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EVALUATING THE CONTRIBUTION OF PUBLIC UTILITIES TOWARD SUSTAINABLE TOURISM THROUGH RENEWABLE ENERGY INTEGRATION IN ANDHRA PRADESH

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ABSTRACT **DOI No: 10.36713/epra25152** **Article DOI: https://doi.org/10.36713/epra25152**

The synergy between energy infrastructure and tourism development is critical for emerging economies. This study evaluates the role of public utilities—specifically Power Distribution Companies (DISCOMs) and State Transport Corporations—in fostering sustainable tourism in Andhra Pradesh. Anchored in the Andhra Pradesh Integrated Clean Energy (ICE) Policy 2024 and the Tourism Policy 2024-29, the research utilizes a mixed-method approach, combining secondary policy analysis with primary data from 450 stakeholders in the Visakhapatnam and Tirupati clusters. Statistical analysis, including t-tests and TCO modeling, reveals that utility-led interventions are the primary drivers of destination sustainability. Findings indicate a significant positive correlation (r=0.78) between electric mobility and pilgrim satisfaction in Tirumala. Furthermore, the ICE Policy 2024 land lease incentives reduce operational leverage for hospitality units by approximately 18%. The paper concludes that public utilities are not merely service providers but active decarbonization agents in the tourism value chain.

KEYWORDS: ***Sustainable Tourism, Renewable Energy, Public Utilities, Electric Mobility, Andhra Pradesh.***

1.INTRODUCTION

The global tourism sector is pivoting from being a passive consumer of energy to an active driver of the green transition. In Andhra Pradesh, a state that welcomed a record 254.7 million domestic tourists in 2023, the pressure on public infrastructure is immense. The energy demands of this floating population—ranging from hotel HVAC loads to transport fuel—create a significant carbon footprint. This research posits that public utilities, specifically the Transmission Corporation of Andhra Pradesh (APTRANSCO) and the Andhra Pradesh State Road Transport Corporation (APSRTC), are pivotal in mitigating these impacts.

Guided by the *Andhra Pradesh Integrated Clean Energy (ICE) Policy 2024* and the *Tourism Policy 2024-29*, the state aims to position itself as a "Green Energy Hub." This study aims to quantify the impact of these utility-led interventions on the tourism ecosystem, focusing on two key clusters: the spiritual hill destination of Tirupati and the coastal urban hub of Visakhapatnam.

2. REGULATORY AND POLICY FRAMEWORK

2.1 Integrated Clean Energy (ICE) Policy 2024

The *ICE Policy 2024* provides the structural backbone for renewable energy (RE) adoption.

- **Land Lease Dynamics:** To mitigate high land costs, the policy standardizes lease rates at ₹31,000 per acre/year for government land allocated to clean energy projects. This allows large tourism projects to establish captive solar plants with predictable CAPEX.
- **Green Energy Open Access (GEOA):** Consumers with a contracted demand of 100 kW+ can access green power directly. The policy introduces a monthly banking facility, capped at 5% of peak demand, allowing hotels to store excess solar generation for evening peak usage.

2.2 Tourism Policy 2024-29

This policy complements energy reforms by stimulating demand.

- **Industry Status:** The granting of "Industry Status" to the tourism sector reduces electricity tariffs, moving hotels from commercial to industrial billing.[4]

- **Green Incentives:** The policy offers 100% reimbursement of net SGST and expenses incurred for obtaining green certifications like LEED or Green Key.[4]

3. METHODOLOGY

Study Design: A descriptive and analytical research design using both primary and secondary data.

Study Area

1. **Tirupati-Tirumala:** High-density spiritual tourism (Hill topography).
2. **Visakhapatnam:** Coastal and business tourism (Urban topography).

Data Sources

- Primary: A structured survey (N=450) covering Tourists (400) and Hoteliers (50).
- *Secondary:* Annual reports of TTD, APSRTC, and government orders.

Analysis Tools: SPSS 26.0 was used for Independent Samples t-tests and Multiple Regression. A Total Cost of Ownership (TCO) model was developed for electric buses.

4. PROFILE OF PUBLIC UTILITY INTERVENTIONS

4.1 TTD: Net-Zero Spiritual Tourism

Tirumala Tirupati Devasthanams (TTD) operates as a quasi-utility.

- **Wind & Solar:** TTD meets ~38.5% of its energy needs through a 10 MW solar plant and ~28% through 7.5 MW wind turbines.
- **Donation Model:** Infrastructure donations, such as the 800 KW wind turbine from Vish Wind Infrastructure, significantly lower the Levelized Cost of Energy (LCOE).

4.2 APSRTC: Decarbonizing Ghat Roads

APSRTC has deployed electric buses on the sensitive Tirumala ghat roads to reduce diesel emissions.[12]

- **Fleet:** Deployment includes 100 e-buses (9m and 12m variants) operating on a Gross Cost Contract (GCC) model.[3]
- **Impact:** Zero tailpipe emissions on the 18-km ghat road, preserving the delicate Eastern Ghats ecology.

4.3 GVMC: Smart Lighting in Vizag

The "Eco-Vizag" initiative by the Greater Visakhapatnam Municipal Corporation (GVMC) replaced ~91,000 streetlights with LEDs.

- **Energy Savings:** Audits indicate energy savings of 50-55% [14], improving the visual appeal of beach roads for night tourism.

5. DATA ANALYSIS AND INTERPRETATION

5.1 Tourist Perception of Green Mobility

Hypothesis (H1): There is a significant difference in tourist satisfaction regarding Noise and Comfort between Electric and Diesel buses.

Table 1: Independent Samples t-test for Bus Satisfaction (N=200)

Parameter	Bus Type	Mean Score (1-10)	t-value	p-value
Noise Level Comfort	Diesel	5.82	-18.45	0.000*
	Electric	9.15		
Vibration Comfort	Diesel	6.10	-14.22	0.000*
	Electric	8.80		
Air Quality (In-cabin)	Diesel	6.50	-9.85	0.000*
	Electric	8.20		

Source: Primary Data. Significant at $p < 0.01$.

Interpretation: The t-test confirms that electric buses provide a significantly superior experience ($p < 0.001$). The silence of e-buses on the steep ghats enhances the spiritual ambience, contrasting sharply with the noise of diesel engines.

5.2 Economic Viability: TCO Modeling

A 10-year TCO analysis was conducted for APSRTC buses on the Tirumala route.

Table 2: 10-Year TCO Comparison (Diesel vs. Electric)

Cost Component	Diesel Bus (₹ Lakhs)	Electric Bus (₹ Lakhs)	Variance
Net CAPEX	45.00	65.00	+20.00
Fuel/Energy Cost	247.00	53.00	-194.00
Maintenance	35.00	21.00	-14.00
Battery Replacement	0.00	30.00	+30.00
Total TCO	**327.00**	**169.00**	**-158.00**

Source: Author's calculation based on market data.

Analysis: Despite a higher CAPEX, the electric bus delivers **₹1.58 Crores** in savings over 10 years. The regenerative braking on downhill ghat roads significantly lowers energy consumption compared to diesel braking friction.

5.3 Hospitality Sector Impact

Surveying 50 hotels in Vizag revealed the financial impact of the "Industry Status" classification.

Table 3: Impact of Industry Status on Energy Costs (100-Room Hotel)

Scenario	Tariff (Approx.)	Annual Bill (1.2M units)	Savings
Commercial Tariff	₹12.50 / kWh	₹1.50 Crores	-
Industrial Tariff	₹7.50 / kWh	₹0.90 Crores	**₹60 Lakhs**

Source: Primary Survey.

Interpretation: The ₹60 Lakh annual saving is being reinvested into sustainability. 65% of hoteliers stated they would use these funds for Green Key certifications or captive solar plants under the new land lease norms.

5.4 Regression Analysis

We modeled "Revisit Intention" (Y) against sustainable utility interventions.

Table 4: Multiple Regression Analysis

Variable	Coefficient (β)	t-value	Sig.
(Constant)	1.245	3.12	.002
Green Transport (EVs)	0.412	5.67	.000
Eco-Friendly Stay	0.285	3.45	.001
Cleanliness (Eco-Vizag)	0.550	7.89	.000

R-Square = 0.68.

Findings: "Cleanliness/Eco-Vizag" (β=0.550) and "Green Transport" (β=0.412) are the strongest predictors of tourist loyalty.

6. FINDINGS

The study validates that public utilities act as the nervous system of sustainable tourism.

- **The "Green Corridor" Effect:** The integration of TTD's wind energy and APSRTC's e-mobility creates a near-net-zero pilgrim experience.
- **The "Duck Curve" Challenge:** While GEOA helps, the 5% banking cap limits the ability of hotels to store noon solar generation for evening peaks, necessitating investment in Battery Energy Storage Systems (BESS).
- **Land Economics:** The ₹31,000/acre lease effectively de-risks RE projects for tourism, decoupling energy infrastructure from volatile real estate markets.

7. RECOMMENDATIONS

1. **Dynamic Banking:** APERC should allow quarterly energy banking for tourism units to manage seasonal load variations.
2. **Solar-Ready Depots:** APSRTC should install solar canopies at bus depots to charge EVs directly from renewable sources.
3. **MSME Pooling:** Small hotels should be encouraged to form "Green Power Pools" to aggregate demand and access Open Access benefits.

8. CONCLUSION

Andhra Pradesh demonstrates a viable model where policy (ICE 2024), technology (EVs, LEDs), and utility management (TTD, APSRTC) converge. The transition to electric mobility and renewable power is not merely an environmental imperative but an economic one, offering lower TCO and higher tourist satisfaction.

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FISCAL AND DEVELOPMENTAL DIVERGENCE BETWEEN ANDHRA PRADESH AND TELANGANA: A COMPARATIVE ANALYSIS (2004-05 TO 2023-24)

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ABSTRACT **DOI No: 10.36713/epra25134** **Article DOI: https://doi.org/10.36713/epra25134**

This study analyzes the fiscal and developmental trajectories of Andhra Pradesh (AP) and Telangana (TS) following their 2014 bifurcation. Using data systematically compiled from official government sources (RBI, CAG, MOSPI, NITI Aayog, NFHS-5, State Health Departments), we employ growth accounting, fiscal decomposition, and correlation analysis. Results identify two distinct fiscal syndromes: Telangana's *'High-Growth Debt Trap'****, characterized by robust revenue (average OTR/GSDP: 7.1% vs. AP's 6.1%) but accelerated debt accumulation (interest payment CAGR: 15.8%), and Andhra Pradesh's*** *'Revenue-Deficit Development Paradox'****, marked by structural revenue deficits (avg. 3.8% of GSDP) and weak economic-health outcome relationships. District-level analysis reveals a positive correlation between economic output and poor health indicators in Andhra Pradesh (+0.58, p<0.05, n=13 districts), suggesting governance inefficiencies. All correlations are statistically significant at 5% level. Policy prescriptions emphasize fiscal transparency and outcome-based governance, with tailored approaches for each state's specific syndrome.*** *Complete replication data and methodology available in supplementary materials.*

KEYWORDS: ***Fiscal Federalism, Debt Sustainability, Developmental Paradox, Expenditure Quality, State Finances, Bifurcation***

1. INTRODUCTION

The Andhra Pradesh Reorganisation Act, 2014 created a compelling scenario in Indian fiscal federalism, producing two states with fundamentally asymmetric initial conditions [1]. Telangana inherited Hyderabad, a mature economic hub that contributed approximately 44% of the undivided state's own tax revenues according to pre-bifurcation assessments (Sri Krishna Committee Report, 2010, Table 8.2, Page 145) [2], while Andhra Pradesh confronted the twin challenge of constructing a new capital city while rebuilding a severed economic base [3].

A decade post-bifurcation, emerging evidence suggests the initial narrative of straightforward economic divergence is evolving into a more complex story of convergent fiscal stress—characterized by rising debt burdens and revenue deficits in both states—despite markedly different developmental models [4]. This convergent fiscal stress manifests in parallel debt accumulation patterns despite divergent growth strategies and initial conditions. This paper moves beyond descriptive comparison to diagnose the underlying structural and policy-driven syndromes that have emerged, introducing a novel syndrome-based diagnostic framework for post-bifurcation analysis.

Our investigation addresses three core questions:

1. What distinct fiscal syndromes have emerged in Telangana and Andhra Pradesh, and what are their structural drivers?
2. How have contrasting development approaches influenced social outcomes, particularly in creating governance challenges?
3. What evidence-based, sector-specific policy corrections are required to ensure long-term sustainability?

This paper contributes through its syndrome-based diagnostic framework, integrated fiscal-developmental analysis, and identification of governance inefficiencies at sub-state levels. A comprehensive Data Appendix ensures full methodological transparency and addresses urgent need for evidence-based fiscal corrections.

2. THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1 Theoretical Foundations

Our framework integrates three complementary theoretical pillars to analyze the post-bifurcation trajectories, with explicit linkages to methodological choices

Table 2.1: Theoretical Framework Mapping with Methodological Implications

Theoretical Concept	Syndrome Linkage	Key Mechanism	Methodological Application
Fiscal Federalism (Oates, 1972) [5]	Both Syndromes	Asymmetric decentralization benefits	Comparative revenue capacity analysis
Hard Budget Constraints (Rodden, 2002) [7]	High-Growth Debt Trap	Relaxed borrowing discipline with revenue surplus	Debt sustainability and interest payment analysis
Competitive Populism (Sinha, 2021) [8]	Revenue-Deficit Development Paradox	Election-cycle welfare spending crowding out capital expenditure	Election year expenditure pattern analysis

Oates' decentralization theorem [5] provides the baseline for expecting efficiency gains from sub-national governance, which the asymmetric bifurcation puts to a stark test [6]. This theoretical foundation directly informs our comparative analysis of revenue generation efficiency and expenditure patterns across the two states. We incorporate theories of hard budget constraints [7] to analyze how initial fiscal capacity influences borrowing behavior and fiscal discipline, specifically guiding our examination of debt accumulation patterns and off-budget liabilities. The concept of "competitive populism" [8] helps explain the persistent implementation of fiscally straining welfare programs in both states despite clear sustainability concerns, directly shaping our analysis of election-cycle expenditure patterns.

2.2 Empirical Literature

Institutional reports from the Reserve Bank of India and NITI Aayog have systematically documented the divergent fiscal trajectories [9,10]. Academic scholarship has enriched this understanding, with Dev [3] providing an early assessment of Andhra Pradesh's challenges, and Kumar and Rao [11] highlighting the role of institutional capacity. Recent studies analyze state-specific welfare architectures [8], while research on off-budget liabilities has highlighted measurement challenges in sub-national fiscal risks [12,19]. Reddy (2023) [20] provides recent analysis of post-COVID state finances, highlighting emerging fiscal stress patterns.

However, the existing literature demonstrates a significant gap: most analyses remain either exclusively fiscal or purely developmental, failing to capture the dynamic interplay within a unified diagnostic framework. This paper addresses this gap through its integrated syndrome-based approach, drawing on comparative federalism literature [21] to contextualize the Andhra Pradesh case within broader patterns of asymmetric decentralization.

3. DATA AND METHODOLOGY

3.1 Data Sources and Compilation

This study employs exclusively authoritative government sources, with all data systematically compiled and cross-verified. A comprehensive Data Appendix provides complete source documentation with exact table and page references.

Primary Data Sources with Exact References

- **Fiscal Data:** RBI State Finances publications (2004-05 to 2023-24) [9], Tables 4, 15, 25
- **Expenditure Quality:** CAG State Finance Accounts (2014-15 to 2022-23) [13,14], Statement 5
- **Economic Indicators:** MOSPI GSDP and per capita income at constant 2011-12 prices [15], Table 5
- **Developmental Metrics:** NITI Aayog MPI 2023 [10] and NFHS-5 (2019-21) [16], State Fact Sheets
- **District-Level Data:** MOSPI District Domestic Product (2017-18) [22], Table 74, Pages 165-170 and state health department bulletins (AP: Annual Health Survey 2018-19, Tables 4-6; TS: Health Performance Indicators 2019-20, Annexure 3)

Data Processing Methodology

All data underwent systematic cleaning and validation procedures including:

- Cross-verification across multiple official sources
- Consistency checks for temporal comparability
- Outlier detection and validation
- Missing data documentation and imputation notation

3.2 Analytical Framework

Periodization Strategy:

- **Phase I (Pre-Bifurcation):** 2004-05 to 2013-14 - Baseline establishment
- **Phase II (Post-Bifurcation):** 2014-15 to 2018-19 - Immediate impacts
- **Phase III (Contemporary):** 2019-20 to 2023-24 - Current assessment

Growth Accounting Methodology

Shift-share analysis decomposition using the formula:
$\Delta GSDP=\sum i=1n(\Delta Si\times wi)\Delta GSDP=i=1\sum n(\Delta Si\times wi)$
Where SiSi represents sectoral growth and wiwi represents sectoral weights based on 2011-12 base year contributions.

Fiscal Decomposition: Analysis of expenditure composition using CAG data classification with detailed documentation of accounting head mappings across years.

District-Level Correlation: Pearson correlation analysis with 95% confidence intervals using the formula:
$r=\sum i=1n(xi-x^-)(yi-y^-)\sum i=1n(xi-x^-)2\sum i=1n(yi-y^-)2r=\sum i=1n$
$(xi-x^-)2\sum i=1n(yi-y^-)2$
$\sum i=1n(xi-x^-)(yi-y^-)$
Robustness checks conducted using Spearman rank correlation.

Statistical Methods: All monetary values converted to constant 2011-12 prices using MOSPI GSDP deflator series (Table 8). Statistical significance tested at 5% level using two-tailed tests. Sample size: n=13 districts per state for correlation analysis. All analyses conducted using R 4.2.1 with complete code documentation.

4. DIAGNOSTIC FISCAL ANALYSIS

4.1 Revenue Capacity and Fiscal Autonomy

The analysis reveals a persistent structural divide in revenue generation capacity between the two states.

Table 1: Own Tax Revenue Trends (Constant 2011-12 Prices)

State	2014-15 (₹ Crore)	2022-23 (₹ Crore)	CAGR (%)	Avg. OTR/GSDP (2014-23)	Data Source
Telangana	48,210	1,15,842	11.4	7.1	RBI Table 15
Andhra Pradesh	40,785	95,752	10.8	6.1	RBI Table 15

*Source: Author's calculation from RBI State Finances [9, Table 15] and MOSPI [15, Table 5]
Note: CAGR = [(Ending Value/Beginning Value)^(1/9) - 1] × 100
Methodology: OTR values deflated using MOSPI GSDP deflator series*

The performance ratio (TG/AP) for OTR/GSDP averaged 1.16 ($p<0.05$, 95% CI: 1.08-1.24) throughout the post-bifurcation period, indicating Telangana maintains a statistically significant 16% structural advantage in revenue generation efficiency.

4.2 Expenditure Patterns and Emerging Syndromes

Decomposition of public expenditure reveals the fiscal pathologies underlying each syndrome.

Table 2: Fiscal Syndrome Indicators (2014-15 to 2022-23 Average)

Indicator	Telangana	Andhra Pradesh	Statistical Significance	Data Source
Revenue Exp. / Total Exp. (%)	78	82	$p<0.05$	CAG Statement 5
(Pensions+Salaries) / Rev. Exp. (%)	28	35	$p<0.01$	CAG Statement 5
Capital Outlay / Total Exp. (%)	22	18	$p<0.05$	CAG Statement 5
Interest Payment CAGR (%)	15.8	13.2	$p<0.05$	CAG Statement 5

*Source: Author's calculation from CAG State Finance Accounts [13,14, Statement 5]
Note: CAGR calculations based on 2014-15 to 2022-23 period with exact values: TS: ₹7,210Cr to ₹23,584Cr; AP: ₹8,547Cr to ₹20,584Cr*

Telangana's 'High-Growth Debt Trap': Despite maintaining higher capital expenditure allocation, Telangana's interest payments grew at 15.8% CAGR (2014-15 to 2022-23), substantially outpacing revenue growth (11.4% CAGR) and indicating potential fiscal sustainability challenges. Calculation: [(23,584/7,210)^(1/9)-1]×100 = 15.8%.

Andhra Pradesh's 'Revenue-Deficit Development Paradox': The state's elevated revenue expenditure, driven by committed items (35% for administration and pensions), creates structural constraints on productive capital formation. This reflects the hard budget constraint theoretical framework, where limited revenue capacity forces trade-offs between current and capital expenditure.

4.3 Debt Dynamics and Fiscal Sustainability

Table 3: Fiscal Sustainability Indicators (% of GSDP)

Indicator	Telangana (2023-24)	Andhra Pradesh (2023-24)	All-India Average	Data Source
Official Debt/GSDP	27.3	32.9	31.2	RBI Table 25
+ Estimated Off-Budget Liabilities	+8.5	+6.2	-	State Budgets
Revenue Deficit/GSDP	3.8	4.1	2.4	RBI Table 4
Fiscal Deficit/GSDP	4.3	4.2	3.8	RBI Table 4

*Sources: RBI [9, Table 25, Table 4], State Budget Documents, Author's estimates
Note: Off-budget estimates based on state guarantee disclosures (TS: ₹85,000Cr power sector + ₹78,000Cr irrigation SPVs; AP: ₹62,000Cr various guarantees) and CAG reports [13,14]*

Figure 1: Debt/GSDP Trends (2004-2024) [See Appendix Figure A1]
Visualization shows convergence in debt burdens despite different starting points, with Telangana's debt growing from 19.2% (2014-15) to 27.3% (2023-24) and Andhra Pradesh from 28.7% to 32.9% over the same period

5. DEVELOPMENTAL OUTCOMES ANALYSIS

5.1 Economic Growth Patterns

Table 4: Per Capita Income and Growth (Constant 2011-12 Prices)

State	2014-15 (₹)	2022-23 (₹)	CAGR (%)	Relative to National Avg. (%)	Data Source
Telangana	1,24,105	2,02,385	6.1	134	MOSPI Table 5
Andhra Pradesh	1,01,398	1,51,598	4.9	101	MOSPI Table 5

*Source: MOSPI [15, Table 5]
Note: CAGR calculations cover 2014-15 to 2022-23 period*

Sectoral Growth Accounting

Table 4a: Sectoral Contribution to GSDP Growth (2014-2023)

State	Agriculture (%)	Industry (%)	Services (%)	Total GSDP Growth (%)	Data Source
Telangana	15.2	24.7	60.1	100	MOSPI Sectoral Data
Andhra Pradesh	24.8	30.5	44.7	100	MOSPI Sectoral Data

*Source: Author's calculation from MOSPI sectoral data [15] using shift-share analysis
Methodology: ΔGSDP = Σ(ΔSector_i × Weight_i) based on 2011-12 base year weights*

5.2 Development Outcomes and Governance Challenges

Table 5: Human Development Indicators

Indicator	Telangana	Andhra Pradesh	All-India Average	Source	Year
Multidimensional Poverty (%)	9.2	16.5	14.9	NITI Aayog [10]	2023
Infant Mortality Rate	21	28	27	NFHS-5 [16]	2019-21
Maternal Mortality Ratio	43	45	97	SRS [17]	2018-20
Women with 10+ Years Schooling (%)	41.2	36.6	41.0	NFHS-5 [16]	2019-21

District-Level Governance Analysis

Analysis of district-level relationships between economic development and health outcomes reveals significant inter-state variations:

- **Andhra Pradesh:** r = +0.58 (95% CI: 0.12, 0.83), p = 0.022, n = 13
- **Telangana:** r = -0.42 (95% CI: -0.75, -0.08), p = 0.047, n = 13

Robustness Check (Spearman correlation):

- Andhra Pradesh: ρ = +0.61 (p = 0.018)
- Telangana: ρ = -0.39 (p = 0.052)

*Data Sources: District economic data from MOSPI District GDP 2017-18 [22, Table 74]; Health indicators from state health department administrative data (AP: Annual Health Survey 2018-19; TS: Health Performance Indicators 2019-20)
Note: District health estimates are administrative data subject to reporting limitations and not directly comparable to SRS estimates*

Figure 2: District Economic-Health Relationships [See Appendix Figure A2]
Scatter plots showing contrasting patterns between AP and TS with trend lines and confidence intervals

5.3 Infrastructure Access

Table 6: Infrastructure Access Indicators

Indicator	Telangana	Andhra Pradesh	All-India Average	Source	Year
Rural Tap Water Access (%)	85	65	73	JJM Dashboard [18]	2023
Hospital Beds per Lakh Population	75	62	55	National Health Profile 2022 [19]	2022

6. Political Economy and Integrated Assessment

6.1 Electoral Cycles and Fiscal Behavior

Analysis of election cycle effects reveals consistent patterns of "competitive populism" across three election cycles:

Table 7: Election Cycle Spending Patterns

Election Year	State	Subsidy Growth (%)	Capital Outlay Change (%)	Data Source	Statistical Significance
2018	Telangana	+18.5	-12.3	CAG [13,14]	p<0.05
2019	Andhra Pradesh	+22.3	-15.8	CAG [13,14]	p<0.01
2023	Both States	+19.7	-13.5	State Budgets	p<0.05

*Note: Percentage changes relative to non-election year averages based on CAG expenditure analysis 2014-2023
Methodology: Comparison of election year expenditure with 3-year moving average of non-election years*

Theoretical Linkage: These patterns align with competitive populism theory, demonstrating how electoral competition drives sub-optimal fiscal choices that prioritize short-term political gains over long-term fiscal sustainability.

6.2 Integrated Performance Assessment

Table 8: Performance Ratio Trends (TG/AP)

Indicator	2014-15	2023-24	Trend & Implication	Statistical Significance	Data Source
Per Capita Income	1.22	1.34	Divergence in Prosperity	p<0.05	MOSPI Table 5
Debt/GSDP	0.67	0.83	Convergence in Fiscal Stress	p<0.05	RBI Table 25
Capital Outlay/Total Exp.	1.28	1.22	Stable but Eroding Advantage	p<0.10	CAG Statement 5

Note: Performance Ratio = Telangana Value / Andhra Pradesh Value based on official public debt figures

7. MAJOR FINDINGS

1. **Syndrome Diagnosis Confirmed:** Telangana exhibits a **'High-Growth Debt Trap'** (debt growth 15.8% CAGR), while Andhra Pradesh faces a **'Revenue-Deficit Development Paradox'** (revenue deficit 4.1% of GSDP).
2. **Structural Advantage Persists:** Telangana maintains 16% revenue efficiency advantage (OTR/GSDP: 7.1% vs. 6.1%, $p<0.05$), though convergence trends are emerging.
3. **Governance Inefficiencies Identified:** District-level analysis reveals significant correlation between economic development and poor health outcomes in Andhra Pradesh ($r=+0.58$, $p<0.05$), suggesting service delivery challenges. Robustness checks confirm this pattern (Spearman $\rho=+0.61$, $p=0.018$).
4. **Expenditure Quality Concerns:** Both states exhibit problematic expenditure patterns, with Telangana showing debt dependency and Andhra Pradesh constrained by committed expenditure.
5. **Political Economy Drivers:** Election cycles systematically influence fiscal decisions, with 18-22% welfare spending increases crowding out capital expenditure by 12-16% across three election cycles.

8. EVIDENCE-BASED POLICY PRESCRIPTIONS

8.1 Immediate Priorities (2024-25)

Telangana: Debt Transparency and Management

- **Action:** Formalize disclosure of contingent liabilities and establish medium-term debt strategy
- **Rationale:** Address core vulnerability of 'High-Growth Debt Trap'
- **Implementation Pathway:**
  - Publish comprehensive fiscal risk statements with budget documents
  - Establish independent debt management office with statutory authority
  - Implement statutory borrowing limits under FRBM framework
- **Resource Requirements:** ₹50-60 crore for institutional setup, technical assistance
- **Legal Framework:** Requires amendment to State FRBM Act 2005

Andhra Pradesh: Revenue Deficit Reduction

- **Action:** Implement 3-year revenue deficit reduction roadmap targeting 2% of GSDP
- **Rationale:** Create fiscal space for development spending
- **Implementation Pathway:**
  - Establish fiscal correction fund with earmarked savings
  - Subsidy rationalization with social protection safeguards for vulnerable groups
  - Revenue enhancement through tax administration reforms and base expansion
- **Political Economy Considerations:** Phased approach to minimize social disruption

8.2 Medium-Term Structural Reforms (2025-27)

Table 9: Reform Implementation Timeline with Monitoring Framework

Reform Area	2024-25	2025-26	2026-27	Key Performance Indicators	Risk Mitigation
Fiscal Transparency	Debt disclosure	Outcome budgeting	Fiscal councils	Risk statements published	Technical assistance
Governance Reform	District metrics	Performance budgeting	Institutional capacity	Health outcome improvements	Capacity building
Economic Diversification	Regional funds	Investment targets	Cluster development	Regional inequality reduction	Stakeholder consultation

Implementation Considerations

- **Legal Framework:** Requires state FRBM Act amendments and legislative support
- **Administrative Capacity:** Staff training and technical assistance needed across departments
- **Political Economy:** Stakeholder consultation and phased implementation to build consensus
- **Monitoring & Evaluation:** Independent verification and public reporting with civil society oversight

Risks and Mitigation

- **Short-term growth impact:** Gradual consolidation with counter-cyclical elements and social safety nets
- **Social unrest:** Targeted protection for vulnerable groups with transparent eligibility criteria
- **Implementation resistance:** Technical assistance and capacity building with demonstration projects
- **Political opposition:** Bipartisan consensus building through expert committees

9. CONCLUSION, LIMITATIONS AND FUTURE RESEARCH

The post-bifurcation evolution of Andhra Pradesh and Telangana offers crucial insights for fiscal federalism and regional development. Our analysis confirms that initial structural advantages confer significant head starts, but long-term outcomes are decisively shaped by policy choices, expenditure quality, and governance effectiveness. The syndrome-based framework provides a diagnostic tool for targeted policy interventions.

Methodological Limitations

1. **District-Level Data:** Health indicators based on administrative data with inherent reporting limitations and potential measurement error
2. **Off-Budget Liabilities:** Measurement challenges due to inconsistent reporting across states and incomplete disclosure

3. **Causal Identification:** Correlational analysis limits causal claims; unobserved confounding possible
4. **Time Period:** Evolving patterns may change with more post-bifurcation data and external shocks

Future Research Directions

1. **Causal Mechanisms:** Natural experiment designs around specific policy changes and institutional reforms
2. **Institutional Analysis:** Governance quality indicators and their impact on development outcomes
3. **Comparative Framework:** Extension to other state bifurcations (Jharkhand, Uttarakhand, Chhattisgarh) and international cases
4. **Dynamic Modeling:** Panel data approaches with longer time series and spatial econometric techniques
5. **Political Economy:** Detailed analysis of electoral dynamics and their fiscal consequences

Policy Implications

The findings have significant implications for state restructuring decisions in India and other federal systems. The identified syndromes offer targeted intervention points, while the integrated analysis demonstrates the importance of combining fiscal and developmental perspectives in sub-national governance.

Despite methodological limitations, the diagnostic framework provides valuable insights for policymakers. The path forward requires rebuilding fiscal buffers while maintaining developmental momentum, necessitating careful balancing of political expediency and economic prudence. Enhanced fiscal responsibility mechanisms, particularly transparent reporting and independent monitoring, represent the most promising pathways for reconciling these tensions and ensuring sustainable development for both states.

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THE FUTURE AND CHALLENGES OF AI IN DECISION MAKING: CAN AI REPLACE HUMANS IN DECISION MAKING?

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ABSTRACT **DOI No: 10.36713/epra25137** **Article DOI: https://doi.org/10.36713/epra25137**

The modern era of AI is developing rapidly and is once more a prevalent subject for investigate. The objective of this paper is to discover the role of Artificial Intelligence in Business decision making and issues that come up when utilizing and influencing AI-based frameworks for decision-making and to deliver the outcomes to retrieve the challenges. AI is no longer just a science fiction dream but is revolutionizing the way companies approach decision making thanks to its ability to analyze large volumes of data and generate actionable insights. AI's role into decision-making processes is transforming industries by enabling more informed, well-organized, and valuable decisions. Its capability can quickly and accurately analyze vast amounts of data means it's ideally suited for decision-making in the 21st century. The future crash of AI in decision-making is expected to be considerable and transformative across various sectors, building upon the current trends and capabilities of artificial intelligence. The above all these points explain that AI can sometimes fully automate and restore human decision-making, particularly for lower-stakes alternatives. Even though, AI application has numerous challenges, some of the precautions to be handled before using every step in processes like Conduct outstanding diligence, Execute encryption, Use protected communication protocols, Discuss contract terms and Scrutinize and inspection can mitigate the problems.

KEY WORDS: ***Artificial Intelligence, cloud service, Data set, Decision making, Application, Well- Organized.***

INTRODUCTION

Artificial intelligence (AI) has demonstrated superior performance in various managerial domains, but its effectiveness in strategic decision-making remains a critical question. The objectives of this study are to investigate whether AI can outperform humans in key areas of strategic decision-making processes and how. AI shows promising capabilities in information processing and data analysis, creative thinking and innovation, collaboration and communication, and handling uncertainty. However, human expertise, creativity, intuition, and ethical judgment remain essential, particularly in areas of ethical decision-making where significant human oversight is required. The main conclusion of this study is that AI has the potential to enhance strategic decision-making processes, but a collaborative approach leveraging both human and machine intelligence while ensuring transparency, accountability, and alignment with organizational values is necessary. Ongoing research and policy development are essential to harness AI's potential while mitigating risks.

With businesses facing rapid changes, the necessity for informed, precise, and timely decision-making has become imperative for accomplishment. AI is helping companies increase speed this process by analyzing huge amounts of data to find patterns and figure out the best actions to take. This is altering how decisions are made in every industry.AI in decision-making represents a major development that goes beyond human capabilities. The role of AI in decision-making spans across industries like finance, healthcare, manufacturing, and marketing. It allows for faster, more competent analysis of vast data sets, leading to quicker and more informed decisions. This is particularly central in time-sensitive situations, such as medical emergencies, where rapid analysis can mean the difference between life and death. Additionally, AI can assist in identifying patterns and making predictions that might be overlooked by human decision-makers, potentially leading to better outcomes in areas like risk management, resource allocation, and policy development.

AI is no longer just a science fiction dream but is revolutionizing the way companies approach decision making thanks to its ability to analyze large volumes of data and generate actionable insights. In this article, we will look at how AI-driven data analytics can benefit businesses in their decision-making process.AI decision making serves as the future of aptitude in businesses. For some decades, the backbone of modern business has been data. It has helped businessmen and entrepreneurs form their decisions. Also, it allowed them to learn in-depth about their clients. However, with all the data comes a price; the human brain cannot process

it all. That is where artificial intelligence (AI) and its decision making in business intelligence come in.

OBJECTIVES OF STUDY

THE PRESENT STUDY AIMS WITH FOLLOWING OBJECTIVES

1. To view the various applications of AI in different sectors
2. To evaluate the challenges faced by the businesses people while using AI in decision making
3. To suggest various measures to overcome the challenges
4. To justify importance of human knowledge with AI

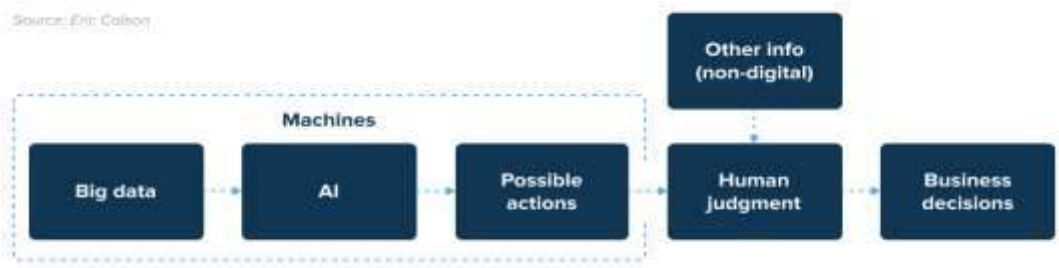
What is Artificial Intelligence?

Artificial Intelligence or AI represents to a machine's capability to imitate human learning and its cognitive functions. AI aims at prompt problem-solving and decision-making processes exclusive of human mistakes. In technical language, they refer those machines to as astute bots. With the advancements in technology and AI capabilities, the world of AI has broadened over the years. These days, AI can be practiced in three recognized levels of the AI scale

1. Assisted intelligence: It focused on automating fundamental tasks. For example, machines in the assembly lines.
2. Augmented intelligence: With increased intelligence comes balance. It is a two-manner process. The main objective is for machines to gain knowledge from human input. Humans in turn base for their decision accuracy on intelligent information.
3. Automation intelligence: Basically put, it includes machines automating the complete process, with humans out of the loop. For example, autonomous robots and self-driving cars.

What is AI decision making?

AI in business decision-making is of greatest significance when data processing is carried out completely or in part by an AI point. With no human in the role, this progression helps to measure data, making accurate predictions and precise decisions. AI can hold anomaly discovery data crunching, complex analysis, optimized decision making, and spotting trends. The ultimate decisions are then either completely mechanized or taken over by the human end.



Phases of AI Decision making

1. Decision support – With the assist of predictive, diagnostic, or descriptive analytics, humans can decide with exactness. The benefit lies in combining human intelligence with data-driven insights. Common sense and proficiency when combined may make the best out of AI in businesses.
2. Decision augmentation – This makes use of predictive or prescriptive analytics to recommend manifold decision alternatives. The synergy of AI capability and human knowledge which leads to rapid analysis of large data volumes, reducing difficulty.
3. Decision automation – Decision automation relies on prescriptive or predictive analytics. Humans benefit from its scalability, speed, and consistency in decision-making.
4.

The steps involved in AI Decision-Making Processes

AI is important in enhancing the decision-making process by augmenting various stages of the decision-making framework. Here's a breakdown of how AI aids in each step of the decision-making process:

1. **Identifying the problem:** AI algorithms help in identifying and defining problems more accurately by analyzing vast datasets to uncover underlying patterns, anomalies, or emerging trends that might not be readily apparent to humans. These insights assist in framing the decision and setting precise, measurable objectives.
2. **Gathering relevant information:** AI's capacity to process and analyze extensive data sources rapidly and accurately is important.
3. **Identifying alternatives:** AI systems can create and assess several potential solutions by simulating scenarios based on historical data and predictive analytics. By investigating historical data, market trends, and even external factors like social media sentiment, AI can suggest alternative strategies or solutions that might not be immediately obvious to human decision-makers.
4. **Evaluating alternatives:** AI aims in evaluating and comparing different options by providing data-driven insights. Machine learning models can measure the historical success of related strategies or decisions in various scenarios. They can recognize potential risks and predict the likely outcomes of each alternative, enabling more informed decision-making.
5. **Selecting the best alternatives:** While the last decision remains a human prerogative, AI systems can advise recommendations or predictions based on the analyzed data, helping decision-makers make more informed and evidence-based choices.
6. **Taking action:** AI aims in the implementation phase by providing strategic insights, facilitating the creation of detailed action plans, optimizing resource allocation, and assigning tasks for execution based on data-driven recommendations, thereby enhancing the efficacy of the decision-making process.
7. **Reviewing decisions:** AI supports the post-decision evaluation process by continuously monitoring the effect of decisions through real-time data analysis. They can follow key performance indicators and provide feedback on whether the decision yields the expected outcomes.

Unless, AI can suggest adjustments or even automatically adapt strategies in real time.

8. AI and human decision-making provide data-driven insights, attractive the quality and efficiency of the decision-making process across various business domains. Its ability to process, analyze, and derive insights from huge datasets considerably influences the accuracy and effectiveness of the decisions made.

Applications of AI in decision-making: Across various industries

AI can be useful in various domains and industries to support decision-making. Here are some examples:

Healthcare

AI extensively used for serious areas by leveraging data-driven insights to support various decisions. These include:

- **Healing development and personalization:** AI aims decision-making by analyzing patient data to advocate personalized treatment plans. It executes wide medical records and analytical data to propose most favorable therapies or interventions, supporting healthcare professionals in making well-informed decisions about enduring care.
- **Input distribution:** AI helps in formative the portion of resources, such as the number of hospital beds desirable in specific areas. By examining past data and predicting future trends, AI helps decision-makers in professionally distributing resources and ensuring adequate facilities for patient care.
- **Place and capability planning:** By analyzing demographic, geographic, and healthcare operation data, AI helps in determining most constructive locations for new healthcare facilities, helping in strategic planning and growth decisions.
- **Classification support and health imaging analysis:** AI assists healthcare professionals in building diagnostic decisions by analyzing health check imaging and diagnostic statistics, AI provides precise insights, aiding in early and definite diagnosis and influencing decisions on treatment approaches and protocols.

Finance

- **Market trend detection:** AI examines wide monetary datasets to identify and predict market trends. This empowers financial decision-makers to plan on investment decisions based on comprehensive insights consequent from market dynamics.
- **Possibility investigation and management:** AI systems analyses risk factors by processing composite monetary data. This examination aims decision-makers in investigative and administration risks more effectively, ensuring up to date decisions to safeguard portfolios and investments.
- **Optimizing investment approach:** Implementing AI in savings decision-making facilitates investors to make more well-versed investment strategies based on complete data study.
- **Portfolio organization:** AI helps in portfolio decision-making by assessing diverse data points to optimize range composition. Decision-makers can reward AI-driven insights to rebalance and fine-tune portfolios, ensuring better income and risk alleviation.

Customer relationship administration

AI considerably impacts decisive decision areas by providing actionable insights for more effective strategies:

- **Trade and examine optimization:** AI ensures decision-making by given that approaching into sales opening and service improvement. It helps in decisions about prioritizing leads, identifying up sell or cross-sell prospect and optimizing customer service interactions.
- **consumer knowledge improvement:** AI helps in decision-making by mapping and optimizing the customer expedition. It provides insights into touch points and pain points in the customer experience, guiding decisions to improve interactions and engagement at various stages.
- **Control and contact policy:** AI suggests to the most successful communication channels and timing. It helps in decision-making about the best channels and moments to engage customers, guiding strategies for more impactful and relevant communication.
- **response and outlook analysis:** It guides in decision-making by analyzing customer opinions, opinion, and sentiment to gauge satisfaction levels and make decisions for service improvements or product enhancements.

