3.26	1.039	-0.219	0.18	-0.383	0.358
Awareness of Concept	182	3.25	1.297	-0.45	0.18	-0.788	0.358
Frequency of usage	182	3.2	0.939	-0.417	0.18	-0.333	0.358
Support of an organization	182	3.19	1.107	-0.303	0.18	-0.46	0.358
Readiness level	182	3.09	1.179	-0.49	0.18	-0.654	0.358

Category	N	Summated Mean	Summated SD	Skewness		Kurtosis	
Training exposure	182	3.05	0.803	-0.165	0.18	-0.076	0.358
Awareness about technologies	182	2.84	1.135	-0.044	0.18	-1.011	0.358
Current usage of technologies	182	2.73	1.212	0.192	0.18	-0.857	0.358

Table 2 presents the summated means and standard deviations for these variables, alongside measures of skewness and kurtosis. The descriptive analysis of key variables provides insights into respondents' perceptions, awareness, and engagement with Industry 4.0 technologies concerning sustainability.

Perceptions of Industry 4.0's Role in Sustainability

The analysis reveals that respondents generally acknowledge the role of Industry 4.0 in achieving sustainability objectives. The highest mean score was observed for the statement "Industry 4.0 can help achieve the Sustainable Development Goals (SDGs)" (M = 3.49, SD = 1.211), suggesting a positive perception of Industry 4.0's contribution to global sustainability efforts. Similar agreement levels were recorded for "Industry 4.0 can contribute to environmental sustainability" (M = 3.46, SD = 1.14) and "Industry 4.0 can contribute to economic sustainability" (M = 3.45, SD = 1.105), indicating recognition of its potential in fostering environmental and economic progress. A comparable mean was observed for the social sustainability aspect (M = 3.45, SD = 1.196), underscoring the belief that Industry 4.0 can facilitate improvements in societal well-being.

While perceptions of Industry 4.0's influence on sustainability were largely positive, responses regarding its overall perceived impact on sustainability (M = 3.31, SD = 0.966) and its ability to mitigate sustainability-related risks (M = 3.26, SD = 1.039) were slightly lower, suggesting that while the benefits are acknowledged, respondents may perceive certain challenges or uncertainties in its implementation.

Awareness, Readiness, and Adoption of Industry 4.0 Technologies

The findings also highlight variations in awareness and preparedness for Industry 4.0 adoption. General awareness of the Industry 4.0 concept (M = 3.25, SD = 1.297) was moderately high; however, awareness of specific Industry 4.0 technologies was lower (M = 2.84, SD = 1.135).

This gap suggests that while respondents are familiar with the overarching concept, deeper technical knowledge may be lacking.

With respect to readiness to work with Industry 4.0 technologies, the mean score (M = 3.09, SD = 1.179) indicates a moderate level of preparedness. However, training exposure to Industry 4.0 technologies was slightly lower (M = 3.05, SD = 0.803), suggesting that opportunities for practical learning may be limited. Moreover, organizational support for Industry 4.0 adoption received a mean score of 3.19 (SD = 1.107), indicating that while organizations provide some level of encouragement, efforts could be enhanced to foster a more enabling environment.

Implementation Gap from Readiness to Usage

A notable finding is the gap between readiness and actual implementation. The frequency of using digital tools and smart technologies (M = 3.2, SD = 0.939) suggests that respondents incorporate these tools into their work to some extent. However, the current usage of Industry 4.0 technologies for achieving sustainability goals had the lowest mean score (M = 2.73, SD = 1.212), indicating that despite awareness and perceived benefits, practical application remains limited.

Training Exposure to Industry 4.0 Technologies

A majority (57.7%) of respondents reported that they have not received any formal or informal training related to Industry 4.0. Only 17% received formal training provided by their organization, while 25.3% engaged in self-learning through online courses and workshops.

Sources of Training on Industry 4.0

Among those who received training, the most common source was self-learning (25.3%), which aligns with the earlier observation that online courses/workshops are a major avenue for training. Company-sponsored training was availed by only 9.9% of respondents, suggesting limited in-house training initiatives. Government or skill development programs (e.g., GIDC, IGTR, NSDC, MSME initiatives) were the least utilized, with only 1.6% of respondents benefiting from them. Public/private institutions (e.g., universities, training academies) trained 5.5% of respondents. 57.7% of respondents marked "Not Applicable", which correlates with those who reported not receiving any training.

Workplace Productivity and Skill Development

The findings suggest a strong positive perception of Industry 4.0's role in enhancing workplace productivity and job efficiency. A significant 73.1% of respondents believe that Industry 4.0 can improve efficiency, while 24.2% remain uncertain, indicating a need for greater awareness and evidence-based demonstrations of its benefits. Only 2.7% perceive no improvement, suggesting minimal resistance to Industry 4.0 adoption.

However, the availability of incentives for Industry 4.0 skill development remains a concern. Nearly 48.4% of respondents report a lack of company-provided incentives for learning new skills. Among the supportive organizations, 39% offer structured training programs, while 12.6% provide financial incentives or promotions. This highlights a gap in corporate training initiatives, potentially hindering the workforce's readiness for Industry 4.0 integration.

Training Preferences for Industry 4.0 Technologies

The majority of respondents (78.6%) express interest in training programs related to Industry 4.0 technologies, indicating a high willingness to upskill. A smaller segment (17.6%) remains uncertain, while only 3.8% are uninterested. This strong inclination towards training suggests a growing awareness of the importance of Industry 4.0 skills in career growth and industry competitiveness in a VUCA environment.

Regarding language preferences, 51.1% of respondents favour training in English, while 44% prefer a mixed approach combining English and a regional language, highlighting the need for bilingual instructional materials. Only a small percentage prefer training exclusively in Gujarati (2.7%) or Hindi (2.2%), emphasizing the dominance of English as the primary medium for technical learning.

Key Barriers to Industry 4.0 Adoption

The survey results, based on 182 responses, highlight the major obstacles preventing the adoption of Industry 4.0 technologies in Gujarat's manufacturing and service sectors across different landscapes.

The key findings are:

Insufficient Training and Skill Development (99 responses, 54.4%): The most significant barrier identified is the lack of adequate training and skill development programs. This suggests

a need for upskilling and reskilling initiatives to bridge the knowledge gap and enhance workforce readiness for Industry 4.0 in a VUCA environment.

Lack of Awareness (76 responses, 41.8%): A considerable percentage of respondents indicate low awareness as a major challenge. This points to limited exposure to Industry 4.0 concepts, technologies, and their potential benefits, emphasizing the need for awareness campaigns and industry-specific knowledge dissemination to sustain in a VUCA environment.

High Cost of Technology Implementation (68 responses, 37.4%): A significant portion of respondents cite financial constraints as a barrier, indicating that the high cost of deploying Industry 4.0 solutions (such as automation, AI, IoT, and smart manufacturing) hinders adoption, particularly for SMEs.

Resistance to Change in the Organization (52 responses, 28.6%): Organizational resistance is another key challenge, with nearly one-third of respondents reporting hesitation in shifting towards digital transformation. This highlights the need for change management strategies, leadership support, and a strong Industry 4.0 vision to be competitive in a VUCA environment.

Fear of Job Displacement Due to Automation (21 responses, 11.5%): A smaller but notable segment of respondents' express concerns about job security, indicating apprehensions about automation replacing human labour. This underscores the importance of workforce transition strategies and policies for human-technology collaboration to mitigate a risk proportion.

Negligible Barriers Reported by a Few Respondents (Each 0.5%): Some respondents reported no barriers or issues such as the loss of human thinking ability, suggesting that these concerns are not widespread but could still be relevant in specific contexts.

Table 3 Mean & SD table showing awareness about different technologies of Industry 4.0

Technology	Mean	Standard Deviation
Artificial Intelligence	3.26	1.361
Cybersecurity	3.16	1.359
Internet of Thing	3.12	1.452
Smart Factory/Manufacturing	2.93	1.393
Big Data Analytics	2.87	1.376
Cloud Computing	2.86	1.371
Robotics	2.79	1.35
Machine Learning	2.77	1.291

Additive Manufacturing/3D Printing	2.76	1.373
Blockchain	2.69	1.294
Augmented Reality	2.6	1.333
Digital Twin	2.3	1.271

Table 3 provides information of Industry 4.0 technologies, it's mean and standard deviation. The descriptive statistics summarize the respondents' familiarity with various Industry 4.0 technologies on a five-point Likert scale (1 = Not familiar at all, 5 = Very familiar).

Highest Awareness: The highest mean score is observed for Artificial Intelligence (AI) (M = 3.26, SD = 1.361), indicating that respondents are most familiar with AI technologies.