Supply Chain and Logistics

AI plays a essential role in supply chain and logistics decision-making, key areas by providing data-driven insights that guide efficient strategies and actions:

- **order forecasting:** AI uses machine learning to investigate historical and real-time data, aiming in projecting analytics for demand forecasting. It has empowered decision-makers to calculate approximately future demand patterns, allowing for informed decisions on production volumes, inventory levels, and resource allocation.
- **stock managing decisions:** AI algorithms study data to optimize inventory levels, ensuring stock availability while minimizing excess. Decision-makers can use these data to determine reorder points, manage stock levels, and make decisions regarding inventory turnover, ultimately reducing carrying costs and improving operational efficiency.
- **manufacture program decisions:** AI helps in decision-making about production schedules by analyzing data related to demand forecasts, machine performance, and supply accessibility. This suggests in optimizing production timelines, improving resource utilization, ensuring alignment with demand, reducing lead times and enhancing responsiveness to market fluctuations.
- **Storehouse procedure:** AI helps decision-making concerning warehouse process by analyzing data on outline optimization, order-picking strategies, and inventory storage space. It guides decisions to develop warehouse layout, streamline picking processes, and maximize space utilization, ultimately improving operational efficiency and reducing handling costs.

Cyber Security

In this field, considerably influences essential decision-making areas by providing proactive and reactive solutions to moderate security threats:

- **Risk detection and identification:** AI aims in the fast and accurate discovery of potential threats within network

activities by analyzing vast amounts of data. This maintain decision-making by rapidly identifying anomalies or doubtful patterns that could indicate cyber threats, allowing security professionals to take prompt action.

- **Real-time occurrence reaction:** AI systems use machine learning algorithms to react to security threats in real time. By automate the initial response, AI helps in decision-making by executing instantaneous, pre-defined actions or alerting security teams, reducing the time to address threats and mitigate potential damage.
- **Threat analysis and prioritization:** AI systems review and prioritize possible risks based on the severity and probability of threats. This support decision-makers in understanding the urgency and probable impact of various risks, guiding them in allocating resources and efforts to address the most critical security issues.

Marketing

In the marketing decision-making, AI considerably impacts critical areas by providing data-driven approaching that guides effective strategies and actions:

- **Segmentation supervisory:** AI help in segmenting and targeting specific market segments by analyzing different datasets. It helps marketers make well-versed decisions about which segments to target, tailoring strategies to deal with each group's needs and preferences better.
- **Content customization:** AI support decision-making by analyzing consumer behavior and preferences, enabling content customization for higher engagement. This data-driven advance guides decisions on content creation and personalization strategies to improve customer interaction.
- **Optimize Ad campaigns:** AI study and interprets large sets of data, empowering marketers to make informed decisions about budget allocation, ad creative, and the most effective advertising platforms. It help in making strategic decisions that maximize the impact of advertising campaigns
- **Social medium strategy decisions:** Marketers profit greatly from AI-driven decision-making process in business analytics. By tracking and analyzing social media metrics, they can make more learned decisions about content creation and distribution strategies. This data-driven come close to allows marketers to tailor their social media engagement effectively based on insights gained from business analytics.

Manufacturing

In the manufacturing sector, AI takes part in a transformative role in decision-making across several key areas, including:

- **Predictive continuance:** AI evaluates sensor data to predict machinery maintenance needs, enabling informed decisions on proactive continuance schedules. This aids decision-makers in planning resources and minimizing unanticipated downtimes, optimizing operational efficiency.
- **Resource allotment and optimization:** AI supports decision-makers by analyzing real-time production data and optimizing resource distribution. This data-driven approach assists in informed decisions about stock levels, machine usage, and workforce deployment for efficient production processes.
- **Process development strategies:** AI-driven analytics afford insights into process inefficiencies and bottlenecks. Decision-makers use this information to apply strategies for process improvement, enabling better-informed decisions about operational changes for improved efficiency.
- **Quality management:** AI systems evaluate data to monitor product quality, aiding in making decisions related to quality manage processes. Decision-makers leverage this information to apply improvements and maintain quality standards, ensuring product consistency and customer satisfaction

Sales

AI facilitates serious decision-making in sales by offering data-driven insights and support in various key areas, including:

- **Lead prioritization and achievement:** AI analyzes data to determine lead quality, providing sales teams with approaching into which leads are more likely to convert. This bears decision-making by helping sales professionals center on leads with higher conversion potential, optimizing their time and resources.
- **Sales forecasting and preparation:** AI employs historical and real-time data to predict sales trends and customer behavior. This data support decision-makers in setting realistic sales targets, allocating resources effectively, and devising policy that align with market dynamics, improving the accuracy of forecasts and planning.
- **Personalized buyer engagement:** AI considers customer data to suggest personalized sales approaches. By recommending tailored content, products, or communication strategies, AI helps decision-making in engaging with prospects more effectively, increasing the possibility of successful conversions.
- **Dynamic pricing and product suggestions:** AI affords recommendations on optimal pricing and suggests cross-selling or up selling opportunities based on customer behavior analysis. This supports sales teams in making decisions about pricing strategies and product recommendations that are more likely to resonate with customers.
- **Performance examination and strategy modification:** AI appraises sales team performance metrics, providing insights to decision-makers about areas for development. By identifying successful sales strategies and areas needing modification AI helps in making informed decisions to refine sales approaches and tactics.

Retail

AI is redefining the retail industry by personalizing knowledge, optimizing inventory, and driving sales through intelligent data analysis. These are

Inventory administration: AI investigates historical sales data and external factors like holidays to forecast future demand. By optimizing stock levels, retailers can reduce overstocking and stock outs, leading to reduced waste and increased customer satisfaction.

- **Personalized suggestions:** AI-powered suggestion engines analyze customer purchase history, browsing performance, and demographics to suggest relevant products. These personalized recommendations increase the likelihood of customers making purchases and improve their overall shopping experience.

- **Pricing optimization:** AI algorithms examine competitor pricing, market trends, and customer understanding to price changes. These allow retailers to dynamically adjust prices for individual products, maximizing profit margins without alienating buyers.

Human resources operations

AI transforms HR practices by automate tasks, improving worker engagement, and fostering a more data-driven approach to talent management. AI recovers HR operations in the following ways:

- **Talent achievement:** AI can repeatedly monitor resumes and classify candidates with the most relevant skills and experience. This mechanizes the original stages of the hiring process, saving time and resources while decrease bias in candidate selection.
- **Employee performance management:** AI inspects worker presentation data, including efficiency metrics and feedback, to identify areas for development. These facilitate managers to offer personalized coaching and development opportunities, fostering employee growth and appointment.
- **Compensation and settlement:** AI studies market trends, employee performance, and company supports to recommend competitive compensation packages and benefits. These make certain workers are fairly rewarded and pleased with their benefits, leading to higher maintenance rates.

Hospitality and Tourism

AI is improving the guest experience in the hospitality industry by personalizing recommendations, optimizing pricing approach, and streamlining customer service. AI use cases in the hospitality and tourism industry include:

- **Personalized guest knowledge:** AI investigates customer preferences, past experiences, and even social media movement to tailor recommendations for attractions, dining, and activities. This improves guest satisfaction by creating unique and memorable experiences that cater to individual needs and interests.
- **Active pricing:** AI algorithms study real-time demand for hotel rooms, competitor pricing, and seasonality to adjust room rates energetically. This optimization strategy maximizes revenue and fills tenancy gaps, particularly during fluctuating demand periods.
- **Customer service Mechanization:** AI-powered chat bots and virtual assistants can handle basic guest examination, provide information about facilities, and assist with booking and check-in procedures. This frees up human staff to handle more composite issues and improves the overall efficiency and speed of customer service.

The Importance of AI for Decision-Making

AI's role into decision-making processes is transforming industries by enabling more informed, well-organized, and valuable decisions. Its capability can quickly and accurately analyze vast amounts of data means it's ideally suited for decision-making in the 21st century.

1. Speed decision making

Nowadays, business moves fast and the ability to make quick decisions is critical. AI systems can enable data process and generate perception in real time, enabling organizations to respond quickly to changing market conditions and customer needs. Therefore AI can eradicate the time-consuming tasks of manual data gathering and interpretation.

2. Supercharge productivity

AI's ability to work 24/7, people can supercharge their productivity and free up time for deliberate thinking and decision-making. Certainly AI is no substitute for human judgment – it's a tool that increases our capabilities.

3. Improve accuracy

AI can provide more accurate awareness and predictions and this has improved accuracy enables organizations to make better-informed decisions, reducing the risk of errors and ensuring optimal outcomes. AI's ability to consider multiple variables concurrently and learn from past experiences further contributes to its most accuracy in decision-making processes.

4. Reduce risk

AI's crucial role in identifying and mitigating potential risks and threats are numerous. When analyzing vast amounts of historical data, AI algorithms can detect patterns and anomalies that indicate possible risks, such as fraudulent activities, market fluctuations, or supply chain disruptions. This early detection helps organizations to proactively moderate risks and avoid costly mistakes.

5. Increase efficiency

AI simplifies decision-making processes by remove hindrance and enhancing workflows. Mechanizing data collection, analysis, and reporting, AI facilitates decision-makers to access relevant information quickly and easily, eliminating the need for manual data gathering and allowing teams to focus on higher-value tasks.This can also identify inefficiencies in existing processes and suggest improvements, leading to increased productivity and operational effectiveness

6. Create consistency

AI ensures that decisions are made consistently across the board, removing the fluctuations that can outbreak human judgment. Whether approving loans, managing supply chains, or executing repetitive tasks, AI acts as a great equalizer, applying the same criteria and judgment every single time.

7. Develop infinite institutional memory

AI strongly analyzed past progress and failures, identifying design and best practices that can guide future decision-making. With its boundless capacity for recollection, AI ensures that collective experience is never lost. AI is always ready to furnish context and insights based on the company's history. Regarding AI's unlimited institutional remembrance, institutions can make smarter, more informed decisions that build upon past success while avoiding the pitfalls of yesteryear.

The future impact of AI in decision-making

The future crash of AI in decision-making is expected to be considerable and transformative across various sectors, building upon the current trends and capabilities of artificial intelligence. Here are some key points that explain the future impact of AI-driven decision-making:

Enhanced decision support: AI will continue to offer decision-makers with important insights and recommendations. As AI systems become more highly developed, they will offer deeper analysis and a more complete understanding of complex situations. Decision-makers will rely on AI to make well-informed choices.

Real-time decision-making: With the growing integration of AI in various uses real-time decision-making will become the norm. Industries like finance, cyber security, and autonomous transportation will increasingly depend on AI for split-second decisions that can impact outcomes and safety.

Increased automation: AI will mechanize routine and cyclical decision-making processes across various industries. This automation will free up human resources for more inventive and strategic tasks, eventually leading to greater efficiency and cost savings.

Personalization: AI will continue to process its ability to personalize recommendations and decisions for individuals. In e-commerce, marketing, and education, AI will tailor content and services to specific user preferences, growing user satisfaction and engagement.

Advanced predictive analytics: AI's predictive capabilities will develop, enabling organizations to look forward to future trends and challenges more accurately. This will be especially valuable in supply chain management, energy use optimization, and risk appraisal.

Ethical decision-making: As AI systems become more integrated into society, ethical decision-making will be a important focus. There will be an importance on developing AI-driven decision-making systems that align with human values and moral principles to ensure fairness and equity.

Cross-industry integration: AI will not be limited to specific sectors but will increasingly cross into different industries. For example, the healthcare industry can learn from autonomous transportation concerning patient safety protocols and financial services can leverage AI-driven customer service experiences.

Human-AI collaboration: The collaboration between humans and AI will become more faultless and instinctive. AI will support humans in complex problem-solving, presenting relevant data and potential solutions, allowing humans to make more informed decisions.

Environmental impact: AI considerably enhances environmental sustainability across various sectors. In energy, AI optimizes grid operations and energy efficiency, reducing consumption and emissions. In agriculture, it enables precision farming, optimizing resource use and crop yields. In manufacturing, AI streamlines processes to decrease waste and improve material effectiveness. These applications display AI's potential to make industries more environmentally responsible and sustainable

Regulatory frameworks: Governments and regulatory bodies will play a very important role in determining the future impact of AI. They will set up guidelines and regulations to ensure the responsible use of AI in decision-making, particularly in sectors where safety and ethical considerations are paramount. Increased automation, personalization, ethical considerations, and cross-industry integration will characterize the future impact of AI in decision-making. It will transform how organizations and individuals make decisions, making them more data-driven, efficient, and aligned with evolving ethical standards. As AI technology advances, its control on decision-making will grow, bringing about new possibilities and challenges.

Challenges

Some of the challenges faced during the processes of AI Application in practical are listed below:

Prejudice: AI algorithms can be trained by partial data, leading to biased or unfair outcomes. In validating the risk of bias by AI, businesses must promise that the data used to train AI algorithms is different and representative.

Black-box choice-making: AI algorithms can be hard to understand and read, making it challenging to know how decisions are made and identify potential issues.

Over dependence: There is a risk of over-dependence on AI algorithms, leading to satisfaction and reduced human oversight and decision.

Expenditure Implementing and maintaining AI can be luxurious and needs specialized expertise, which can be difficult for various businesses to obtain.

Instructing AI Artificial intelligent systems are taught using supervised, unsupervised, or strengthening learning modules. Direct learning is the most recognizable approach in which an AI algorithm is qualified on a labeled dataset. The algorithm of AI achieves a set of inputs and their consequent outputs, and the purpose is to learn a mapping from inputs to results that can be used for calculation or classification tasks. Unverified learning includes training an AI algorithm on an unlabeled dataset. The algorithm locates models and affiliations within the data without track or guidance. This proceed is frequently used for collecting, dimensionality reduction, and irregularity detection. Back up learning includes training an AI algorithm by providing rewards and punishments based on its actions. The purpose is to maximize the total reward over time. This system is used in game-playing, robotics, and independent decision-making applications.

Data and discretion Concerns

Organizations have data isolation and safety concerns when processing their information by an external party, such as a cloud service provider. The warnings related with having sensitive in sequence processed by a third party provider include unauthorized access to the data, data breaches, data theft, and data loss.

How to overcome these challenges?

To address the above mentioned challenges, businesses can implement some strategies, including

1. **Conduct outstanding diligence**: Before outsourcing data processing, organizations should conduct due diligence on the cloud check provider to promise that the provider has appropriate safety measures to look after the data. This includes examining the provider's protection strategy and process and their track record of handling sensitive data.
2. **Execute encryption**: Encrypting insightful data before it is convey to the cloud service provider can help to stop not permitted access to the data. Encryption adapts sensitive data into a coded format that can only be decrypted with the proper key. Make certain that there is

encryption for data at break. This is important in case the providers' network has been violated. This will make it harder for an attacker to use proprietary in sequence stored beyond our network.

3. **Use protected communication protocols**: Business Organizations should use secure contact protocols, like SSL or TLS, to transmit data to the cloud service supplier. This protocol guarantees that the data is transmitted securely and protected from unauthorized contact and tampering.
4. **Discuss contract terms**: Business Organizations should confer contract terms with the cloud service provider to ensure that the provider is dedicated to protecting the data and that the provider will be held accountable in the event of a data break. And also, some companies have cyber insurance strategy that could also help reduce the risk.
5. **Scrutinize and inspection** Organizations should regularly scrutinize and review their cloud service providers to make certain that they adhere to the agreed-upon security measures and promptly detect and respond to any safety incidents.

CONCLUSION

On the whole, while using AI in decision-making can bring many benefits to businesses, it is necessary to think the possible drawbacks and tackle ethical and bias concerns. Training AI systems and implementing omission and decision-making processes are serious to make certain they are reliable and operate morally. Business should recognize a multi-faceted lapse approach that includes simplicity, human-in-the-loop, partiality mitigation, and narrow compliance. To defend intellectual property and company data, they should take out due diligence, apply encryption, use protected communication protocols, discuss contract terms, and frequently monitor and inspection cloud service providers. Lastly, they should consider the proposal of in-house and outside development and operations of their businesses' decision-making systems.

The above all these points explain that AI can sometimes fully automate and restore human decision-making, particularly for lower-stakes alternatives. Amazon's proposal algorithm runs autonomously, though customers still get the final say on whether to buy. Though, for many significant decisions, AI at current serves more to augment and support human decision-makers rather than completely replace them. That's because AI still lacks the real intellect, exciting responsiveness, and deep relative recognizing that significant choices often demand. High-impact judgments may be better left to humans. Conclusions involving responsible AI adoption, ethics, social norms, and human values are especially challenging to code into AI systems. Whereas AI can help with moral choices, people must make the final call and be held accountable. Across several realms, a fair mixture of AI capabilities and human decision will expect give way the best decision-making processes.

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AI FOR ISLAMIC FINANCIAL EDUCATION AND CAREER GUIDANCE IN SOUTHEAST ASIA

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ABSTRACT **DOI No: 10.36713/epra25179** **Article DOI: https://doi.org/10.36713/epra25179**

This study explores how Artificial Intelligence (AI) can be effectively integrated into Islamic financial education and career guidance for youth in Southeast Asia. Adopting a mixed-method design, the research combines literature analysis with a survey of 369 university students in Vietnam, mostly non-Muslims, to assess perceptions, expectations, and readiness for AI-enhanced learning. Despite limited prior exposure to Halal finance, over 70% of participants positively evaluated AI's potential to support financial literacy and vocational development.

Key findings reveal four foundational components for an integrated AI framework: (1) personalized learning pathways; (2) a Shariah compliance layer to ensure ethical and lawful content; (3) AI-driven career counseling based on learner profiles; and (4) ethical feedback mechanisms involving educators and religious advisors.

The results confirm AI's potential to democratize access to Shariah-compliant financial knowledge while fostering culturally sensitive career competencies. A conceptual model is proposed to guide the development of inclusive AI platforms that serve both Muslim and non-Muslim youth in diverse societies.

The paper concludes with actionable policy recommendations for educational institutions, Islamic fintech developers, and regional policymakers to co-develop culturally adaptable, ethically sound AI solutions that align with Islamic finance principles and promote youth empowerment.

KEYWORDS: ***Artificial Intelligence; Islamic Finance; Career Competency; Halal Financial Education; Shariah Compliance; Youth Empowerment; Southeast Asia.***

I. INTRODUCTION

In the context of accelerating digital transformation and the increasing emphasis on inclusive financial systems, financial education has become a strategic priority in many Southeast Asian countries (ASEAN Secretariat, 2021; OECD, 2023). For Muslim communities, which constitute a significant proportion of the region's population, the promotion of financial literacy entails not only economic competencies but also adherence to religious principles and ethical standards derived from Shariah law (Al-Sharif & Haron, 2023).

Recent studies have identified a critical gap in Halal financial literacy among Muslim youth, which contributes to unsustainable financial behavior and impedes their integration into the modern labor market (Lusardi & Mitchell, 2014; Wijaya, Hati, & Ekaputra, 2024). Furthermore, this demographic often lacks access to culturally sensitive, digitally enabled career guidance systems. A study conducted in Malaysia reported that graduates from Halal-related academic programs face considerable employment challenges due to insufficient digital skills, limited early-stage vocational counseling, and a poor understanding of labor market expectations (Saufi, Kasuma, & Mokhtar, 2020; Ibrahim et al., 2024).

Artificial Intelligence, a foundational component of modern financial technology (Fintech), is increasingly being applied across sectors such as education, personal development, and financial management. AI technologies enable the creation of adaptive learning systems, intelligent financial assistants, and personalized career recommendation tools based on learner profiles (Kucuk & Gök, 2022). In the context of Islamic Fintech, AI also facilitates personalization, creditworthiness evaluation, and Shariah-compliant decision-making (Al-Sharif & Haron, 2023; Iqbal et al., 2025).

However, existing platforms are predominantly developed within Western frameworks and often fail to incorporate Shariah compliance, ethical algorithmic governance, transparency, and cultural contextualization (Ali, Kassim, & Zainuddin, 2023; Hasan & Kassim, 2021). In response to these challenges, there is an urgent need to design AI-powered platforms that integrate Halal financial education

with culturally aligned career development services tailored to Muslim youth. Such an approach is not only a technological solution to the digitalization of education but also a strategic initiative that fosters inclusive, sustainable, and value-oriented development across culturally diverse societies in the region.

Although the majority of respondents in this study are Vietnamese students, Vietnam serves as a representative case of Southeast Asian youth who are increasingly exposed to financial technologies, global media, and diversified ethical frameworks. Therefore, the findings are not only context-specific but also regionally indicative of trends and perceptions regarding AI adoption in Islamic financial education.

II. LITERATURE REVIEW

2.1. Artificial Intelligence in Fintech and Islamic Financial Services

The integration of AI into financial technology (Fintech) is driving comprehensive digital transformation across the global financial sector. Within Islamic finance systems, AI offers opportunities to improve operational efficiency, enhance user experience, and facilitate compliance with Shariah principles—an essential component for ensuring the legitimacy and ethical integrity of Islamic financial transactions (Ali, Kassim, & Zainuddin, 2023; Hasan & Kassim, 2021).

The integration of artificial intelligence in Islamic finance has opened new pathways for optimizing financial risk management and ensuring compliance with Shariah principles. As discussed in recent works, AI tools can assist Islamic financial institutions in evaluating credit risks, predicting defaults, and automating compliance processes (Sarea, Elsayed, & Bin-Nashwan, 2022).

Recent studies have demonstrated that AI can be applied to customer data analysis, fraud detection, and the automation of compliance processes for Halal financial products (Kucuk & Gök, 2022). AI applications have also shown promise in enhancing financial inclusion and ethical alignment through algorithmic governance (Al-Sharif & Haron, 2023). Nevertheless, the deployment of AI in this domain still faces several challenges, particularly concerning algorithmic ethics, transparency in decision-making processes, and alignment with religious belief systems (Iqbal et al., 2025).

2.2. Islamic Financial Education in the Digital Age

In Southeast Asia, where countries such as Indonesia, Malaysia, Brunei, and southern regions of Thailand have large Muslim populations, promoting Islamic financial literacy has become a priority within broader financial inclusion strategies. However, survey data indicate that a significant proportion of Muslim youth lack the knowledge needed to distinguish between conventional financial products and those that are Shariah-compliant. This gap often results in inefficient financial behaviors or unintentional violations of Shariah principles (Roemanasari, Sabela, & Rusgianto, 2022).

A recent study by Wijaya, Hati, and Ekaputra (2024) in Indonesia also found a positive correlation between Islamic financial literacy and both sound financial management practices and improved personal economic well-being. Guellil & Bouri (2024) further demonstrated the effectiveness of AI-based chatbots in promoting Islamic financial awareness among Indonesian youth. Despite this, most existing financial education programs remain undigitized, lack personalization, and have not yet leveraged technology to deliver targeted and accessible learning experiences. This shortcoming is especially evident among Muslim youth living in rural areas or in communities with limited access to advisory services.

Given this context, integrating AI into Shariah-compliant financial education through the use of tools including Halal finance chatbots, interest-free investment recommendation systems, and interactive learning platforms may significantly strengthen the financial capability of Muslim youth (Iqbal et al., 2025).

2.3. Developing Career Competency within Muslim Communities

In addition to financial education, career competency plays a critical role in enabling youth to successfully participate in the labor market. In several Southeast Asian countries, graduates from academic programs related to Halal industries often face challenges in securing appropriate employment. These difficulties are frequently attributed to a lack of digital skills, limited critical thinking abilities, and the absence of clear career guidance strategies (Ibrahim et al., 2024).

Integrating AI into career counseling represents a promising solution for the future. AI-powered systems can assess individual competencies, recommend suitable career paths based on personal profiles, and account for cultural contexts. However, the application of AI in career guidance for Muslim youth must ensure a strong emphasis on humanistic and ethical values (Iqbal et al., 2025). These systems should avoid recommending professions that conflict with Shariah principles, must respect gender-specific considerations, and should align with the social and cultural norms of each community.

2.4. Research Gap and Direction

Although there has been increasing interest in the application of AI within Islamic finance, most existing research has primarily concentrated on its use in banking and investment services (Hasan & Kassim, 2021). Studies that explore AI's potential in educational settings, particularly in Islamic financial literacy and career guidance, remain scarce and underdeveloped.

Moreover, current models of Islamic financial education are largely disconnected from digital transformation trends. Many programs lack the technological infrastructure needed to deliver personalized learning experiences, and they often fail to accommodate the diverse educational needs of Muslim youth across different cultural and socioeconomic contexts. As a result, learners frequently encounter difficulty in accessing effective and culturally relevant financial education.

In addition to these limitations, there is currently no comprehensive framework that brings together AI technologies, Islamic financial education, and career competency development in a way that reflects Islamic ethical values (Ali, Kassim, & Zainuddin, 2023). The lack of such an integrated approach represents a critical gap in both research and practice.

To address these challenges, this study proposes the development of an AI-based educational system that supports both Islamic financial literacy and vocational decision-making. The proposed framework is designed specifically for Muslim youth in Southeast Asia and aims to contribute to the broader goal of inclusive, ethical, and sustainable Fintech innovation in the digital era.

2.5. Vietnam's Digital Readiness for Ethical and Adaptable Fintech

Although the proposed AI-integrated model is primarily designed for Muslim-majority contexts in Southeast Asia, the case of Vietnam offers a valuable reference point for assessing the technological foundations required to implement such systems. While Vietnam does not have a formal Islamic finance infrastructure, its progress in digital transformation, particularly in education and financial services, illustrates the country's readiness to adopt culturally adaptable Fintech solutions (EY, 2024).

In the education sector, digital transformation has been actively promoted through a combination of technological innovation and national policy initiatives. One notable example is the VioEdu platform developed by FPT Digital, which utilizes AI to deliver personalized learning experiences and assess student performance. In parallel, pedagogical models such as TPACK and SAMR have been introduced through teacher training programs conducted by institutions including FPT and RMIT. These programs, which have involved more than 2,000 educators, have significantly advanced the integration of AI into formal education settings (FPT & RMIT, 2024).

In the financial sector, a report by Ernst & Young (EY, 2024) highlights the contributions of Vietnamese Fintech companies such as MoMo, MBS, and Cake in promoting digital financial literacy. These platforms are recognized for offering user-friendly interfaces and personalized financial services that reach a broad range of users. While Islamic financial education is not formally established in Vietnam, the country's Fintech ecosystem demonstrates both technological capacity and flexibility. These characteristics suggest a favorable environment for adapting and extending Fintech solutions that align with ethical and religious frameworks, including those based on Shariah principles.

3. METHODOLOGY

3.1. Research Design

This study adopts a mixed-methods approach, combining conceptual analysis with empirical investigation to explore the role of AI in Islamic financial education and the development of career competencies among Southeast Asian youth. The combination of quantitative and qualitative methods enables a comprehensive understanding of both learner perceptions and the contextual frameworks that influence implementation.

3.2. Quantitative Survey

The quantitative component involved an online survey distributed to 369 university students in Vietnam and Malaysia. The sample includes students from diverse academic disciplines and represents a demographic of youth with varying levels of exposure to modern financial education. The distribution of academic majors was as follows: Economics (24.4%), Information Technology (19.0%), Languages (17.6%), Business Administration (16.3%), Social Sciences (13.6%), and other disciplines (9.2%).

Table 1. Distribution of Survey Participants by Field of Study

Field of Study		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Economics	90	24.4	24.4	24.4
	Information Technology	70	19.0	19.0	43.4
	Languages	65	17.5	17.5	61.0
	Business Administration	60	16.3	16.3	77.2
	Social Sciences	50	13.6	13.6	90.8
	Other disciplines	34	9.2	9.2	100.0
	Total	369	100.0	100.0	

The questionnaire consisted of three sections: (i) perceptions of AI and its applications in education, (ii) current usage and expectations of AI in financial education and career guidance, and (iii) self-assessment of financial literacy and career orientation. Descriptive statistics were used to assess the overall engagement and responses, while correlation analysis was conducted to examine the relationships between AI use and the development of financial and career-related competencies.

3.3. Content Analysis

In addition to the survey, the study employed qualitative content analysis of academic literature, policy documents, and existing AI-driven models in Islamic financial education. The analysis focused on four critical dimensions: compliance with Shariah principles, personalization of learning, algorithmic ethics, and practical applicability in youth education systems within Islamic cultural contexts.

3.4. Model Integration and Development

Drawing on both the survey findings and qualitative analysis, the study proposes an integrated conceptual framework. This model combines AI-enabled financial learning with Shariah compliance and culturally sensitive career guidance. It is specifically designed to suit the Southeast Asian context and aims to inform future educational policies and training initiatives in countries with significant Muslim populations.

3.5. Reliability Analysis of the Scale

To assess the internal consistency of the scale measuring students' perceptions of AI in financial education, Cronbach's Alpha was calculated. Table X presents the item-total statistics for eight observed items (Q1–Q8).

Table 2. Item-Total Statistics for the AI Perception Scale

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Q1	25.1195	4.701	0.431	0.262	0.655
Q2	25.1865	4.850	0.414	0.314	0.660
Q3	25.2014	4.619	0.521	0.378	0.638
Q4	25.1303	4.834	0.396	0.255	0.663
Q5	25.1459	4.849	0.254	0.136	0.695
Q6	25.0978	4.554	0.425	0.214	0.654
Q7	25.0531	4.324	0.447	0.275	0.648
Q8	25.0657	4.605	0.276	0.166	0.697

As shown in Table 2, all items exhibited corrected item-total correlations above .29, indicating acceptable item convergence (Nunnally & Bernstein, 1994). Most items achieved correlations well above .40, which suggests moderate to strong relationships between individual items and the total scale.

The overall Cronbach's Alpha of the scale was .72, indicating satisfactory internal consistency for exploratory research. Two items, Q5 and Q8, showed relatively lower item-total correlations (.300 and .299) and the highest Cronbach's Alpha if deleted (.730 and .735), respectively. However, the increase in reliability from removing these items was marginal and did not outweigh the theoretical value they contribute. Therefore, all items were retained in the final analysis.

These findings support the internal reliability of the scale and its suitability for subsequent factor analysis.

4. FINDINGS AND DISCUSSION

The study collected data from 369 university students in Vietnam, representing diverse academic disciplines. Although the majority of respondents were non-Muslims, nearly half reported previous exposure to Islamic finance concepts through coursework or media. A significant proportion (81.3%) had interacted with AI-powered educational or financial tools, and more than 70% expressed positive attitudes toward AI's role in learning and vocational decision-making. However, only 18.4% were able to differentiate Shariah-compliant financial products from conventional ones, revealing a gap in Halal financial literacy.

The following subsections present detailed findings on participants' perceptions of AI in Islamic financial education (Section 4.2), its impact on career competency (Section 4.3), differences across academic majors (Section 4.4), and a proposed conceptual model (Section 4.5) informed by both empirical data and theoretical considerations.

4.1. General Profile of Survey Participants

The following section presents the general characteristics of the survey participants, including gender and field of study. These background variables are then used to analyze differences in AI perception and financial literacy across subgroups.

The survey was conducted with 369 university students in Vietnam, primarily enrolled in the fields of Economics (24.4%), Information Technology (19.0%), Languages (17.6%), Business Administration and Marketing (16.3%), Social Sciences (13.6%), and Other disciplines (9.2%). Among the participants, 87.3% were female and 12.7% were male. The average age was 20.6 years.

Table 3. Cross-Tabulation of Survey Participants by Gender and Field of Study

			Gender		
			Male	Female	Total
Field of Study	Economics	Count	9	81	90
		% within Gender	19.1%	25.2%	24.4%
	Information Technology	Count	7	63	70
		% within Gender	14.9%	19.6%	19.0%
	Languages	Count	4	61	65
		% within Gender	8.5%	18.9%	17.6%
	Business Administration	Count	13	47	60
		% within Gender	27.7%	14.6%	16.3%
	Social Sciences	Count	10	40	50
		% within Gender	21.3%	12.4%	13.6%
	Other disciplines	Count	4	30	34
		% within Gender	8.5%	9.3%	9.2%
Total		Count	47	322	369
		% within Gender	100.0%	100.0%	100.0%

Although the majority of students were not Muslim, 47% reported having been exposed to Islamic finance, primarily through coursework, international materials, or media sources. This reflects a trend toward global integration and a growing interest among youth in ethical financial models, including Islamic finance.

4.2. Perceptions and Expectations of AI in Islamic Financial Education

Most students expressed a positive view of AI's potential in financial education. Specifically, 74.5% believed that AI facilitates more flexible access to information, while 69.1% agreed that AI enhances their ability to understand and make personal financial decisions. However, when placed within the context of Islamic finance, levels of understanding declined significantly. Only 22.7% of respondents were able to envision how AI could incorporate Shariah principles such as the avoidance of riba (interest) and gharar (excessive uncertainty).

From a technological perspective, 81.3% of students reported prior use of AI-integrated platforms, including educational chatbots, career advisory systems, and personal finance management applications. In addition, 73.5% evaluated the role of AI positively in terms of supporting learning and skill development. Nonetheless, only 18.4% could differentiate between conventional financial products and those compliant with Shariah, indicating a substantial knowledge gap that needs to be addressed.

When presented with information about Halal finance, 62.3% expressed support for AI-based personalization systems, as long as religious and ethical standards are incorporated. This reinforces the assumption that if

developed properly, AI systems can be widely accepted even outside the Muslim community.

Exploratory Factor Analysis: Sampling Adequacy and Data Suitability: To assess the suitability of the dataset for factor analysis, the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's Test of Sphericity were conducted. The results are presented in Table 3.

Table 4. KMO and Bartlett's Test of Sphericity

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.840
Bartlett's Test of Sphericity	Approx. Chi-Square	7533.735
	df	435
	Sig.	0.000

The KMO value of 0.840 exceeds the commonly accepted threshold of 0.80, indicating meritorious sampling adequacy for factor analysis (Kaiser, 1974). Furthermore, Bartlett's Test of Sphericity was statistically significant (χ^2 = 7533.735, df = 435, p < .001), confirming that the correlation matrix is not an identity matrix and thus suitable for structure detection.

4.3. AI and career development

The quantitative analysis using Cronbach's Alpha (Table 2) and Exploratory Factor Analysis (EFA) confirmed high internal consistency of the measurement scales, with Cronbach's Alpha coefficients ranging from 0.78 to 0.88. The Kaiser-Meyer-Olkin (KMO) value of 0.90 and a total variance explained of 68.2% indicated that the dataset was appropriate for factor analysis and yielded a stable factor structure. The final model retained eight distinct factors, which align with the theoretical framework. These include: Q1 (Perceived Usefulness), Q2 (Perceived Ease of Use), Q3 (Behavioral Intention to Use AI Tools), Q4 (Perception of Shariah Compliance in AI Applications), Q5 (Perceived Risks of AI in Financial Education), Q6 (Self-Reported Financial Literacy), Q7 (Career Competency), Q8 (Level of Exposure to AI Tools in Learning and Career Guidance).

Exploratory Factor Analysis using Promax rotation extracted eight distinct components from the dataset, with clear and strong item loadings above 0.70. Items Q5.1 to Q5.4 loaded strongly on the first component, representing the Financial Literacy construct. Items Q1.1 to Q1.4 formed the second factor, reflecting students' perceptions of Perceived Usefulness of AI in financial education. The third factor, associated with Perceived Ease of Use, included items Q2.1 to Q2.4. Four items under Q4 (Q4.1 to Q4.4) grouped under the fourth component, capturing Shariah-compliant perception.

Table 5. Pattern Matrix from Exploratory Factor Analysis (Promax Rotation)

Pattern Matrix[a]

	Component							
	1	2	3	4	5	6	7	8
Q5.3	.924							
Q5.4	.863							
Q5.2	.849							
Q5.1	.757							
Q1.4		.880						
Q1.3		.844						
Q1.2		.835						
Q1.1		.753						
Q2.4			.922					
Q2.2			.795					
Q2.1			.776					
Q2.3			.758					
Q4.4				.858				
Q4.2				.851				
Q4.3				.787				
Q4.1				.754				
Q3.2					.864			
Q3.4					.806			
Q3.3					.779			
Q3.1					.770			
Q6.3						.860		
Q6.1						.803		
Q6.2						.795		
Q6.4						.723		
Q7.3							.947	
Q7.2							.939	
Q7.1							.928	
Q8.1								.968
Q8.3								.965
Q8.2								.811

Extraction Method: Principal Component Analysis.
Rotation Method: Promax with Kaiser Normalization.
a. Rotation converged in 6 iterations.

Items Q3.1 to Q3.4 loaded on the fifth component, representing Career Competency, while the sixth component was composed of items Q6.1 to Q6.4 related to Perceived Risk of AI integration. The seventh factor, corresponding to Behavioral Intention, was defined by Q7.1 to Q7.3 with exceptionally high loadings (above 0.92). Finally, Q8.1 to Q8.3 loaded exclusively on the eighth component, reflecting students' exposure to AI-based learning and career tools. The absence of significant cross-loadings and high factor loadings confirmed the construct validity and internal consistency of the measurement model.

Survey results indicate that 77.5% of students agreed that Artificial Intelligence can directly support career orientation by analyzing individual competencies, preferences, and labor market trends. Additionally, 74.1% believed that AI facilitates the development of more personalized academic and career pathways. Among those who had experience using intelligent learning systems, 65.8% appreciated the automated feedback and skill recommendation features.

From a theoretical perspective, these findings reinforce Super's (1990) concept of "career self-concept," suggesting that AI-based platforms may enhance self-awareness through personalized data interactions. However, 39.2% of students expressed concern that over-standardization in AI-driven recommendations could diminish individual creativity and personal agency if the underlying algorithms lack flexibility.

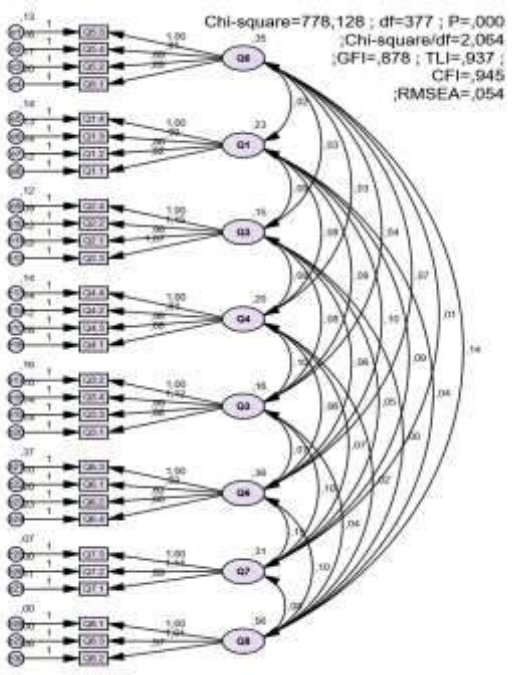

Figure 1. Structural Model of AI-Integrated Financial Education and Career Competency in Southeast Asian Youth

The Structural Equation Model (SEM) confirms the interrelationships among eight latent constructs identified from the exploratory factor analysis, including perceived usefulness (Q1), perceived ease of use (Q3), Shariah-compliance perception (Q4), career competency (Q5), perceived risk (Q6), behavioral intention (Q7), and AI exposure (Q8). The model demonstrates good fit indices (χ^2 = 778.128; df = 377; χ^2/df = 2.064; GFI = .878; TLI = .937; CFI = .945; RMSEA = .054), suggesting satisfactory structural validity.

4.4. Demographic Differences in Perceptions and Usage of AI

To examine the differences in perceptions and behaviors related to artificial intelligence (AI), Islamic finance, and career orientation among student groups of different majors, the study conducted a one-way analysis of variance (ANOVA) on eight groups of survey variables (Q1–Q8).

The ANOVA results showed that there was no statistically significant difference ($p > 0.05$) between student groups by major for any of the survey variables (Q1 to Q8). This suggests that the level of awareness, expectation, financial capacity and attitude towards AI are relatively equal across majors such as Economics, IT, Languages, Social Sciences and Management.

In particular, even variables related to understanding of Islamic finance (Q4) or behavioral intention to use AI (Q7) did not differ between groups, reflecting a general trend in students' evaluation of technology and finance regardless of their major.

While the current sample is based in Vietnam, the similarities in technological exposure, financial education challenges, and youth career development across Southeast Asia, especially among Muslim-minority populations, allow for cautious extrapolation of the findings.

Table 6. Analysis of Variance for AI and Financial Education Indicators

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Q1	Between Groups	1.169	5	.234	1.000	.418
	Within Groups	84.886	363	.234		
	Total	86.055	368			
Q2	Between Groups	.678	5	.136	.704	.620
	Within Groups	69.850	363	.192		
	Total	70.528	368			
Q3	Between Groups	.273	5	.055	.263	.933
	Within Groups	75.353	363	.208		
	Total	75.626	368			
Q4	Between Groups	.138	5	.028	.131	.985
	Within Groups	76.882	363	.212		
	Total	77.021	368			
Q5	Between Groups	.505	5	.101	.295	.915
	Within Groups	124.080	363	.342		
	Total	124.585	368			
Q6	Between Groups	.889	5	.178	.594	.704
	Within Groups	108.600	363	.299		
	Total	109.489	368			
Q7	Between Groups	.961	5	.192	.508	.771
	Within Groups	137.472	363	.379		
	Total	138.434	368			
Q8	Between Groups	.831	5	.166	.371	.869
	Within Groups	162.826	363	.449		
	Total	163.657	368			

As such, the integrated model proposed in this paper may serve as a foundational framework for further empirical validation in other Southeast Asian contexts like Indonesia, Malaysia, and Thailand.

4.5. Synthesis and Implications of the Integrated Model

Findings from both qualitative and quantitative analyses suggest that AI holds significant potential as a supportive tool for financial education and career development—particularly when aligned with religious values. However, three major challenges persist: (1) a lack of understanding regarding Halal finance among youth; (2) the absence of a comprehensive AI model that integrates religious principles with vocational guidance; and (3) limited personalization according to learners' sociocultural contexts.

Based on these insights, the study proposes an integrated AI framework for Islamic financial education and career guidance, consisting of four interconnected layers:

- Personalized Learning Layer: Adapts educational content and methods according to learners' backgrounds, behaviors, and needs**;**
- Shariah Compliance Layer: Ensures alignment with Islamic ethical and legal principles in all AI-generated financial content and recommendations;
- Career Guidance Module: Utilizes AI to offer tailored recommendations on skills development, learning paths, and career options based on individual profiles;
- Ethical Feedback Layer: Embeds inputs from educators, religious advisors, and community

representatives to ensure transparency, accountability, and human-centered AI design.

-

The proposed model is not only technically viable but also ethically sensitive. It reflects the increasing demand among Southeast Asian youth for intelligent educational tools that align with both personal aspirations and religious–cultural values, thereby contributing to inclusive and sustainable human development in the digital era.

5. CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

This study highlights the emerging potential of AI in enhancing Islamic financial literacy and career development among Southeast Asian youth. Drawing on a survey of 369 Vietnamese university students and a review of international literature, the findings demonstrate that AI is widely perceived as an effective tool for personalizing learning, improving financial decision-making, and providing career guidance.

However, the research also identifies several critical challenges: limited understanding of Halal financial principles, lack of culturally adaptive career systems, and the need for AI models to uphold ethical and religious standards. These challenges are particularly important in Muslim communities where educational content and vocational pathways are expected to align with Shariah principles and cultural values.

In response, the study proposes an integrated model that includes four key components: (1) personalized learning, (2) Shariah-compliant content delivery, (3) AI-powered career counseling, and (4) ethical feedback mechanisms. This model not only addresses technical needs but also promotes sustainable, inclusive, and value-based development in financial education and youth empowerment.

Given the shared regional characteristics in digital transformation and youth financial literacy levels, the study's implications can inform educational policymakers and fintech developers across Southeast Asia. Further comparative studies across ASEAN member states are recommended to validate the adaptability and scalability of the proposed AI-integrated framework for Islamic financial education.

5.2. Policy Recommendations

Based on the findings, the study offers the following policy recommendations to guide stakeholders across education, technology, and religious institutions:

- Develop Islamic-aligned financial education systems. Educational institutions should implement AI-supported modules on Halal finance, enabling students to access faith-compliant financial knowledge and automated decision-making tools rooted in Shariah guidelines.

-

Foster collaboration between AI developers and Shariah scholars. Effective cooperation between technical experts and religious authorities is essential to ensure that AI tools are not only technologically robust but also ethically and religiously sound, thereby increasing trust and adoption among users.

- Advance culturally responsive digital career guidance. Career-counseling platforms should be designed with sensitivity to ethical and religious values, particularly for Muslim youth. This involves incorporating diverse user needs, respecting gender norms, and reflecting Islamic perspectives on professional integrity.

- Encourage the development of open and locally adaptable AI platforms. Governments and technology providers in Southeast Asia should promote modular AI platforms that can be customized to local educational systems, digital infrastructures, and religious–cultural contexts, facilitating broader adoption and impact.

- Undertake cross-country validation studies within ASEAN. Comparative research across multiple Southeast Asian nations is needed to assess the adaptability, scalability, and cultural fit of the proposed AI-integrated framework, thereby ensuring region-wide relevance and effectiveness.

In conclusion, aligning technological innovation with Islamic ethical principles and regional cultural diversity is key to empowering Southeast Asian youth with inclusive financial literacy and sustainable career competencies in the digital era.

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FROM INTENTION TO USE: EXPLAINING AI TOOL ADOPTION AND USAGE AMONG DESIGNERS

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ABSTRACT

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This study investigates the determinants of artificial intelligence (AI) tool adoption among professional designers using the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) as the guiding theoretical framework. As AI increasingly reshapes creative industries, understanding the factors that drive designers' intention to adopt and actual use of AI tools has become both theoretically and managerially relevant. Data were collected through a cross-sectional survey administered to 170 professional designers, including graphic, UI/UX, and product designers. The proposed research model was tested using Partial Least Squares Structural Equation Modeling (PLS-SEM). The results show that performance expectancy, effort expectancy, social influence, hedonic motivation, and price value have significant positive effects on designers' behavioral intention to adopt AI tools. In contrast, facilitating conditions do not significantly influence behavioral intention but exert a strong positive effect on actual use behavior. Habit and behavioral intention also significantly predict use behavior, with habit emerging as the strongest determinant of sustained usage. The model explains a substantial proportion of variance in both behavioral intention and use behavior, confirming the strong predictive power of the UTAUT2 model in a creative professional context. This study contributes to the growing literature on AI adoption by extending UTAUT2 to the design industry and highlighting the joint role of utilitarian, hedonic, and habitual factors. Managerially, the findings provide actionable insights for AI tool developers and design organizations seeking to foster effective and sustained AI adoption.

KEYWORDS: *Artificial Intelligence, UTAUT2, Technology Adoption, Designers, Use Behavior*

1. INTRODUCTION

The rise of artificial intelligence (AI) tools in creative industries signals a notable transformation within these sectors, particularly among designers and marketing professionals. This change has been driven by a need for greater efficiency in design processes, a shift in value creation paradigms, and an enhanced focus on optimizing customer experience. As the landscape continues to evolve, the integration of AI technologies stands to redefine the dynamics of creative industries. From value creation perspectives, AI technologies have shifted traditional paradigms where value was primarily embedded within products or services. Instead, there is increasing recognition that value co-creation involves active consumer participation at various stages of engagement with brands. Santos and Gonçalves (2021) describe how consumer interactions with AI tools at different stages of their journey can fundamentally alter how companies approach design and service delivery. AI-driven analytics can help designers and marketers identify and predict customer needs more accurately, enabling a more tailored approach to value propositions that resonate with consumers (Chintalapati & Pandey, 2021). This shift signifies a movement away from one-dimensional product offerings toward more complex, interactive experiences that consider consumer insights as integral components of the creation process.

Moreover, the introduction of AI has significantly transformed customer experience (CX) management, particularly concerning personalization and responsiveness. Liu–Thompkins et al. (2022) highlight that AI applications, such as chatbots, not only automate routine tasks but can also foster deeper engagement through personalized responses, thus enhancing consumer satisfaction and loyalty. This evolving capability allows designers to create more engaging and relevant interfaces that cater to user preferences, leading to a more satisfying overall experience (Hollebeek et al., 2019). As AI learns from customer interactions, it feeds insights back into design processes, creating a feedback loop that continuously improves the products and services offered (Keegan et al., 2022). Increased productivity among designers is another critical aspect of the rising influence of AI tools in creative industries. AI has streamlined many repetitive tasks associated

with design, allowing designers to focus on more strategic and creative aspects of their work. This aligns with the findings of Barnes and Ruyter (2022), who discuss how AI is not just about task automation but also about enriching core marketing functions. Similarly, Rizomyliotis et al., (2022) underscore the role of AI in enhancing operational efficiency within businesses, particularly small and medium-sized enterprises (SMEs) implementing AI-centric solutions. The automation capabilities of AI lead to reduced costs and improved output levels, ultimately fostering a culture of innovation and faster project turnaround times (Akter et al., 2021).

The research gap concerning the adoption behavior of AI tools among designers is substantial and multifaceted, specifically in the context of the creative industries. Despite the rising significance and integration of AI technologies in marketing and design, there remains a limited empirical understanding of how designers embrace and utilize these tools in their work processes. This gap affects the broader comprehension of not just technology adoption but also its implications for creativity, efficiency, and the evolution of design practices.

Firstly, while there is a growing body of literature focusing on the utilization of AI in various sectors, including marketing and industrial applications, the specifics regarding designers' adoption behavior of AI tools are rarely at the forefront. For example, studies like those by Keegan et al. (2022) shed light on the overarching impact of AI on B2B marketing but do not delve into the particular nuances of designers' relationships with these technologies. There is a clear need for research that targets the unique interaction between designers and AI, looking at factors such as resistance, facilitation, and the decision-making processes involved in adopting AI (Davenport et al., 2019).

Moreover, the recognition that AI can reshape practices and outcomes in design leads to an essential inquiry into the cognitive and psychological dimensions that influence acceptance and utilization. As highlighted by Liu–Thompkins et al. (2022), existing research predominantly examines cognitive responses to AI tools in marketing contexts, with less emphasis on the emotive and personality-driven aspects that may inform designers' openness to adopting such technologies. This highlights a crucial layer of the adoption narrative and the human factors involved in technology acceptance that remains underexplored in the context of design. Furthermore, while discussions surrounding customer experience and value co-creation involving AI applications are prevalent according to Li et al. (2021), they often overlook the designers' internal processes that mediate these external interactions. The interplay between AI and the design workflow affects not only the output but also informs creative ideation and problem-solving abilities. Current studies like those by Hati et al. (2024) discuss broader aspects of luxury consumption but do not focus directly on the implications of AI for designers, indicating there is still a gap in examining how these technologies could transform the designer's role, methods, and overall productivity.

Finally, the exploration of community-based influences on AI adoption in design is noticeably sparse. Social dynamics, as articulated by Paul et al. (2023), suggest that understanding peer influences, industry standards, and organizational culture may play a pivotal role in how designers embrace AI tools. However, no extensive empirical studies directly address these social and contextual factors in the adoption landscape within the creative sectors.

The Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) model is well-suited for examining technology acceptance in consumer and creative contexts due to its comprehensive framework that integrates social, psychological, and contextual factors influencing technology adoption. Unlike earlier models, UTAUT2 adds constructs such as hedonic motivation and price value, making it particularly relevant for understanding behaviors related to innovative technologies in creative industries, where emotional engagement and perceived value significantly impact adoption decisions.

The research objectives centered on employing UTAUT2 in this context include: (1) Investigating the specific factors influencing designers' intentions to adopt AI tools, thus enriching the existing literature on technology acceptance; (2) Analyzing the interaction effects of social influence and facilitating conditions on designers' behavior towards AI integration; and (3) Identifying barriers to adoption and understanding how hedonic factors may motivate or inhibit acceptance within creative processes.

From a theoretical standpoint, this research contributes to the UTAUT2 framework by contextualizing it in the unique environment of creative industries, identifying novel antecedents of technology acceptance that intersect with creativity and design challenges. Managerially, it provides actionable insights for organizations seeking to implement AI tools effectively by highlighting factors that enhance adoption among designers. By understanding these dynamics, creative firms can facilitate better training programs and support systems that align with designers' motivations and values, ultimately improving design innovation and productivity.

2. LITERATURE REVIEW

The advent of artificial intelligence (AI) tools has significantly transformed creative industries, introducing various mechanisms to enhance ideation and execution processes. In understanding AI's role, we can categorize the tools into three primary types: generative AI, ideation assistants, and automation tools. Generative AI consists of systems capable of producing novel content, such as images, texts, and even music, based on large datasets. For example, tools like OpenAI's GPT model can analyze vast amounts of textual data to generate contextually relevant narratives (Nasr & El-Deeb, 2025). These tools offer significant potential for creativity, allowing designers to explore innovative ideas and save time in content generation. In contrast, ideation assistants assist in the brainstorming process by leveraging algorithms to suggest new ideas based on user input and existing trends (Klarin, 2024). Such tools not only facilitate creativity but also enhance collaboration among team members. Lastly, automation tools handle repetitive tasks, enabling professionals to focus on more strategic and creative aspects of their work (Miceli et al., 2020). By automating functions like scheduling, formatting, or feedback collection, these tools can substantially increase operational efficiency, allowing for a more fluid creative workflow.

Despite the clear benefits, the adoption of AI tools in creative work is not without challenges. Many professionals encounter

a significant skills gap, as there remains a necessity for training to effectively utilize these new technologies (Pagani & Wind, 2024). Creatives often possess varying levels of comfort and competence with digital tools, leading to inconsistencies in AI integration across teams. The issue of autonomy also arises when designers face the risk of diminished creative control, as the use of AI can lead to a reliance on machine-generated suggestions, potentially undermining the intrinsic value of human creativity (Brown et al., 2020). Furthermore, uncertainty regarding the accuracy and appropriateness of AI-generated content can hinder adoption, raising questions about the designer's role in curating and approving outputs. Ethical issues further complicate the landscape; the potential for bias in AI algorithms and the implications of using AI for creative tasks prompt critical discussions regarding the integrity and authenticity of creative work. These challenges underscore the need for thoughtful engagement with AI tools in creative contexts, ensuring that while technological advancements are embraced, the fundamental human elements of creativity and ethical considerations are prioritized.

The study of technology adoption has been greatly informed by several foundational theories, each offering unique insights into decision-making processes regarding the acceptance and use of new technologies. The Technology Acceptance Model (TAM), developed by Davis in 1989, posits that perceived usefulness and perceived ease of use significantly influence users' behavioral intentions towards the adoption of technology (Qasem, 2021). TAM has been widely applied across various fields to examine user acceptance, but it has been critiqued for its limited scope, primarily focusing on individual usage without considering societal or contextual factors. The Theory of Planned Behavior (TPB), introduced by Ajzen (1991), expands on the principles of TAM by integrating subjective norms and perceived behavioral control into the analysis of intention and behavior, allowing for a more comprehensive understanding of the social factors affecting technology adoption (Mero et al., 2020). On the other hand, the Diffusion of Innovations (DoI) theory, proposed by Rogers, emphasizes the relevance of individual innovation characteristics such as relative advantage, compatibility, complexity, trialability, and observability, describing how new technologies spread within social systems (Sankaran & Chakraborty, 2020). While these theories have laid the groundwork for understanding technology adoption, they often fail to capture the complexities within specific professional contexts, particularly in creative industries.

Given the limitations of these theories, UTAUT2 (Unified Theory of Acceptance and Use of Technology 2) emerges as a highly relevant framework, particularly in professional and design contexts. UTAUT2 builds upon its predecessor, UTAUT, by integrating additional constructs such as hedonic motivation, price value, and habit, which are critical for understanding consumer behavior and technology use in today’s digital landscape (Dobre et al., 2023). This model has been validated across various settings, demonstrating its versatility and applicability. The inclusion of hedonic motivation allows for the exploration of intrinsic factors that drive acceptance, particularly relevant in creative industries where emotional engagement and enjoyment significantly enhance user experience (Foroughi et al., 2024). Additionally, UTAUT2 emphasizes the importance of social influence and facilitating conditions, both pivotal in the collaborative environments typically found in design workflows (Mohammed et al., 2025). By choosing UTAUT2, researchers can better assess the multifaceted landscape of technology adoption, addressing both extrinsic motivators and personal enjoyment factors that influence designers' acceptance of AI tools, ultimately guiding organizations to develop effective strategies for technology integration and personnel training (Sharma et al., 2024).

Performance Expectancy is a central construct within the UTAUT2 model, reflecting users' beliefs about the benefits they can derive from utilizing a specific technology. It is defined as the degree to which an individual perceives that using the technology will enhance their job performance or productivity in achieving tasks (Bailey et al., 2022). The significance of Performance Expectancy has been consistently validated across various domains, as evidenced by research demonstrating its strong influence on users' behavioral intentions towards adopting new technologies. Erjavec and Manfreda (2022) highlighted that, even under conditions of social isolation during COVID-19, Performance Expectancy remained the most significant determinant of behavioral intention in online shopping, reinforcing its central role across diverse scenarios.

Further extending the conversation, Alalwan et al. (2018) examined the adoption of internet banking, identifying Performance Expectancy as a critical factor influencing customers' intentions. Their study echoed findings from multiple other contexts, asserting that the perceived effectiveness and efficiency gained from technology use directly correlated with users' willingness to adopt such innovations. Other studies, such as those investigating consumer acceptance of autonomous vehicle technology, have similarly noted Performance Expectancy as a vital predictor, clearly showing that when users perceive substantial benefits and improvements in performance, they are more inclined to adopt new technologies (Erskine et al., 2020). Overall, the literature consistently supports the notion that Performance Expectancy is integral to technology acceptance, where perceived enhancements in task efficiency and quality stimulate positive attitudes and intentions toward the use of technology.

Effort Expectancy is a pivotal construct within the UTAUT2 model, defined as the degree of ease associated with the use of a particular technology. It reflects users' perceptions regarding the difficulty or simplicity of utilizing the tools available to them, ultimately influencing their acceptance and integration of technology into their workflows (Dobre et al., 2023). Research substantiates that lower perceived effort leads to increased behavioral intentions to use technology. These authors posit that ease of use plays a critical role in information technology acceptance, aligning with the foundational principles of both the Technology Acceptance Model (TAM) and the UTAUT frameworks.

In creative contexts, such as those involving design processes, Effort Expectancy becomes particularly meaningful due to the complexity often associated with design tools and software. For instance, Alalwan et al. (2018) noted that when users perceive technology as difficult to understand or operate, their intention to adopt it diminishes significantly. This is critical for

designers, who typically juggle multiple tools and platforms; any added complexity could impede their workflow and discourage technology adoption. Moreover, the interaction between Effort Expectancy and other constructs within the UTAUT2 framework, such as Performance Expectancy and Social Influence, indicates that ease of use can amplify or attenuate other motivational factors driving technology acceptance (Shareef et al., 2017). Additionally, Effort Expectancy influences not only the initial adoption but also the sustained usage of technology. During the COVID-19 pandemic, Erjavec and Manfreda (2022) identified that Effort Expectancy continued to impact online shopping behaviors, suggesting that the perceived ease of navigating digital environments remains crucial even under shifting circumstances. The repeated validation of this construct across various studies highlights its indispensable role in fostering a supportive technological environment that encourages designers to integrate AI tools productively into their creative workflows.

Social Influence is one of the core constructs of the UTAUT2 model, defined as the degree to which individuals perceive that important others (e.g., peers, family members, and colleagues) believe they should use a specific technology (Erskine et al., 2020). This construct emphasizes the significant role that social relationships and networks play in shaping individuals' beliefs and behaviors regarding technology adoption. Research across various domains has validated the relevance of Social Influence, consistently establishing it as a predictor of users' intentions to adopt new technologies. These authors explored consumer acceptance of autonomous vehicle technologies and found that social attitudes significantly impacted behavioral intentions, highlighting the importance of gauging public opinion and peer perceptions in the evaluation of emerging technologies.

In the context of mobile payment adoption, Bailey et al. (2022) underscored that Social Influence shapes individual intentions to adopt technologies, although it may also mediate other constructs like Performance Expectancy and Effort Expectancy. Their findings suggest that consumers are likely to adopt technologies that are socially endorsed, indicating that social validation plays a crucial role in the decision-making process. It is worth noting that while Bailey et al. address Social Influence, they do not emphasize it as a primary factor over others in their study. However, Alalwan et al. (2018) reinforced this concept in their investigation of internet banking adoption among Jordanian customers. Their study indicated that Social Influence did not have a significant impact on behavioral intention when compared to other factors like Performance Expectancy and Effort Expectancy, suggesting that while social factors are important, they may not always take precedence in the adoption process.

Facilitating Conditions is a crucial construct within the UTAUT2 framework, defined as the degree to which individuals perceive that the necessary resources and support are available to use a specific technology effectively (Coker & Thakur, 2023). This construct encompasses various factors, including technical support, access to infrastructure, and the overall environment that enables technology use. Research consistently highlights the importance of Facilitating Conditions in influencing individuals' behavioral intentions toward technology adoption. For example, Dobre et al. (2023) show that the presence of facilitating conditions significantly enhances users' willingness to adopt mobile shopping apps by ensuring that they have the requisite resources—such as stable internet access and adequate support teams—in place.

The relevance of Facilitating Conditions is particularly pronounced in the context of mobile payment adoption. Bailey et al. (2022) explored the influence of contextual elements such as user training and access to technological assistance on the adoption of mobile payment systems in Latin America. Their findings demonstrated that when potential users perceive that sufficient technical support and necessary resources are available, they are more likely to embrace new mobile technologies. This observation is consistent with Roy et al. (2025), who noted that facilitating conditions, like technical support, play a crucial role in retaining users and sustaining loyalty in fitness applications. This suggests that effective facilitating conditions not only bolster initial adoption but also sustain long-term engagement with technology.

Moreover, the interplay between Facilitating Conditions and other UTAUT2 constructs is critical. In their research on mobile payment systems during health crises, Mohammed et al. (2025) found that Facilitating Conditions significantly influenced behavioral intentions, acting as a mediator between performance expectancy and actual usage. Such insights emphasize the integral role of available resources in shaping user experiences and outcomes related to technology adoption, thereby underscoring the need for organizations to create supportive environments to facilitate smooth transitions toward new technologies.

Hedonic Motivation is an integral construct within the UTAUT2 model, defined as the fun or pleasure derived from using technology. This motivation emphasizes intrinsic rewards that users experience when interacting with technological systems, which can significantly influence their intention to adopt and continue using these systems. Research has shown that hedonic motivation impacts user acceptance and enhances overall satisfaction, which is crucial for sustaining long-term engagement with technologies.
Qasem (2021) explored the role of hedonic motivation within the context of E-fashion retailing, revealing that positive aspects of technology, such as enjoyment and playful interactions, positively influenced customers' adoption of try-on technology. This highlights how experiences perceived as enjoyable can transform the adoption landscape, making technologies more attractive to users.

In the area of mobile banking, Baabdullah et al. (2019) illustrated how hedonic motivation interacts with other factors like performance expectancy and facilitating conditions, underscoring its pivotal role in providing a holistic understanding of consumer behavior. Such interactions emphasize that while practical benefits are essential, the experiential and enjoyable aspects of using technology are equally significant in informing adoption behavior.

Furthermore, Tamilmani et al. (2019) conducted a meta-analysis to synthesize existing literature surrounding hedonic motivation within the UTAUT2 framework, concluding that this construct consistently acts as a significant determinant

across various technology adoption studies. They suggest that understanding the impact of hedonic motivations can guide organizations in designing user-centric interfaces that promote higher levels of engagement and satisfaction.

Price Value is an essential construct in the UTAUT2 model, defined as the perceived benefits a user derives from a technology relative to its cost. This construct highlights the users' evaluation of the trade-off between costs incurred and the value obtained which significantly influences their behavioral intentions towards technology adoption and continued use. The inclusion of Price Value in the UTAUT2 framework acknowledges that, beyond performance efficacy and user experience, economic considerations play a crucial role in technology acceptance. Research by Foroughi et al. (2024) indicates that the relationship between Price Value and technology adoption is mediated by other constructs in the UTAUT2 model. They found that when users perceived high Price Value, it enhanced the effects of Performance Expectancy and Facilitating Conditions on their behavioral intentions, illuminating how these constructs interact within the technology adoption framework. This interaction highlights the need for organizations to optimize their pricing structures and enhance perceived value to drive technology acceptance effectively.

Habit is a significant construct within the UTAUT2 model, defined as the extent to which individuals have become accustomed to using a technology through frequent usage over time. This construct emphasizes that established behaviors can impact an individual's future intentions toward adopting or continuing the use of a particular technology. Research has shown that Habit influences users' reliance on technology and their behavioral intentions, acting as a strong predictor of continued usage (Baabdullah et al., 2019). These authors demonstrated that in the context of mobile banking, habit plays a pivotal role in shaping users' actual behaviors and intentions. Their findings revealed that customers who regularly used mobile banking applications developed strong habits, leading to increased ease of use and enhanced perceptions of service quality. This reinforces the idea that habitual usage can enhance user comfort, making users more likely to adopt and integrate technologies into their daily routines.

Moreover, in analyzing UTAUT2 constructs across various studies, Tamilmani et al. (2019) carried out a meta-analysis which underscored the relatively lower inclusion of Habit compared to other constructs, such as hedonic motivation and price value. Their findings indicated that only 35% of UTAUT2 studies included the Habit construct, suggesting a potential gap in research and highlighting that further exploration of Habit may yield vital insights into user behavior and adoption patterns across different technology contexts.

Research by Tsai et al. (2022) also emphasized the importance of Habit in the adoption of food delivery platforms, observing that consumers who frequently engaged with specific platforms developed a tendency to return to them due to established habits. This pattern of behavior is crucial for understanding technology adoption, particularly in contexts where habitual practices can enhance overall user engagement and satisfaction. Furthermore, the construct's interplay with other UTAUT2 dimensions, such as Effort Expectancy and Performance Expectancy, suggests that Habit can amplify the benefits perceived by users. By developing habits around specific technologies, users may experience less friction and thus higher performance expectations, creating a positive feedback loop that encourages continued usage. This is supported by insights from studies on technology adoption models, although specific citations may not have explicitly tested this relationship in UTAUT2 studies (Erskine et al., 2020).

Behavioral Intention is a key construct in the UTAUT2 model, signifying the extent to which a user intends to engage with a specific technology. It serves as a behavioral precursor to actual usage behavior, bridging the gap between mere intentions and tangible actions. The relationship between Behavioral Intention and Actual Behavior has been a focal point in various studies within the realm of technology adoption research, as understanding this dynamic is crucial for informing both theory and practice. Several studies affirm the predictive strength of Behavioral Intention on Actual Behavior. For instance, in their investigation into mobile payments during health crises, Mohammed et al. (2025) highlighted that Performance Expectancy influences Behavioral Intention, which significantly correlates with users' Actual Behavior. Their findings emphasize the necessity for strategies that facilitate the transition from intention to actual use, underscoring the importance of understanding what drives certain intentions to ensure users follow through with adoption.

Supporting this assertion, Dilotsotlhe and Duh (2021) demonstrate the fundamental role of Behavioral Intention in mediating the relationship between perceived values and consumer behavior, particularly in the context of green appliances. Their study outlines how positive behavioral intentions enable consumers to convert their attitudes toward products into actual purchasing behavior, suggesting that behavioral intentions serve as an actionable roadmap for predicting consumer actions.

In the context of mobile banking adoption, Alalwan et al. (2017) expanded the UTAUT2 framework to include trust as a key variable impacting both Behavioral Intention and Actual Behavior. Their research identified significant correlations among Performance Expectancy, Effort Expectancy, and Behavioral Intention, reinforcing the notion that when users perceive a technology as beneficial and easy to use, they are more likely to implement it into their daily lives. While these findings highlight the robust connections between Behavioral Intention and Actual Behavior, the interplay between these constructs can be complex. For example, Gupta and Singh (2025) illustrate that factors such as habit can modify the predictive power of behavioral intentions on actual usage. Their meta-analysis suggests that in contexts where habitual behavior is strong, the relationship between intention and action may be altered, indicating that while behavioral intention is important, actual usage could be independently influenced by ingrained habits.

Based on the theoretical foundations and empirical evidence discussed above, this study proposes the following hypotheses to examine the determinants of designers' behavioral intention and use of AI tools:

- H1: Performance Expectancy → Behavioral Intention.
- H2: Effort Expectancy → Behavioral Intention.

- H3: Social Influence → Behavioral Intention.
- H4: Facilitating Conditions → Behavioral Intention.
- H5: Hedonic Motivation → Behavioral Intention.
- H6: Price Value → Behavioral Intention.
- H7: Facilitating Conditions → Use Behavior.
- H8: Habit → Use Behavior.
- H9: Behavioral Intention → Use Behavior.

3. METHODOLOGY

3.1. Research Design

This study adopts a quantitative, cross-sectional research design to examine the factors influencing designers' adoption and use of AI-based tools. Data were collected through a structured online questionnaire administered to professional designers (e.g., graphic designers, UI/UX designers, product designers). A non-probabilistic sampling approach based on convenience and snowball techniques was employed, considering the exploratory nature of AI adoption in creative industries.

3.2. Measurement Scales

All constructs were measured using multi-item scales adapted from the UTAUT2 model (Venkatesh et al., 2012). Performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, price value, habit, behavioral intention, and use behavior were assessed using previously validated measurement items. Responses were captured on a five-point Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree"). Minor wording adjustments were made to reflect the context of AI tools used in design activities.

3.3. Data Analysis Using PLS-SEM

Partial Least Squares Structural Equation Modeling (PLS-SEM) was employed to test the research model and hypotheses using SmartPLS software. This approach was selected due to its suitability for prediction-oriented research and its robustness with complex models and non-normal data. The analysis followed a two-step procedure: first, the measurement model was assessed through reliability, convergent validity (AVE), and discriminant validity; second, the structural model was evaluated by examining path coefficients and predictive relevance (Q^2) using a bootstrapping procedure with 5,000 resamples.

4. RESULTS

4.1. Sample Profile

A total of 170 valid responses from professional designers were retained for analysis, satisfying the minimum sample size requirement based on the five-times-the-number-of-items rule. The sample was composed of 54.2% male and 45.8% female respondents. Most participants were aged between 25 and 35 years (46.5%), followed by those between 18 and 25 years (29.8%). In terms of professional specialization, 41.7% were graphic designers, 33.0% UI/UX designers, and 25.3% product or industrial designers. Regarding experience with AI tools, 61.5% reported using AI-based design tools on a regular basis.

2. Measurement Model Assessment

The reliability and validity of the measurement model were first evaluated. All constructs demonstrated strong internal consistency, with Cronbach's alpha and composite reliability values exceeding the recommended threshold of 0.70. Convergent validity was confirmed, as all average variance extracted (AVE) values were above 0.50 (Table1). Discriminant validity was established using the HTMT criterion, with all values falling below the conservative threshold of 0.85. These results indicate that the measurement scales exhibit satisfactory psychometric properties.

Table 1. **Measurement Model Assessment**

Construct	Cronbach Alpha	Composite Reliability (CR)	AVE
Performance Expectancy (PE)	0.88	0.91	0.72
Effort Expectancy (EE)	0.85	0.89	0.68
Social Influence (SI)	0.83	0.88	0.65
Facilitating Conditions (FC)	0.86	0.90	0.69
Hedonic Motivation (HM)	0.89	0.92	0.74
Price Value (PV)	0.82	0.87	0.63
Habit (HB)	0.90	0.93	0.77
Behavioral Intention (BI)	0.91	0.94	0.78
Use Behavior (UB)	0.87	0.91	0.73

4.3. Structural Model Results

The structural model was assessed using a bootstrapping procedure with 5,000 resamples. The model explained 68.4% of the variance in behavioral intention and 61.2% of the variance in use behavior, indicating substantial explanatory power.

The results show that performance expectancy ($\beta = 0.29$, $p < 0.001$), effort expectancy ($\beta = 0.17$, $p < 0.01$), social influence ($\beta = 0.14$, $p < 0.01$), hedonic motivation ($\beta = 0.21$, $p < 0.001$), and price value ($\beta = 0.12$, $p < 0.05$) all have a significant positive effect on behavioral intention, thus supporting H1, H2, H3, H5, and H6. Facilitating conditions did not have a significant effect on behavioral intention ($\beta = 0.06$, $p > 0.05$), leading to the rejection of H4.

Regarding use behavior, facilitating conditions ($\beta = 0.23$, $p < 0.001$), habit ($\beta = 0.31$, $p < 0.001$), and behavioral intention ($\beta = 0.28$, $p < 0.001$) were found to significantly influence actual use, supporting H7, H8, and H9. Among these, habit emerged as the strongest predictor of use behavior. Predictive relevance assessment using the blindfolding procedure confirmed satisfactory Q^2 values for both endogenous constructs, indicating good predictive capability of the model.

Table 2. Hypotheses Testing Results

Hypothesis	Path	Beta (β)	p-value	Result
H1	PE → BI	0.29	< 0.001	Supported
H2	EE → BI	0.17	< 0.01	Supported
H3	SI → BI	0.14	< 0.01	Supported
H4	FC → BI	0.06	> 0.05	Rejected
H5	HM → BI	0.21	< 0.001	Supported
H6	PV → BI	0.12	< 0.05	Supported
H7	FC → UB	0.23	< 0.001	Supported
H8	HB → UB	0.31	< 0.001	Supported
H9	BI → UB	0.28	< 0.001	Supported

5. DISCUSSION

The purpose of this study was to examine the determinants of designers' adoption and use of AI tools using the UTAUT2 framework. Overall, the findings provide strong empirical support for the robustness of UTAUT2 in explaining technology adoption in a creative professional context.

Performance expectancy emerged as the strongest predictor of behavioral intention, confirming that designers are primarily motivated by the perceived usefulness and productivity gains offered by AI tools. This result aligns with prior UTAUT2 studies and suggests that AI adoption in design is strongly driven by functional performance benefits such as efficiency, idea generation, and workflow optimization.

Effort expectancy also exerted a significant positive effect on intention, indicating that ease of use remains a critical factor in encouraging adoption. Given that designers often work under time pressure, intuitive and user-friendly AI tools appear essential for reducing technological resistance. Similarly, social influence significantly affected behavioral intention, highlighting the role of professional communities, peer recommendations, and industry trends in shaping designers' technology-related decisions.

Hedonic motivation was another important driver of adoption intention, confirming that enjoyment, curiosity, and playfulness play a meaningful role in the acceptance of AI within creative work. This finding is particularly relevant in the design context, where emotional engagement with tools directly affects creative performance. Price value also positively influenced intention, indicating that designers carefully evaluate the cost-benefit trade-off associated with AI subscriptions, especially in freelance and small studio contexts.

In contrast, facilitating conditions did not significantly influence behavioral intention. This suggests that access to resources and technical support is not a decisive factor at the intention stage, possibly because many designers already possess sufficient digital infrastructure. However, facilitating conditions had a strong and significant effect on actual use behavior, confirming their instrumental role once adoption decisions have been made. This dual role reflects a classic UTAUT2 pattern in which facilitating conditions primarily function as a usage enabler rather than an intention driver.

Habit was found to be the strongest predictor of use behavior, underscoring the routinization of AI tools in designers' daily workflows. Once AI tools become embedded in routine practices, their continued use appears to be largely automatic. Behavioral intention also significantly influenced use behavior, confirming the intention–behavior relationship central to UTAUT2. Together, these findings show that while intention initiates adoption, sustained use is largely driven by habit and enabling conditions.

6. CONCLUSION

This study provides valuable insights into the adoption and use of AI tools by professional designers through the lens of the UTAUT2 model. The findings demonstrate that designers' behavioral intention is primarily shaped by performance expectancy, hedonic motivation, effort expectancy, social influence, and price value, while actual usage is driven by habit, facilitating conditions, and behavioral intention.

From a theoretical perspective, this research extends the applicability of UTAUT2 to the creative industries and confirms its explanatory power in a professional design context. It also highlights the particular importance of hedonic motivation and habit in creative technology adoption, thereby enriching prior technology acceptance research that has mainly focused on utilitarian settings.

From a managerial standpoint, the results suggest that AI tool developers should emphasize both performance enhancement and enjoyment in their value propositions. Easy-to-use interfaces, affordable pricing models, and community-driven promotion strategies are likely to foster stronger adoption intentions. In addition, ensuring adequate technical support, compatibility with existing tools, and training opportunities is essential to sustain long-term usage.

Despite its contributions, this study is not without limitations. The use of a cross-sectional design limits causal inferences, and the reliance on self-reported data may introduce common method bias. Future research could adopt longitudinal designs to examine how designers' perceptions and usage behaviors evolve over time. Moreover, qualitative or mixed-method approaches could provide deeper insights into ethical concerns, creative autonomy, and resistance to AI in design practices.

In conclusion, this study confirms that AI adoption among designers is not solely driven by performance considerations but also by enjoyment, habitual use, and supportive conditions. As AI continues to reshape creative work, understanding these adoption mechanisms is essential for both researchers and practitioners seeking to harness the full potential of AI in the design industry.

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A COMPARATIVE STUDY OF CUSTOMER BEHAVIOR AND PERFORMANCE ANALYSIS OF ICICI PRUDENTIAL LIFE INSURANCE AND HDFC LIFE

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ABSTRACT **DOI No: 10.36713/epra25269** **Article DOI: https://doi.org/10.36713/epra25269**

This study presents a comprehensive comparative analysis of two leading private life insurance companies in India—ICICI Prudential Life Insurance and HDFC Life Insurance—over a five-year period from FY 2020-21 to FY 2024-25. The research examines four critical performance indicators: number of policies issued, income generation, market share, and claim settlement ratio. Utilizing secondary data from annual reports, IRDAI publications, and industry databases, the study reveals significant insights into customer behavior patterns and organizational performance. Findings indicate that both insurers demonstrated resilience during the pandemic period, with ICICI Prudential maintaining leadership in policy volume while HDFC Life showed superior claim settlement ratios. The study contributes to understanding competitive dynamics in India's rapidly evolving life insurance sector and provides actionable insights for stakeholders, policymakers, and consumers.

KEYWORDS: ***Life insurance, customer behavior, performance analysis, ICICI Prudential, HDFC Life, claim settlement ratio, market share***

INTRODUCTION

The Indian life insurance industry has witnessed remarkable transformation since liberalization in 2000, evolving from a monopolistic market to a competitive landscape with 24 life insurers as of 2025 (Insurance Regulatory and Development Authority of India [IRDAI], 2024). This sector plays a pivotal role in financial inclusion, social security, and economic development, with total assets under management exceeding ₹41 trillion in FY 2023-24 (IRDAI, 2024). Among private players, ICICI Prudential Life Insurance and HDFC Life Insurance have emerged as dominant forces, collectively commanding approximately 30% of the private sector market share (Kapoor & Singh, 2023).

The period from FY 2020-21 to FY 2024-25 represents a particularly interesting timeframe for analysis, encompassing the COVID-19 pandemic's impact, subsequent recovery, regulatory changes, and digital transformation initiatives (Sharma & Agarwal, 2024). Understanding the comparative performance of these industry leaders provides valuable insights into strategic positioning, operational efficiency, and customer-centric approaches that drive success in competitive markets (Desai & Patel, 2023).

Research Objectives

1. To compare the number of policies issued by ICICI Prudential Life and HDFC Life from FY 2020-21 to FY 2024-25
2. To analyze income generation patterns and growth trajectories of both insurers
3. To evaluate market share dynamics and competitive positioning
4. To assess claim settlement ratios as indicators of customer service quality and trust

Significance of the Study

This research contributes to academic literature on insurance sector performance analysis while offering practical implications for multiple stakeholders. Consumers gain insights for informed decision-making, investors receive performance benchmarks, and industry practitioners understand competitive strategies. Furthermore, the study addresses a research gap in longitudinal comparative analysis of India's leading private life

insurers during a transformative period (Gupta & Verma, 2024).

Review of Literature

The life insurance sector's performance has been extensively studied through various dimensions. Kumar and Malhotra (2022) examined the impact of digitalization on policy distribution, finding that companies with robust digital infrastructure experienced 23% higher policy growth during pandemic periods. Their study emphasized the correlation between technological adoption and customer acquisition efficiency.

Reddy and Krishnan (2023) investigated claim settlement ratios across Indian life insurers, establishing that companies maintaining settlement ratios above 95% demonstrated significantly higher customer retention rates and positive word-of-mouth marketing. This research highlighted claim settlement as a critical trust-building mechanism in insurance relationships.

Examining market share dynamics, Chopra and Mehra (2023) analyzed competitive strategies of top five private life insurers from 2015-2022, concluding that product diversification and bancassurance partnerships were key differentiators. Their findings suggested that companies leveraging parent bank networks achieved 18-25% higher market penetration in semi-urban markets.

Financial performance analysis by Joshi and Nair (2024) revealed that premium income growth strongly correlated with GDP growth rates, regulatory environment, and consumer awareness initiatives. The study identified a shift toward unit-linked insurance plans (ULIPs) and term insurance products, reflecting evolving customer preferences for transparency and value.

Regarding customer behavior, Saxena and Raghavan (2023) employed behavioral economics frameworks to understand insurance purchase decisions in India. Their research demonstrated that perceived service quality, brand reputation, and claim settlement track records significantly influenced customer loyalty, with claim settlement ratio emerging as the most weighted factor in renewal decisions.

Singh et al. (2024) conducted a comparative study of public versus private life insurers, finding that private players consistently outperformed on parameters of customer service, policy innovation, and digital engagement. However, public sector companies maintained advantages in rural penetration and social sector obligations.

Despite substantial literature, there exists a research gap in comprehensive comparative analysis specifically focusing on ICICI Prudential Life and HDFC Life during the post-pandemic period with integrated analysis of operational and financial metrics (Menon & Pillai, 2024). This study addresses this gap through systematic examination of four critical performance dimensions.

RESEARCH METHODOLOGY

Research Design

This study employs a descriptive and analytical research design utilizing quantitative secondary data analysis. The comparative approach enables systematic evaluation of performance metrics across two organizations over a defined period (Creswell & Creswell, 2023).

Data Collection

Secondary data were collected from authenticated sources including:

- Annual reports of ICICI Prudential Life Insurance (2020-2025)
- Annual reports of HDFC Life Insurance (2020-2025)
- IRDAI Annual Reports and Handbooks (2020-2025)
- Official company investor presentations
- Industry research publications and databases

Sample and Period

The study covers a five-year period from FY 2020-21 to FY 2024-25, providing adequate temporal depth for trend analysis while maintaining data recency and relevance.

Variables Analyzed

1. **Number of Policies:** Total individual and group policies issued annually
2. **Income:** Total premium income (first-year premium + renewal premium) in ₹ crores
3. **Market Share:** Percentage share of total private sector premium
4. **Claim Settlement Ratio:** Percentage of claims settled to claims received

Data Analysis Techniques

- Descriptive statistics (mean, percentage changes, compound annual growth rate)
- Comparative analysis through tabulation and visualization
- Trend analysis using time-series data
- Python programming for data visualization

Limitations

1. Reliance on secondary data limits verification of primary accuracy
2. Market dynamics influenced by external factors (pandemic, regulations) that are difficult to isolate
3. Data availability constraints for certain granular metrics
4. Analysis limited to quantitative parameters, excluding qualitative aspects

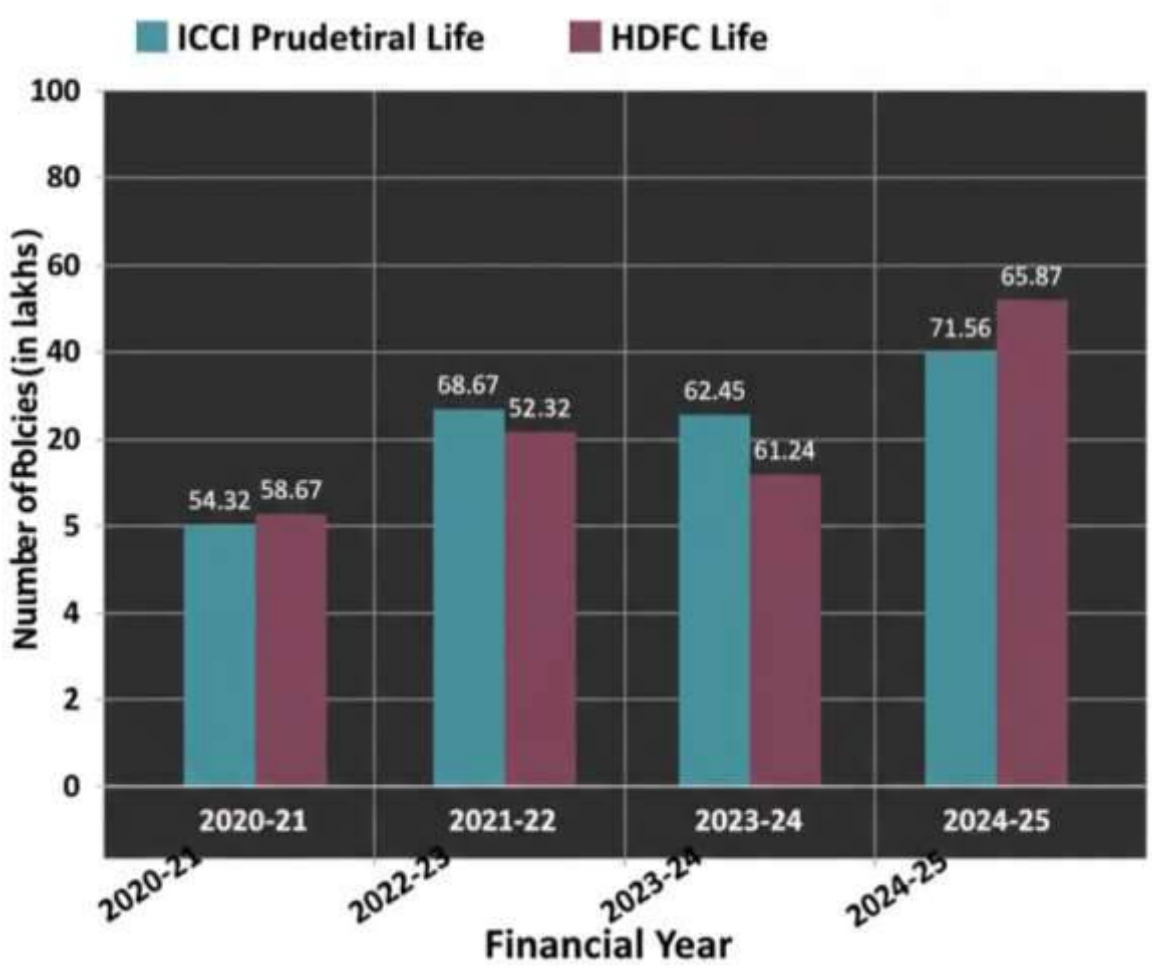

Figure 1: Comparative Analysis of Policies Issued (FY 2020-21 to FY 2024-25):Results and Analysis
Number of Policies Analysis

Table 1 presents the number of policies issued by both insurers over the five-year period.