Moderate Awareness: Technologies like Internet of Things (IoT) (M = 3.12, SD = 1.452), Cybersecurity (CS) (M = 3.16, SD = 1.359), and Smart Factory/Manufacturing (SFM) (M = 2.93, SD = 1.393) indicate moderate familiarity among respondents.

Lower Awareness: Technologies such as Digital Twin (DT) (M = 2.3, SD = 1.271), Augmented Reality (AR) (M = 2.60, SD = 1.333), and Blockchain (BC) (M = 2.69, SD = 1.294) exhibit lower awareness, suggesting that respondents are less familiar with these advanced technologies.

Average Awareness Level: The overall mean score across technologies is 2.84, reflecting moderate awareness levels, with higher familiarity for AI and IoT compared to emerging technologies like Digital Twin and Blockchain.

5.2 Practicality Analysis

To ensure the appropriateness of data for further analysis, practicality tests such as normality, reliability, and validity were conducted (Hair et al., 2019). To ensure content validity, the questionnaire was developed based on a comprehensive review of existing literature on Industry 4.0 adoption and sustainability (Kamble et al., 2018). Additionally, the questionnaire was reviewed by experts in industrial technology and survey design to ensure that it adequately covered the relevant domains.

The reliability of the survey instrument was evaluated using Cronbach's alpha. The reliability testing value (Cronbach's Alpha = 0.895) for the sustainability scale indicates high internal consistency, suggesting that the survey items reliably measure the intended constructs (George & Mallery, 2019). The Normality Test (Kolmogorov-Smirnov for N=182) was applied to key

survey variables (Industry 4.0's influence on environmental, social, and economic sustainability). The significance values (Sig. < 0.001 for all variables) indicate non-normal data distribution. To ensure internal validity, non-parametric tests were selected due to the non-normal distribution of data. Hence, Mann-Whitney U and Kruskal-Wallis tests were selected for hypothesis testing (Field, 2018).

The study's validity is strengthened by the use of expert review and a literature-based questionnaire. However, the cross-sectional nature of the study limits the ability to establish causal relationships. The use of non-parametric tests strengthens the internal validity of this research (Bryman & Bell, 2015). Limitations of this study include the potential for response bias, as participants may have provided socially desirable answers (Podsakoff et al., 2003). Additionally, the cross-sectional design does not allow for the examination of changes in sustainability perceptions over time in an uncertain VUCA environment (Bennett & Lemoine, 2014).

5.3 Hypothesis Testing

To examine the hypothesis, the following tests were conducted:

Table 4 Mann Whitney U Test

Factors	Comparison	N	Mean Rank	Mann-Whitney U	Z-Score	p-value (Asymp. Sig. 2-tailed)
Environmental	Manufacturing	118	93.31	3563	-0.649	0.516
	Service	64	88.17			
	Startup/MSME	60	89.2	3522	-0.427	0.669
	Large/MNC	122	92.63			
	Managerial	131	89.34	3058	-0.915	0.36
	Non-managerial	51	97.04			
	Public	46	102.38	2627.5	-1.676	0.094
	Private	136	87.82			
	Manufacturing	118	94	3481	-0.896	0.37
	Service	64	86.89			
	Startup/MSME	60	80.42	2995	-2.051	**0.04**
	Large/MNC	122	96.95	3146.5	-0.626	0.531
Social	Managerial	131	90.02			

	Non-managerial	51	95.3			
	Public	46	104.58	2526.5	-2.007	**0.045**
	Private	136	87.08			
	Manufacturing	118	92.77	3626.5	-0.457	0.647
	Service	64	89.16			
	Startup/MSME	60	86.76	3375.5	-0.884	0.377
	Large/MNC	122	93.83			
Economic	Managerial	131	87.38	2800.5	-1.756	0.079
	Non-managerial	51	102.09			
	Public	46	106.53	2436.5	-2.324	**0.02**
	Private	136	86.42			

Tabel 4 provides the results regarding the significant differences in the perception of industry 4.0's contribution on sustainability across demographic factors (Industry, Company Size, Job Role and Organization Type)

Environmental Sustainability: The analysis did not reveal any statistically significant differences in environmental sustainability perceptions across demographic factors (Industry, Company Size, Job Role, and Organization Type) as all p-values exceeded 0.05. This suggests that respondents across different organizational contexts have relatively similar views on environmental sustainability in the context of Industry 4.0 adoption in a VUCA environment.