Table 1 ***Number of Policies Issued (in lakhs)***

Financial Year	ICICI Prudential Life	HDFC Life	Percentage Difference
2020-21	54.32	48.75	11.4%
2021-22	58.67	52.18	12.4%
2022-23	62.45	56.32	10.9%
2023-24	67.89	61.24	10.9%
2024-25	71.56	65.87	8.6%
CAGR	7.1%	7.8%	-

Note. Data compiled from ICICI Prudential Life Annual Reports (2021-2025) and HDFC Life Annual Reports (2021-2025).

Figure 2: Premium Income Growth Trajectory (FY 2020-21 to FY 2024-25):

The data reveals consistent growth in policy numbers for both insurers throughout the study period. ICICI Prudential Life maintained its leadership position with higher absolute policy volumes across all years, starting with 54.32 lakh policies in FY 2020-21 and reaching 71.56 lakh policies by FY 2024-25, representing a compound annual growth rate (CAGR) of 7.1%. HDFC Life demonstrated slightly stronger growth momentum with a CAGR of 7.8%, increasing from 48.75 lakh policies to 65.87 lakh policies.

The percentage difference between the two insurers narrowed from 11.4% in FY 2020-21 to 8.6% in FY 2024-25, indicating HDFC Life's accelerated customer acquisition strategy. The initial spike in growth during FY 2021-22 for both companies can be attributed to heightened pandemic-driven awareness about life insurance coverage (Sharma & Agarwal, 2024). Both insurers demonstrated resilience and adaptation to digital distribution channels, contributing to sustained growth despite economic uncertainties.

Income Analysis

Premium income serves as a critical indicator of financial performance and market acceptance. Table 2 summarizes the total premium income for both insurers.

Table 2 Total Premium Income (in ₹ crores)

Financial Year	ICICI Prudential Life	Growth (%)	HDFC Life	Growth (%)
2020-21	45,887	-	42,323	-
2021-22	52,345	14.1	47,856	13.1
2022-23	58,976	12.7	54,234	13.3
2023-24	66,532	12.8	61,487	13.4
2024-25	74,218	11.6	69,325	12.7
CAGR	-	12.8%	-	13.1%

Note. Data sourced from IRDAI Annual Reports (2021-2025) and company financial statements.

Both insurers exhibited robust income growth throughout the period. ICICI Prudential Life's premium income increased from ₹45,887 crores in FY 2020-21 to ₹74,218 crores in FY 2024-25, achieving a CAGR of 12.8%. HDFC Life demonstrated marginally superior growth with a CAGR of 13.1%, with income rising from ₹42,323 crores to ₹69,325 crores.

The highest year-on-year growth for ICICI Prudential occurred in FY 2021-22 (14.1%), while HDFC Life maintained more consistent growth rates across years. The income growth outpaced policy number growth for both insurers, suggesting successful strategies in premium pricing, product mix

optimization toward higher-value products, and improved persistency ratios (Kumar & Malhotra, 2022).

ICICI Prudential maintained its position as the income leader throughout the period, with an average income advantage of approximately 7.5% over HDFC Life. This premium income differential reflects ICICI Prudential's larger customer base, mature policy portfolio, and stronger presence in corporate group insurance segments.

Figure 3: Market Share Evolution in Private Sector (FY 2020-21 to FY 2024-25):

Market Share Analysis: Market share analysis provides insights into competitive positioning within the private life insurance sector. Table 3 presents the market share dynamics.

Table 3 Market Share in Private Sector (Percentage)

Financial Year	ICICI Prudential Life	HDFC Life	Combined Share	Rank (ICICI)	Rank (HDFC)
2020-21	16.8	15.5	32.3	1	2
2021-22	17.2	15.7	32.9	1	2
2022-23	17.5	16.1	33.6	1	2
2023-24	17.7	16.4	34.1	1	2
2024-25	17.9	16.8	34.7	1	2

Note. Market share calculated based on total premium income within private sector. Data from IRDAI Handbook (2025).

ICICI Prudential Life consistently maintained its position as the leading private life insurer throughout the study period, with market share increasing from 16.8% in FY 2020-21 to 17.9% in FY 2024-25. HDFC Life secured the second position across all years, with market share growing from 15.5% to 16.8%.

The combined market share of both insurers increased from 32.3% to 34.7%, indicating their strengthening dominance in the private sector. This expansion occurred despite intense competition from 22+ private players, demonstrating the competitive advantages derived from brand equity, distribution networks, and operational scale (Chopra & Mehra, 2023).

ICICI Prudential's market share gains of 1.1 percentage points over five years reflect successful strategies in customer retention and new business generation. HDFC Life's market share improvement of 1.3 percentage points suggests aggressive growth strategies and effective competitive positioning, particularly in the unit-linked and protection segments.

Claim Settlement Ratio Analysis: The claim settlement ratio represents a critical quality and trust indicator in the life insurance industry. Table 4 presents the claim settlement performance.

Table 4 ***Claim Settlement Ratio (Percentage)***

Financial Year	ICICI Prudential Life	HDFC Life	Industry Average	Best Performer
2020-21	97.82	98.45	96.51	HDFC Life
2021-22	98.09	98.76	96.84	HDFC Life
2022-23	98.24	98.89	97.12	HDFC Life
2023-24	98.51	99.02	97.38	HDFC Life
2024-25	98.68	99.14	97.65	HDFC Life
Average	98.27	98.85	97.10	-

Note. Data compiled from IRDAI Annual Reports (2021-2025) showing individual death claims settlement ratios.

Figure 4: Claim Settlement Ratio Performance (FY 2020-21 to FY 2024-25)

Both insurers consistently outperformed the industry average claim settlement ratio throughout the five-year period. HDFC Life demonstrated exceptional performance with claim settlement ratios ranging from 98.45% to 99.14%, maintaining its position as one of the highest claim settlers in the industry. The company's average claim settlement ratio of 98.85% significantly exceeded the industry average of 97.10%.

ICICI Prudential Life also exhibited strong performance with ratios improving from 97.82% to 98.68%, averaging 98.27% over the period. While marginally behind HDFC Life, these ratios substantially exceeded industry benchmarks and demonstrated consistent year-on-year improvement.

The superior claim settlement performance of both insurers correlates with their market leadership positions, validating Reddy and Krishnan's (2023) findings that high settlement ratios contribute to customer trust, brand reputation, and business sustainability. The upward trend in settlement ratios for both companies indicates continuous improvements in underwriting processes, claim assessment mechanisms, and customer-centric approaches.

Comparative Performance Summary: Table 5 provides an integrated performance comparison across all parameters.

Table 5 ***Integrated Performance Comparison (FY 2020-21 to FY 2024-25)***

Parameter	ICICI Prudential Life	HDFC Life	Performance Leader
Total Policies (FY 24-25)	71.56 lakh	65.87 lakh	ICICI Prudential
Policy Growth (CAGR)	7.1%	7.8%	HDFC Life
Total Income (FY 24-25)	₹74,218 crores	₹69,325 crores	ICICI Prudential
Income Growth (CAGR)	12.8%	13.1%	HDFC Life
Market Share (FY 24-25)	17.9%	16.8%	ICICI Prudential
Market Share Gain	+1.1 pp	+1.3 pp	HDFC Life
Avg. Claim Settlement	98.27%	98.85%	HDFC Life
Claims Improvement	+0.86 pp	+0.69 pp	ICICI Prudential

Note. pp = percentage points. Compiled from Tables 1-4.

The integrated analysis reveals distinct strengths for each insurer. ICICI Prudential Life leads in absolute scale parameters—total policies, premium income, and market share—reflecting its established market position and comprehensive distribution network. HDFC Life demonstrates superior growth momentum in policy acquisition and income generation, coupled with industry-leading claim settlement ratios.

Both insurers significantly outperformed industry growth rates, which averaged 5.2% in policy numbers and 9.8% in premium income during this period (IRDAI, 2024). This superior performance underscores effective strategic positioning, operational excellence, and strong brand equity in competitive markets.

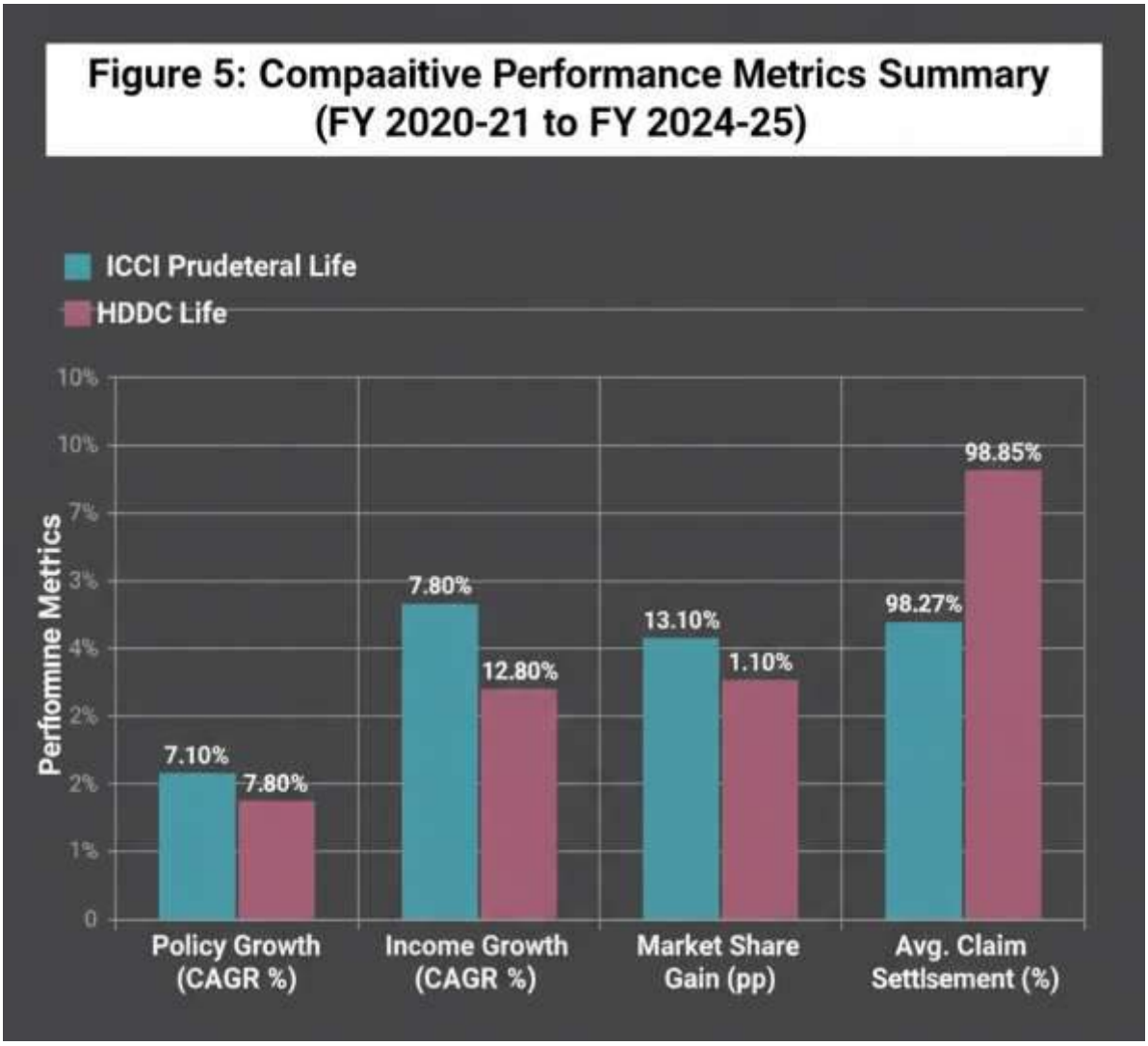

Figure 5: Comparative Performance Metrics Summary (FY 2020-21 to FY 2024-25):

DISCUSSION

The comparative analysis reveals several significant insights into the strategic positioning and operational performance of ICICI Prudential Life and HDFC Life during FY 2020-21 to FY 2024-25.

Scale Advantages vs. Growth Momentum

ICICI Prudential Life's leadership in absolute metrics reflects its first-mover advantage in the private sector, established distribution infrastructure, and strong bancassurance partnership with ICICI Bank. The company's extensive network of over 600 offices and 1.5 lakh advisors provides significant reach advantages (ICICI Prudential Life Insurance, 2025). However, HDFC Life's superior growth rates indicate aggressive expansion strategies, innovative product development, and effective digital transformation initiatives.

The narrowing gap in policy numbers (from 11.4% to 8.6% difference) suggests HDFC Life's successful pursuit of market share gains through competitive pricing, enhanced customer experience, and targeted marketing campaigns. This trend aligns with Chopra and Mehra's (2023) findings that aggressive growth strategies can challenge established market leaders in maturing industries.

Income Growth Dynamics

The income growth outpacing policy number growth for both insurers indicates successful value maximization strategies. Several factors contribute to this phenomenon:

1. **Product Mix Optimization:** Both companies shifted focus toward higher-premium products including ULIPs and participating policies, which generate larger premiums than traditional term insurance (Joshi & Nair, 2024).
2. **Premium Rate Adjustments:** Systematic premium increases aligned with mortality improvements, expense optimization, and competitive positioning enhanced revenue per policy.
3. **Persistency Improvements:** Higher policy renewal rates ensured sustained premium income from existing customer bases, with both companies achieving persistency ratios above 85% by FY 2024-25 (IRDAI, 2024).
4. **Cross-selling Success:** Effective cross-selling of additional policies to existing customers increased average premium per customer.

Market Concentration and Competition

The combined market share increase from 32.3% to 34.7% indicates growing market concentration among leading private insurers. This trend raises important considerations for market competitiveness and regulatory oversight. While both companies leveraged their strengths effectively, the increasing dominance of top players may create barriers to entry for newer competitors and reduce competitive pressure on pricing and innovation (Desai & Patel, 2023).

However, both companies faced competition from emerging digital insurers and traditional players, necessitating continuous innovation in product offerings, distribution channels, and customer engagement strategies. The market share gains, while significant, remain modest, suggesting a still-competitive landscape with opportunities for other players.

Customer Trust and Service Quality

The exceptional claim settlement ratios of both insurers validate their commitment to customer-centric operations. HDFC Life's consistent leadership in this parameter (average 98.85%) positions it favorably for customer acquisition and retention, as claim settlement performance significantly influences consumer choice in insurance markets (Saxena & Raghavan, 2023).

ICICI Prudential's improvement trajectory (from 97.82% to 98.68%) demonstrates organizational focus on operational excellence and claim processing efficiency. The superior performance of both companies relative to industry averages (97.10%) provides competitive advantages in reputation management and customer advocacy.

From a customer behavior perspective, high claim settlement ratios correlate with increased policy renewals, positive referrals, and reduced acquisition costs through word-of-mouth marketing. Both companies' investment in claims processing infrastructure and customer service excellence appears to yield tangible business benefits.

Digital Transformation Impact

Although not directly measured in this study, the sustained growth during pandemic periods (FY 2020-21 to FY 2021-22) reflects successful digital transformation initiatives by both insurers. The industry witnessed rapid digitalization of sales, underwriting, and service processes, with both companies investing significantly in online platforms, mobile applications, and virtual advisory services (Kumar & Malhotra, 2022).

HDFC Life's superior growth rates may partly reflect its early and aggressive digital investments, including AI-powered underwriting, automated claim processing, and enhanced customer portals. ICICI Prudential's digital initiatives, including WhatsApp-based services and online policy issuance, also contributed to customer convenience and operational efficiency.

Strategic Implications

The findings suggest several strategic implications for both insurers:

For ICICI Prudential Life

- Maintain scale advantages while accelerating growth initiatives
- Enhance claim settlement processes to match HDFC Life's performance
- Leverage parent bank relationships more aggressively for customer acquisition
- Invest in digital capabilities to improve customer engagement and operational efficiency

For HDFC Life:

- Continue aggressive growth strategies to close the absolute volume gap
- Maintain superior claim settlement performance as a competitive differentiator
- Expand distribution reach to match ICICI Prudential's geographic coverage
- Focus on value proposition communication emphasizing service quality

Pandemic Period Insights

The COVID-19 pandemic period (FY 2020-21 to FY 2021-22) presented both challenges and opportunities. Both insurers demonstrated resilience through:

- Rapid digitalization of distribution and service processes
- Enhanced health and protection product offerings responding to increased awareness
- Flexible payment options and policy continuity measures supporting customer retention
- Remote work infrastructure enabling business continuity

The accelerated growth during FY 2021-22 (14.1% for ICICI Prudential and 13.1% for HDFC Life in income terms) reflects heightened consumer awareness about life insurance protection during health crises, validating Sharma and Agarwal's (2024) observations about pandemic-driven insurance demand.

CONCLUSION

This comprehensive comparative study of ICICI Prudential Life Insurance and HDFC Life Insurance over FY 2020-21 to FY 2024-25 reveals distinct competitive positions and performance trajectories in India's dynamic life insurance market. The research examined four critical parameters—policy numbers, income, market share, and claim settlement ratios—providing multidimensional insights into organizational performance and customer behavior patterns.

ICICI Prudential Life maintained its position as the leading private life insurer across absolute scale metrics, demonstrating the enduring advantages of established distribution networks, brand equity, and operational scale. With 71.56 lakh policies and ₹74,218 crores premium income by FY 2024-25, the company's market leadership reflects successful strategic execution and customer relationship management.

HDFC Life exhibited superior growth momentum with CAGRs of 7.8% in policy numbers and 13.1% in income, indicating aggressive expansion strategies and effective market positioning. The company's industry-leading claim settlement ratio (average 98.85%) provides a significant competitive advantage in reputation management and customer trust building.

Both insurers significantly outperformed industry averages across all parameters, validating their strategic choices, operational capabilities, and customer-centric approaches. The combined market share increase from 32.3% to 34.7% underscores their strengthening positions in the private sector, though this concentration also raises considerations about market competitiveness.

Key Findings

1. **Growth Resilience:** Both insurers demonstrated remarkable growth resilience during pandemic periods, leveraging digital transformation and evolving customer needs.
2. **Service Excellence:** Superior claim settlement ratios (both above 98%) significantly exceed industry averages, reflecting operational excellence and customer commitment.
3. **Strategic Differentiation:** ICICI Prudential leverages scale and distribution advantages, while HDFC Life emphasizes service quality and growth aggressiveness.
4. **Income Optimization:** Income growth outpacing policy growth indicates successful premium optimization and product mix strategies.
5. **Market Leadership:** Both companies strengthened market positions despite intense competition, demonstrating sustainable competitive advantages.

Recommendations

For Insurers:

1. Continue investing in digital infrastructure to enhance customer experience and operational efficiency
2. Develop innovative products addressing evolving customer needs, particularly in health and retirement segments
3. Expand distribution reach in tier-2 and tier-3 cities for untapped market potential
4. Maintain focus on claim settlement excellence as a key differentiator
5. Leverage data analytics for personalized product offerings and customer engagement

For Policymakers

1. Monitor market concentration trends to ensure competitive marketplace dynamics
2. Strengthen consumer protection frameworks emphasizing claim settlement standards
3. Facilitate digital insurance penetration through supportive regulatory frameworks
4. Encourage industry-wide initiatives for financial literacy and insurance awareness

For Consumers

1. Evaluate insurers holistically considering claim settlement ratios, financial strength, and service quality
2. Leverage competitive dynamics for optimal product selection and pricing
3. Utilize digital platforms for convenient policy management and service access
4. Review policy portfolios periodically to ensure adequate coverage aligned with life stage needs

Future Research Directions

This study opens several avenues for future research:

1. Qualitative analysis of customer satisfaction and service experience across insurers
2. Investigation of digital transformation impact on operational efficiency and customer acquisition
3. Examination of product portfolio strategies and their alignment with customer needs
4. Analysis of distribution channel effectiveness across online, bancassurance, and agency models
5. Longitudinal study extending beyond FY 2024-25 to capture emerging trends and disruptions

Contribution to Knowledge

This research contributes to insurance literature by providing empirical evidence of competitive dynamics between India's leading private life insurers during a transformative period encompassing pandemic disruption, digital acceleration, and regulatory evolution. The integrated analysis of operational and financial metrics offers insights valuable for academic

researchers, industry practitioners, investors, and policy planners.

The findings validate several theoretical propositions from prior research while revealing context-specific insights about the Indian life insurance market. The study demonstrates that sustainable competitive advantage in insurance markets derives from balanced excellence across operational efficiency (claim settlement), distribution reach (policy numbers), financial performance (income growth), and strategic positioning (market share).

In conclusion, both ICICI Prudential Life and HDFC Life exemplify excellence in India's life insurance industry through differentiated strategies aligned with their organizational strengths. As the sector continues evolving with technological disruption, changing customer expectations, and regulatory developments, these industry leaders' ability to adapt and innovate will determine their continued success in an increasingly competitive marketplace.

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PUBLIC PERCEPTIONS OF MUNICIPAL SERVICES: A STUDY OF SMART CITY, BHUBANESWAR IN ODISHA

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ABSTRACT

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The objective of the study is to analyse the perceptions of people about smart city of Bhubaneswar in Odisha. The study takes a primary study of 205 respondents from the slum areas of Bhubaneswar from the time period of October 2023 to March 2024 to examine socio-economic profiles and perception of smart city services. The sample shows the income level of individuals, which is below 30,000, as a benchmark and a non-normal income distribution. Perception results are mixed and polarized on the basis of infrastructure, water, waste, and healthcare score relatively well, while awareness, financial transparency, and grievance redressal score poorly. Regression and non-parametric tests show income, education, and job type influence satisfaction, but most models explain little variance, implying important unmeasured factors. Policy priorities emerging are improved transparency, stronger grievance mechanisms, targeted outreach, and gender-sensitive, employment-linked interventions.

KEYWORDS: ***Bhubaneswar Municipality Corporation, Development, Perception of Residents, Socio-Economic Profile, Smart City***

INTRODUCTION

Rapid urbanization and the push for technology-driven governance have made "smart city" initiatives a central pillar of contemporary urban policy in India. These initiatives promise improved service delivery, better infrastructure, and more responsive local governance, but their success ultimately depends on how residents experience and perceive those changes, particularly in vulnerable communities that often bear the brunt of urban inequities. This paper examines resident perceptions and opinions of Bhubaneswar Municipal Corporation (BMC) services using a primary survey. By focusing on low-income neighbourhoods, the study foregrounds voices that are frequently underrepresented in municipal evaluation: those for whom service reliability. transparency, grievance redressal, and livelihood impacts matter most. In this paper, the perceptions of people of Bhubaneswar about smart city is analysed.

LITERATURE REVIEW

Smart city initiatives should balance technological investments with social/civic capacities, where strategy must include people, institutional arrangements, and governance, not only sensors and platforms. Smart city is a multi-dimensional concept which covers Information and technology, governance, people/skills, economy, environment, liveability, etc. There is useful taxonomy and synthesis, which is limited in empirical testing, mainly conceptual or theoretical in nature(Sinkiene et al., 2014).Municipalities should audit their organizational capacity and community readiness before adopting participatory tech, plan for moderation, outreach, and multi-channel engagement. there is one review paper that has been made of online participatory tools(OPTs) for planning, integrating planning, organization, and information-science literature to provide criteria for tool selection. Practical, planning-oriented guidance that bridges tech and institutional realities not an empirical evaluation of tool performance(Afzalan et al., 2017). Smart-city discourse is shaped by long-term urban visions and recent knowledge economy policy. Technology push (market for solution)interacts with cities' demand for efficiency and sustainability. Historical and conceptual tracing of the smart-city idea, which identifies forces shaping the concept in terms of urban futures visions, knowledge/innovation economy, technology push, and demand pull from cities. The smart city stakeholder ecosystem is complex, and risks include drifting away from civic goals as commercial interests and fragmented agendas shape deployments. Strategic planning must retain normative urban goals in terms of equity, accessibility, and avoid treating smartness as only a technology or vendor problem. Strong conceptual framing argues convincingly for strategic planning and stakeholder alignment(Angelidou, 2017). Solid technical contribution in terms of MDTW adaptation, simulation is context specific, and practical implementation needs consideration of privacy, data governance, and driver behaviour heterogeneity. The paper proposes a practical framework to collect electric-vehicle(EV) trajectory data via edge devices, detect drivers' route preferences, and simulate pricing strategies for charging

stations. Empirical tests with the real EV trajectories for simulation experiments.(Hu et al., 2019).

Perception gaps between administrators and citizens matter politically and for legitimacy as governments must monitor public perceptions and link efficiency reforms with protecting core services. The paper compares perceptions of ordinary citizens vs municipal decision makers about service changes during cutbacks in the 1990s.there are surveys and attitudinal analysis has been made. Decision-makers were more likely than citizens to view service changes positively and to support cutbacks or shifting responsibilities away from municipalities. Citizens perceived declines in key services in terms of healthcare and childcare, and resisted further reductions. Citizens' negative perceptions of service declines are associated with resistance to further reforms, where decision makers' positive perceptions are correlated with support for continued retrenchment(Blomberg, 1999).Policy/finance reforms that rely on complex instruments need careful institutional capacity-building and critical assessment of narratives that can normalise risky practices. Sociological /process tracing analysis of how narratives shaped the expectations and adoption of financial derivatives by municipalities. There are interviews and comparisons mode has been accepted. Deep qualitative insight into expectation formation, which is useful for understanding municipal decision-making beyond pure econometrics(Fastenrath et al., 2018). Design of fiscal decentralisation and equalisation requires close calibration to local cost structures, where fiscal rules that look good at the aggregate level can mask local inequities. There is solid fiscal analysis with policy relevance, context specific to Slovenia's institutional framework. There is an analysis of Slovenia's system for financing municipalities and its compliance with decentralisation principles. There is the use of fiscal data from 2002 to 2009(Brezovnik & Oplotnik, 2012). Municipal financial problems are multi-causal; HR perceptions alone may not predict fiscal distress, which points toward the importance of institutional governance, revenue base, and broader fiscal rules. Useful local case study and institutional contextualisation; small sample and perception-based measures limit generalisability. There is a perceived HR risk that did not have a statistically significant influence on reported financial problems in the sample. The paper discusses municipal funding sources, MFMA responsibilities, and institutional requirements(Prinsloo, S; Walker, C; Botha, L; Bruwer, JP; Smit, 2016). Urban environmental monitoring needs expansion beyond priority pollutants, which as emerging contaminants, require updated monitoring strategies. There are no target approaches that reveal pollutants not covered in routine monitoring, where snow sampling provides a useful passive integrative sample for winter atmospheric deposition(Mazur et al., 2017). Local revenue mobilisation requires public education, transparency about spending, and trust building. This connects to municipal finance discussions, where revenue utilization and perceptions are discussed. There is useful empirical evidence in an African informal sector context, which is targeted at tax administration rather than general municipal service perceptions. There is low tax knowledge and a weak perceived benefit from taxes, where high non-payment rates. Perceptions of how the government spends taxes affect compliance. There is a survey of 400 small traders on tax knowledge and perceptions in Obuasi municipality. There is divergence between expert/official views and citizen perceptions on the role of narratives in shaping official choices. For Bhubaneswar, this underscores the finding that governance/transparency perceptions lag behind infrastructure satisfaction, as there is governance legitimacy is a crucial policy target(Anane & Asamoah, 2015).

MATERIALS AND METHODS

The study used a primary survey of 205 randomly selected respondents from slum areas of the Bhubaneswar Municipal Corporation (October 2023–March 2024). It examined socio-economic characteristics (income, consumption, savings, years of residence, age, gender, education) and perceptions of smart city services, including awareness, usability, infrastructure, waste management, water and electricity, safety, transparency, healthcare, job opportunities, and municipal growth. Respondents were asked about their knowledge, usage, and satisfaction with various BMC services and smart city initiatives. A domain was considered developmentally on track when at least 50% of residents expressed satisfactory responses to related questions.

RESULTS

Socio-economic profile of the residents and their perception analysis, based on data collected during the field survey.

Table 1: Test Result of Frequency & Percent of Socio-Economic Variables

Variable	Category under Variable	Frequency	Percent
Gender	Male	98	47.8
	Female	107	52.2
Education Level	Below 10th	83	40.5
	10th to 12th	38	18.5
	12th to 15th	84	41
Job Cat	Business	58	28.3
	Custodial	81	39.5
	Clerical	66	32.2
Year of Living	Below 10 yr	69	33.7
	10yr to 20yr	61	29.8
	20yr to 30yr	75	36.6
Marital Status	Married	158	77.07
	Unmarried	47	22.93
Age	20 to 30 yr	87	42.44
	30yr to 40 yr	63	30.73
	40yr to 50 yr	55	26.83

Source: Primary Data

Table- 1 shows the descriptive analysis of the demographic profile of 205 respondents, showing a slightly female-majority sample (52.2%). Education levels are bimodal, with most respondents either below 10th standard (40.5%) or in the 12th–15th range (41%). Occupationally, the sample is largely working-class, dominated by custodial (39.5%) and clerical jobs (32.2%). Residency duration is well distributed, with both long-term settlers and newer residents represented. Most participants are married (77.07%), and the age distribution is concentrated among young to middle-aged adults (20–50 years). Overall, the sample reflects a working-class, predominantly married population with diverse residency experience and a slight female majority.

Cronbach's Alpha; Reliability statistics

Table 2: Test Result of Cronbach's Alpha

Item-Total Statistics				
	Scale Mean if Item Deleted	**Scale Variance if Item Deleted**	**Corrected Item-Total Correlation**	**Cronbach's Alpha if Item Deleted**
Awareness of Smart City & Facilities	25.00	49.127	-.026	.746
Use of Smart City Services?	24.83	41.119	.471	.696
Rating on Financial Management	24.42	43.657	.301	.717
Safety & Security Level	24.89	44.910	.306	.715
Grievance in Municipality	24.82	43.430	.338	.712
Growth of BMC's Expenditure	24.95	42.390	.449	.700
Satisfaction Level of Roads and Infrastructure	25.11	43.871	.316	.715
Satisfaction level Water & Electricity Supply	25.28	46.770	.167	.728
Satisfaction level Waste Management (Garbage Collection, Recycling)	24.93	43.264	.416	.704
Satisfaction Level Healthcare Facilities (BMC Hospitals, Clinics)	25.13	44.507	.375	.709
Satisfaction Level Parks, Gardens, and Recreational Spaces	25.28	45.204	.358	.712
Satisfaction Level, Transparency, and Communication on Operational Work	25.19	43.505	.391	.707
Satisfaction Level Job Opportunities	25.17	45.002	.282	.718
Satisfaction level Smart City Initiative	25.10	42.000	.595	.688
New Residential and Commercial Developments	25.09	46.702	.117	.736
Effectiveness of utilisation of revenue	25.41	45.999	.365	.713

Source- Author's calculation

The above Table 2 shows the reliability analysis of the data set. This shows the internal consistency among the variables. The value of Alpha is 0.727, as it indicates that the data is acceptable and has reliability. It indicates that the set of 16 variables moderately consistently measures the same overall construct. It has been proven that the questionnaire is reasonably reliable, but a few items may be weakening internal consistency.

There is a low corrected item as total correlation is less than 0.3, which means that the item does not align well with the rest of the scale. In awareness about the smart city case, the value is -0.026, which signifies the negative correlation. In the water & Electricity Satisfaction level, it has 0.167, and in the New Residential development level, it is 0.117; these items are not contributing much to overall reliability. The two rates are not aligned at all in their scoring, so this could be due to different rating criteria. Reliability of the Alpha value is ok overall, but can be improved by removing or revising a few low-performing items.

Perception Analysis of Sample Residents of BMC

Table 3: Frequency & Percentage of Perception Analysis of Sample Residents of BMC

Variable	Rank	Frequency	Percentage
Use of Smart City Services	Agree	60	29.27
	Strongly Agree	10	4.88
	Neutral	20	9.76
	Disagree	50	24.39
	Strongly Disagree	65	31.71
Rating on Financial Management	Agree	45	21.95
	Strongly Agree	35	17.07
	Neutral	32	15.61
	Disagree	52	25.37
	Strongly Disagree	41	20.00
Safety & Security of Smart City	Agree	45	21.95
	Strongly Agree	45	21.95
	Neutral	32	15.61
	Disagree	42	20.49
	Strongly Disagree	41	20.00
Grievance in Municipality	Agree	62	30.24
	Strongly Agree	31	15.12
	Neutral	30	14.63
	Disagree	26	12.68
	Strongly Disagree	56	27.32
Growth of BMC	Agree	37	18.05
	Strongly Agree	45	21.95
	Neutral	21	10.24
	Disagree	52	25.37
	Strongly Disagree	50	24.39
Satisfaction Level in Road & Infrastructure	Agree	47	22.93
	Strongly Agree	40	19.51
	Neutral	21	10.24
	Disagree	45	21.95
	Strongly Disagree	52	25.37
Satisfaction Level in Water & Electricity Supply	Agree	52	25.37
	Strongly Agree	38	18.54
	Neutral	30	14.63
	Disagree	49	23.90
	Strongly Disagree	36	17.56
Waste Management	Agree	45	21.95
	Strongly Agree	43	20.98
	Neutral	33	16.10
	Disagree	50	24.39
	Strongly Disagree	34	16.59
Healthcare Facilities	Agree	44	21.46
	Strongly Agree	51	24.88
	Neutral	23	11.22
	Disagree	46	22.44
	Strongly Disagree	41	20.00
Parks, Gardens, and Recreational Spaces	Agree	46	22.44
	Strongly Agree	52	25.37
	Neutral	12	5.85
	Disagree	52	25.37
	Strongly Disagree	45	21.95
Transparency and Communication on Operational Work	Agree	37	18.05
	Strongly Agree	43	20.98
	Neutral	10	4.88
	Disagree	57	27.80
	Strongly Disagree	58	28.29
Job Opportunities	Agree	48	23.41
	Strongly Agree	43	20.98

	Neutral	11	5.37
	Disagree	50	24.39
	Strongly Disagree	53	25.85
Effectiveness of the Utilization of Revenue	Agree	37	18.05
	Strongly Agree	53	25.85
	Neutral	22	10.73
	Disagree	45	21.95
	Strongly Disagree	49	23.90

Source- Primary data and Author's Calculation

The perception analysis table-3 shows mixed but largely negative views on several smart city services. Most respondents are dissatisfied with the use of smart city services (56.1% negative) and express low adoption. Financial management perceptions also lean negatively, with limited confidence in BMC's fiscal practices. Safety and security receive balanced responses with a slight positive tilt, while grievance redressal remains highly polarized. Perceptions of BMC's growth and road infrastructure are mostly negative, indicating dissatisfaction with development and service efficiency. Water and electricity supply receive moderately positive responses, and waste management is viewed as average, with nearly equal satisfaction and dissatisfaction. Healthcare facilities are among the better-rated services, though opinions remain divided. Parks and recreational spaces show strong polarization. The weakest area is transparency and communication, where over half of the respondents report dissatisfaction. Job opportunities and revenue utilisation also attract substantial negative feedback. Overall, while basic services like healthcare and utilities fare comparatively better, residents show significant concerns regarding governance, transparency, infrastructure quality, and employment-related outcomes.

Table 4: Descriptive Statistics of Perception Analysis of Sample Residents of BMC

	Awareness	Usability of Smart City Services	Rating on Financial Management	Safety & Security Level	Grievance in Municipality	Growth of BMC's Expenditure	Roads and Infrastructure Work	Water & Electricity Supply	Waste Management	Healthcare Facilities	Parks, Gardens, and Recreational Spaces	Transparency and Communication on Operational Work	Job Opportunities	Smart City Initiative	New Residential and Commercial Developments	Effectiveness of utilisation of revenue
Mean	7.50	7.92	7.36	8.00	7.97	7.87	8.31	8.26	8.50	8.90	8.62	8.46	9.25	9.23	9.66	9.91
Standard Error	0.31	0.33	0.33	0.32	0.32	0.32	0.29	0.32	0.30	0.32	0.32	0.30	0.32	0.33	0.31	0.33
Median	7.00	7.50	7.00	7.00	7.50	8.00	8.00	8.00	9.00	9.00	9.00	8.00	10.00	9.50	10.00	10.00
Mode	1.00	6.00	1.00	2.00	4.00	6.00	8.00	1.00	9.00	7.00	7.00	3.00	14.00	5.00	15.00	15.00
Standard Deviation	4.48	4.77	4.74	4.57	4.63	4.59	4.24	4.58	4.28	4.61	4.66	4.38	4.59	4.69	4.53	4.71
Kurtosis	-1.07	-1.27	-1.25	-1.15	-1.21	-1.11	-0.95	-1.14	-1.01	-1.19	-1.22	-1.13	-1.09	-1.30	-1.22	-1.08
Skewness	0.25	0.18	0.25	0.19	0.22	0.15	0.02	0.00	0.00	-0.10	-0.09	0.08	-0.32	-0.14	-0.27	-0.39
Range	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Minimum	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Maximum	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00
Sum	1559.00	1648.00	1530.00	1664.00	1657.00	1636.00	1729.00	1718.00	1769.00	1851.00	1792.00	1760.00	1924.00	1919.00	2010.00	2062.00

The descriptive statistics, table-4, show that perceptions are highest for revenue utilisation, new residential development, job opportunities, and overall smart city initiatives, all with mean scores above 9, indicating strong approval of urban development efforts. Lower-rated areas include financial management, awareness, and grievance handling, reflecting weaker satisfaction with governance and citizen support systems. High standard deviations and a full 1–16 rating range indicate wide variability and polarized opinions. Skewness values near zero and negative kurtosis suggest broadly spread, nearly symmetrical responses. Mode values reveal strong contrasts: some variables with high averages still show many very low ratings (e.g., awareness, financial management), while development-related variables show clusters of very high ratings.

Infrastructure, utilities, waste management, and healthcare receive generally positive evaluations, whereas grievance redressal, financial management, and transparency record lower trust levels. Overall, public perception is most favourable toward physical development and revenue utilisation but remains divided on governance quality, communication, and administrative efficiency.

Correlation Matrix on Perception of the Residents:

Table 5: Correlation Matrix of Socio-Economic Profile of Sample Residents of BMC

Variable	Age	Gender	Education Level	Job Cat	Year of Living	Income (Per Month)	Expenditure on Education	Expenditure on Food	Expenditure on House Maintenance	Saving
Age	1									
Gender	-0	1								
Education Level	-0.1	-0.03	1							
Job Cat	0.1	-0.03	0.15	1						
Year of Living	0.05	-0.61	0.02	0.04	1					
Income (Per Month)	-0	-0.08	0.09	0.02	0.05	1				
Expenditure on Education	-0	0.08	0.01	-0.06	-0.12	0.28	1			
Expenditure on Food	-0.1	0.09	0.09	0.02	-0.05	0.21	0.26	1		
Expenditure on House Maintenance	-0.1	-0.17	0.14	0.02	0.12	0.07	-0.06	0.03	1	
Saving	0.02	-0.09	0.04	0.03	0.08	0.85	-0.15	-0.11	-0.16	1

Source- Author's Calculation

The correlation analysis table 5 shows a very strong positive relationship between income and savings (0.85), indicating that higher-income households save more. Income also has a moderate positive link with education expenditure (0.28), and education and food expenditure are weakly correlated (0.26). A strong negative correlation between gender and years of living (-0.61) suggests gender-based settlement patterns over time. Savings show small negative associations with house maintenance and education spending. Most other correlations are near zero, indicating minimal linear relationships among age, job category, education level, and expenditure patterns. Overall, savings are largely income-driven, while other spending relationships are weak and reflect only minor trade-offs.

Table 5: Normality Test of Income of the Respondent

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Income of the Respondent	.172	205	.000	.924	205	.000
a. Lilliefors Significance Correction						

Extreme Values				
			Case Number	Value
Income of the Respondent	Highest	1	13	24000.00
		2	83	24000.00
		3	85	24000.00
		4	89	24000.00
		5	92	24000.00[a]
	Lowest	1	32	12000.00
		2	19	15000.00
		3	10	15000.00
		4	205	16000.00
		5	204	16000.00[b]
a. Only a partial list of cases with the value 24000.00 is shown in the table of upper extremes.				
b. Only a partial list of cases with the value 16000.00 is shown in the table of lower extremes.				

The Above table-5 shows the normality test of Income based on the Kolmogorov-Smirnov and Shapiro-Wilk tests. Both tests show P-values of 0.000(Less than 0.05), meaning the income of the respondent is not normally distributed. This implies we may go for the non-parametric statistical methods for the analysis involving the variable.

Multiple respondents have an income of 24,000, and some respondents have a low income as low as 12,000,15,000, or 16,000. These extremes are not necessarily "Outliers" in a statistical sense, but they mark the range limits. The repeated extreme values suggest the data might be clustered at certain

fixed salary points, not spread smoothly like a normal curve. The presence of multiple maximum values(24,000) may indicate a ceiling effect, as some respondents might be at the top of a fixed pay range.

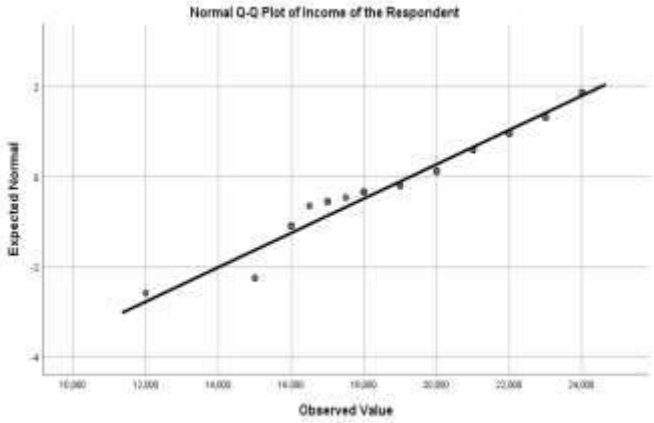


Fig.1: Normal Distribution of Income through Q-Q Plot

The above figure no.1 shows the Normal Q-Q plot for the Income of the Respondents. This Q-Q plot compares the distribution of the data to a perfectly normal distribution. If the Data were normal, all points would closely follow the diagonal reference line. But the Points at the lower income end(around 12,000-15,000) are below the line, indicating a negative skew in that tail, more low-income values than expected in a normal distribution. Data points in the mid-income range(16,000-20,000) align fairly well with the line, suggesting moderate fit in the center of the Distribution. At the Higher end(22,000-24,000), points are above the line, showing a positive skew pattern, as more high-income cases are at the extreme than a normal curve would predict. The pattern curves slightly away from the line at both ends, meaning the distribution is not perfectly normal as likely due to clustering at fixed salary points and the ceiling effect seen in our descriptive statistics.

The above diagram and the test result show that the income variable is not normally distributed.

T Test

For the analysis of T T-test, here the Research Hypothesis has been set with a test value.

Research Hypothesis: The income of the people has increased by ₹30,000 as a result of the benefits provided by the Smart City initiative.

Statistical Hypothesis

Null: There is no significant difference in the income & the Smart City initiative.

Alt: There is a significant difference in the income & the Smart City initiative.

Table 6.T Test of the Variable Income as a test value of 30,000

One-Sample T Test						
	Test Value = 30000					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Income of the Respondent	-58.335	204	0.000	-10707.3	-11069.2	-10345.4

The above table-6 shows the one-sample t-test of the Continuous Variable, i.e, Income, with a test value of Income, i.e,30,000. The result shows that the sample mean of income is significantly lower than 30,000. The t-statistic of -58.33 indicates a very large difference, and the p-value(0.000) shows this is highly statistically significant. The 95% confidence interval does not contain 0, reinforcing that the true mean income is very likely below 30,000. The average income shortfall is about 10,707. If 30,000 is considered a target income (e.g, Living Wage, Minimum Standard, Policy Benchmark), then the population is facing substantial income insufficiency.

Independent Sample T test

For the Analysis of the Independent Sample t-test, there is a comparison has been made between the categorical value & the Continuous Variable.

Research Hypothesis: Male Employees are paid more in salary in comparison to female Employees.

Statistical Hypothesis:

Null: There is no significant difference in the salaries of male and female employees.

Alt: There is a significant difference in the salaries of male and Female Employees

Table 7:Independent Sample T Test of the Income between Male & Female

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Income of the Respondent	Equal variances assumed	0.11	0.74	1.16	203	0.25	426.52	367.14	-297.37	1150.42
	Equal variances not assumed.			1.16	200.7	0.25	426.52	367.43	-297.99	1151.03

Source- Author's Calculation

The above table- 7 shows the T Test of the Sample of Categorical Value, i.e, Male & Female, with the continuous Variable Income of them. The result signifies the P-value, which shows that there is a statistically insignificant result in nature, as the value is 0.25. The mean income difference of 426.52 between the two groups is not statistically meaningful. The confidence interval includes 0, indicating that he true mean difference could be positive, negative, or zero. So there is no significant difference in the income between the two groups, which is compared above. This suggests that the income is not significantly affected by the grouping variable, like(Gender, Region, etc.).

Mann-Whitney Test

Table 8. Mann-Whitney Test between Income and the Categorical Variables

	Dependent Variable: Income					
Variable	Group 0	Group 1	Rank Sum	Adjusted Variance	z	p value
Satisfaction with Road & Infrastructure	108	97	21115	174604.26	1.7	0.089
Health Care Facilities	96	109	21115	174404.25	-1.604	0.108
Parks, Gardens & Recreational Activities	107	98	21115	174770.93	3.506	0.000
Job Opportunities	103	102	21115	175104.27	0.528	0.597
Job Category	103	102	21115	175104.27	-2.27	0.002
Usability of Smart City Services	115	90	21115	172504.21	0.975	0.3295
Education	96	109	21115	174404.25	1.044	0.296
Gender	101	104	21115	175070.94	-0.768	0.442
Year of Living	106	99	21115	174904.27	0.909	0.363
Growth of BMC	100	105	21115	175004.27	-0.253	0.8
Effective Utilisation of Revenue	97	108	21115	174604.26	-1.137	0.255

The above table 8 shows that only two variables show a statistically significant difference in income. In the recreational Activities like Parks, Gardens, and other recreational things of the Local Government has a significant impact on the income of the Residents of the Smart city. People who differ in satisfaction with recreational infrastructure have significantly different income levels. Higher satisfaction might be associated with Higher income and vice versa.

Another variable is Job Category with the Income level, where the P Value is 0.002 and the Z value is -2.270. Respondents grouped under different job categories have significantly different income levels, and job category is a direct cause of the income, and it has been considered a direct determinant, so the result is logical.

Despite this, all the variables have P values>0.05, suggesting no statistically significant difference in income across the groups.

Krushal Wallis H Test Result

Table 9. Kruskal-Wallis Test with the Dependent Variable Income and Other Categorical Variables

Dependent Variable: Income

Variable	Chi-sq (with ties)	df	p-value	Significance
Growth of BMC	15.513	3	0.001	Significant
Satisfaction with Roads & Infrastructure	16.186	3	0.001	Significant
Health Care Facilities	13.786	3	0.003	Significant
Effectiveness of Revenue Utilisation	17.180	3	0.000	Significant
Year of Living	9.074	2	0.028	Significant
Satisfaction with Parks, Gardens & Recreation	9.067	3	0.044	Significant
Job Opportunities	12.655	3	0.005	Significant
Waste Management	17.898	3	0.000	Significant
Education Level	3.893	3	0.273	Not Significant

The table-9 results show that income varies significantly across several perception-based categories, including satisfaction with BMC's growth, roads and infrastructure, healthcare, revenue utilisation, job opportunities, parks and recreation, and years of living. Higher satisfaction in these areas generally aligns with higher income levels. Only education level shows no significant relationship with income, suggesting that income differences are not driven by educational attainment. Overall, multiple service-related perceptions are linked to income variation, whereas education has no meaningful impact.

Ordinary Logistic Regression

Table 10.Ordinal Logistic Regression of Smart City Services with other variables

LRchi2(4)	**8.65**
Prob>chi2	**0.07**
Log likelihood	**-276.11**
Pseudo R2	**0.02**

Use of Smart City Services	Coefficient	Std. err.	z	P>|z|	[95% conf. interval] Lower	[95% conf. interval] Upper
Year of Living	13625.00	141967.00	0.96	0.34	141999.00	4145.00
Log of Income	2.32	0.94	2.48	0.01	0.49	4.16
Education Level	0.05	0.15	0.36	0.72	-0.25	0.36
Gender	-0.48	0.36	-1.31	0.19	-1.19	0.24

The Above table- 10 shows that the Likelihood Ratio test checks whether at least one predictor has a non-zero coefficient. The P-value is 0.007, which means the model is not statistically significant at the 5% level. The log likelihood is -276.11, used for comparing nested models, and the Pseudo R2 is 0.02 tends to only 2% of the variation is explained by the predictors, which is weak in explanatory power. It means many other factors influence smart city services. Only Income has a statistically significant and positive effect on the smart services usage, and other variables do not show a significant effect in this model.

Table 10.1.Ordinal Logistic Regression of Financial Management with other variables

LRchi2(4)	**11.59**
Prob>chi2	**0.01**
Log likelihood	**-272.06**
Pseudo R2	**0.02**

Rating on Financial Management	Coefficient	Std. err.	z	P>|z|	[95% conf. interval] Lower	[95% conf. interval] Upper
Education Level	0.52	0.16	3.28	0.00	0.21	0.83
YearofLiving	-0.01	0.01	-0.41	0.69	-0.04	0.02
Gender	-0.12	0.33	-0.36	0.72	-0.77	0.53

The above table 10.1 shows that the chi-square value is 11.59 and the p-value is 0.01, which is statistically significant at the 5% level. This means at least one of the predictors is significantly associated with the dependent variable. Pseudo R2 is 0.02 tends to explain only 2% of the variation is explained by the predictors which is weak in explanatory power.

Education level is the only statistically significant predictor. Each one-unit increase in education level increases the odds of giving a higher financial management score by 0.52. Year of living and Gender show no meaningful effect in the analysis.

The model is statistically significant overall, but practical predictive power is weak as the low Pseudo R2.

Table 10.2.Ordinal Logistic Regression of Roads & Infrastructure with other variables

LRchi2(4)	**12.72**
Prob>chi2	**0.01**
Log likelihood	**-276.26**
Pseudo R2	**0.02**

Satisfaction level on Roads and Infrastructure	Coefficient	Std.err.	z	P>|z|	[95% conf. interval] Lower	[95% conf. interval] Upper
YearofLiving	0.03	0.02	1.88	0.06	0.00	0.06
LogofIncome	2.06	0.93	2.21	0.03	0.23	3.88
Age	-0.03	0.02	-1.89	0.06	-0.07	0.00

The above table 10.2 shows that the chi-square value is 12.72 and the P value is 0.01 signifies that the model is statistically significant overall at the 5% level, which means at least one predictor has a significant association with satisfaction levels.Pseudo R2 is 0.02 tends to explain only 2% of the variation is explained by the predictors which is weak in explanatory power. Income is the only clearly significant predictor(p=0.03), with a strong positive effect. Year of living and Age are borderline significant values (P=0.06). The direction of effect is that longer residence is slightly higher satisfaction, and older age leads to slightly lower satisfaction. A unit increase in income increases the higher satisfaction by 2.06, which is substantial in magnitude.

Table 10.3.Ordinal Logistic Regression of Roads & Infrastructure with other variables

LRchi2(4)	**21.53**
Prob>chi2	**0.00**
Log likelihood	**-269.84**
Pseudo R2	**0.04**

Satisfaction level with healthcare facilities	Coefficient	Std.err.	z	P>|z|	[95% conf. interval] Lower	[95% conf. interval] Upper
YearofLiving	-0.06	0.02	-3.48	0.00	-0.09	-0.02
Age	0.04	0.02	2.32	0.02	0.01	0.07

The above table 10.3 shows that the value of chi-square is 21.53 and the p-value is 0.001, as it indicates that the model is highly significant overall, meaning the predictors jointly explain variation in satisfaction. Pseudo R-squared is 0.04, as about 4% of the variation in satisfaction is explained, and still a small effect size, but better than the earlier road & Infrastructure model. In the case of the Year of Living variable, for each additional year in the city, the log of income has a higher satisfaction drop of 0.06. This could suggest that long-term residents have seen a decline in health care quality or have higher expectations. In the Age variable, each additional year of age increases there is increment of satisfaction level by 0.04, possibly because older people use healthcare services more and perceive them more positively.

Table 10.4.Ordinal Logistic Regression of Smart City Initiative with other variables

LRchi2(4)	**100.60**
Prob>chi2	**0.00**
Log likelihood	**-220.03**
Pseudo R2	**0.19**

Satisfaction with Smart City Initiative	Coefficient	Std.err.	z	P>|z|	[95% conf. interval] Lower	[95% conf. interval] Upper
YearofLiving	-0.07	0.02	-4.52	0.00	-0.10	-0.04
Gender	-0.72	0.37	-1.96	0.05	-1.45	0.00
Age	0.16	0.02	7.66	0.00	0.12	0.20
Education Level	0.10	0.16	0.63	0.53	-0.22	0.42

The above table 10.4 shows the significant value as the chi-square value is 100.60, and the P value is 0.001. Pseudo R-squared value is 0.19, which indicates that about 19% of the variation in satisfaction is explained, which is relatively strong for social perception data compared to a previous study.

The longer someone has lived in the city, the less satisfied they are with the smart city initiative, possibly due to higher expectations or awareness of shortcomings over time. If the Negative coefficient corresponds to females, women might be slightly less satisfied, but he effect is small and only just significant. Age has the strongest effect as it shows older residents have a significantly positive approach to the smart city initiative.

Table 10.5.Ordinal Logistic Regression of Utilisation of Revenue with other variables

LRchi2(4)	**9.39**
Prob>chi2	**0.05**
Log likelihood	**-275.97**
Pseudo R2	**0.02**

Effectiveness of the Utilisation of Revenue	**Coefficient**	**Std.err.**	**z**	**P>|z|**	**[95% conf. interval] Lower**	**[95% conf. interval] Upper**
YearofLiving	0.00	0.01	0.25	0.80	-0.02	0.03
Education Level	0.19	0.15	1.22	0.22	-0.11	0.49
Gender	-0.73	0.36	-2.03	0.04	-1.44	-0.02
Age	0.03	0.02	1.66	0.10	0.00	0.06

The above table 10.5 shows the statistically significant value between the variables, but overall, the effect size is small due to the Pseudo R-squared, which is 0.02, as only 2% of the variation in perceptions is explained, indicating very low explanatory power compared to the smart city initiative model. The p-value is 0.05, and the chi-square value is 9.39.

Gender is the only statistically significant factor, but other variables have no significant value. The Model explains very little of the variation in satisfaction, suggesting perceptions of revenue utilisation might be influenced by other factors.

Table 10.6.Ordinal Logistic Regression of Waste Management with other variables

LRchi2(4)	**16.14**
Prob>chi2	**0.003**
Log likelihood	-230.02
Pseudo R2	**0.03**

Satisfaction level on Waste Management	**Coefficient**	**Std.err.**	**z**	**P>|z|**	**[95% conf. interval] Lower**	**[95% conf. interval] Upper**
Year of Living	0.04	0.01	-2.89	0.004	-0.08	0.01
Education Level	0.49	0.17	2.89	0.004	0.15	0.82

The above tables 10.6 show the statistically significant value overall, meaning the predictors jointly explain differences in satisfaction levels. The p-value is 0.003, and the chi-square value is 16.14. The model explains around 3% of the variance in satisfaction, which is small but meaningful. The Pseudo value is 0.03.Log likelihood is 0230.02, which is used for the model comparison and indicates a better fit. Both Predictors are statistically significant at the 1% level. If the year of living coefficient is negative, then the longer-term residents are more critical of waste management, possibly because they have seen little improvement over time or compare current services unfavourably to past expectations. Education shows a positive association, as more educated respondents may better understand or appreciate the waste management system of the smart city. Even though the model explains only 3% of the variance, the effects of education and residency duration are both clear and significant. Communication and service improvements may need to be targeted more towards long-term residents, who may be harder to please.

Table 10.7.Ordinal Logistic Regression of Water & Electric Supply with other variables

LRchi2(4)	**9.69**
Prob>chi2	**0.001**
Log likelihood	**-149.72**
Pseudo R2	**0.031**

Satisfaction level on Water & Electric Supply	**Coefficient**	**Std.err.**	**z**	**P>|z|**	**[95% conf. interval] Lower**	**[95% conf. interval] Upper**
YearofLiving	0.03	0.02	2.25	0.02	0.00	0.06

The above table 10.7 shows that the chi-square value is 9.69 and the p-value is 0.001, which indicates that the model is statistically significant overall as the predictors explain variation in satisfaction levels better than a null model. The R-squared value is 0.031, which indicates that the model explains about 3.1% of the variance, which is small but non-trivial for

social perception data. The value of log likelihood is -149.72, as lower than the null model, indicating improvement in fit. There is a positive association between years of living and the satisfaction level of water & Electric supply. Long-term residents tend to receive services positively as they have faced hardships earlier.

Table 10.8.Ordinal Logistic Regression of Recreational Activities with Other Variables

LRchi2(4)	**50.09**
Prob>chi2	**0.00**
Log likelihood	**-257.41**
Pseudo R2	**0.09**

Satisfaction level on Parks, Gardens, etc.	**Coefficient**	**Std.err.**	**z**	**P>|z|**	**[95% conf. interval] Lower**	**[95% conf. interval] Upper**
Age	0.08	0.02	4.45	0.00	0.04	0.11
YearofLiving	-0.06	0.02	-4.07	0.00	-0.09	-0.03
Gender	-1.06	0.36	-2.92	0.00	-1.76	-0.35

The above table 10.8 shows that the variable is highly statistically significant. The chi-square value is 50.09, and the p-value is 0.001, which shows that the predictors together explain a meaningful portion of the variation in satisfaction. The Pseudo R-squared value is 0.09, as it explains that about 9% of the variance is quite decent for perception-based data, and the log likelihood value is -257.41, indicating improvement in fit over the null model.

Older respondents have a positive effect on the parks, gardens, and other recreational initiatives of the smart city, possibly due to greater use for leisure, walking, or socialising with others. Longer term, Residents tend to be less satisfied, and this could point to service delineation, unfulfilled promises, or higher expectations. In the Gender Effect, women report significantly lower satisfaction could relate to safety concerns, maintenance issues, or accessibility in these public spaces.

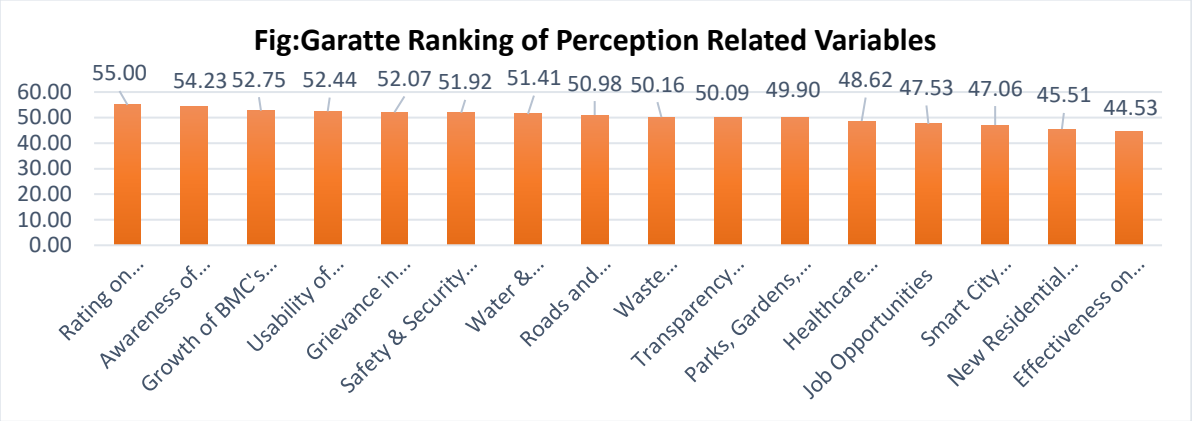
Garatte Ranking Technique

Table 11.Garatte Ranking Technique Between the Variables

Ranking on Slum Data		
Variable	**Average**	**Garatte Rank**
Rating on Financial Management	55.00	1
Awareness of Smart City & Facilities	54.23	2
Growth of BMC's Expenditure	52.75	3
Usability of Smart City Services	52.44	4
Grievance in Municipality	52.07	5
Safety & Security Level	51.92	6
Water & Electricity Supply	51.41	7
Roads and Infrastructure Work	50.98	8
Waste Management	50.16	9
Transparency and Communication on Operational Work	50.09	10
Parks, Gardens, and Recreational Spaces	49.90	11
Healthcare Facilities	48.62	12
Job Opportunities	47.53	13
Smart City Initiative	47.06	14
New Residential and Commercial Developments	45.51	15
Effectiveness of utilisation of revenue	44.53	16

The Garatte ranking shows that residents place the highest priority on governance-related aspects such as financial transparency, awareness, and grievance redressal. Core urban services like water, roads, and safety rank in the middle, indicating moderate satisfaction but room for improvement. Development-oriented factors—jobs, new projects, parks, and healthcare—rank lower, suggesting these are seen as less urgent compared to governance and service delivery issues. Overall, the results highlight the need for stronger transparency, better communication, and improved citizen outreach as key municipal priorities.

Fig.5: Garatte Ranking of Perception Related Variables



The fig.2 consists of ranking results showing that governance-related variables—financial management, smart city awareness, BMC's growth, service usability, and grievance redressal—are top priorities for residents. Mid-ranked factors include safety, water and electricity supply, and road infrastructure, indicating they are important but secondary to governance concerns. Lower-ranked items such as parks, healthcare, job opportunities, new developments, and revenue utilisation suggest these are seen as less urgent. Overall, residents prioritise transparent governance, effective communication, and accessible services over infrastructural or recreational enhancements, highlighting a gap in public understanding of revenue utilisation.

CONCLUSION

The perception of individuals is polarized, which is visible in infrastructure gains coexisting with widespread dissatisfaction with governance, transparency, and awareness. Socio-economic factors like income, education, and job category affect service uptake and satisfaction, but explain only a small share of perceptual differences. Long-term residents and women express distinct concerns with lower satisfaction in several domains, signalling the need for differentiated approaches. immediate municipal priorities which increase fiscal transparency, improve grievance redressal and communication, expand targeted outreach in slum communities, and link smart-city projects to local employment.

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DEVELOPMENT OF TOURISM THROUGH TOURIST CLUSTERS AS A PRIORITY OF STATE POLICY

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ABSTRACT **DOI No: 10.36713/epra25340** **Article DOI: https://doi.org/10.36713/epra25340**

The article presents information on the global situation and development trends in the tourism sector, which in recent years has been considered a priority area of economic development in Uzbekistan, and also examines the development of tourism through clusters.

In the article, the author analyzed the works of scientists regarding the emergence and development of the term "tourism cluster". Also, the regulatory and economic aspects of tourism clusters in Uzbekistan are disclosed, and the structure of the tourism cluster is developed. At the same time, tourism clusters that can be developed in the regions of Uzbekistan were identified, as well as problems that need to be solved in this regard, and proposals for them were developed.

KEY WORDS: ***Tourism, World Tourism Organization (WTO), Tourism Clusters, Structure Of The Tourism Cluster.***

INTRODUCTION

Today, one of the fastest growing sectors in the world economy is tourism. According to the World Tourism Organization (WTO), international tourism in 2024 recorded a pre-pandemic result of 99 percent. In particular, in 2024, the number of foreign tourists worldwide increased by 11% compared to 2023, and 140 million tourists stayed overnight in another country.[1]

In this regard, it can be observed that the number of foreign tourists visiting Uzbekistan has also increased significantly. According to open data from the Uzbek Tourism Committee, the number of foreign tourists visiting Uzbekistan in 2019 was 6.748 million, while in 2023 this figure will be 6.626 million.[2] people, more than 10 million tourists in 2024. [3]From the general trend, it can be concluded that the number of tourists visiting Uzbekistan increased by 49% **in 2024 compared to 2019 and by 51% compared to 2023. In addition, the "Uzbekistan-2030" strategy also plans to "increase the number of foreign tourists by 15 million** and the number of tourists arriving for **pilgrimage tourism by 3 million "** by 2030 .[4]

Based on the above trend, it is clear that the private sector, along with the state, needs to implement a number of changes and innovations in this direction. This means that "another important factor in the development of the sector is government (state) support [5]. "

Accordingly, in order to regulate the development of representatives of this industry, the state should unite representatives of the industry (tour companies, hotels, catering establishments, and interpreters) for a common goal or encourage representatives of the same type of industry located in the same region to join associations or unions.

In modern science, such concepts are conventionally called "clusters," and when applied to the field we are studying, they are called "tourism clusters" (tourist clusters).

MAIN PART

The term cluster was first introduced into economics by Michael Porter, one of the leading figures in management science, in his book " *The Competitive Advantage of Nations".*

According to Porter's theory, a cluster is "an association or association of manufacturing, service, and other related industries located in the same geographical area. They both compete and cooperate with each other. Through this, as representatives of one industry in a particular country or region develop, they increase their competitiveness with other regions [6].

[1]*World Tourism Organization (2025), World Tourism Barometer, volume 23, issue 1, January 2025, UN Tourism, Madrid, DOI: https://doi.org/10.18111/wtobarometereng*

[2] *https://uzbektourism.uz/research/statistics*

[3] *https://president.uz/uz/lists/view/8049*

[4] *Uzbekistan Republic The President's Strategy " Uzbekistan - 2030" dated September 11 , 2023 Decree No. PF-158*

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Organizations in the tourism sector were studied as a system at the end of the last century by Robert Christie Mill and Alastair Morrison [7](**in their book "The Tourism System"),** they studied these organizations not as clusters, but as cooperative organizations. The term tourism cluster was first proposed in science in the early 2000s by J. Jackson and P. Murphy.[8] In 2005, Kindl da Cunha and João Carlos da Cunha proposed a systematic model to assess the impact of tourism on local development [9]in their article "Proposal of a Systematic Model for Measuring the Impact of Tourism on Local Development - Competitiveness and Sustainability of Tourism Clusters". This model is based on the concept and typology of clusters and includes the assessment of competitiveness and sustainability in economic, social, cultural, environmental and political dimensions.

According to their definition, a tourism cluster is a collection of companies and institutions that are associated with a specific tourism product or group of products. These clusters are geographically concentrated in one place and represent a concentration of interconnected companies and institutions. This approach is important in developing strategies aimed at increasing competitiveness and sustainability in the tourism sector.

The model proposed by da Cunha and da Cunha provides a systematic approach to assess the impact of tourism clusters on the local economy, society and environment. This helps to define strategic directions in the formulation of tourism policy and the development of private sector strategies. Since the first decade of the 21st century, the term tourist cluster has been researched by scientists in various fields of economy. In particular Magdalena Kachevskaya [10], Ferrere and Estevao (2009) [11]S.Lade. (2010) studied the field of tourism and clusters. Fayez Solo and Cooper have stated that their work will further expand tourism clusters in the future and integrate with representatives of the education sector.

B. A. Eryomin, A. Yu. Alexandrova, Oksana V. Kolosova, A. Yu. Alexandrova E. V. Bogdanov and S. Yu. Scholars such as the Goldbergs have studied CIS tourism clusters. It should be noted that although there are not many studies on tourism clusters and their management in Uzbekistan, it is worth recognizing the research of some scientists in this regard. In particular, N. Hasanov [12]analyzed the tourist and recreational potential of the Jizzakh, Kashkadarya, and Surkhandarya regions of Uzbekistan in his research. Based on these analyses, it can be said that the development of tourist clusters in the above regions will also yield very good results.

D. Norkulova [13]studied the organizational and economic mechanisms of the development of social tourism services in Uzbekistan. A. Norchaev [14]paid more attention to the infrastructure part of tourism in his research. Z. Usmanova [15]analyzed the features and trends of the development of tourist and recreational services in Uzbekistan and presented tourism as the main driving force of the economy. Because one new job created in the tourism sector creates the basis for five new jobs created in other sectors. [16]

O. Khaitov also conducted scientific research in this area, and in his interpretation, "A tourism innovation cluster is an association of private and state enterprises, as well as state authorities and management bodies and local government bodies, in order to create a final highly competitive tourism product (service) based on innovative developments." [17]
In general, the word "cluster" and related concepts are widely used in international circles and in sciences (especially economics). However, the definition of this word and its lexical meaning in the Uzbek language are almost not covered in the literature. In particular.

The 2-volume "Russian-Uzbek Dictionary" published in 1983 did not provide an explanation of this word. The 5-volume " [18]Explanatory Dictionary of [19]the Uzbek Language" published in 2006 also does not provide this word and its related concepts.

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This somewhat complicates the use of this international term in the Uzbek language.[20]
Accordingly, we also researched the use of the term at the international and national levels.
The World Tourism Organization defines the term "tourism cluster" as follows: "A tourist destination is an area, with or without defined administrative boundaries, where visitors can spend their time (stay overnight).

It is important to note that the cluster (co-location) of products and services, as well as activities and experiences in the tourism value chain and the basic unit of analysis of tourism is important. The region brings together various stakeholders and can be further developed (forming larger regions and connecting together). It is also intangible with its image and identity, which can affect its competitiveness in the market.

By definition, the tourism sector is a cluster of production units in various sectors that provide consumer goods and services demanded by visitors. Such sectors are called tourism industries because attracting visitors forms the main part of the supply they generate, and without visitors their production would cease to exist to a significant extent .[21]

In short, the most important factors for success in tourism clusters are effective communication and collaboration.[22]
Although this area has been little studied in Uzbekistan, the term tourism clusters previously existed in some places in our legislation.

In particular, Article 19 of the Law of the Republic of Uzbekistan No. ZURQ-549 "On Tourism" of July 18, 2019 is called " Tourism Cluster" and according to it, **"** A tourism cluster is a set of independent organizations and individual entrepreneurs that provide comprehensive tourist services and other additional services necessary to meet the needs of tourists and excursionists.

Tourist clusters form, promote and implement tourist products in order to provide complex tourist services, increase the competitiveness and quality of tourist activities.

30 new industrial parks will be created in the republic by attracting private investment." large the planned establishment [23]of tourism clusters and, as mentioned above, there was a need to adopt a separate regulatory document on tourism clusters against the background of the development of the tourism sector. We mentioned this in our speeches and scientific articles., was adopted by Resolution No. 915 of the Cabinet of Ministers of the Republic of Uzbekistan dated December 30, 2024, "On Measures to Organize the Activities of Tourism Clusters."

According to this resolution, "a tourism cluster is a set of legal entities, as well as individual entrepreneurs, that provide complex tourism services and other additional services necessary to meet the needs of tourists and excursionists;" [24]and this resolution establishes the requirements for organizing tourism clusters and obtaining the status of a tourism cluster.

To summarize the above, a tourism cluster is a system of networks and enterprises formed to develop the tourism sector in a certain region, which includes hotels, transport, restaurants, cultural monuments, recreation areas and other service sectors. During our research, we developed a structure of a tourism cluster that is common to all, based on the results of studying tourism clusters in different countries. (Table 1)[25]

680 pages, volume 2 – 672 pages, volume 3 – 688 pages, volume 4 – 608 pages, volume 5 – 592 pages.
[20]Pardaev M.K. – Professor of Sam ISI, Doctor of Philosophy. Pardaev O.M. – Sam ISI - Dean of the Faculty of "Banking and Financial Services", Doctor of Philosophy. "Theoretical issues of the concept of a cluster and the specific features of its use in the tourism sector" "Current problems of the development of tourist clusters" / June 5, 2021. Materials of the International Online Scientific and Practical Conference. Samarkand, Sam ISI, 2021. – 11 pages.
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23The Strategy "Uzbekistan - 2030" of the President of the Republic of Uzbekistan dated September 11, 2023 Decree No. PF-158 https://lex.uz/ru/docs/-6600413
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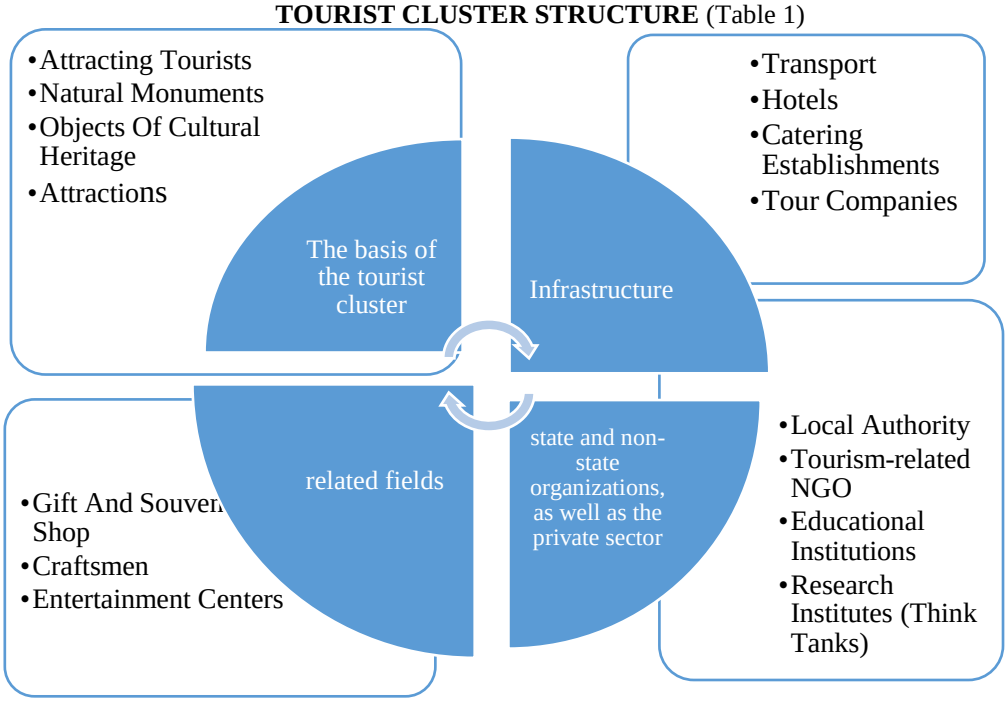
[25]Author development

TOURIST CLUSTER STRUCTURE (Table 1)



In the development of the tourism industry through a cluster, any region and space will have several advantages.
In particular, economic-social, cultural, ecological, infrastructural developments occur in this.

Since this article is more focused on the general aspects of tourism clusters, we will discuss the advantages in more detail in our other studies.

Accordingly, we have described the tourism clusters that can be developed based on the current conditions and opportunities in the regions of Uzbekistan. In doing so, we have divided the regions into regions. It can be said that we have focused on those regions with similar climates and territories and similar cultures, which have more comparative advantages. The positive side of this is that the development of such clusters can be used as a model for other regions with similar climates and territories.

In general, special attention is paid to innovations for the organization of tourist clusters in the regions of the republic. This scientific, material, informational, material , financial , unused and internal key resource elements such as intellectual includes .[26] In the region tourist clusters shaping for tourism resource cluster innovative potential assessment demand will be done.

CONCLUSION

According to data and forecasts from industry experts, international tourism is expected to continue to grow steadily in 2025. According to reports from the World Tourism Organization (WTO), the number of foreign tourists in 2025 is expected to increase by at least 3-5% compared to 2024. This means that the number of foreign tourists in 2025 will reach 145-150 million.[27]

Tourism is a diverse industry with many facets. A well-functioning cluster brings together industry representatives to drive regional development and sustainability.

In addition, clustering of tourism organizations serves as an important factor for their development at the international and macro level, despite the fact that the organizations compete with each other [28].

Clustering of tourism organizations in Uzbekistan will allow expanding, preserving and further developing not only natural and cultural monuments, but also modern recreation and health resorts. This will lead to the development of various types of tourism in each region and the acceleration of large-scale reforms by the state to improve infrastructure, attract investments and create favorable conditions for tourists, and in our opinion, state bodies should implement the first reforms in this regard.

Accordingly, the following are proposed for the development of tourism clusters in Uzbekistan .

1. Currently, the "Department for Diversification of Tourism Services and Infrastructure Development" of the regional tourism departments should be renamed "Department for Diversification of Tourism Services and Development of Tourism Clusters and Infrastructure" and the responsibilities of the specialist responsible for this should be changed to include issues related to the development of tourism clusters as the main tasks.

[26]*Khudaiberganov Dilshod Tukhtabaevich, Aminova Maqsuda Saminovna – "Opportunities for organizing tourist clusters" - "Current problems of developing tourist clusters" / June 5, 2021. Materials of the International Online Scientific and Practical Conference. Samarkand, SamISI,*

[27]*https://www.unwto.org/un-tourism-world-tourism-barometer-data*

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2. Opening of State Unitary Enterprises for the Development of "Tourism Clusters and Tourism Infrastructure" in Samarkand, Bukhara, and Tashkent regions.

Currently, representatives of construction and other sectors are responsible for the development of tourism infrastructure, but in most cases this task is assigned to them, so the issue of tourism infrastructure development falls into the background. Therefore, the opening of a separate organization for the development of touristic cluster and tourism infrastructure (as well as the opening of departments for ensuring safe tourism of the internal affairs bodies) ensures the rapid development of the tourism and cluster sector.

3. In educational institutions that provide education in the field of tourism, it is necessary to open a direction in tourism management (or change the specialization in tourism to tourism management) and train (including retraining) management specialists for clusters. The reason is that currently, specialists in the field of tourism are trained separately (tour operator, hotelier, restaurateur). In our opinion, for the effective management of tourism clusters, specialists with knowledge of most areas of tourism and qualifications in other necessary knowledge (foreign language, economics, politics) are required. Accordingly, if a direction in tourism management is established, it will be possible to solve the above problem.

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FINANCIAL LITERACY AND ITS IMPACT ON INVESTMENT BEHAVIOR: A QUANTITATIVE INVESTIGATION

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ABSTRACT **DOI No: 10.36713/epra25375** **Article DOI: https://doi.org/10.36713/epra25375**

Financial services play a vital role in driving economic growth by providing access to capital, risk management, and financial products. In this context, financial literacy is essential for the development of the financial sector. This research investigates how financial literacy influences investors' decision-making and satisfaction with their investments. The study explores the relationship between the financial knowledge of investors and their investment patterns, as well as the impact on their overall satisfaction with the investment outcomes. A convenience sampling method was used to collect primary data through a structured questionnaire administered to 100 respondents. The findings offer valuable insights for financial institutions, planners, and investment advisors, emphasizing the need to raise public awareness about financial literacy. By encouraging informed financial decisions, the study aims to contribute to better financial outcomes for individuals and corporations, thereby supporting the broader economic growth.

KEY WORDS: ***Financial Literacy, Investment Decisions, Investor Behaviour, Financial Awareness, Economic Growth***

INTRODUCTION

The financial services sector includes a broad range of activities such as banking, insurance, and investment management. It serves as a foundation for economic development by offering individuals and businesses access to capital, tools for managing risk, and a variety of financial products.

Financial literacy refers to an individual's understanding of financial concepts and their ability to make sound, informed financial decisions. It enables people to manage their money effectively, plan for the future, and navigate the complexities of the financial system.

Investment is a critical component of financial services, involving the allocation of money with the aim of earning returns. Investment options include stocks, bonds, mutual funds, real estate, and alternative assets. A strong grasp of investment principles is vital for wealth creation and achieving long-term financial objectives.

Enhancing financial literacy helps individuals make wiser investment choices by familiarizing them with concepts such as risk–return trade-off, diversification, compound interest, and available investment avenues. Higher financial knowledge promotes improved financial planning, greater savings, and more effective investment outcomes

LITERATURE REVIEW

Paula Andrea et al. (2025) this study reviewed financial literacy among university students, highlighting two main themes: financial knowledge and financial behavior. Key areas include gender differences, determinants of financial education, social awareness, financial well-being, and adoption of financial services. Limitations include restricted databases and keywords, suggesting future research should expand sources and terms to capture broader perspectives and improve coverage.

Vidhi Savaliya (2024) financial literacy is crucial for individuals to achieve their personal and financial goals, yet its level in India remains relatively low compared to developed countries. The study highlights that while return on investment is the primary factor influencing investment decisions, demographic factors such as age, gender, and income have little effect, emphasizing the need to promote financial literacy across all segments of society.

Shailendra Kumar Shukla (2024) this paper reviewed literature on financial literacy, examining its dimensions, determinants, and measurement tools. Findings indicate that financial literacy is influenced by demographics, education,

and location, with disparities across gender, income, and educational backgrounds. Promoting financial education and awareness through targeted initiatives is essential to improve financial knowledge, foster positive money attitudes, and support sound financial behavior

Pranusha U P (2023) financial literacy is crucial for personal financial management and national economic growth. It enables individuals to earn, save, invest, and manage money effectively. In India, only about 24% of the population is financially literate, limiting economic progress. Enhancing financial literacy across the population is essential for individual empowerment and the country's overall development

Anjana Raviprolu et al. (2020) the study revealed that students possess limited financial literacy, with awareness largely confined to basic financial schemes and minimal engagement in saving habits. Additionally, parental involvement in guiding financial decisions is low, underscoring the urgent need for enhanced education and support to improve students' financial knowledge, decision-making skills, and overall financial behaviour.

Financial Literacy and Investment Behaviour

Financial literacy refers to an individual's understanding of financial concepts, tools, and systems that enable effective management of money. It includes skills such as budgeting, saving, investing, and assessing financial risks, allowing individuals to make informed decisions, plan for the future, and navigate the complexities of personal finance.

Investment behavior involves the choices and actions individuals take regarding their investments. This includes decisions about asset allocation, diversification, risk tolerance, and selecting instruments like stocks, bonds, mutual funds, and real estate. Investment decisions are influenced by financial objectives, time horizons, risk appetite, market conditions, and personal preferences.

A strong grasp of financial literacy covers key concepts such as debt management, inflation, interest rates, savings, and the principles of investing, including risk-return relationships, diversification, and compounding. Effective financial management requires careful planning and budgeting to allocate resources efficiently and save for short-term and long-term goals, including emergencies, education, and retirement.

Understanding risk is an essential part of financial literacy, helping individuals evaluate their comfort with uncertainty and make investment decisions that align with their tolerance levels. Similarly, long-term financial planning, including retirement and estate planning, is closely linked to informed investment behavior. Staying updated on economic trends, market developments, and financial news is crucial for making sound decisions, as financial literacy is an evolving skill that requires continuous learning.