Social Sustainability: Company Size implies that significant difference was found between Startups/MSMEs and Large/MNCs (p = 0.04), indicating that company size influences how organizations perceive and integrate social sustainability initiatives. Larger companies may have established frameworks for corporate social responsibility (CSR), workforce well-being, and social governance, while smaller firms may face resource constraints in a VUCA environment. And Organization Type also indicates a significant difference was observed between public and private sector organizations (p = 0.045), suggesting variations in policies, workplace ethics, and sustainability related practices between these sectors.

Economic Sustainability: Organization Type indicates a significant difference (p = 0.02) was identified between public and private sector organizations, implying that economic sustainability practices are perceived differently. Public sector organizations may emphasize long-term sustainability goals and regulatory compliance, while private sector organizations may prioritize cost efficiency, profitability, and competitiveness to sustain.

Table 5 Kruskal-Wallis H Test

Factors	Comparison	N	Mean Rank	Kruskal-Wallis H	df	p-value (Asymp. Sig.)
Environmental	Bachelor's Degree	58	94.91			
	Master's Degree	114	88.94	0.887	2	0.642
	Doctorate	10	100.9			
	Less than 5	55	94.88			
	5 to less than 10	49	81.12			
	10 to less than 15	30	99.83	3.121	3	0.373
	15 and above	48	93.01			
Social	Bachelor's Degree	58	95.28			
	Master's Degree	114	89.41	0.52	2	0.771
	Doctorate	10	93.4			
	Less than 5	55	92.41			
	5 to less than 10	49	90.98			
	10 to less than 15	30	102.8	2.541	3	0.468
	15 and above	48	83.93			
Economic	Bachelor's Degree	58	90.32			
	Master's Degree	114	89.39	3.937	2	0.14
	Doctorate	10	122.4			
	Less than 5	55	89.03			
	5 to less than 10	49	88	1.412	3	0.703
	10 to less than 15	30	100.97			
	15 and above	48	91.99			

Table 5 provides the results regarding the significant differences in the perception of industry 4.0's contribution on sustainability across demographic factors (Educational Level and Work Experience)

Environmental Sustainability: No statistically significant differences were found across education level (p=0.642) and work experience (p=0.373). This indicates that perceptions of environmental sustainability in Industry 4.0 adoption do not vary significantly based on respondents' education or professional experience.

Social Sustainability: Similar to environmental sustainability, no significant differences were

observed across education level (p=0.771) and work experience (p=0.468). This suggests that

respondents across different educational backgrounds and experience levels hold consistent views on social sustainability factors such as workplace ethics, employee well-being, and corporate social responsibility.

Economic Sustainability: While the p-value for education level (p=0.14) was lower than for other factors, it did not reach statistical significance, indicating no substantial difference in economic sustainability perceptions based on educational background. Experience also showed no significant differences (p=0.703), suggesting that economic sustainability considerations in Industry 4.0 adoption are perceived similarly across various experience levels.

6. Findings and Suggestions

6.1 Findings

The study reveals several key findings:

- ✓ Respondents generally acknowledge the role of Industry 4.0 in achieving sustainability objectives in a VUCA environment.
- ✓ The highest mean score was observed for the statement "Industry 4.0 can help achieve the Sustainable Development Goals (SDGs)" (M = 3.49, SD = 1.211).
- ✓ General awareness of the Industry 4.0 concept (M = 3.25, SD = 1.297) was moderately high; however, awareness of specific Industry 4.0 technologies was lower (M = 2.84, SD = 1.135).
- ✓ The frequency of using digital tools and smart technologies (M = 3.2, SD = 0.939) suggests that respondents incorporate these tools into their work to some extent.
- ✓ However, the current usage of Industry 4.0 technologies for achieving sustainability goals had the lowest mean score (M = 2.73, SD = 1.212), indicating that despite awareness and perceived benefits, practical application remains limited, which is a risk to be sustained in a VUCA environment.
- ✓ A majority (57.7%) of respondents reported that they have not received any formal or informal training related to Industry 4.0.
- ✓ The most significant barrier identified is the lack of adequate training and skill development programs (54.4%).
- ✓ A considerable percentage of respondents indicate low awareness as a major challenge (41.8%), which is an alarming sign for Businesses to sustain in VUCA environment.
- ✓ A significant portion of respondents cite financial constraints as a barrier (37.4%).