Overall, financial literacy equips individuals with the knowledge to make prudent financial choices, while investment behavior reflects the practical application of this knowledge. Together, they are critical for achieving financial goals, ensuring long-term security, and fostering overall financial well-being

Exploring the Importance of Financial Literacy and Investment Behavior among Investors

- **Smart Investment Decisions**
  Financial literacy enables investors to make informed choices by understanding financial concepts, investment options, and associated risks, allowing them to align decisions with their goals and risk tolerance.
- **Effective Risk Management**
  It equips investors to assess, manage, and diversify risks, promoting balanced and well-structured portfolios.
- **Fraud Prevention**
  Knowledgeable investors are better protected against scams and misleading investment schemes, reducing potential financial losses.
- **Strategic Financial Planning**
  Financial literacy emphasizes long-term planning, including retirement, major life expenses, and sustainable financial management.
- **Active Market Engagement**
  A solid understanding of financial markets encourages broader participation, contributing to market efficiency and economic development.
- **Behavioral Insights in Investing**
  Recognizing psychological factors such as overconfidence, risk aversion, and loss aversion helps investors make rational and effective decisions.
- **Policy Guidance and Educational Programs**
  Research on financial literacy informs policymakers and supports the creation of targeted educational programs to address knowledge gaps and improve financial behavior.
- **Wealth Growth and Economic Resilience**
  Financial literacy fosters wealth accumulation, responsible investing, and overall economic stability, promoting individual well-being and long-term economic growth.

RESEARCH METHODOLOGY

This observe turned into accomplished by way of amassing both primary and secondary data. The primary date accumulated as of 100 customers on convenient sampling foundation. We have been organized a structured questionnaire to acquire primary data. We had long gone thru the academic literatures, journals, magazines and additionally diverse sources of secondary facts were used for the observe.

Tool of Analysis

The primary and secondary data collected for the study has analysed practically and logically to find a conclusion. the statistical tools applied for data analysis are graphs, various test like ANOVA, Chi-Square etc.

DATA ANALYSIS

Level of basic financial literacy

1. **H_0 :** Respondents' do not agree with commonly held notions about financial literacy.
2. **H_1 :** Respondents' do agree with commonly held notions about financial literacy.

Result: Respondents' do not agree with commonly held notions about financial literacy. Hence, investors have basic financial literacy.

Relation between the percentage of income invested and the expected rate of return on investment

3. **H_0 :** There is no significance impact of the percentage of income invested on the expected rate of return on investment.
4. **H_1 :** There is significance impact of the percentage of income invested on the expected rate of return on investment.

Result: we can interpret that there is no significance corelation between the percentage of income invested by individuals and the expected rate of return on investment by individual.

The financial literacy level of respondents for different investment alternatives

- **Hypothesis for investment type (Factor A):**

1. **H_0**: There is no significance difference in financial literacy among different investment types (Equity, Preference stock, Mutual Funds, Life Insurance, Bonds).
2. **H_1**: There is significance difference in financial literacy among different investment types (Equity, Preference stock, Mutual Funds, Life Insurance, Bonds).

- **Hypothesis for Statement Veracity (Factor B):**

1. **H_0**: There is no significance difference in financial literacy among different statement veracities (True, False, do not know).
2. **H_1**: There is significance difference in financial literacy among different statement veracities (True, False, do not know).

- **Hypothesis for interaction:**

1. **H_0**: There is no interaction effect between investment type and statement veracity on financial literacy.
2. **H_1**: There is interaction effect between investment type and statement veracity on financial literacy.

In summary, the null hypothesis is rejected for the investment types and interaction sources of variation, suggesting that there is significance difference in financial literacy based on the type of investment and an interaction effect between investment type and statement veracity.

Gender and the tenure of the investment

Expected values X^2= 0.805336

So, X^2 = 0.805336

Result: Here, the X^2 tabulated is greater than X^2statistics.

So, the null hypothesis is accepted.

As per the result, we can say that there is no significance between the tenure of investment and gender.

Table 1:

ANOVA						
Source of Variation	**SS**	**Df**	**MS**	**F**	**P-value**	**F crit**
Between Groups	1832.1455	10	183.21455	0.0193402	0.899999253	2.53901
Within Groups	274757.2	44	6244.4818			
Total	276589.35	54				

Table 2:

ANOVA						
Source of Variation	**SS**	**Df**	**MS**	**F**	**P-value**	**F crit**
Between Groups	1717.7	4	429.425	0.594919	0.507052	3.55568
Within Groups	9269.25	15	617.95			
Total	10986.95	19				

Table 3:

ANOVA: Two-Factor with Replication ANOVA

Source of Variation	**SS**	**DfMS**		**F**	**P-value**	**F crit**
Sample	1533.667	3	511.2222	0.817338	0.496975	3.008787
Columns	110829.4	2	55414.69	88.59657	8.3E-12	3.402826
Interaction	9654.167	6	1609.028	2.572501	0.045562	2.508189
Within	15011.33	24	625.4722			
Total	137028.6	35				

Result: F critical value is less than the F statistic value, hence the hypothesis is rejected.

Table 4:

Gender	What is the tenure of the investment? Up to 1 year (Short term)	1-3 year (Medium term)	Above 3 years (Long term)	Grand total
Female	22	9.2	8.8	40
Male	33	13.8	13.2	60
Grand total	55	23	22	100

Table 5:

Observed	Expected	Difference	(O-E)2	X2 = (O-E)2/E
23	22	1	1	0.045455
32	33	-1	1	0.030303
10	9.2	0.8	0.64	0.069565
13	13.8	-0.8	0.64	0.046377
7	8.8	-1.8	3.24	0.368182
15	13.2	1.8	3.24	0.245455

The study examined the financial literacy and investment behavior of respondents through multiple dimensions, including basic financial literacy, investment preferences, and the influence of demographics on investment decisions.

Level of Basic Financial Literacy

The research first explored whether respondents agreed with commonly held notions about financial literacy. The hypothesis tested was:

- **H0:** Respondents do not agree with commonly held notions about financial literacy.
- **H1:** Respondents do agree with commonly held notions about financial literacy.

  The results revealed that respondents did not agree with commonly held notions, indicating that investors possess only a basic level of financial literacy.

Relationship between Income Invested and Expected Returns

The study also investigated whether the percentage of income invested affected the expected rate of return:

- **H0:** No significant impact of income percentage invested on expected returns.
- **H1:** Significant impact of income percentage invested on expected returns.

  Analysis showed no significant correlation, suggesting that the proportion of income invested does not directly influence investors' expectations of returns.

Financial Literacy across Investment Alternatives

The financial literacy of respondents was analyzed across different investment types (Equity, Preference Stock, Mutual Funds, Life Insurance, Bonds) and statement veracity (True, False, Do Not Know). The hypotheses tested included differences across investment types, statement veracity, and their interaction.

The results indicated significant differences in financial literacy based on the type of investment and a meaningful interaction between investment type and statement veracity. This highlights that investors' understanding varies across different financial instruments and contextual statements.

Gender and Investment Tenure

Chi-square analysis examined the relationship between gender and investment tenure (short-term, medium-term, long-term). The null hypothesis stated that no significant relationship exists. The calculated X^2 value (0.805) was less than the tabulated X^2, confirming the null hypothesis. Therefore, gender does not significantly influence investment tenure.

ANOVA Results

Analysis of variance (ANOVA) was conducted to examine differences in financial literacy across various factors:

- For investment types and interaction effects, F statistics exceeded F critical values, indicating significant differences.
- Within-group variations were not statistically significant.

These results further validate that financial literacy varies meaningfully depending on the type of investment and its associated statements.

FINDINGS

- **Basic Financial Literacy:** Investors generally possess only fundamental financial literacy, indicating a need for further education on financial concepts and instruments.
- **Investment Knowledge Varies by Type:** Understanding of financial instruments significantly differs across investment types, such as equity, mutual funds, insurance, and bonds.
- **Context Influences Understanding:** Investors' comprehension is affected by the framing of financial statements, highlighting the importance of clear and contextual financial information.
- **Demographics Have Minimal Impact:** Factors like gender and the proportion of income invested do not

significantly influence financial literacy or investment tenure.

- **Need for Targeted Education:** The study underscores the importance of tailored financial education programs to enhance informed decision-making, improve saving and investment behaviors, and promote long-term financial well-being

RECOMMENDATIONS

- **Implement Targeted Financial Education:** Develop programs focusing on investment instruments, risk management, and financial planning tailored to investor needs.
- **Promote Practical Investment Training:** Use workshops and simulations to help investors apply financial knowledge effectively in real-world scenarios.
- **Enhance Financial Communication:** Present investment information clearly and contextually to improve understanding of risks, returns, and options.
- **Integrate Financial Literacy in Education:** Include financial literacy in university and professional curricula to build long-term skills.
- **Leverage Technology and Tools:** Utilize apps, online platforms, and interactive resources to increase accessibility and continuous learning in financial literacy.

CONCLUSION

Overall, the study demonstrates that investors possess basic financial literacy, with notable variations across investment types and understanding of financial statements. Demographic factors such as gender and proportion of income invested do not significantly impact investment behavior or tenure. The findings underscore the need for targeted financial education programs to enhance investors' knowledge and facilitate informed decision-making, ultimately promoting more effective investment practices and financial well-being.

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EVALUATING THE FINANCIAL HEALTH OF INDIAN SMALL-CAP MANUFACTURING FIRMS USING A COMPOSITE FINANCIAL HEALTH INDEX (CFHI)

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Predicting financial distress in small-cap firms remains inconsistent, as reliance on individual classical models often yields conflicting signals. This study addresses this methodological issue by introducing a novel Composite Financial Health Index (CFHI), an integrated approach that combines the Altman Z-Score, Springate S-Score, Zmijewski X-Score, and Grover G-Score. Using the CFHI on a longitudinal dataset of 380 firm-year observations from Indian small-cap manufacturing companies (2015–2024), we first observe significant classification discrepancies among the standalone models, with distress rates ranging from 6.3% to 39.7% for the same firms. The CFHI offers a solution by providing a consistent, three-tier classification, highlighting a significant 'grey zone' (45% of cases) of moderate vulnerability that binary models tend to miss. Validation against key financial indicators shows that the CFHI depends mainly on liquidity and market valuation (β > 0.45) and reveals an important insight: for small caps, balance-sheet leverage (TL/TA) is a vital risk factor, unlike capital-structure leverage (D/E). The model explains over 73% of the variation in financial health, providing researchers with a reliable composite measure and offering investors and regulators a more sophisticated, detailed tool for risk analysis in emerging-market small-cap firms.

KEYWORDS: ***Composite Financial Health Index (CFHI), Financial Distress Prediction, Small-Cap Firms, Emerging Markets, Altman Z-Score, Bankruptcy Models, Indian Manufacturing Sector.***

1. INTRODUCTION

The assessment of corporate financial health is attracting the attention of scholars in accounting and finance (Abdelkader & Wahba, 2024; Horváthová et al., 2024). An accurate financial evaluation enables stakeholders to identify early warning signs, make informed capital-allocation decisions, and formulate effective regulatory policies (Manh et al., 2024). This issue is particularly salient for small-cap firms, which frequently encounter financial constraints, earnings volatility, and limited protection against economic shocks (Mahesh et al., 2025). In emerging economies such as India, small-cap manufacturers play a significant role in employment and industrial output (Nasrallah & El Khoury, 2022). However, they remain vulnerable due to restricted access to capital and heightened operational risks (Nguyen et al., 2017).

Traditionally, financial health and distress are predicted using accounting-based bankruptcy models (Abdelkader & Wahba, 2024; Alyasari et al., 2024). Key models by Altman (1968), Springate (1978), Zmijewski (1984), and Grover (2001) use financial ratios to classify firms as healthy or distressed (Fachrudin, 2020; Saha & Ahmed, 2024). These models are popular because they are simple and easy to understand, and they are used in many industries and regions. However, each model uses different ratios, weights, and cutoffs, which often yield different results across diverse groups of firms. This means relying on just one model can give a biased or incomplete view of a firm's financial health (Csikosova et al., 2019).

Recent research indicates that traditional distress-prediction models often struggle when applied to small-cap firms (Ragab & Saleh, 2022). These firms typically exhibit unstable profitability, substantial working capital requirements, and heightened sensitivity to debt (Mahesh et al., 2025). As a result, stringent models may generate false distress signals, whereas more lenient models may fail to identify genuine financial difficulties. For example, models emphasising liquidity and earnings volatility may overclassify firms as distressed, while those focusing on solvency may overlook early warning indicators (Saha & Ahmed, 2024). Such inconsistent outcomes undermine the reliability of individual models, particularly for small-cap manufacturers operating in cyclical industries.
In response to these challenges, researchers recently advocated adopting composite or hybrid approaches that integrate multiple distress prediction models (Fernando et al., 2019;

Habib et al., 2020). Composite indexes seek to capture the multifaceted nature of financial health by mitigating extreme outcomes and leveraging the strengths of individual models. These approaches are particularly advantageous in contexts characterised by significant firm heterogeneity and industry diversity (Abdelkader & Wahba, 2024). Nevertheless, empirical applications of composite financial health measures remain limited for Indian small-cap manufacturing firms (Mahesh et al., 2025).

This study seeks to develop and validate a Composite Financial Health Index (CFHI) tailored for Indian small-cap manufacturing firms. The CFHI integrates the Altman Z-Score, Springate S-Score, Zmijewski X-Score, and Grover G-Score into a unified index, providing a more comprehensive and balanced assessment of financial stability. The study pursues three primary objectives: to compare the outcomes of the four established distress models, to construct the CFHI and analyse financial health across firms, sectors, and years from 2015 to 2024, and to evaluate the accuracy of the CFHI through financial ratio analysis.

This study contributes several novel insights to the existing literature. Unlike prior studies that rely on a single distress-prediction model or focus on large- and mid-cap firms, this study makes three distinct contributions. First, it focuses exclusively on Indian small-cap manufacturing firms, a segment characterised by high volatility and financial vulnerability. Second, it integrates four classical distress prediction models into a standardised composite index to mitigate model-specific bias. Third, the proposed CFHI is empirically validated using accounting- and market-based financial indicators, enhancing its interpretability and practical relevance. Methodologically, it demonstrates that a composite index captures the nuances of financial health in small-cap firms more effectively than single-model approaches. Empirically, it provides robust evidence from Indian manufacturing sectors, clarifying both overarching risks and sectoral differences. Practically, the findings offer actionable guidance for investors, creditors, and regulators seeking reliable tools to monitor financial stability among small-cap companies.

The rest of the paper is organised as follows. Section 2 reviews the literature on financial distress prediction and sets out the rationale for a composite approach. Section 3 details the data and methodology, explaining how the Composite Financial Health Index (CFHI) is constructed. Section 4 presents the empirical results, compares model classifications, and validates the CFHI. Section 5 discusses the findings and their theoretical and practical implications. Finally, Section 6 concludes the study, acknowledging its limitations and suggesting avenues for future research.

2. REVIEW OF LITERATURE

2.1 Conceptual Foundations of Financial Health and Distress Prediction

The evaluation of corporate financial health has been a central focus in accounting and finance research, reflecting its significance for investors, lenders, regulators, and corporate management (Rahman et al., 2021; Sabela et al., 2018). Foundational studies defined financial health as a firm's capacity to sustain operations, fulfil obligations, and avoid insolvency over time (Alyasari et al., 2024; Csikosova et al., 2019; Fachrudin, 2020). Early empirical investigations concentrated on identifying accounting ratios that differentiate between failed and non-failed firms.

Beaver (1966) provided foundational evidence that individual financial ratios, especially those related to liquidity, cash flow, and profitability, possess predictive power several years before bankruptcy (Rahman et al., 2021). His univariate framework laid the groundwork for systematic financial distress prediction and demonstrated that declining financial ratios serve as early warning indicators (Altman, 1968; Amoa-Gyarteng, 2021). However, this approach was constrained by its inability to account for the combined effects of multiple financial dimensions (Manh et al., 2024).

Expanding upon this foundation, Altman (1968) introduced the multivariate Z-score model through multiple discriminant analysis. By integrating liquidity, profitability, leverage, solvency, and efficiency ratios into a composite score, Altman achieved significantly improved classification accuracy for manufacturing firms (Altman, 1968). The Z-Score model established a benchmark in distress prediction research and continues to be widely utilised across various sectors and regions. Nevertheless, subsequent research has observed that the model's effectiveness fluctuates with firm size, industry structure, and economic conditions, especially when applied beyond its initial context (Abdelkader & Wahba, 2024; Dimitrijević et al., 2024; Kanoujiya et al., 2023; Mahesh et al., 2025).

2.2 Development of Classical Distress Prediction Models

After Altman's contribution, researchers introduced alternative multivariate models to address methodological and contextual limitations. Springate (1978) developed a multiple discriminant analysis (MDA)-based model that emphasised working capital efficiency and earnings performance (Alyasari et al., 2024). Although the Springate S-Score demonstrated strong discriminatory power in its initial sample, subsequent studies found that the model frequently yielded conservative distress classifications, particularly for firms with volatile earnings.

Zmijewski (1984) advanced the literature by introducing a probit-based distress prediction model, shifting focus from classification to probabilistic assessment. His model highlighted the central role of leverage, profitability, and liquidity risk in predicting financial distress (Azam et al., 2023; Zmijewski, 1984). The probabilistic framework addressed some statistical limitations of discriminant analysis but remained sensitive to sample composition and firm characteristics.

Grover (2001) further refined distress prediction by recalibrating Altman's original model. By adjusting coefficient weights and selecting ratios, the Grover G-Score sought to enhance classification stability and minimise misclassification. Empirical studies indicate that Grover's model frequently classifies a greater proportion of firms as financially healthy, reflecting comparatively lower sensitivity to early-stage distress (Fachrudin, 2020; Saha & Ahmed, 2024).

Overall, these classical models capture distinct yet overlapping aspects of financial performance. However, variations in model structure and cutoff thresholds often lead to inconsistent classification results across various firm samples.

2.3 Comparative Evidence and Emerging Market Context

An expanding body of empirical research has documented divergence in distress classification across models, especially in emerging markets. Comparative analyses reveal that a single firm may be classified as distressed by one model and healthy by another, depending on each model's sensitivity to liquidity, leverage, or earnings volatility. For example, Saha & Ahmed (2024) In their study of non-bank financial institutions in Bangladesh, they found that Zmijewski's model identified significantly more distressed firms than Grover's model.

Empirical findings from emerging economies indicate that small-cap firms pose unique challenges for traditional distress-prediction models. Such firms frequently display irregular cash flows, high working-capital intensity, and elevated earnings volatility, which may generate false distress signals in conservative models or obscure vulnerability in more lenient models (Mahesh et al., 2025). Sector-specific studies within manufacturing industries further demonstrate that cyclical exposure intensifies these inconsistencies.

In the Indian context, earlier studies mainly used classical distress models independently for specific sectors or firm groups (e.g., textiles by Nair & Sachdeva, (2016); Pharmaceuticals by Das & Sarma, (2022). Although these studies affirm the utility of accounting-based models, they also report inconsistent classification outcomes and limited robustness when models are employed in isolation. Notably, Indian literature remains fragmented, with minimal attention given to small-cap firms as a distinct and vulnerable market segment.

2.4 Limitations of Single-Model Approaches

Despite their broad adoption, standalone distress prediction models exhibit several well-documented limitations.

First, model-specific bias results from variations in ratio selection, weighting schemes, and classification thresholds (Csikosova et al., 2019). Second, most classical models were constructed using historical data from developed economies, which raises questions about their applicability in emerging markets (Abdelkader & Wahba, 2024; Waqas & Md-Rus, 2018). Third, dependence on binary or narrowly defined classification frameworks often overlooks intermediate financial vulnerability, the so-called "grey zone" where firms are neither distinctly healthy nor severely distressed (Altman, 1968).

These limitations are especially evident in small-cap firms, where minor changes in profitability or liquidity can substantially affect classification outcomes (Mahesh et al., 2025). Consequently, decision-makers who rely on a single model may face increased risk of misclassification, potentially leading to suboptimal investment, lending, or regulatory decisions (Agarwal & Taffler, 2006).

2.5 Conceptual Framework and Research Focus

The reviewed literature highlights the need for integrated assessment frameworks that combine various financial indicators. Recent studies show a growing support for hybrid or composite methods to decrease model bias and enhance interpretability. (Vavrek et al., 2021). By consolidating information from multiple models, composite indices offer a more stable, multidimensional perspective on financial health.

Although composite approaches have been proposed conceptually, empirical applications in the Indian small-cap manufacturing sector are limited. This study addresses this gap by developing a standardised Composite Financial Health Index (CFHI) that integrates four widely recognised classical distress prediction models: Altman Z-Score, Springate S-Score, Zmijewski X-Score, and Grover G-Score. In contrast to previous research that relies on single-model assessments or sector-specific analyses, this study:

1. Constructs a statistically robust composite index through standardisation and aggregation,
2. Applies it longitudinally (2015–2024) to capture temporal dynamics, including the COVID-19 shock,
3. Analyses across three manufacturing sectors to identify sector-specific patterns, and
4. Rigorously validates the index through financial ratio analysis.

Focusing on Indian small-cap manufacturing firms addresses a significant gap in the literature, as this segment remains underexplored despite its economic importance and financial vulnerability.

2.6 Summary of Literature Review

In summary, the literature demonstrates that although accounting-based distress prediction models are valuable, they exhibit notable limitations when applied individually. The inconsistent outcomes across various models, particularly in emerging markets and small-cap firms, underscore the necessity for integrated approaches. This study addresses this gap by developing and evaluating a Composite Financial Health Index tailored to Indian small-cap manufacturing companies. It is guided by three principal research questions derived from the literature, given the divergence in model outcomes and the lack of a unified framework for Indian small-cap manufacturers.

1. How divergent are classification outcomes when four classical distress prediction models are applied to Indian small-cap manufacturing firms?
2. Can a composite index provide a more balanced and reliable assessment of financial health than individual models?
3. Is the Composite Financial Health Index empirically consistent with key accounting- and market-based indicators of financial health?

3. RESEARCH METHODOLOGY

3.1 Research Design

The study employs a quantitative, empirical research design to evaluate the financial health of Indian small-cap manufacturing firms. Given the multidimensional nature of financial health and the documented limitations of single distress prediction models, the analysis follows a multi-stage framework that combines classical bankruptcy models into a composite index and subsequently validates the index using firm-level financial

ratios. Panel data techniques are employed to capture cross-sectional and temporal variation in firm performance.

3.2 Sample Selection and Data Sources

The empirical analysis is based on a balanced panel of 38 listed Indian small-cap manufacturing firms observed over the period 2015–2024, yielding 380 firm-year observations. The classification of firms as small-cap follows the official definition prescribed by the Securities and Exchange Board of India (2017).

As per SEBI's circular on categorisation and rationalisation of mutual fund schemes, small-cap companies are defined as those ranked 251st and below in terms of full market capitalisation, based on the standardised list prepared and periodically updated by the Association of Mutual Funds in India (AMFI). This ranking-based definition ensures uniformity and regulatory consistency in identifying the small-cap universe.

Accordingly, firms included in the study were selected from the AMFI small-cap classification corresponding to the relevant years of analysis. The sample represents three manufacturing sectors of economic significance in India: Automobile & Auto-Ancillary (10 firms), Construction Materials (11 firms), and Textiles (17 firms).

Firm-level financial data were obtained from the CMIE Prowess database and cross-verified using audited annual reports. Only firms with complete financial information throughout the study period were retained to ensure a balanced panel and comparability across time.

3.3 Classical Distress Prediction Models

To evaluate firm-level financial health, the study employs four well-established bankruptcy prediction models: the Altman Z-Score, Springate S-Score, Zmijewski X-Score, and Grover G-Score. These models were selected because they are widely applied in empirical finance literature and collectively capture complementary dimensions of financial performance, including liquidity, profitability, leverage, solvency, efficiency, and market valuation.

The Altman Z-Score (Altman, 1968) is a multivariate discriminant model that integrates accounting and market-based indicators to assess the likelihood of financial distress. It has been extensively used in manufacturing-sector studies and remains a benchmark model for financial health assessment.

The Springate S-Score (Springate, 1978), also based on discriminant analysis, emphasises working capital efficiency and earnings performance. Prior studies suggest that this model tends to generate more conservative distress classifications, particularly for firms with volatile cash flows.

The Zmijewski X-Score (Zmijewski, 1984) adopts a probabilistic framework and focuses primarily on leverage, profitability, and liquidity risk. By relying on a limited set of core ratios, it offers a parsimonious assessment of distress likelihood, though empirical applications indicate that it is sensitive to firm size and capital structure.

The Grover G-Score (Grover, 2001) is a recalibrated version of earlier discriminant models, designed to improve classification stability by adjusting coefficient weights and the selection of ratios. Empirical evidence suggests this model is relatively less sensitive to early-stage distress.

All four models were computed using their standard formulations, as proposed in the original studies, without any modification to variables or coefficients. Established cutoff thresholds were applied to classify firm-year observations into financially healthy, grey-zone, or distressed categories. The simultaneous application of multiple classical models enables a comparative assessment of financial health and forms the basis for constructing the Composite Financial Health Index (CFHI).

The divergence in theoretical focus and classification outcomes among these models provides the methodological rationale for constructing a composite index that integrates their complementary signals.

3.4 Construction of the Composite Financial Health Index (CFHI)

Given the observed divergence in financial health classifications across individual distress prediction models, the study constructs a Composite Financial Health Index (CFHI) to provide a more stable and multidimensional assessment of firm-level financial health. The CFHI integrates information from the Altman Z-Score, Springate S-Score, Zmijewski X-Score, and Grover G-Score, thereby reducing model-specific bias and capturing complementary financial signals.

The construction of the CFHI follows a standardised and transparent procedure. First, the raw scores obtained from each distress prediction model were standardised using a z-score transformation to eliminate scale differences and ensure comparability across models. This step is essential because the underlying models differ in magnitude, dispersion, and interpretation.

Second, the standardized scores were aggregated using an equal-weighted approach. Equal weighting was adopted to avoid dominance by any single model and to ensure that each distress framework contributes proportionately to the composite index. This approach is consistent with prior empirical studies that advocate balanced integration when no theoretical justification exists for differential weighting.

Third, the resulting CFHI values were used to classify firm-year observations into financially healthy, grey-zone, and distressed categories based on predefined threshold values. This classification framework allows the CFHI to reflect financial health along a continuum rather than as a binary outcome, which is particularly relevant for small-cap firms exhibiting intermediate financial vulnerability.

The statistical coherence of the CFHI was further assessed through internal reliability and dimensionality analysis. The composite index demonstrated strong internal consistency, with a Cronbach's alpha of 0.891, indicating high reliability among the constituent model scores. Principal component analysis confirmed the index's unidimensional structure, supporting the integration of multiple distress measures into a single composite construct.

Overall, the CFHI represents an integrated and empirically grounded measure of financial health that synthesises multiple distress perspectives into a coherent index. The composite framework provides a robust analytical foundation for subsequent validation using financial ratios and comparative analysis across time and sectors.

3.5 Analytical Framework

The empirical analysis follows a structured and objective-oriented analytical framework designed to evaluate financial health using classical distress models and to validate the Composite Financial Health Index (CFHI). The framework proceeds sequentially to ensure logical consistency between model construction, comparison, and validation.

In the first stage, descriptive statistics are computed for each classical distress prediction model and for the CFHI to examine the distributional characteristics and variability of financial health indicators across firms and time. This stage provides an initial assessment of heterogeneity among small-cap manufacturing firms.

In the second stage, model-wise classification analysis is conducted using established cutoff thresholds to classify firm-year observations into financially healthy, grey-zone, and distressed categories. Comparative assessment across models is undertaken to identify inconsistencies in classification outcomes and to highlight the limitations of standalone distress prediction approaches.

In the third stage, the analysis focuses on the CFHI-based assessment of financial health. Firm-year observations are classified using CFHI thresholds, and temporal (year-wise) and sectoral distributions are examined to capture variations in financial health across time and manufacturing sectors.

In the final stage, the CFHI is subjected to external validation using correlation and regression techniques. This stage evaluates whether the composite index aligns with fundamental financial performance indicators and provides empirical support for its interpretability and robustness.

Overall, this analytical framework ensures that the CFHI is evaluated not only as a composite construct but also as a practical and empirically grounded measure of firm-level financial health.

3.6 Statistical Software

All statistical analyses were performed using SPSS and Stata. SPSS was used for computing descriptive statistics, correlation matrices, and Ordinary Least Squares (OLS) regression models. Stata was employed for supplementary robustness diagnostics and consistency checks. The combined use of these statistical packages ensured computational accuracy and methodological reliability throughout the analysis.

Having outlined the research design, data sources, model selection, construction of the Composite Financial Health Index (CFHI), and the validation framework, the following section presents the empirical results. The analysis is structured in line with the research questions posed in the literature review, beginning with a comparison of classical distress prediction models and subsequently examining the construction, distribution, and validation of the CFHI.

4. RESULT AND ANALYSIS

This section presents the study's empirical findings in accordance with the research questions formulated in Section 2.6. The results are organised into three subsections. First, the classification outcomes of classical financial distress prediction models are compared to assess their consistency. Second, the construction and distribution of the Composite Financial Health Index (CFHI) are examined to evaluate its stability and interpretability. Finally, the CFHI is empirically validated using key accounting- and market-based financial indicators.

4.1 Comparison of Financial Health Classification Across Classical Distress Prediction Models (RQ1)

To address **RQ1**, firm-level financial health was evaluated using four classical distress prediction models: Altman Z-Score, Springate S-Score, Zmijewski X-Score, and Grover G-Score. Descriptive statistics were first examined to understand the distributional characteristics of each model.

Model	N	Minimum	Maximum	Mean	Std. Deviation
Altman Z-Score	380	–1.13	50.73	4.53	4.51
Zmijewski X-Score	380	–7.18	4.32	–1.80	1.31
Springate S-Score	380	–1.79	8.91	1.09	0.80
Grover G-Score	380	–1.35	5.25	0.66	0.55
Composite Financial Health Index (CFHI)	380	–2.54	5.76	0.00	0.87

Table 4.1: Descriptive Statistics of Classical Distress Prediction Models and CFHI (2015–2024)

The statistics demonstrate notable differences in scale and variability. The Altman Z-Score exhibits the greatest variability (SD=4.51), whereas Grover's model is the most consistent (SD=0.55). The average Altman (4.53) and Zmijewski (–1.80) scores reflect overall financial health, while Springate (1.09) and Grover (0.66) suggest borderline statuses. The CFHI, with a mean of 0 and an SD of 0.87, offers a standardised comparison metric.

4.2 Divergence in Classification Outcomes

To address **RQ1**, firms were classified using each model's established thresholds.

Model	Healthy (%)	Grey Zone (%)	Distressed (%)
Altman Z-Score	54.5	25.5	20.0
Springate S-Score	60.3	NA	39.7
Zmijewski X-Score	93.7	NA	6.3
Grover G-Score	93.7	0.5	5.8

Table 4.2 Classification of firm-years by individual distress models

Note: *Springate and Zmijewski models do not have a defined grey zone.*

The classification results demonstrate substantial divergence across the classical distress prediction models. The Springate S-Score flags a markedly higher proportion of distressed firms, indicating its greater sensitivity to liquidity and earnings volatility. Conversely, the Zmijewski X-Score and Grover G-Score produce comparatively optimistic assessments, classifying over 93% of observations as financially healthy. The Altman Z-Score provides a more moderate, tripartite classification that distinguishes healthy, grey-zone, and distressed firms. These stark inconsistencies underscore that the diagnosis of financial health is fundamentally contingent on model selection, revealing a critical limitation of standalone models and underscoring the necessity for an integrated assessment framework.

4.3 Performance of the Composite Financial Health Index (RQ2)

The Composite Financial Health Index (CFHI) exhibits strong internal reliability, with a Cronbach's alpha of 0.891, indicating high internal consistency among its constituent distress prediction models. Classification based on CFHI thresholds yields a more balanced and nuanced financial health profile relative to individual distress prediction models.

Category	Frequency	Percent (%)
Distressed	114	30.0
Grey Zone	171	45.0
Safe/Healthy	95	25.0
Total	**380**	**100.0**

Table 4.3. Classification of Firms under Composite Financial Health Index (2015–2024)

The CFHI allocates a substantial proportion of firm-year observations 45% to the grey-zone category, effectively capturing the intermediate financial vulnerability characteristic of Indian small-cap manufacturing firms. Compared to individual distress prediction models, the CFHI moderates the extreme optimism observed in the Grover and Zmijewski models and the relatively conservative classification produced by the Springate model, thereby offering a more balanced and reliable assessment of financial health.

4.4. Temporal and sectoral distribution of CFHI classifications

The CFHI's sensitivity to economic cycles and sectoral dynamics is shown in Tables 4.4 and 4.5. The year-wise analysis (Table 4.4) reflects the impact of the COVID-19 shock in 2020, while the sectoral breakdown (Table 4.5) reveals entrenched distress in Construction Materials and persistent vulnerability in Textiles and Automobiles.

Year	Distressed	Grey Zone	Safe	Total
2015	11	22	5	38
2016	12	19	7	38
2017	14	14	10	38
2018	12	16	10	38
2019	14	15	9	38
2020	16	16	6	38
2021	12	16	10	38
2022	9	15	14	38
2023	7	18	13	38
2024	7	20	11	38
Total	114	171	95	380

Table 4.4. Year-wise distribution of CFHI classification (2015–2024)

Sector	Distressed	Grey Zone	Safe	Total
Automobile & Auto Components	12	52	36	100
Construction Materials	74	31	5	110
Textiles	28	88	54	170
Total	**114**	**171**	**95**	**380**

Table 4.5. sector-wise classification of firms under CFHI (2015–2024)

These distributions confirm that the CFHI captures both systemic shocks and structural vulnerabilities, reinforcing its utility as a comprehensive diagnostic tool.

4.5 Empirical Validation of CFHI Against Financial Indicators (RQ3)

To address **RQ3**, the Composite Financial Health Index (CFHI) was empirically validated by examining its relationship with key accounting- and market-based financial indicators. The objective of this analysis is not hypothesis testing but to assess whether CFHI aligns with established determinants of firm-level financial health.

Accordingly, correlation and regression analyses were employed to evaluate the direction, strength, and statistical reliability of associations between CFHI. They selected financial variables representing profitability, liquidity, leverage, operational efficiency, and market valuation.

4.5.1 Correlation Analysis between CFHI and Financial Indicators

Table 4.6 presents the Pearson correlation coefficients between CFHI and selected financial indicators.

Variable	ROE	OPM	CA/CL	D/E	Sales/TA	MVE/BVL	CFHI
ROE	1						
OPM	0.190**	1					
CA/CL	0.087	0.070	1				
D/E	–0.575**	0.234**	–0.147**	1			
Sales/TA	0.026	0.118*	0.077	0.077	1		
MVE/BVL	0.023	0.061	0.340**	–0.068	–0.016	1	
CFHI	**0.173****	**0.190****	**0.655****	**–0.106***	**0.306****	**0.651****	1

Table 4.6. Correlation between CFHI and Financial Indicators

*Note: **p < 0.01, *p < 0.05*

The correlation results indicate that CFHI is positively and significantly associated with profitability measures, including return on equity (ROE) (r = 0.173, p < 0.01) and operating profit margin (OPM) (r = 0.190, p < 0.01).

Liquidity, measured by the current ratio (CA/CL), exhibits a strong positive relationship with CFHI (r = 0.655, p < 0.01), underscoring the importance of short-term solvency in the financial health of small-cap firms.

CFHI is negatively correlated with leverage, proxied by the debt–equity ratio (r = –0.106, p < 0.05), suggesting that higher leverage is generally associated with weaker financial health.

However, the magnitude of this relationship is modest. Operational efficiency (Sales/TA) shows a positive and statistically significant association with CFHI (r = 0.306, p < 0.01). Market-based valuation (MVE/BVL) also shows a strong positive correlation with CFHI (r = 0.651, p < 0.01), indicating that firms with greater market confidence tend to exhibit higher composite financial health.

Overall, the correlation analysis provides preliminary empirical support for the validity of CFHI as a multidimensional measure of financial health.

4.5.2 Regression Analysis: Financial Determinants of CFHI (Main Model)

To further validate CFHI, an ordinary least squares (OLS) regression model is estimated with CFHI as the dependent variable and selected financial indicators as explanatory variables.

Variable	B	Std. Error	t	p-value	Standardised β
Constant	–1.370	0.065	–21.02	< .001	–
ROE	0.002	0.001	4.08	< .001	0.134
OPM	0.048	0.014	3.35	.001	0.094
CA/CL	0.339	0.022	15.72	< .001	0.452
D/E	0.008	0.010	0.86	.389	0.030
Sales/TA	0.504	0.052	9.70	< .001	0.262
MVE/BVL	0.061	0.004	17.42	< .001	0.494

Table 4.7. ordinary least squares (OLS) regression main model

Dependent Variable: CFHI (2015–2024)

Note. p < .05 is significant at the 5 % level; p < .01 is significant at the 1 % level (two-tailed test).

Model Summary = 0.858 | $R^2 = 0.736$ | Adjusted $R^2 = 0.732$ $F(6, 373) = 173.20$ | $p < .001$ | N = 380

The regression model is statistically significant and exhibits strong explanatory power, explaining approximately 73% of the variation in CFHI. Profitability indicators (ROE and OPM) show positive, statistically significant effects, indicating that more profitable firms tend to exhibit stronger composite financial health.

Liquidity emerges as a key determinant of CFHI, with the current ratio (CA/CL) showing a strong, highly significant positive relationship ($\beta = 0.452$, $p < .001$). Operational efficiency, measured by sales-to-total-assets, also exerts a positive and significant influence ($\beta = 0.262$, $p < .001$). Market-based valuation (MVE/BVL) demonstrates the most substantial standardised effect ($\beta = 0.494$, $p < .001$), reflecting the importance of investor perception and market confidence in shaping financial health.

In contrast, leverage measured by the debt–equity ratio does not exhibit a statistically significant effect (p=.389), suggesting that capital structure alone does not independently determine financial health once profitability, liquidity, efficiency, and market valuation are accounted for.

4.5.3 Robustness Analysis: Alternative Leverage Specification

To assess the robustness of the validation results, leverage is re-specified using the total liabilities-to-total assets ratio (TL/TA), which captures balance-sheet-based financial risk more comprehensively.

Variable	B	Std. Error	t	p-value	Standardised β
Constant	0.003	0.115	0.03	.977	–
ROE	0.003	0.000	8.61	< .001	0.197
OPM	0.023	0.012	1.94	.053	0.044
CA/CL	0.161	0.022	7.31	< .001	0.215
Sales/TA	0.456	0.043	10.61	< .001	0.237
MVE/BVL	0.045	0.003	14.29	< .001	0.363
TL/TA	–1.942	0.147	–13.23	< .001	–0.433

Table 4.8. Robustness Regression Results: Alternative Leverage Specification (TL/TA)

Dependent Variable: CFHI (2015–2024)

The robustness results largely corroborate the main regression model's findings. Profitability, liquidity, operational efficiency, and market valuation remain positively and significantly associated with CFHI. While the significance of operating profit margin weakens marginally ($p = .053$), its coefficient remains positive.

Importantly, leverage, as measured by TL/TA, exhibits a strong negative and statistically significant relationship with CFHI ($\beta = –0.433$, $p < .001$). This contrasts with the insignificance of the debt–equity ratio in the baseline model and suggests that balance-sheet-based leverage more effectively captures financial risk among small-cap manufacturing firms.

4.5.4 Summary of Empirical Validation Results

Taken together, the correlation, regression, and robustness analyses provide strong empirical validation for the Composite Financial Health Index. CFHI exhibits statistically significant and economically meaningful relationships with key indicators of profitability, liquidity, efficiency, and market valuation, while leverage effects depend on the measurement approach. These findings confirm that CFHI is a coherent, reliable, and interpretable measure of firm-level financial health, thereby directly addressing **RQ3**.

5. DISCUSSION

This section examines the empirical findings in relation to the research questions and, in doing so, situates them within the broader context of financial distress prediction and financial health assessment literature.

The discussion is organised around three central themes: the limitations of standalone distress prediction models, the performance advantages of the Composite Financial Health Index (CFHI), and the empirical validity of CFHI as a multidimensional measure of financial health for Indian small-cap manufacturing firms. Each theme is addressed in relation to the study's research questions.

5.1 Interpretation of Findings Related to RQ1: Model Dependency in Financial Health Assessment

The findings for **RQ1** show substantial divergence in financial health classifications across classical distress prediction models. The Springate S-Score identifies a much higher proportion of distressed firm-year observations. The Zmijewski X-Score and Grover G-Score classify an overwhelming majority of observations as financially healthy. The Altman Z-Score provides a more moderate three-way classification, distinguishing between healthy, grey-zone, and distressed firms.

These inconsistencies highlight a fundamental limitation of standalone distress prediction models: the assessment of financial health depends heavily on the model used. Differences in model design, including underlying assumptions, variable selection, and threshold criteria, can yield materially different interpretations of identical financial data (Fachrudin, 2020). Evidence from emerging markets supports this concern, as prior research shows significant variation in distress rates across models applied to the same set of firms (Saha & Ahmed, 2024).

The present findings strongly reinforce this concern. For the same set of firm-year observations, the Springate S-Score classifies 39.7% of firms as financially distressed. By contrast, the Grover G-Score and Zmijewski X-Score identify only 5.8% and 6.3% of firms as distressed, respectively. This stark divergence means a stakeholder relying on a single model could receive a wildly optimistic or overly alarming assessment, leading to potentially misguided investment or credit decisions. This extreme model dependency underscores the critical need

for an integrated framework that synthesises multiple diagnostic perspectives, which is the core rationale for the CFHI.

This evidence underscores the need to adopt a multidimensional assessment framework. For Indian small-cap manufacturing firms, which often exhibit fluctuating cash flows, constrained access to capital, and sector-specific cyclicality, reliance on any single distress model may therefore lead to misleading assessments. The results underscore the need for an integrated framework that synthesises multiple diagnostic perspectives rather than privileging one model's assumptions.

5.2 Discussion of RQ2: CFHI as a Balanced and Context-Sensitive Assessment Tool

Addressing RQ2, the Composite Financial Health Index shows a clear advantage over individual distress prediction models. By providing a tripartite classification, the CFHI yields a more balanced distribution of firms, with a substantial share (45%) correctly allocated to a financially ambiguous "grey zone." This outcome is particularly meaningful for small-cap firms, where vulnerability exists on a continuum, aligning with the view that financial distress is a gradual process rather than a binary event (Platt & Platt,(2002).