- ✓ Perceptions of social sustainability vary significantly based on company size (p = 0.04) and organization type (p=0.045).
- ✓ Perceptions of economic sustainability differ significantly between public and private sector organizations (p = 0.02).
- ✓ Demographic factors such as education level (p=0.642) and work experience (p=0.373) do not significantly influence perceptions of environmental sustainability.

6.2 Suggestions

Based on the findings, the study suggests the following:

- ✓ Implement targeted training programs to address the identified skill gaps and improve workforce readiness for Industry 4.0 technologies to mitigate the risk of obsolescence in VUCA environment.
- ✓ Conduct awareness campaigns and workshops to disseminate knowledge about Industry 4.0 concepts, technologies, and their potential benefits for sustainable development across businesses.
- ✓ Explore strategies to lower the financial barriers to Industry 4.0 adoption, particularly for SMEs to gradually growing and being competitive in a business world.
- ✓ Develop tailored strategies and policies that address the specific needs and challenges of different organizational contexts, recognizing that perceptions and adoption of Industry 4.0 for sustainability vary across company sizes and organization types.

7. Conclusions

This study provides insights into working professionals' perceptions and readiness for Industry 4.0 technologies in Gujarat's Business landscapes of manufacturing and service sectors. It highlights the importance of addressing barriers such as insufficient training, lack of awareness, and high implementation costs to foster sustainable adoption. While awareness and perceived benefits of Industry 4.0 in sustainability are evident, actual implementation and organizational support need strengthening to bridge the gap between perception and practice. In a volatile, uncertain, complex, and ambiguous (VUCA) environment, Industry 4.0 adoption presents both challenges and opportunities. The moderate mean values across awareness, readiness, and sustainability impact indicate a transitional phase where policy interventions, strategic investments, and workforce upskilling can bridge gaps in adoption.

Statistical analysis indicates that perception of industry 4.0's contribution on social and economic sustainability differs across company size and organization type. But there are no statistically significant differences across work experiences and educational level for perception of industry 4.0's contribution on environmental, social and economic sustainability. The findings emphasize the need for collaborative efforts to promote Industry 4.0 as a driver of sustainable development. By implementing the suggested recommendations, stakeholders can create a more enabling Business environment for Industry 4.0 adoption, ensuring that it contributes to environmental conservation, social well-being, and economic growth.

The descriptive analysis provides empirical evidence that while Industry 4.0 is perceived as a key enabler of sustainability, there exists a practical implementation gap that must be addressed through strategic planning, cross-sectoral collaboration, and policy interventions. Future research should explore sector-specific adoption barriers, technological integration frameworks, and the longitudinal impact of Industry 4.0 adoption on sustainability performance.

References

Bag, S., Telukdarie, A., Pretorius, J. H. C., & Gupta, S. (2021). Industry 4.0 and supply chain sustainability: Framework and future research directions. Benchmarking: An International Journal, 28(5), 1413-1450. https://doi.org/10.1108/BIJ-11-2019-0506

Beier, G., Ullrich, A., Niehoff, S., Reißig, M., & Habich, M. (2020). Industry 4.0: How it is defined from a sustainability and resilience perspective. Procedia CIRP, 93, 282-287. https://doi.org/10.1016/j.procir.2020.03.014

Bennett, N., & Lemoine, G. J. (2014). What a difference a word makes: Understanding threats to performance in a VUCA world. Business Horizons, 57(3), 311-317. https://doi.org/10.1016/j.bushor.2014.01.001

Birkel, H. S., & Hartmann, E. (2020). Impact of IoT and blockchain on supply chain transparency. Business Strategy and the Environment, 29(2), 524-534. https://doi.org/10.1002/bse.2399

Bonilla, S. H., Silva, H. R. O., Terra da Silva, M., Franco Gonçalves, R., & Sacomano, J. B. (2018). Industry 4.0 and sustainability implications: A scenario-based analysis of the impacts and challenges. Sustainability, 10(10), 3740. https://doi.org/10.3390/su10103740

Bryman, A., & Bell, E. (2015). Business research methods (4th ed.). Oxford University Press.

Büchi, G., Cugno, M., & Castagnoli, R. (2020). Smart factory performance and Industry 4.0. Technological Forecasting and Social Change, 150, 119790. https://doi.org/10.1016/j.techfore.2019.119790

Deloitte. (2020). The Industry 4.0 paradox: Overcoming disconnects on the path to digital transformation. Retrieved from https://www2.deloitte.com

Field, A. (2018). Discovering statistics using IBM SPSS statistics (5th ed.). SAGE Publications.

George, D., & Mallery, P. (2019). IBM SPSS statistics 26 step by step: A simple guide and reference (16th ed.). Routledge.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). Multivariate data analysis (8th ed.). Cengage Learning.

Hermann, M., Pentek, T., & Otto, B. (2016). Design principles for Industrie 4.0 scenarios. 49th Hawaii International Conference on System Sciences (HICSS), 3928-3937. https://doi.org/10.1109/HICSS.2016.488

Jabbour, C. J. C., Fiorini, P. D., Ndubisi, N. O., Queiroz, M. M., & Piato, É. L. (2020). Digitally enabled sustainable supply chains in Industry 4.0: A framework and practice-based view. Sustainability, 12(5), 1929. https://doi.org/10.3390/su12051929

Kamble, S. S., Gunasekaran, A., & Gawankar, S. A. (2018). Sustainable Industry 4.0 framework: A systematic literature review identifying the current trends and future perspectives. Business Strategy and the Environment, 27(7), 1008-1025. https://doi.org/10.1002/bse.2041

Kamble, S. S., Gunasekaran, A., & Sharma, R. (2018). Analysis of the driving and dependence power of barriers to adopt Industry 4.0 in Indian manufacturing industry. Computers & Industrial Engineering, 125, 536-548. https://doi.org/10.1016/j.cie.2018.04.011

Kamble, S. S., Sangwan, K. S., & Dhone, N. (2019). Industry 4.0 and sustainability: An integrative research framework for analyzing the triple bottom line performance. Business Strategy and the Environment, 29(3), 1063-1079. https://doi.org/10.1002/bse.2427

Lu, Y. (2017). Industry 4.0: A survey on technologies, applications, and open research issues. Journal of Industrial Information Integration, 6, 1-10. https://doi.org/10.1016/j.jii.2017.04.005

Luthra, S., & Mangla, S. K. (2018). Evaluating challenges to Industry 4.0 initiatives for supply chain sustainability in emerging economies. Process Safety and Environmental Protection, 117, 168-179. https://doi.org/10.1016/j.psep.2018.04.018

Marr, B. (2018). The intelligence revolution: Transforming your business with AI. Kogan Page Publishers.

Müller, J. M., & Voigt, K. I. (2018). Sustainable industrial value creation in SMEs: A comparison between Industry 4.0 and Made in China 2025. International Journal of Precision Engineering and Manufacturing-Green Technology, 5(5), 659-670. https://doi.org/10.1007/s40684-018-0056-z

Osterrieder, P., Budde, L., & Friedli, T. (2020). The smart factory as a key construct of Industry 4.0: A systematic literature review. International Journal of Production Economics, 221, 107476. https://doi.org/10.1016/j.ijpe.2019.08.011

Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. Journal of Applied Psychology, 88(5), 879-903. https://doi.org/10.1037/0021-9010.88.5.879

Raj, A., Dwivedi, G., & Sharma, A. (2020). Barriers to the adoption of Industry 4.0 technologies in the manufacturing sector: An inter-country comparative perspective. International Journal of Production Economics, 224, 107546. https://doi.org/10.1016/j.ijpe.2019.107546

Raji, I. O., Habib, K., Hamdan, S., & Salih, M. (2021). Digital transformation in the manufacturing sector: Examining the barriers and enablers for Industry 4.0 adoption. Sustainability, 13(15), 8560. https://doi.org/10.3390/su13158560

Stock, T., & Seliger, G. (2016). Opportunities of sustainable manufacturing in Industry 4.0. Procedia CIRP, 40, 536-541. https://doi.org/10.1016/j.procir.2016.01.129

United Nations. (2015). Transforming our world: The 2030 agenda for sustainable development. United Nations General Assembly. https://sdgs.un.org/2030agenda

Zhou, K., Liu, T., & Zhou, L. (2015). Industry 4.0: Towards future industrial opportunities and challenges. Procedia Manufacturing, 2, 586-591. https://doi.org/10.1016/j.promfg.2015.07.045