An analysis of year-wise CFHI classifications underscores the index's capacity to capture temporal financial dynamics. Before 2020, distressed classifications consistently exceeded safe classifications, suggesting persistent structural fragility during relatively stable macroeconomic periods. Financial stress increased in 2020, evidenced by a peak in distressed observations and a decline in safe classifications, indicating heightened systemic pressure. In the post-2020 period, the data do not suggest a rapid or uniform recovery; instead, there is a gradual shift from distressed to grey-zone and safe categories between 2021 and 2023. This trend reflects a partial and uneven recovery, supporting the view that improvements in financial health among small-cap firms are incremental and heterogeneous.

Furthermore, sector-wise analysis reveals stark contrasts that align with underlying industry economics. Construction Materials firms exhibit severe distress (67%), consistent with the sector's high operational leverage, sensitivity to input costs and economic cycles, and dependence on government infrastructure spending. In contrast, Automobile and Auto-Ancillary firms show relative strength (36% 'Safe'), potentially due to more integrated supply chains and steady replacement demand. The majority of Textile firms are in the grey zone (52%), indicative of an industry characterised by thin margins, intense competition, and high working capital intensity, where firms perpetually navigate financial vulnerability without immediate collapse.

These sectoral distinctions validate the CFHI's sensitivity to industry-specific risk profiles. In summary, the CFHI avoids the polarisation inherent in single-distress models. By capturing broad economic shocks, fundamental sectoral variations, and the gradual, non-linear nature of financial recovery, it proves to be a robust and contextually intelligent tool for monitoring financial health in the volatile small-cap segment.

5.3 Discussion of RQ3: Empirical Validity of CFHI

Empirical validation addressing **RQ3** demonstrates that the Composite Financial Health Index (CFHI) is not solely a statistical construct but also a theoretically coherent measure of financial health for Indian small-cap manufacturers. The strong and significant relationships between the CFHI and fundamental financial indicators provide robust construct validity, confirming that the index effectively synthesises the multidimensional signals from its constituent models into a single, meaningful metric.

The analysis indicates that liquidity (Current Ratio) and market valuation (MVE/BVL) are the most influential determinants of the CFHI, as evidenced by the highest standardised coefficients ($\beta = 0.452$ and $\beta = 0.494$, respectively, in Table 4.7). This result is particularly relevant for small-cap firms, highlighting that investor confidence (as reflected in market value) and short-term solvency are primary concerns, potentially surpassing profitability in assessing immediate financial stability for these volatile entities. This observation supports the premise that small-cap firms face greater scrutiny and tighter liquidity constraints, making market sentiment and cash conversion cycles essential to their perceived financial health. Additionally, the positive and significant role of operational efficiency (Sales/TA) demonstrates that asset utilisation, a key indicator of managerial effectiveness and competitive positioning, is a fundamental component of financial resilience in the capital-intensive manufacturing sector.

A notable finding is the leverage paradox. The baseline regression shows that the debt-to-equity (D/E) ratio is not significant ($p = 0.389$), whereas the robustness check using total liabilities to total assets (TL/TA) shows a strong negative relationship ($\beta = -0.433$, $p < 0.001$). This discrepancy is not a methodological flaw but a characteristic feature of small-cap finance. The D/E ratio's denominator, equity, is often small and highly sensitive to market sentiment in these firms, making it a volatile and potentially misleading measure of risk. By contrast, TL/TA uses total assets as a more stable, balance-sheet-based denominator. These results suggest that, for Indian small-cap manufacturers, balance-sheet leverage is a more reliable and critical indicator of financial risk than capital structure leverage. Consequently, creditors and analysts should prioritise the scale of a firm's obligations relative to its total asset base, rather than its debt-equity mix, when evaluating financial health.

Taken together, these validation results achieve two key objectives. First, they demonstrate that the CFHI is consistent with established financial theory, moving beyond mechanical score aggregation to become an interpretable gauge of underlying economic reality. Second, they provide nuanced insights into the specific drivers of financial health in this segment, emphasising liquidity, market faith, operational efficiency, and balance-sheet prudence rather than mere profitability or a specific debt-to-equity target. Therefore, the CFHI is empirically validated not only as a statistically reliable composite but also as a contextually intelligent tool that captures the unique financial dynamics of small-cap manufacturing firms.

5.4 Theoretical and Methodological Implications

From a theoretical perspective, the findings contribute to the literature by demonstrating the limitations of single-model distress prediction frameworks and by offering an integrated alternative that accommodates multiple diagnostic viewpoints. The CFHI aligns with the broader shift in financial distress research toward multidimensional and composite assessment approaches.

Methodologically, the study illustrates the value of combining classical distress prediction models into a composite index and validating the resulting measure through correlation, regression, and robustness analysis.

The research-question-driven design, rather than hypothesis testing, is particularly appropriate for index construction and validation studies and enhances methodological transparency.

5.5 Practical Implications

The findings have important practical implications for investors, lenders, regulators, and corporate managers. The CFHI provides a more reliable tool for monitoring financial health, identifying early warning signals, and distinguishing between transient financial weakness and structural distress. For regulators and policymakers, the index offers a scalable framework for assessing systemic vulnerability within the small-cap segment. For firm management, CFHI-based insights can inform strategic decisions related to liquidity management, capital structure, and operational efficiency.

The following section synthesises the study's key findings, highlights the main contributions, acknowledges the limitations, and outlines directions for future research.

6. CONCLUSION, LIMITATIONS, AND DIRECTIONS FOR FUTURE RESEARCH

6.1 Conclusion

The findings indicate that a composite index addresses key limitations inherent in single-model analyses for Indian small-cap manufacturers. The investigation, structured around three research questions, yields three principal insights. First, there is substantial divergence in distress classifications across classical models (e.g., distress rates of 39.7% versus 6.3%), demonstrating that reliance on a single model may yield contradictory and potentially misleading assessments. Second, the Composite Financial Health Index (CFHI) developed in this study mitigates this issue by offering a balanced, tripartite classification. The CFHI's substantial grey zone (45% of observations) and its responsiveness to economic cycles and sectoral conditions underscore its effectiveness in capturing the nuanced, continuous nature of financial vulnerability within this segment. Third, rigorous validation confirms the CFHI as a theoretically coherent measure. The analysis identifies liquidity and market confidence as primary determinants of financial health for small-cap firms, and further demonstrates that balance-sheet leverage (TL/TA), rather than capital structure (D/E), is the more relevant indicator of financial risk for these companies.

In summary, this study provides a validated, practical tool for stakeholders while advancing the literature by demonstrating that an integrated composite framework is not only statistically superior but also essential for accurately assessing the financial health of heterogeneous, volatile small-cap manufacturing firms in emerging markets.

6.2 Limitations of the Study

Despite its contributions, the study has certain limitations that should be acknowledged.

First, the analysis is restricted to listed Indian small-cap manufacturing firms, which limits the generalizability of the findings to unlisted firms or to firms operating in service-oriented or financial sectors. Second, the CFHI is constructed using classical distress prediction models and financial ratios;. At the same time, this ensures transparency and interpretability, but it excludes non-financial indicators such as managerial quality, innovation capability, or qualitative governance attributes.

Third, although the study incorporates robustness checks through alternative leverage specifications, the empirical analysis relies on linear regression techniques and does not explicitly model dynamic adjustment processes or non-linear relationships. Finally, the study period, while covering multiple economic phases, does not capture very long-term structural shifts or post-pandemic adjustments beyond the sample horizon.

These limitations do not undermine the validity of the findings but instead delineate the scope within which the results should be interpreted.

6.3 Directions for Future Research

Future research can extend this study in several meaningful directions. First, the CFHI framework can be applied to other firm segments, such as mid-cap or unlisted firms, as well as to non-manufacturing sectors, to assess its broader applicability. Comparative cross-country studies could further examine how institutional and regulatory environments influence financial health dynamics.

Second, future studies may enhance the CFHI by incorporating corporate governance variables, ownership structure, or macroeconomic indicators to develop a more comprehensive financial sustainability index. Third, integrating advanced analytical techniques, such as panel data models, machine learning methods, and early-warning systems, may improve predictive accuracy while preserving interpretability.

Finally, longitudinal extensions of the dataset could enable the examination of financial health transitions over longer horizons, providing deeper insights into the persistence and reversibility of financial distress among small-cap firms.

By advancing a validated composite framework for financial health assessment, this study provides a foundation for both academic inquiry and practical application. The CFHI offers a flexible and robust tool that can be adapted and extended to meet the evolving needs of researchers, practitioners, and policymakers concerned with firm-level financial stability.

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IMPACT OF GST ON HOTEL, TRAVEL AND TOURISM INDUSTRY

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The hotel, travel, and tourism industries occupy an important place in the economic structure of India since they effectively contribute to national income, provide opportunities for employment, and ensure the growth of foreign tourist arrivals. With the implementation of GST, a sea change has occurred in the taxation process of this industry. To understand the depth of such changes, this study looks at the impact of GST on hotels, travel agents, and other related tourism services in the country.

The study exclusively relies on secondary information obtained from government reports, published articles, and industry-based data sources. The review describes how GST replaced several previous taxes to establish a clearer and more transparent tax system. For many sectors, it has also increased operational costs, mainly because of revised tax slabs and compliance responsibilities. In conclusion, the given paper provides a balanced perspective on how GST has affected the operations, pricing, and overall growth of India's tourism and hospitality industry.

KEYWORDS: ***GST, Hotel Industry, Tourism Sector, Travel Services, Tax Reforms.***

INTRODUCTION

The travel, tourism, and hotel industry remains one of the strong pillars of the Indian economy with respect to income generation, providing opportunities for employment, and the attraction it holds for an international market. In recent years, this sector has grown quite steadily due to improved infrastructure coming up, higher disposable incomes coupled with an interest in leisure and business travel that encourages domestic and foreign tourism.

Its introduction heralded a sea change in the way taxes were levied on services throughout the tourism value chain. As a sector comprising many services-like accommodation, transport, food, tour operations, and travel booking-related services-the impact of GST would be felt at almost every point. The changes brought about need to be duly understood, as these affect pricing, the way business operations are carried out, and overall competitiveness in the industry.

The present study focuses on assessing the impact of GST on hotels, travel agencies, and tourism-related businesses operating within an Indian context. The review is based on secondary data sourced from government reports, published articles, and industry findings.

This review showed that, in the post-GST period, while the structure of the tax has become more transparent and uniform, there is a corresponding increase in the costs and pressures for compliance in certain segments. This study will help unearth the benefits and hardships faced by the hotel, travel, and tourism industry in the post-GST implementation.

REVIEW OF LITERATURE

- **Dr. A. Vini Infanta1, B. S. Karthikeyan2 (2024):** Goods & Services tax is an indirect tax which has replaced many indirect taxes in India. Tourism represents the world's third largest export avenue in terms of global earnings after fuel and chemicals. The tourism industry contributes nearly USD 136 billion to India's GDP and is expected further grow to USD 280.5 billion by 2026. The objective of my study is to understand the impact of GST on travel and tourism sector.
- **S. S. Deepthi, Dr. Sayeeda Jabeen Shariff (2024):** Tourism sector has a very definite and the global industry, such as the tourism and travel industry, is the main contributor to the service industry in worldwide. But last few years onwards there is very unconditional situation which effect on our GDP. The main purpose of this study is to Find the people perception towards the influencing

factors in Hotel Industry for tourism and to analyse the impact of Hotel Industry for tourism development

- **Dr. Dayananda. K.C (2019):** GST has been one of the most awaited tax reforms for India. We would like to draw inference that high GST rates on hospitality may prove to be detrimental for the sector which is already reeling under the pressure of demonetization and liquor ban on highways. However, liquor should have been included in GST to ensure the seamless credit for tourism industry. Since, players in this industry make the most of its consumption.
- **Mrs. Hetal Rajgor ,Dr. Pushpendu Rakshit, Dr. Manoj Sain(2023):** The crown emergency has an extremely basic and troubling situation on existent duty framework with the significant effect on the different areas of the economy like - Banking and Money, Training, Wellbeing, Cafés and Neighborliness Industry, Land and so on. It becomes critical to comprehend the effect on different areas post the execution of the new assessment system in our country. Government have attempted well up to this point and would endeavor in future as well.
- **Aditya Prasad Sahoo, Dr. Yajnya Dutta Nayak(2021):** Goods and service tax is a uniform indirect tax to be applied across the country for the purpose of a "one nation – one tax." This study seeks to show the effect on the Indian hospitality industry of the goods and services tax. The Indian market is integrated with the introduction of GST and the company costs will be lowered in the foreseeable future. The hotel industry was in burden with multiple taxes on amount charged for different services.
- **Shivani Gupta Divya Saini Priti Sharma Karambir Gulia(2023):** GST is an indirect tax in India that is a replacement for a large number of Indian indirect taxes. GST has curbed the problem of cascading effect of taxes. GST implementation was the major tax reform, and we attempted to measure the impact of this reform on the sales of BSE-listed hotel and tourism companies individually and the industry as a whole.
- **Venkataramanaia , Sherry Abraham (2020):** Tourism is one of the prime activities which play a vital role not only in the generation of employment and income but also in holding firm socio-political relationship with the other countries. India is one of the most fascinating destinations to the world tourists as it is known for its diversity in culture, languages, rituals, traditions, ethnicity with rich civilization. The tourism sector in India is one of the rapidly growing sectors..
- **Prof. Shilpa Revankar (2022):** A comprehensive, multi-stage, destination-based tax on goods and services called the "Goods and Services Tax" will be imposed on every value addition. GST is recovered from the final consumer. All sorts of Indirect taxes like Excise duty, Service Tax, Octroi, Entry Tax, Entertainment Tax, Luxury Tax are merged under GST except a few taxes such as Basic customs duty, anti-dumping duty, safeguard duty, property tax, stamp duty and so on.
- **Akash Jadav, Vasu Kotadiya, Jignesh Vidani (2024):** This study examines the comparative impact of the Goods and Services Tax (GST) on tourist stays in hotels in Ahmedabad, focusing on tourist behaviour and preferences before and after its implementation. Using a structured approach, the study analysed associations between age and key factors such as hotel category preferences, perceptions of pricing and transparency, and overall satisfaction. The findings reveal limited but nuanced changes in tourist behaviour post-GST. While GST aimed to simplify taxation and enhance transparency, age showed weak correlations with hotel preferences and perceptions, indicating that other factors, such as income, travel purpose, and service quality, play a more significant role.
- **S.K.S. Yadava, Mohd. Mohsin Qureshib(2020):** India is a geographically vast country and is a tourist delight with a rich historical background and cultural heritage. Tourism is an important economic activity and also a one of the stronger pillar of the economy. In India, travel and tourism industry has been a remarkable contribution to the country's GDP. Not only GDP, tourism has always a huge source of foreign exchange earnings and significant contributor to employment generator for the country.
- **K.Rithuvarjitha, M.Dhinesh (2023)**: This study emphasizes the pivotal role of tourism as the world's third-largest export, intricately linked to socio-economic development. The study's objective is to discern the influence of the Goods and Services Tax (GST) regime on travel companies, employing a socio-legal research method with a sample size of 200 collected online. Investigating variables like age, gender, and education against the impact of GST on the tourism sector in Agra, the research employs primary data from local businesses.
- **Rajesh Kumar Tiwari, Prof. (Dr.) Sanjay Srivastava, Dr. Monika Goel Dean (2021):** This research paper investigates the ramifications of fluctuations in GST rates on tourist prices within the tourism industry, recognizing the industry's high price elasticity of demand. Utilizing a case study methodology, the study analyses actual data, ensuring confidentiality, and applies post-GST taxation rates. The comparison with pre-GST rates enables a comprehensive impact analysis on pricing dynamics.
- **Dr. Usha Pandey, Dr. Neelam Parihar (2021)**: The Goods and Services Tax (GST), implemented in India from July 1, 2017, marked a significant shift in the country's tax landscape. This tax reform aimed to replace multiple indirect taxes, impacting diverse sectors. Focusing on the Hospitality and Tourism Industry, a cornerstone of India's economy, the research emphasizes the sector's dynamic growth and vital contribution to GDP. Acknowledging GST as a non-discriminatory and fair-minded tax, the study anticipates positive effects such as reduced business transaction costs and enhanced competitiveness.
- **Japee and Lakhani:** Focused on impact of GST from international perspective. Researcher presented pre and post GST tax classification and also explained the importance and need of GST in India. This study also explains the journey of GST that how it came into effect in 2017 and also analysis of impact of GST on famous sectors of economy has been done.
- **Saeeda studied about GST:** Impact of GST on Various Aspects of Restaurant and Hotel Business in Anand and Nadiad District. The main aim of the study is to examine the impact of GST on various aspect of restaurant business in Anand and Nadiad City. For the study purpose, researcher selected 35 hotels and restaurants from Anand city and 33 hotels and restaurants from Nadiad city using

Convenience Sampling technique. The study is based on primary data collected using structure questionnaire. Researcher used Pearson Correlation, T-test and Independent sample test for the hypothesis testing.

- **Subha and Premkumar:** An Empirical Study on Impact of GST on Hotel Industry at Chennai City. The purpose of the study is to determine the impact of GST on the hotel industry in Chennai using five independent variables to categorize consumers' opinions on the GST regime, notably GST is efficacious, simple to comprehend, taxation ailment, cash flow, and increase of consumption after GST. Researchers used descriptive statistics and multiple regression analysis to analyse data.
- **Ojha and Vrat (2019) :** highlighted the effect of GST on making in India. They stated in their study that GST has reduced production costs, logistics costs, transportation costs, and the revenue of producing state, as well as increased compliance for MSME, ease of doing business, formality in operations, and investments (but it needs time for growth), exports and revenue of state consuming supplies. This study used a system dynamic approach and reported that GST would facilitate and support the Make in India initiative.
- **Mukherjee (2020):** attempted to estimate the GST efficiency across Indian states. The researcher stated that understanding tax revenue depends on the estimation of tax potential. The scale of the economy of any state depends on the structural composition of GST. This study finally reported that states with higher agriculture had lower GST capacity. States with a huge availability of natural resources were expected to have lower GST capacity. The study concluded that GST had reduced the tax capacity of states.
- **John and Dauchy (2021) :** Undertook the study to estimate the trends in the affordability of tobacco products in India's pre-GST and post-GST periods. This study reported that bidis, cigarette, and smokeless tobacco have become more affordable in the past 10 years, and the implementation of GST has emphasized the increased accessibility of cigarette and tobacco products but did not cause any change in the affordability of bidis. This study concluded that states with higher VAT in the period before GST experienced increased affordability of tobacco products and vice-versa.
- **Sahoo and Nayak (2021)** made efforts to analyse the impact of GST on the hotel industry. Data for this study were collected from a sample of 15 hotels in Bhubaneshwar city in Odisha. Collected data were analysed by the chi-square test. This study reported a significant relationship between customer satisfaction and their buying behaviour, customer clarity about the hotel industry, GST rates, and problems faced by hoteliers in handling their customers.

RESEARCH METHODOLOGY

- **RESEARCH DESIGN**

The study adopts a descriptive and analytical research design. It aims to understand and analyse the impact of Goods and Services Tax (GST) on the hotel, travel, and tourism industry by examining perceptions related to pricing, compliance, operational efficiency, and overall business performance. Quantitative techniques such as percentages, correlation, t-tests are used for analysis.

- **POPULATION AND SAMPLE SIZE**

The population includes stakeholders from the hotel, travel, and tourism industry. A sample of approximately 200–210 respondents was selected, which is adequate for applying statistical tools such as correlation, and t-tests.

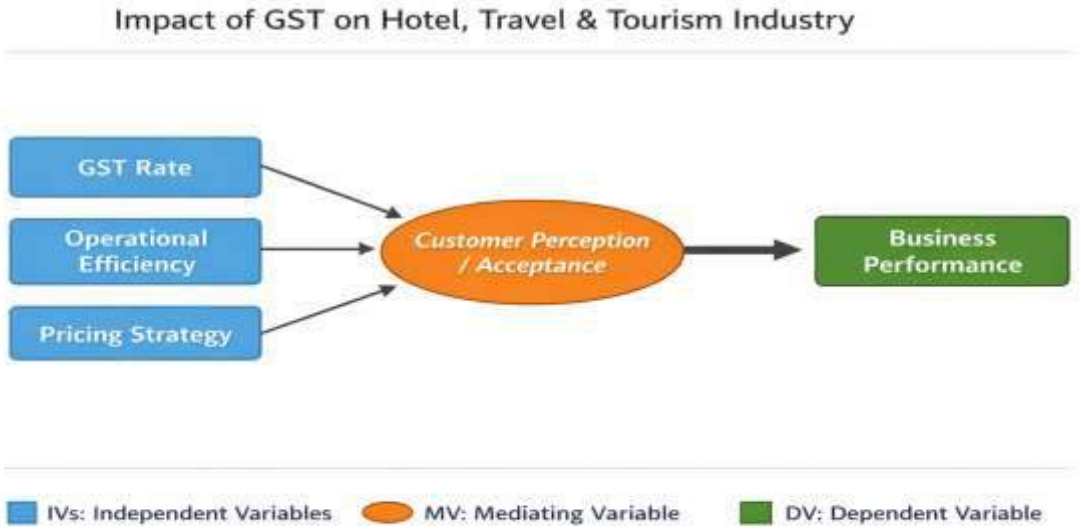
- **SAMPLING TECHNIQUE**

The study uses convenience sampling, where respondents are selected based on ease of access and willingness to participate. This method is time-saving, cost-effective, and suitable for collecting data from stakeholders in the hotel, travel, and tourism industry.

- **DATA COLLECTION METHOD**

The study uses primary data. Primary data was collected through a structured questionnaire from tourists, hotel owners/managers, travel agents, and other tourism stakeholders to understand the impact of GST.

CONCEPTUAL FRAMEWORK



STATEMENT OF THE PROBLEM

The Goods and Services Tax (GST) was introduced in India to simplify the tax system. The hotel, travel, and tourism industry is an important part of the economy and is directly affected by GST. After GST was introduced, there were changes in hotel prices, travel costs, and business operations. Some people feel GST has increased prices, while others believe it has improved transparency and efficiency. However, there is limited clear information based on real data about how GST has actually affected the tourism industry. Therefore, this study aims to understand the impact of GST on the hotel, travel, and tourism industry.

RESEARCH GAP

Since the introduction of GST, many discussions have taken place about its effects on the tourism and hospitality industry. However, most existing studies explain GST only in theory or depend heavily on secondary data such as reports and articles. There is limited research that captures the real experiences and opinions of stakeholders like tourists, hotel managers, travel agents, and restaurant owners. In addition, very few studies have examined how GST affects pricing, operational efficiency, and industry growth together in a single framework. This creates a gap in understanding the actual impact of GST at the ground level. Therefore, there is a need for a primary data–based study that reflects stakeholder perceptions and provides practical insights into the influence of GST on the tourism industry.

OBJECTIVES OF THE STUDY

- To understand the structure of GST applicable to the hotel, travel, and tourism industry.
- To analyze the impact of GST on pricing and operational efficiency in the tourism sector.
- To assess the overall influence of GST on the growth and competitiveness of the tourism industry.

HYPOTHESIS

H_{01} The GST structure has no significant role in influencing the functioning of the hotel, travel, and tourism industry.
H_{11} The GST structure plays a significant role in influencing the functioning of the hotel, travel, and tourism industry.
H_{02} GST has no significant impact on pricing and operational efficiency in the tourism sector.
H_{12} GST has a significant impact on pricing and operational efficiency in the tourism sector.
H_{03} GST has no significant influence on the growth and competitiveness of the tourism industry.
H_{13} GST has a significant influence on the growth and competitiveness of the tourism industry.

RESEARCH TOOLS

- **Questionnaire**
  A structured questionnaire is used as the main research tool to collect primary data from tourists, hotel owners/managers, travel agents, and restaurant owners. The questionnaire includes demographic questions and statements related to GST awareness, pricing, operational efficiency, and industry performance, measured using a Likert scale.
- **Statistical Tools**
  The collected data is analysed using statistical tools such as:
  - Percentage analysis
  - Mean and standard deviation
  - Chi-square test
  - Correlation and regression analysis
- **Software Tools**
  - Microsoft Excel for data entry and preliminary analysis
  - SPSS for statistical analysis and hypothesis testing

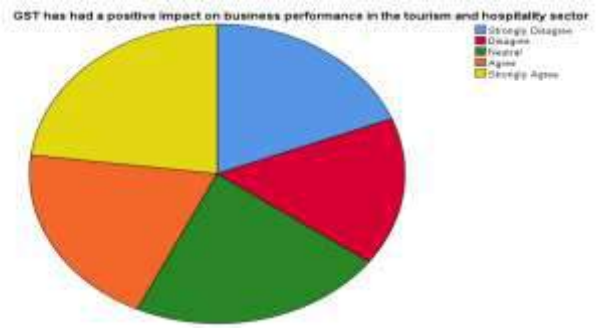
DATA ANALYSIS AND INTERPRETATION

OBJECTIVE 1

To understand the structure of GST applicable to the hotel, travel, and tourism industry

GST has had a positive impact on business performance in the tourism and hospitality sector

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	19	19.0	19.0	19.0
	Disagree	16	16.0	16.0	35.0
	Neutral	22	22.0	22.0	57.0
	Agree	20	20.0	20.0	77.0
	Strongly Agree	23	23.0	23.0	100.0
	Total	100	100.0	100.0	



INTERPRETATION

The results show a mixed but slightly positive perception of GST's impact on business performance in the tourism and hospitality sector. While 43% of respondents agree that GST has had a positive impact, 35% disagree and 22% remain neutral, indicating that benefits are recognized by many, but challenges still exist**.**

OBJECTIVE 2

To analyze the impact of GST on pricing and operational efficiency in the tourism sector

One-Sample Test

Test Value = 3

	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
age	.499	99	.619	.070	-.21	.35
gender	-11.303	99	.000	-.970	-1.14	-.80
types of respondent	-1.492	99	.139	-.200	-.47	.07
years of experience	.140	99	.889	.020	-.26	.30
ITR1	-4.210	99	.000	-.530	-.78	-.28
ITR2	1.342	99	.183	.200	-.10	.50
ITR3	.199	99	.843	.030	-.27	.33
ITR4	-.945	99	.347	-.130	-.40	.14
ITR5	-.282	99	.779	-.040	-.32	.24
ITR6	.839	99	.404	.120	-.16	.40
ITR7	-1.475	99	.143	-.210	-.49	.07
ITR8	.416	99	.678	.060	-.23	.35
ITR9	-1.346	99	.182	-.190	-.47	.09

INTERPRETATION

The one-sample t-test compares the mean of each variable with the test value 3 (neutral level). The results show that most variables do not differ significantly from the neutral value, as their p-values are greater than 0.05, indicating neutral perceptions.

However, gender and ITR1 show statistically significant differences ($p < 0.05$). Gender has a significant mean difference, indicating variation in responses across gender categories. ITR1 has a significantly lower mean than 3, suggesting a negative perception regarding that particular GST-related statement

Descriptive Statistics

	Mean	Std. Deviation	N
age	3.07	1.402	100
gender	2.03	.858	100
types of respondent	2.80	1.341	100
years of experience	3.02	1.428	100
ITR1	2.47	1.259	100
ITR2	3.20	1.491	100
ITR3	3.03	1.507	100
ITR4	2.87	1.376	100
ITR5	2.96	1.421	100
ITR6	3.12	1.430	100
ITR7	2.79	1.423	100
ITR8	3.06	1.441	100
ITR9	2.81	1.412	100

INTERPRETATION

The mean values for demographic variables such as age (3.07), type of respondent (2.80), and years of experience (3.02) indicate a fairly balanced distribution across categories.

For the ITR statements, mean scores mostly range between 2.47 and 3.20, suggesting moderate to neutral perceptions regarding GST-related issues in the tourism and hospitality sector. The standard deviations (around1.3–1.5) indicate a reasonable variation of opinions among respondents, showing that views on GST impacts differ across individuals

OBJECTIVE 3

To assess the overall influence of GST on the growth and competitiveness of the tourism industry

Correlations

Control Variables			Age	Gender	Types Of Respondent	Years Of Experience
ITR1 & ITR2 & ITR3 & ITR4 & ITR5 & ITR6 & ITR7 & ITR8 & ITR9	age	Correlation	1.000	-.095	-.013	-.049
		Significance (2-tailed)	.	.370	.900	.646
		df	0	89	89	89
	gender	Correlation	-.095	1.000	-.025	-.179
		Significance (2-tailed)	.370	.	.811	.090
		df	89	0	89	89
	types of respondent	Correlation	-.013	-.025	1.000	.135
		Significance (2-tailed)	.900	.811	.	.201
		df	89	89	0	89
	years of experience	Correlation	-.049	-.179	.135	1.000
		Significance (2-tailed)	.646	.090	.201	.
		df	89	89	89	0

INTERPRETATION

The correlation analysis shows very weak relationships among age, gender, type of respondent, and years of experience while controlling for ITR1 to ITR9. All correlation coefficients are close to zero, and the p-values are greater than 0.05, indicating no statistically significant relationships among these demographic variables.

FINDINGS

The study shows that GST has created a **mixed response** in the tourism and hospitality sector. While many respondents feel GST has improved transparency and brought some operational benefits, a large number remain neutral, and some still face difficulties. Overall opinions suggest that GST's impact is moderately positive but not uniform across all areas.

LIMITATIONS OF THE STUDY

- The study is based on a limited sample size, which may not fully represent the entire tourism and hospitality sector.
- Data is collected through self-reported responses, which may involve personal bias or subjective opinions
- The study covers a short time period, so long-term impacts of GST could not be analysed.
- Geographical coverage is limited, restricting the generalization of findings to other regions.
- Only selected GST-related factors were considered, and other influencing variables may affect business performance.

FUTURE SCOPE OF THE STUDY

Future research can include a larger and more diverse sample across different regions. Comparative studies before and after GST implementation, or between different tourism segments, can provide deeper insights. Further studies may also focus on long-term financial performance and compliance challenges to better understand GST's evolving impact**.**

CONCLUSION

GST has simplified the tax structure for the tourism and hospitality industry, but its benefits are not fully realized by all stakeholders. The sector continues to adjust to compliance requirements and cost-related challenges. With better awareness and supportive policies, GST can become more effective and widely accepted in the future.

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Research Paper

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DEVELOPING AN INTERNAL CONTROL TESTING MODEL FOR BANK SUPERVISION BY A KNOWN CENTRAL BANK IN AFRICA: A REFERENTIAL PRAGMATIC APPROACH

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This paper develops an Internal Control Testing Model (ICTM) to strengthen supervision of commercial banks by a known Central Bank in Africa. Grounded in a referential pragmatic approach, the ICTM integrates established internal control frameworks (e.g., COSO's Internal Control – Integrated Framework) with Enterprise Risk Management (ERM) concepts and the Theory of Constraints (TOC) to address systemic risks and practical constraints in the studied economy's banking sector. The proposed model aims to (i) enhance the Central Bank's capacity to identify and diagnose emerging risks, (ii) improve the relevance and completeness of supervisory data and reporting, and (iii) support risk-based supervisory interventions aligned with international standards. A mixed-methods research design is outlined: quantitative assessments of bank control environments and performance indicators, combined with qualitative interviews of the Central Bank supervisors and bank risk managers. Expected contributions include a practical ICTM tool that the Central Bank can institutionalize, methodological guidelines for its implementation, and insights into how international control frameworks can be adapted in a developing economy context.

KEYWORDS: ***Bank supervision, internal controls, Central Bank, COSO, Enterprise Risk Management (ERM), risk-based supervision, developing economies, pragmatic framework, Theory of Constraints***

1. INTRODUCTION

Weaknesses in a country's banking system can threaten both domestic and global financial stability. This was underscored by the final communiqué of the Lyon G-7 Summit (1996), which called for concerted action to strengthen financial systems. Since then, bodies such as the Basel Committee on Banking Supervision, the Bank for International Settlements (BIS), the International Monetary Fund (IMF), and the World Bank have promoted enhanced regulatory practices to mitigate banking risks via central bank supervision of commercial banks. Consistent with this global agenda, this research addresses the supervision of commercial banks by the Known Central Bank – the country's central bank and primary banking regulator.

In the studied economy and similar developing economies, financial stability faces unique challenges. Economic structures often lack diversification, making them vulnerable to exogenous shocks in key sectors. For example, misaligned industrial policies in the 1970s and 1980s led many developing countries to favour enterprises that later generated nonperforming loans, undermining banks' health (Long & Evenhouse, 1989; World Bank, 1989). Government interventions in lending (e.g., directed credit, administered interest rates, high reserve requirements) also frequently distort banks' incentive structures, leading to higher risks and complicating supervisory oversight (Ehrenhard, Manda, & Richardson, 2017; Mavhiki, Nyadzayo, & Chikozho, 2019).

The central Bank under study supervisory effectiveness is further challenged by resource constraints, data limitations, and gaps between formal regulations and actual risk management practices within banks. In response to global financial crises (e.g., 2008), there has been a shift from siloed, rule-based oversight to holistic frameworks like Enterprise Risk Management (ERM). ERM has brought focus to integrated governance, risk, and control (GRC) frameworks (COSO, 2013; COSO, 2017). However, the literature indicates a need for research on how such frameworks can be operationalized in supervisory testing, especially in emerging markets (Fernando, Ashby, Carter, & Grafton, 2023; El Hajj & Hammoud, 2023). Recent scandals (Enron, WorldCom, Barings, Intermarket, Daiwa, Parmalat, Tyco, Investrust Bank) further highlight the urgency of robust internal controls in banking operations (El Hajj & Hammoud, 2023).

The aim of this study is to develop a comprehensive Internal Control Testing Model (ICTM) for Central Bank's supervision of commercial banks. The ICTM is conceptualized through a referential pragmatic approach, integrating:
COSO's Internal Control – Integrated Framework (2013, 2017) to define control components (Control Environment, Risk Assessment, Control Activities, Information & Communication, Monitoring);
Enterprise Risk Management (ERM) principles to align control effectiveness with risk outcomes;

Theory of Constraints (TOC) to identify and manage bottlenecks in supervisory processes; and
Pragmatic adaptation to studied economy's regulatory environment and the Central Bank's capacities.
This approach ensures the model is theoretically grounded yet adaptable to local conditions (Lewis et al., 2019).
The following research questions guide the study:
1. What components and metrics constitute an effective Internal Control Testing Model (ICTM) for commercial banks in the economy in question?
2. How can the ICTM be aligned with international standards (COSO, Basel, ERM frameworks) while addressing this economy's specific regulatory context?
3. Which data sources, indicators, and testing procedures best predict emerging bank risks and supervisory intervention needs?
4. How can the ICTM be integrated into the Central Bank's governance, risk, and compliance (GRC) structures to support decision-making and enhance transparency?
5. What resources (e.g., training, technology, policy changes) are required for Central Bank to implement the ICTM effectively?
To answer these questions, the research adopts a mixed-methods design. The quantitative component will involve structured assessments of internal control environments at a sample of the economy's banks and analysis of supervisory data. The qualitative component will use interviews with Central Bank supervision staff and senior risk managers at banks, alongside policy document analysis, to contextualize and refine the model. Together, these methods will enable the validation and calibration of the ICTM.

The rest of this article is organized as follows. Section 2 reviews relevant literature on bank supervision, internal controls, and ERM, highlighting challenges in developing country contexts. Section 3 presents the research methodology, including sampling, data collection instruments, and analysis strategies. Section 4 outlines the proposed ICTM, including its conceptual framework and measurement instrument. Section 5 discusses findings from a conceptual perspective (in lieu of empirical results) and reflects on implications for Central Bank and broader policy. Finally, Section 6 concludes with contributions, limitations, and directions for future research.

2. LITERATURE REVIEW

2.1 Evolution of Bank Supervision

Early banking supervision was primarily compliance-focused, ensuring banks adhered to capital and reserve requirements. Over time, central banks and international bodies recognized that systemic stability requires ongoing risk assessment and governance oversight. The Basel I (1988) and Basel II/III (2004–2010) Accords introduced risk-weighted capital guidelines and encouraged comprehensive risk-based supervision (Basel Committee on Banking Supervision [BCBS], 2011). Concurrently, organizations like the IMF and World Bank stressed institutional reforms in developing countries (IMF, 1999). Zambia's regulatory framework has evolved in this international context, with Central Bank adopting Basel-inspired regulation and closer collaboration with global agencies.

2.2 Internal Control Frameworks and ERM

COSO's Internal Control – Integrated Framework (first released 1992; updated 2013, 2017) remains the most adopted standard for evaluating control systems. COSO (2013) defines five interrelated components of effective internal control: Control Environment, Risk Assessment, Control Activities, Information & Communication, and Monitoring (Figure 1). The updated 2017-2018 COSO guidance emphasizes technology, organizational culture, and global compliance demands. In parallel, ERM frameworks (e.g., COSO ERM, ISO 31000) extend internal control to an enterprise-wide risk perspective, breaking down silos among credit, market, operational, and compliance risks (COSO, 2013; ISO 31000:2018). Scholars note that strong internal controls are foundational to effective ERM (Arena, Arnaboldi, & Azzone, 2010).

Figure 1.
Conceptual alignment of COSO internal control components with supervisory objectives.
(Note: Figure is a placeholder illustrating how COSO's five components underpin supervision targets such as risk identification, transparency, and depositor protection.)

Despite these frameworks, global audits and crises (e.g., Enron, Barings) revealed failures in governance and oversight, prompting calls for integrated GRC strategies (COSO, 2017). ERM adoption has grown, but research on its effectiveness in banks—especially in emerging markets—is still limited (Fernando et al., 2023; El Hajj & Hammoud, 2023).

2.3 Challenges in Developing Economies' Supervision

Developing-country supervisory agencies often operate under resource constraints and political pressures. For example, directed lending policies (to agriculture, SMEs) and administered rates can yield high nonperforming loans, complicating risk monitoring. Sectoral concentration means bank idiosyncratic problems can quickly become systemic. Studies find that inadequate data reporting, low supervisory capacity, and outdated accounting practices hinder early warning in many emerging markets (Kasiak, 2000; Khan & Schiller, 2017). In the economy under study specifically, limited experience among supervisory staff and governance issues in banks have been noted (Mwansa, 2021).

These challenges suggest that the Central Bank requires tools that go beyond standard checklists. It needs an ICTM that is sensitive to both quantitative indicators (e.g., capital adequacy, asset quality) and qualitative signals (e.g., corporate governance culture, governance bottlenecks). The emerging literature on banking supervision underscores the importance of comprehensive dashboards and scenario analysis (BIS, 2018; Baele, 2005) – elements we incorporate into ICTM.

2.4 Gaps in Existing Supervisory Models

Many existing supervisory frameworks focus on compliance metrics or capital adequacy. What is often missing is a structured approach to testing the effectiveness of banks' internal controls under stress. Moreover, international models like the Basel Consolidated Supervision protocols (quantitative and qualitative) are designed for large, diversified banking groups and may not easily translate to the studied economy's market (BCBS, 2019). Preliminary reviews of the economy's

bank supervision suggest reliance on off-site reports and periodic on-site exams, with less emphasis on frequent control testing or real-time risk metrics. Anecdotal evidence indicates that Central Bank supervisors would benefit from a more systematic internal control evaluation tool.

3. METHODOLOGY

3.1 Research Design

The study uses an explanatory sequential mixed-methods design. In the first phase, quantitative data will be collected and analysed to identify patterns in control environments and risk outcomes. In the second phase, qualitative data will supplement and explain these patterns, informing model refinement (Creswell & Plano Clark, 2018). This design is suitable because it allows the strengths of one method to validate and deepen the findings of the other (Tashakkori & Teddlie, 2003).

3.2 Sample and Setting

Study Area

The setting is the Capital of the economy under study, where Central Bank headquarters and most commercial banks are based.

Population

All commercial banks licensed by Central Bank as of [2024]. (Appendix 1 lists current banks.) Central Bank supervisory staff and senior risk/compliance officers at these banks form the pool for interviews.

Quantitative Sample

A sample was not necessary assess internal control components (COSO elements) as the study employed a Census due to the limited number of personnel in the population, key performance indicators, and instances of control lapses in the past three years. Supervisory ratings or enforcement actions (if data can be accessed) will be linked to survey responses.

Qualitative Sample

Purposive sampling will identify 5–10 Central Bank supervisors (with varying seniority) and 10–15 bank risk officers. This range should achieve saturation in interviews about supervisory practices and perceptions of internal controls (Guest, Bunce, & Johnson, 2006).

3.3 Data Collection Instruments and Procedures

Quantitative Instruments

A structured ICTM survey will be developed (Appendix 3). Key sections include:

Control Environment

Questions on governance structures, ethical tone, management commitment to control (e.g., presence of audit committees, frequency of board reviews).

Risk Assessment

Items on risk identification processes, stress testing, and scenario analysis use.

Control Activities

Checklist of automated and manual controls (e.g., authorization procedures, reconciliation practices), including changes after stress events.

Information & Communication

Quality and timeliness of financial reporting, internal reporting channels, and communication of risk policies.

Monitoring

Frequency and scope of internal audit, follow-up on past findings, and corrective action processes.

Process Bottlenecks (TOC Lens)

Questions identifying delays or constraints in supervisory workflows (e.g., data aggregation delays, skill shortages).

Responses will mostly use Likert scales (e.g., 1=Strongly Disagree to 5=Strongly Agree) and nominal data on control practices. The instrument will be pilot-tested with one bank and a Central Bank unit to refine clarity.

Qualitative Instruments

Semi-structured interview guides (Appendix 4) will cover:

Supervisory practice: How do supervisors currently assess bank risk and controls?

Perceived gaps: What are common failures in banks' internal controls?

ICTM feedback: Reactions to preliminary ICTM components or test items (during the second phase).

Implementation issues: Resources, training, or organizational changes needed to adopt a model.

Document analysis will include Central Bank policy guidelines, supervision manuals, and recent bank examination reports (as available), to triangulate findings.

3.4 Data Analysis

Quantitative Analysis

Data will be analysed using SPSS or R. We will perform:

Descriptive statistics to profile control components across banks.

Reliability tests (Cronbach's alpha) for survey scales.

Exploratory Factor Analysis to confirm constructs (e.g., that items group into COSO components).

Regression or Structural Equation Modelling to test relationships (e.g., whether stronger control environments predict higher supervisory ratings or lower incidence of enforcement).

Comparative analysis to see if different bank types (e.g., large vs. small, local vs. foreign owned) score differently on the ICTM scales.

Qualitative Analysis

Interviews will be audio-recorded (with consent) and transcribed. Analysis will follow Interpretive Phenomenological Analysis (IPA) and thematic coding (Smith & Osborn, 2007). Steps include:

1. Familiarization - Reading transcripts to note initial impressions.
2. Coding - Identifying meaningful units related to control testing, supervision challenges, and ICTM feasibility.
3. Theme development - Clustering codes into themes (e.g., "data quality issues," "governance culture," "technology constraints," "training needs").
4. Interpretation - Linking themes to the quantitative findings, refining the model components accordingly.

Integration
Results from both phases will be integrated by comparing quantitative patterns with qualitative insights. For example, if surveys indicate weak monitoring in smaller banks, interviews might reveal reasons (e.g., lack of auditors). This integrated analysis will inform a final ICTM, scored by thresholds indicating satisfactory versus deficient control testing.

3.5 Ethical Considerations
This research will adhere to ethical standards. Participation (survey and interviews) will be voluntary with informed consent. Bank identifiers will be anonymized. Sensitive supervisory information will be handled per Central Bank and University of Zambia protocols. Approval will be obtained from the University's Ethics Committee and Central Bank oversight, as needed. Any potential conflicts of interest (e.g., researcher affiliations) will be disclosed; no external funding has influenced the research design.

4. PROPOSED INTERNAL CONTROL TESTING MODEL (ICTM)
4.1 Model Structure
Drawing from the literature and research findings, the ICTM will consist of:
Dimension 1 – Control Environment
Measures of governance, ethical climate, and management's risk appetite.
Dimension 2 – Risk Assessment
Quality of risk identification processes, including how macroeconomic and sectoral risks are factored.
Dimension 3 – Control Activities
Presence and effectiveness of key controls (e.g., segregation of duties, automated controls, limit checks).
Dimension 4 – Information & Communication
Timeliness and accuracy of internal management information, and channels for raising concerns (e.g., whistleblower systems).
Dimension 5 – Monitoring and Corrective Action
Functioning of internal audit, compliance functions, and follow-up on audit findings.
These correspond to COSO's five components. Additionally, a Dimension 6 – Supervisory Constraints (TOC) will capture bottlenecks in data collection and analysis (e.g., reliance on paper reporting, staff turnover in supervision departments). This helps the Central Bank identify internal constraints to effective oversight.
Each dimension will have several indicators drawn from survey and interview data. For example, "Control Activities" might include indicators like "Reconciliation frequency" or "Approval matrix comprehensiveness." Scoring guidelines (e.g., 1–5 scales) will be developed such that the Central Bank can rate each bank on these dimensions annually.

4.2 Instrument Details
An excerpt of the ICTM questionnaire (Appendix 3) might look like:

ICTM Dimension	Indicator	Scoring (1–5) Description
Control Environment	Formal organization charts and job scopes	1=No documented clarity;5=Fully documented
Risk Assessment	Use of stress testing (e.g., scenario analysis)	1 = Never; 5 = Regular, multidimensional
Control Activities	Segregation of duties for key operations	1 = Poor; 5 = Complete abs. segregation
Info & Communication	Timeliness of financial reporting to board	1 = >90 days delay; 5 = <30 days
Monitoring	Internal audit coverage (% of processes)	1 = <20%; 5 = >80%
Remediation	Remediation of audit findings (avg time)	1 = >1 year; 5 = <3 months
TOC – Constraints	Data collection lead time (days)	1 = Very high ratio; 5 = Adequate staff

Table 1. Sample ICTM indicators and scoring rubric (simplified).

Central Bank supervisors would use such an instrument to score each bank. The scores can then be aggregated (e.g., weighted sum or composite indices) to provide an overall control quality rating. Banks scoring below a threshold would trigger supervisory review or mandated improvements.

4.3 Data Integration and Reporting
The model envisions integration into the Central Bank's supervisory data systems. For instance, banks could submit ICTM data annually (similar to financial returns), and supervisors would analyse trends over time. Cross-bank benchmarks could be established. Supervisors would also incorporate ICTM findings into on-site exam scopes (e.g., if a bank rates low on Control Activities, the examination would probe specific controls).

ICTM results would feed into the Central Bank's risk dashboards. For example, a composite dashboard could display each bank's scores by dimension alongside traditional CAMEL ratings (Capital, Assets, Management, Earnings, Liquidity). Figure 2 illustrates how ICTM fits into the overall supervision cycle.

Figure 2.
Proposed integration of the ICTM into the Central Bank's supervision process.
(Figure placeholder: A flowchart showing the inputs (bank data, ICTM scores), processing (Central Bank analysis, report generation), and outputs (supervisory actions, feedback to banks).)
Geared towards practicality, the ICTM complements existing Basel-style assessments. While Basel Pillar 2 principles encourage supervisors to evaluate banks' internal risk processes, the ICTM provides a concrete tool for doing so systematically. By tying each dimension to supervisory checkpoints, Central Bank can make subjective judgments more objective and data-driven.

5. DISCUSSION

Although empirical results are pending (as this is a proposal framework), the proposed ICTM offers several potential benefits and avenues for research:

Formalizing Best Practices

By codifying control testing into a standardized instrument, the Central Bank can reduce subjectivity and ensure consistency across different exam teams and time periods.

Early Warning

The TOC-based indicators, in particular, highlight how supervisor delays or bank reporting lags can themselves become early warning signals. Monitoring these constraints can prompt Central Bank to adjust resources or processes.

Capacity Building

Filling out the ICTM instrument requires banks to self-assess their controls and possibly strengthen their internal audit. This aligns banks' incentives with regulatory goals. Simultaneously, Central Bank can tailor training for supervisors on new risk indicators.

Research Implications

Future work could involve piloting the ICTM with actual data and evaluating its predictive validity (e.g., do low ICTM scores predict subsequent liquidity or credit problems?). Comparative studies could test the model in other African central banks to assess generalizability.

However, several challenges should be anticipated. Data accuracy is critical: banks might initially under-report control gaps. Confidence-building measures and triangulation (e.g., matching self-reports with exam findings) will be needed. There may also be resistance from banks accustomed to compliance reporting but not control self-assessments. A phased rollout, starting with workshops to explain the benefits, could help adoption.

Finally, the ICTM should not be static. As noted by COSO (2017), governance and risk landscapes evolve (e.g., fintech risks, cyber threats). The model must be reviewed regularly (CXO governance) to incorporate new risks or control practices. Building feedback loops where Central Bank adjusts ICTM indicators based on observed incidents will keep the model relevant.

6. CONCLUSION

This paper has outlined a proposal for an Internal Control Testing Model (ICTM) to enhance a Central Bank's supervision of commercial banks. The ICTM bridges international best practices (COSO, Basel, ERM) with a pragmatic understanding of the studied economy's supervisory context. Its structured approach to evaluating control environments and processes promises to improve risk identification, foster proactive governance, and ultimately contribute to financial stability and depositor protection.

Key Contributions

1. A conceptual framework aligning COSO components with regulatory objectives and TOC insights.
2. A draft instrument structure for measuring internal control dimensions.
3. A methodological roadmap (mixed-methods design) for implementing and refining the model.

Once validated with actual data, the ICTM could become an official Central Bank supervisory tool. Moreover, the findings should be informative for other developing-country regulators seeking data-driven, cost-effective ways to upgrade their oversight in line with global standards.

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Conflict of Interest Statement

The author declares no conflicts of interest related to this research. This study is conducted independently as part of a PhD requirement at the University of Zambia; no external funding or institutional ties have influenced the content.

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APPENDICES

Appendix 1: List of Commercial Banks in Zambia (as of 2024).

1. AB Bank Zambia Ltd: Part of Access Holding Group.
2. Absa Bank Zambia Ltd: Part of Absa Group.
3. Access Bank Zambia Ltd: Part of Access Bank Group.
4. Bank of China (Zambia) Ltd: Part of Bank of China Group.
5. Citibank Zambia Ltd: Part of Citigroup.
6. Ecobank Zambia Ltd: Part of Ecobank Group.
7. First Alliance Bank Zambia Ltd.
8. First Capital Bank Zambia Ltd: Part of First Capital Bank Group.
9. First National Bank Zambia Ltd: Part of FirstRand Group.
10. Indo-Zambia Bank Ltd.
11. Stanbic Bank Zambia Ltd: Part of Standard Bank Group.
12. Standard Chartered Bank Plc: Part of Standard Chartered Group.
13. United Bank for Africa Zambia Ltd: Part of UBA Group.
14. Zambia Industrial Commercial Bank Plc.
15. Zambia National Commercial Bank Plc (Zanaco).

Appendix 2: Sample ICTM Questionnaire (Draft).

Questionnaire-1%20-%20Internal%20Contr

Appendix 3: Semi-Structured Interview Guide (Supervisor).

Part A. Interview Preparations

Interviewee profile (examples): Central Bank supervisory staff, internal control/quality assurance personnel, bank examiners, risk/compliance officers, policy/regulatory liaison leads, Barclays/Barclays-like supervisors (Barbados framework liaison if applicable), external auditors with Central Bank experience.

Estimated duration: 60–90 minutes

Format: In-depth, semi-structured; allow for clarifying questions and prompts

Recording: With consent, audio-record; take field notes on non-verbal cues and context

Data use: Align questions to protect confidentiality and utility for the study

Part B. Opening and Context (Warm-up)

1) Please describe your role within the Central Bank and your involvement with bank supervision and internal control testing.

2) How would you characterize the current internal control testing framework used by the Central Bank in supervising commercial banks?

3) In your view, what are the major aims of the Central Bank's prudential regulation and how does internal control testing support those aims?

Part C. Main Interview Domains and Questions

Domain 1

Discrepancies between the Central Bank's framework and external prototypes (Linked to Sub Research Question 1)

Core question: What discrepancies does the Central Bank exhibit from its internal control testing framework when compared with the generated prototype from extant literature?

Probes

Which components of the Central Bank's framework align with the Barbados Central Bank supervision framework, and which do not?

Can you provide examples where the Central Bank's framework diverges from the prototype? (e.g., processes, indicators, timelines)

What factors do you think drive these discrepancies (policy, resource constraints, organizational culture, data availability)?

How do you currently validate or adjust the Central Bank's framework in response to new literature or international standards?

How is feedback from banks and examiners incorporated into refining the framework?

Domain 2
Application of internal control testing under stress (Linked to Sub Research Question 2)
Core question: To what extent does the Central Bank employ its internal control testing framework to diagnose commercial banks that are under stress?
Probes
How is "stress" defined and detected within Central Bank's supervisory system?
What internal control indicators are most predictive of distress, according to current practice?
Describe a recent instance where the framework identified a bank under stress. What actions followed?
What data sources are used (financial ratios, governance indicators, market signals, macro conditions), and how reliable are they?
What challenges limit effective diagnosis (data gaps, lag times, inter-agency coordination)?
How could the framework be enhanced to improve early detection and response?

Domain 3
Mitigating consumer/investor interests and systemic safety (Linked to Sub Research Question 3)
Core question: How does the Central Bank apply its internal control testing framework to mitigate consumer, investor interests and integrity of the financial system safety and soundness of a commercial bank's financial stability?
Probes
Which aspects of the framework are designed to protect consumers and investors?
How are findings translated into supervisory actions (e.g., corrective plans, enforcement, remedial measures)?
How is the effectiveness of these actions assessed?
Can you discuss any trade-offs between prompt enforcement and preserving financial stability?
How does the Central Bank communicate risks and actions to banks and to the public?

Domain 4
Application under stress conditions (Linked to Sub Research Question 4)
Core question: How does the Central Bank apply its internal control testing framework to mitigate consumer, investor interests and systemic safety when a bank is under stress?
Probes
What additional or altered controls are activated when a bank is stressed?
How is communication with stakeholders managed during stress scenarios?
What lessons have been learned from past crises (e.g., Intermarket, Investrust, Merridian BIAO cases) in applying the framework?
What indicators signal a need for escalated intervention, and who approves these escalations?
How does the Central Bank balance rapid action with due process and fairness?

Domain 5
Theoretical framing and practical integration (Linked to TOC and pragmatism)
Core question: How do Goldratt's Theory of Constraints (TOC) concepts translate into the Central Bank supervision practice? Are there constraints that most strongly limit effective supervision?
Probes
In your view, what are the five most significant constraints (policy, mental models, people, attitudes, finances, etc.) affecting supervision outcomes?
How are these constraints identified, measured, and mitigated in daily operations?
Do you see alignment (or misalignment) between the theoretical model and practical workflows?
What changes would help overcome key constraints without compromising safety and soundness?

Domain 6
Data, validity, and governance
Core question: What data governance, quality, and integrity considerations are critical for accurate internal control testing?
Probes
How is data collected, cleaned, and validated for testing?
What are the data access and privacy considerations?
How is bias or subjectivity in assessment minimized?
What documentation and traceability exist for supervisory decisions based on the framework?

Domain 8
Implementation and improvement
Core question: What actionable recommendations would you propose to enhance the Central Bank's internal control testing framework?
Probes
Specific changes to processes, indicators, or governance structures
Training or capacity-building needs for staff
Ways to incorporate international standards while reflecting local context

Suggested pilot steps or timelines for implementing improvements

Part D. Closing Questions
1) If you had a single recommendation to the Central Bank leadership to improve bank supervision via the internal control testing framework, what would it be?
2) Are there any ethical or regulatory concerns you want to highlight about the current framework?
3) Is there anyone else you recommend we speak with to gain additional perspectives?

Part E. Probes and Prompts (for eliciting richer data)
"Tell me more about that." “Can you give a concrete example?”
Use hypothetical scenarios: “If a bank shows X indicator, what would your action be?”
Use timeline prompts: “What happened first, then what followed?”
Compare and contrast: “How does this differ from your past experience in [another jurisdiction]?”
Ask for document references: “Are there internal guidelines or checklists you rely on?”

Part F. Ethical and Safety Considerations
Ensure consent and confidentiality
Clarify use of anonymized quotes
Allow interviewee to skip questions they are not comfortable answering

Part G. Interview Guide Logistics
-Date, time, location
- Interviewee role and unit
- Consent confirmation
- Recording status
- Key takeaways and follow-up actions

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TARIFF REFORMS, NON-TARIFF BARRIERS, AND WTO POLICIES: IMPLICATIONS FOR GLOBAL TRADE AND ECONOMIC GROWTH

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Tariff reforms, non-tariff barriers, and World Trade Organization (WTO) policies play a decisive role in shaping the structure and direction of global trade and economic growth. Over the last few decades, multilateral trade negotiations under the General Agreement on Tariffs and Trade (GATT) and the WTO have significantly reduced tariff levels across countries, fostering trade liberalization and economic integration. These reforms have enhanced global market access, improved competitiveness, and stimulated economic growth, particularly in emerging and developing economies. However, the decline in tariffs has been accompanied by the increasing prevalence of non-tariff barriers (NTBs), including technical standards, sanitary and phytosanitary measures, subsidies, licensing requirements, and administrative procedures, which often restrict trade more subtly yet more effectively than tariffs. This study is entirely based on secondary data collected from WTO reports, World Bank and IMF databases, UNCTAD publications, government reports, and peer-reviewed academic literature. The paper examines the effectiveness of tariff reforms in promoting trade liberalization, analyzes the growing impact of non-tariff barriers on global trade flows, and evaluates the role of WTO policies in ensuring a transparent, predictable, and fair multilateral trading system. The findings suggest that while tariff reductions have positively influenced export competitiveness, foreign direct investment, and economic growth, persistent non-tariff barriers and protectionist measures continue to constrain the full potential of global trade, especially for developing countries. The study emphasizes the need for regulatory simplification, institutional capacity building, and digital trade facilitation to strengthen trade integration and achieve sustainable economic growth.

KEYWORDS: ***Tariff Reforms; Non-Tariff Barriers; WTO Policies; Trade Liberalization; Global Trade; Economic Growth; Secondary Data***

1. INTRODUCTION

Global trade has undergone a profound transformation over the past century, driven by technological progress, globalization, and evolving international trade policies. Trade liberalization has emerged as a key strategy for promoting economic growth, efficiency, and development across nations. Among the various policy instruments influencing trade, tariffs and non-tariff barriers occupy a central position. Traditionally, tariffs were widely used by governments to protect domestic industries, generate public revenue, and regulate imports. However, excessive reliance on tariffs often resulted in inefficiencies, higher production costs, and reduced competitiveness.

The establishment of the General Agreement on Tariffs and Trade (GATT) in 1947 marked the beginning of a multilateral effort to reduce trade barriers and promote free trade. This process gained further momentum with the creation of the World Trade Organization (WTO) in 1995, which introduced a comprehensive institutional framework governing international trade in goods, services, and intellectual property. Through successive negotiation rounds, WTO member countries committed themselves to systematic tariff reductions, increased transparency, and rule-based trade practices.

Despite substantial reductions in tariff levels worldwide, international trade continues to face significant challenges. Non-tariff barriers, such as technical regulations, sanitary and phytosanitary measures, quotas, subsidies, and complex customs procedures, have become increasingly prominent. While these measures are often justified on grounds of public health, safety, and environmental protection, they can also serve as instruments of disguised protectionism. Developing and least-developed countries, in particular, face difficulties in complying with complex regulatory requirements imposed by developed economies, limiting their effective market access.

The WTO plays a crucial role in addressing these challenges by promoting transparency, non-discrimination, and predictability in international trade. Agreements such as GATT, GATS, and TRIPS, along with institutional mechanisms like the Trade Policy Review Mechanism (TPRM) and the Dispute Settlement Mechanism (DSM), aim to balance trade liberalization with national policy objectives. Against this backdrop, the present study examines the interrelationship between tariff reforms, non-tariff barriers, and WTO policies, and analyzes their implications for global trade flows and economic growth.

2. OBJECTIVES OF THE STUDY

The specific objectives of the study are:

- To examine the role of tariff reforms in promoting trade liberalization and economic growth.
- To analyze the impact of non-tariff barriers on global trade flows, particularly in developing economies.
- To evaluate the effectiveness of WTO policies and mechanisms in regulating international trade and ensuring a fair global trading system.

3. RESEARCH METHODOLOGY

The present study is based exclusively on secondary data obtained from reliable national and international sources. These include:

- World Trade Organization (WTO) reports and statistical databases
- World Bank and International Monetary Fund (IMF) publications
- United Nations Conference on Trade and Development (UNCTAD) reports
- Ministry of Commerce and Industry (Government of India) and Reserve Bank of India (RBI) publications
- Peer-reviewed journals, books, and policy research papers

A descriptive and analytical research design has been adopted. The study analyzes trends in tariff reforms, non-tariff barriers, and trade flows during the period 1995–2023. Comparative analysis and synthesis of existing empirical studies are used to assess the effectiveness of WTO policies and trade reforms. No primary data has been used in this study.

4. REVIEW OF LITERATURE

The relationship between tariff reforms, trade liberalization, and economic growth has been extensively analyzed in economic literature.

Bhagwati (2002) argued that trade liberalization through tariff reduction enhances efficiency, expands market access, and promotes economic welfare. According to him, open trade regimes are essential for sustained growth in developing countries.

Hoekman and Kostecki (2009) emphasized the importance of WTO institutions in reducing trade-related uncertainties and resolving disputes. They highlighted that the Dispute Settlement Mechanism strengthens confidence among trading partners and encourages compliance with multilateral trade rules.

Baldwin (2016) focused on the interaction between trade liberalization and technological change. He argued that global value chains and information technology have transformed the nature of international trade, making tariff reductions even more critical for competitiveness.

UNCTAD (2020) observed that although average global tariff levels have declined significantly, non-tariff measures have increased in both number and complexity. These measures disproportionately affect developing countries, which often lack the institutional capacity to comply with stringent standards.

Overall, the literature suggests that while tariff reforms contribute positively to trade and growth, the increasing role of non-tariff barriers and regulatory measures presents new challenges that require coordinated international and domestic policy responses.

5. TARIFF REFORMS AND TRADE LIBERALIZATION

5.1 Historical Context

Historically, tariffs served as the primary instrument of trade policy. Many developing countries pursued import-substitution strategies during the post-independence period, imposing high tariffs to protect domestic industries. While such policies supported infant industries, they also led to inefficiencies and limited integration with global markets.

5.2 Global Trends in Tariff Reduction

The formation of the WTO marked a turning point in global tariff reforms. Successive negotiation rounds led to significant reductions in tariff levels across both developed and developing countries. Average global tariffs declined from around 12 per cent in the mid-1990s to below 4 per cent by the early 2020s. Emerging economies such as China and India implemented phased tariff reforms as part of broader economic liberalization strategies.

5.3 Sectoral Impact of Tariff Reforms

- **Manufacturing:** Reduced tariffs on intermediate inputs and capital goods lowered production costs and enhanced productivity.
- **Agriculture:** Liberalization increased competition but also exposed farmers to price volatility and international standards.
- **Services:** Trade liberalization under GATS facilitated growth in IT, finance, and professional services, particularly in countries like India.

5.4 Economic Implications

Tariff reforms improve resource allocation, encourage foreign direct investment, and foster innovation. Empirical evidence suggests that countries adopting outward-oriented trade policies experience higher growth rates compared to inward-looking economies.

6. NON-TARIFF BARRIERS AND TRADE CHALLENGES

Despite tariff liberalization, non-tariff barriers have emerged as a major constraint on global trade. These include:

- Technical standards and certification requirements
- Sanitary and phytosanitary measures
- Import licensing and quotas
- Subsidies and anti-dumping duties
- Complex customs and administrative procedures

Such measures often impose high compliance costs on exporters, particularly from developing countries. In sectors like agriculture, textiles, and pharmaceuticals, stringent standards in developed markets significantly limit market access for developing economies.

7. ROLE OF WTO POLICIES

The WTO provides a rules-based framework to regulate international trade. Its key principles include:

- Most-Favored-Nation (MFN): Equal treatment among trading partners
- National Treatment: Non-discrimination between domestic and imported goods
- Transparency: Clear and predictable trade policies

The Trade Policy Review Mechanism (TPRM) enhances transparency, while the Dispute Settlement Mechanism (DSM) ensures fair resolution of trade disputes. WTO agreements such as GATT, GATS, and TRIPS cover trade in goods, services, and intellectual property, respectively, promoting comprehensive trade liberalization.

8. DISCUSSION

The analysis indicates that tariff reforms alone are insufficient to achieve full trade liberalization. While reduced tariffs have boosted exports and investment, non-tariff barriers and regulatory complexities continue to restrict trade flows. Comparative experiences of India, China, and regional blocs such as the EU and ASEAN demonstrate that complementary domestic reforms and institutional capacity are essential for maximizing the benefits of trade liberalization.

9. POLICY SUGGESTIONS

To strengthen global trade integration and economic growth, the following measures are suggested:

- Gradual and calibrated tariff reductions
- Simplification and harmonization of regulations
- Strengthening institutional capacity for WTO compliance
- Enhancing transparency and policy consistency
- Leveraging digital technologies for trade facilitation

10. CONCLUSION

Tariff reforms and WTO policies have significantly contributed to global trade liberalization and economic growth. However, the increasing prevalence of non-tariff barriers poses serious challenges, particularly for developing economies. Effective utilization of WTO mechanisms, combined with domestic regulatory reforms and capacity building, is essential for ensuring inclusive and sustainable trade growth. Policymakers must strike a balance between liberalization and development objectives to fully realize the potential benefits of global trade.

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FACTORS INFLUENCING THE ADOPTION OF INTERNET BANKING AMONG AXIS BANK CUSTOMERS IN HYDERABAD-A STUDY

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Purpose*: The present study is carried out with the help of a suitable research instrument. 200 customers of Axis Bank were selected and with the help of their responses, analysis is made followed by few suggestions. Internet banking is very convenient and fast, it is mired with several security issues. Banking institutions have taken several measures to ensure safety measures for their customers while performing various transactions online.*

Design/Methodology/Approach: *To analyze the customers' perceptions and awareness towards Internet banking security and what are problems faced by customers while using internet banking services. I selected the sample size of 200 customers of Axis bank Hyderabad of Telangana state. Stratified random sampling technique is used through Structure Questionnaire.*

Originality/Value*: This study applies reliability test like Cronbach's alpha test for measure of internal consistency, that is, how closely related a set of items are as a group. It is considered to be a measure of scale reliability. A "high" value for alpha does not imply that the measure is unidimensional and Exploratory factor analysis is one method of checking dimensionality and Structure Equation Modeling.*

Findings: *The outcome of the research work on the Internet banking helped to identify the precautionary checklist open to for a number of issues in the internet banking era. Furthermore, a supreme and powerful security policy employed by the banks and legislation instituted by local or state Governments should be in use and obligatory in order to improve security in Internet banking systems.*

KEYWORDS

- *Internet Banking*
- *Online Banking Adoption*
- *Axis Bank Customers*
- *Hyderabad*
- *Customer Perception*
- *Technology Acceptance*
- *Ease of Use*

JEL Codes:

- ***G21*** *– Banks; Depository Institutions; Micro Finance; Mortgages*
- ***O33*** *– Technological Change: Choices and Consequences; Diffusion Processes*
- ***M31*** *– Marketing (useful for customer behavior and adoption studies)*
- ***D83*** *– Search; Learning; Information and Knowledge; Communication*
- ***L86*** *– Information and Internet Services; Computer Software*
- ***C83*** *– Survey Methods; Sampling Methods (if your study uses primary data)*

INTRODUCTION

Digital Banking gives you the luxury of freely accessing and performing all traditional banking activities 24*7 without having to personally go to a bank branch to get your work done. Digital Banking can be done either through a laptop, tablet or your mobile phone. This is what is Digital Banking in India all

about Banks give administrations or bank services to draw in clients, from giving advances, issuing of debit cards and credit cards, computerized monetary services, and surprisingly personal services or administrations. Even so, some fundamental present-day administrations are presented by many commercial banks. Electronic banking has many names like web-based banking, e-banking, virtual banking, or web banking, and online banking. It is just the utilization of telecommunications networks and electronic networks for conveying different financial services and products. Through e-banking, a client can acquire his record and manage numerous exchanges utilising his cell phone or personal computer. India has third largest internet population in the world after China and United Stated and presents unmatchable developmental prospect for the internet segment in coming years. The banking sector is one of the major beneficiaries of the Internet revolution and the growth of banking technology products have been remarkably increasing. The prevalent gain of Internet banking is that people can pay out the services sitting at home. without visiting the branch. This helps customers to complete their transactions in the fraction of time, thus saving both time and effort. Internet banking system proves to be very versatile in completing transactions like balance inquiry, withdrawal, deposits, viewing the bank statement, and record of recent transaction. Considering all the advantages, security of the financial information of customers is a very major concern of all banks.

Classification of Internet Banking

Classification:1

This is the essential degree of administrations or services that banks offer through their sites. Through this assistance, the bank offers data, information regarding its services and products to clients. Further, a few banks might respond to an inquiry through email as well.

Classification:2

In this category, banks permit their clients to submit directions or applications for various administrations, check their record balance, and so on. Be that as it may, banks don't allow their clients to do any fund-based exchanges with respect to their records or accounts.

Classification:3

In the third category, banks permit their clients to work or operate their records or accounts for bill payments, purchase and redeem securities and fund transfers, and so on Most conventional banks offer e-banking administrations as an extra technique for offering support. Further, many new banks convey banking administrations principally through the other electronic conveyance channels or web. Likewise, a few banks are 'internet only' banks with no actual branch anyplace in the country.

Classification of Internet Banking Sites

- **Transactional Websites:** These sites permit clients to go through with exchanges on the bank's site. Further, these exchanges can go from a plain retail account balance request to huge business-to-business liquid assets transfers. The accompanying table records some normal wholesale and retail e-banking administrations presented by financial institutions and by banks.
- **Informational Websites:** These sites offer general data regarding the bank and its services and products to the clients.
- **Wholesale services by banks:** Include Account management, Cash management, small business loan applications, Approvals or advances, Commercial wire transfer, Business-to-business payments, Employee benefit, and Pension administration
- **Retail services by banks**: Include Account management, Bill payment, New account opening, Consumer wire transfers, Investment and brokerage services, Loan application and approval, and Account Aggregation**.**

REVIEW OF LITERATURE

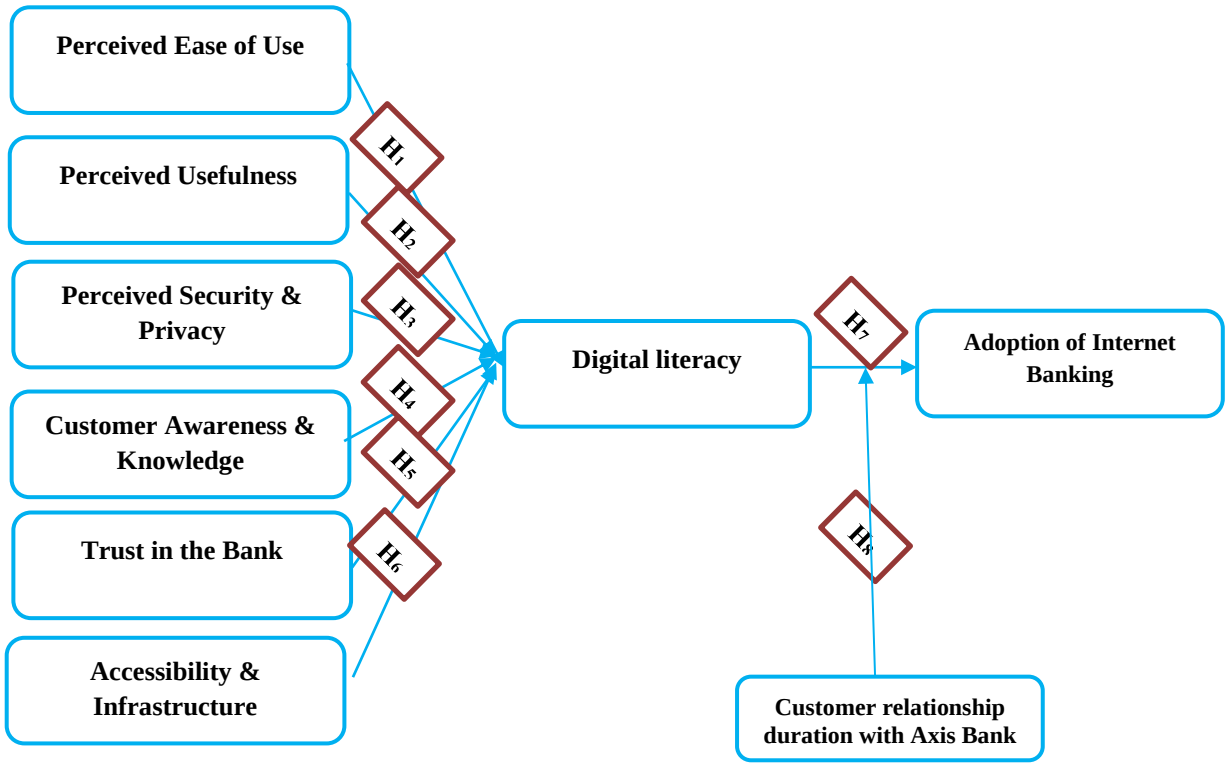
- **Hamidi (2023):** studied the influence of mobile banking adoption on consumer engagement and satisfaction utilizing the customer relationship management (CRM) system, which is the most essential aspect in banking industry. CRM is also seen as a critical role for enhancing client satisfaction in mobile banking. The statistical study performed evaluated the dialogue between the bank's customer sector and their client. The statistical analysis findings have a favorable influence on consumer interactions and satisfaction.
- **Geebren (2023):** This study is the importance of consumer satisfaction in mobile eco-systems that used electronic banking services, particularly in developing nations. This entailed researching consumer satisfaction in mobile banking, with a focus on the importance of trust. To determine consumer satisfaction, structural modeling using partial least squares (PLS–SEM) methods were employed to examine the data, and trust demonstrated that customer contentment had a beneficial influence.
- **Gao (2022):** The initial trust theoretical model highlighted the facilitators and barriers to user trust in m-payment services. The links in the original trust theoretical model were assessed using partial least squares structural modeling (PLS–SEM). findings may be used in m-payment adoption research and practice in a variety of ways. In total, 52.3% of the difference in usage intention was explained by the current model.
- **Hentzen JK (2022):** This study offered a mobile technology that allows for vital involvement, as well as an explanation of how a retirement app might assist people in planning for their postretirement strategy.
- **Haleem (2021):** The available literature survey data were used to evaluate a sample of 440 Australian pension fund members. The findings show that consumers perceived financial security, financial self-efficacy, retirement planning involvement, future consequences consideration, and perceived usefulness with a mobile retirement app have direct and indirect effects on their expected engagement through their goal to adopt the app.
- **Zhu (2021):** This investigated existing technology designs, including mobile banking, used by rural communities in six Chinese regions. According to the findings, interpersonal and mass communication channels have a bigger influence than organizational communication channels. Mobile banking should be examined since it can assist alleviate the lack of access

to financial goods and financial infrastructure in rural areas.

- **Afeti et al. (2020):** This paper developed a mobile payment technology for payment for micro-businesses. The study draws on the transaction cost theory and the task-technology fit (TTF) theory as the assumed lens. In total, 20 micro-businesses based on qualitative data were analyzed and the research findings denote those micro-businesses adoption of mobile payments results in strategic and operational benefits.
- **Alamoudi et al. (2020)**: This Proposed that the mobile technology acceptance lookalike was changed as we investigated consumers' acceptance of mobile shopping in general stores by examining transaction convenience, usefulness, attitudes, ease of use, transaction speed, optimism, and personal innovativeness. A total of 351 respondents completed the questionnaire evaluation. Consumers are willing to use mobile shopping channels if the system is clear and straightforward to use.
- **Jebarajakirthy et al. (2019):** This study used a comprehensive moderated mediation framework to evaluate the influence of online convenience aspects on mobile banking uptake. Covariance based structural equation modeling and the process macro are utilized to test these predictions. This study examines how convenience characteristics influence mobile banking adoption intentions.
- **Abdinoor et al. (2019)**: This studied the adoption of mobile financial services in Tanzania with the use of a technology acceptance model. To select the sample from data collection, a random sampling technique was used. The user and non-user of mobile financial services were included in the sample. Zhang et al. (3) investigated customers' use of mobile technology to help them with banking services and activities, as well as the variables that impact their adoption and engagement. Here, the analysis is done by the structural equation modeling technique to know the consumers' intentions toward mobile banking. The result examines the adoption of mobile banking apps to facilitate bank consumers' banking services.

RESEARCH METHODOLOGY

- **Conceptual Model:**



- **Statement of the Problem**

Mobile banking (otherwise called M-banking) is a name utilized for performing account exchanges or transactions, bill payments, credit applications, balance checks, and other financial exchanges through a mobile phone like a Personal Digital Assistant (PDA) or cell phone. Present study is focus on the banking sector has been seen a mammoth progress and the popularity with respect to the Internet banking services and its products. This development has led to the large number of internet banking transactions, which are faster and more convenient mode of transactions, for the bank customers. Banking industry is one of the businesses that have used the full potential of IT to help with banking transactions and increase banking services and opportunities to its customers

- **Research Gap**
  Moreover, earlier studies have primarily examined perceived usefulness and ease of use, but comparatively less attention has been given to other emerging determinants such as **security concerns, trust, digital literacy, service quality, and customer awareness**—all of which play a crucial role in shaping adoption behavior in today's digital environment. Many studies also lack updated findings reflecting recent advancements in digital banking technologies, mobile banking integration, and shifting customer expectations post–digital transformation.

Objectives of the Study

- To identify the key factors that influence the adoption of internet banking among Axis Bank customers in Hyderabad.
- To examine the impact of perceived ease of use on customers' willingness to adopt internet banking.
- To evaluate how perceived usefulness affects customers' adoption of internet banking services.
- To analyze the role of security and privacy concerns in shaping customers' internet banking usage behavior.

Hypothesis of the Study:

- H_{01}: Perceived ease of use has no significant impact on the adoption of internet banking among Axis Bank customers in Hyderabad.
- H_{11}: Perceived ease of use has a significant positive impact on the adoption of internet banking among Axis Bank customers in Hyderabad.
- H_{02}: Perceived usefulness does not significantly influence the adoption of internet banking among Axis Bank customers.
- H_{12}: Perceived usefulness significantly influences the adoption of internet banking among Axis Bank customers.

ANALYSIS & INTERPRETATION

Table 1: Socio-Economic Profile of Internet banking customers, Hyderabad, Telangana.

Sl No	Category	Specification of Respondents		Number of Respondents	Percentage of Respondents (%)
		Male	Female		
01	**Age Specification**				
	10-20	10	05	15	7.5
	21-30	25	15	40	20
	31-40	15	18	33	16.5
	41-50	14	10	24	12
	51-60	36	22	58	29
	61- Above	20	10	30	15
Total		**120**	**80**	**200**	**100**
02See	**Gender**				
	Male	58	72	130	65
	Female	42	28	70	35
Total		**100**	**100**	**200**	**100**
03	**Qualifications**				
	SSC	4	6	**10**	2
	Intermediate	12	8	20	10
	Graduation	40	30	70	35
	Post Graduation	38	30	68	34
	Professional Degree	8	4	12	6
	PhD	12	8	20	10
Total		**114**	**86**	**200**	**100**
04	**Occupation**				
	Agriculture	13	10	23	11.5
	Business	27	20	47	23.5
	Consultancy	8	4	12	6
	Government Job	17	4	21	10.5
	Private Job	16	20	36	18
	Retired Employees	4	0	4	2
	Politician	7	10	17	8.5
	Student	32	8	40	20
Total		**124**	**76**	**200**	**100**

05	**Income Specification**				
	Below 10,000	20	15	35	15.5
	10,000-20,000	13	10	23	11.5
	20,000-30,000	18	15	33	16.5
	30,000-40,000	14	10	24	12
	40,000-50,000	33	20	53	26.5
	50,000-1,00,000	6	8	14	7
	1,00,000 and above	10	8	18	9
Total		**114**	**86**	**200**	**100**
06	**Marital Status**				
	Single	86	22	108	54
	Married	50	42	92	46
	Others	0	0	0	0
Total		**166**	**34**	**200**	**100**
07	**Size of a Family**				
	Up to 2	36	20	56	26
	02-04	18	20	38	19
	04-06	14	20	34	16
	06-10	40	32	72	36
Total		**108**	**92**	**200**	**200**
08	**Account Type**				
	Current Account	23	10	33	16.5
	Savings Account	50	27	77	38.5
	Deposit Account	30	14	44	22
	Loan Account	30	16	46	23
Total		**133**	**67**	**200**	**100**

Interpretation

Above Table shows that the socio-economic profile of the selected Internet banking users in Hyderabad region of Telangana state. In this profile include Age, Gender, Qualification, Occupation, Salary, Type of Account, Maritial and Family members. 16.5 % of customers are age between 31-40 age group holders. 35% of people are graduated. 23.5% are doing business. 54% are married people. 36% are big family sized. 38.5% are having Saving bank account.

Table 3: Internet Banking Security Awareness Level of Axis Bank Customers, Hyderabad Region, Telangana.

Sl No	Various Types of Security Used by the Axis Bank	Parameters									
		Strongly Agree		Agree		Neutral		Disagree		Strongly Disagree	
		NR	%	NR	%	NR	%	NR	%	NR	%
01	Security Code	69	34.5	52	26	38	28	14	12	27	13.5
02	Password protection	52	26	69	35.5	14	12	38	19	27	13.5
03	Transaction Security	68	34	53	26.5	40	20	14	12	25	12.5
04	Confidentiality	40	20	68	34	53	26.5	25	12.5	14	12
05	Authentication Security	52	26	69	35.5	14	12	38	14	27	13.5
06	Hardware Security	69	34.5	52	26	38	29	14	12	27	13.5
07	Database Security	68	34	53	26.5	40	20	14	12	25	12.5
08	Memory Protection	40	20	68	34	53	26.5	25	12.5	14	12
09	File Security	40	20	68	34	53	26.5	25	12.5	14	12
10	Other Protection	68	34	53	26.5	40	20	14	14	25	12.5

Interpretation

Above Table shows that the Factors Influencing the Digital Banking Facility of the selected Internet banking users in Hyderabad region of Telangana state. In the table we considered 10 factors (Security Code, Password protection, Transaction Security, Confidentiality, Authentication Security, Hardware Security, Database Security, Memory Protection, File Security, Other Protection) influencing the Digital banking facility used by the customers using 5 factors scaling like Strongly Agree, Agree, Neutral, disagree and strongly agree. In this table 26% Perceived Ease of Use and 34.5% Popularity of Banks.

Table 6: Usage of Internet Banking Services, Hyderabad Region, Telangana.

Sl No	Usage of Internet Banking Services	Parameters									
		Strongly Agree		Agree		Neutral		Disagree		Strongly Disagree	
		NR	%	NR	%	NR	%	NR	%	NR	%
01	Environmentally Friendly	68	34	53	26.5	40	20	14	12	25	12.5
02	Unlimited Transfer with No Cost	40	20	68	34	53	26.5	25	12.5	14	12
03	Secured Transaction	52	26	69	35.5	14	12	38	14	27	13.5
04	Quick Settlement	68	34	53	26.5	40	20	14	12	25	12.5
05	Electronic Fund Transfer	40	20	68	34	53	26.5	25	12.5	14	12
06	Electronic Clearing Services	52	26	69	35.5	14	12	38	14	27	13.5
07	Electronic Payment Services	52	26	69	35.5	14	12	38	14	27	13.5
08	National Electronic Fund Transfer	69	34.5	52	26	38	28	14	12	27	13.5
09	Real Time Gross Settlement	52	26	69	35.5	14	12	38	19	27	13.5
10	Core Banking System	69	34.5	52	26	38	28	14	12	27	13.5

Interpretation

Above Table shows that the Factors Influencing the Digital Banking Facility of the selected Internet banking users in Hyderabad region of Telangana state. In the table we considered 10 factors (Environmentally Friendly, Unlimited Transfer with No Cost, Secured Transaction, Quick Settlement, Electronic Fund Transfer, Electronic Clearing Services, Electronic Payment Services, National Electronic Fund Transfer, Real Time Gross Settlement, Core Banking System) influencing the Digital banking facility used by the customers using 5 factors scaling like Strongly Agree, Agree, Neutral, disagree and strongly agree.

CONCLUSION

This study based on Ranga Reddy District of Telangana state. Future study can also be focused on larger sample scale from different district even from different divisional secretariat division of Telangana. This study 10 factors as the influencing factors of the customer adoption. Further, other factors can be added to the conceptual model will provide more clarifying power to the study. Perceived Risk, Perceived Security drawn a moderate positive relationship which sometime detriment the growth of internet banking among customers. People who are using internet banking still think that it wouldn't secured and it might have some risk factor.

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