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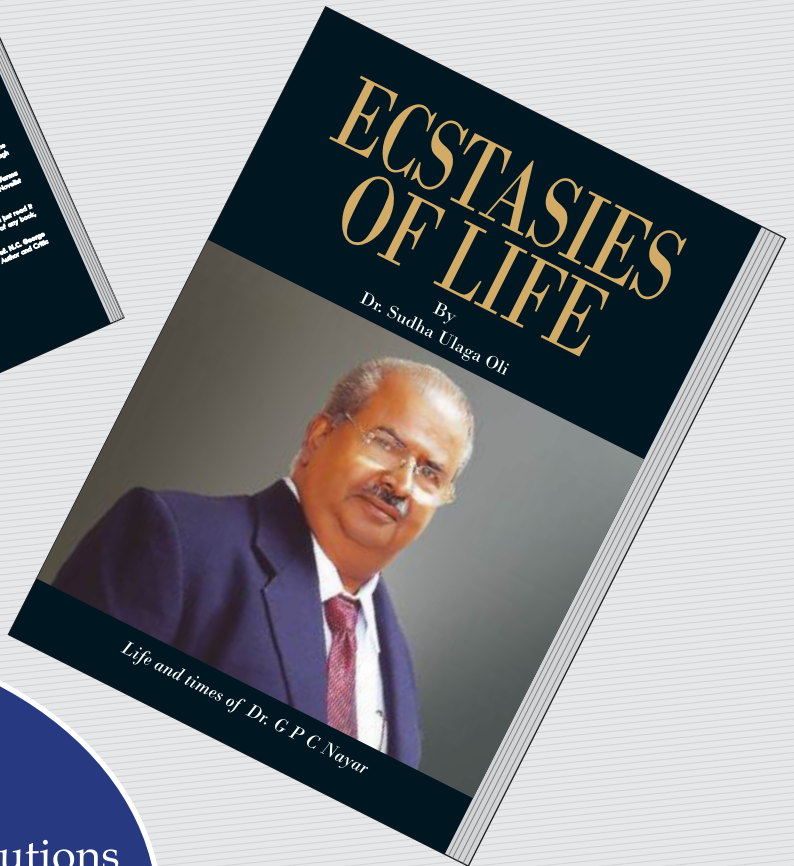
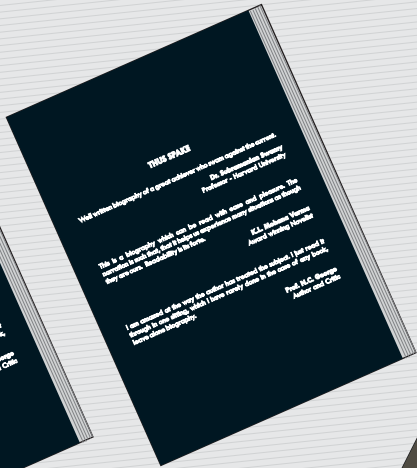
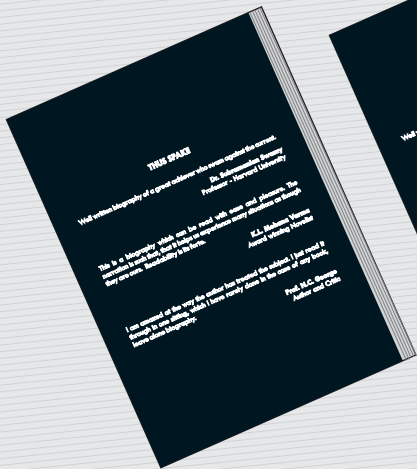
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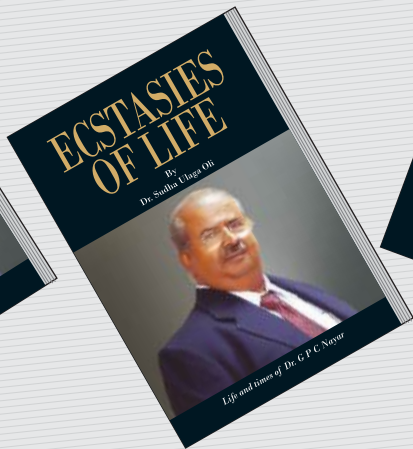
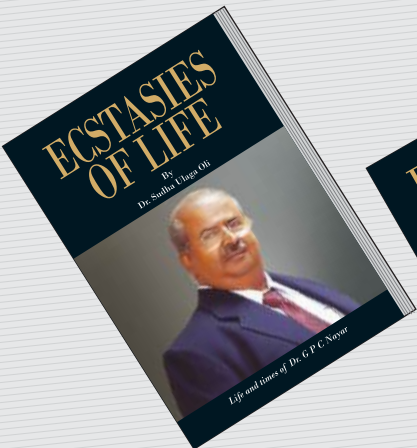


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Chairman's Overview

The FIFA World Cup 2026, running from June 11th to July 19th, is much more than the world's largest sporting spectacle. For the first time in World Cup history, the event is being jointly hosted by three nations—the United States, Canada and Mexico—featuring 16 host cities and expanded to 48 teams. It represents one of the most complex management exercises ever undertaken. Beyond the excitement on the pitch lies a fascinating study in strategy, leadership, technology and governance—one that offers valuable lessons for management scholars, educators and practitioners.

The tournament exemplifies the emergence of the World Cup economy, in which sport functions as a powerful, temporary economic event. Billions of dollars in investment, sponsorship, broadcasting rights, hospitality and merchandising are expected to stimulate local economies while accelerating infrastructure development and employment. Equally significant is the surge in sports tourism, as millions of international visitors generate demand across aviation, hospitality, retail and urban services.

The World Cup also reflects the changing nature of consumer engagement. Digital media has transformed football from a ninety-minute-per-match event into a month-long, always-on experience. Fans now consume personalised content across multiple platforms, while brands increasingly rely on AI-driven marketing to deliver real-time, multilingual campaigns tailored to diverse audiences.

Innovation extends beyond marketing. The World Cup 2026 is the first sporting event in history to earn Sensory Inclusive certification by including dedicated sensory rooms and accessibility initiatives for neurodivergent fans, signalling a broader shift towards inclusive event management. Likewise, the adoption of dynamic ticket pricing mirrors trends in aviation and hospitality, using demand-based algorithms to optimise revenue while simultaneously raising important questions about affordability, fairness and stakeholder trust.

At the same time, the tournament has not been without controversy. The environmental cost of carbon emissions from long-distance travel across three host nations has reignited debates over the sustainability of mega sporting events, even as organisers promote greener infrastructure and operations. Visa and border-entry requirements across the three host countries have highlighted the managerial complexities of facilitating seamless international mobility for fans, officials and participating teams.

Ultimately, the FIFA World Cup 2026 reminds us that organisational success depends not merely on strategy, but on balancing economic growth with environmental responsibility, technological innovation with ethical governance, and commercial ambition with stakeholder value. For business schools and management researchers, the tournament is more than a sporting event—it is a living laboratory that vividly illustrates the opportunities and dilemmas confronting organisations in an increasingly interconnected world.

Dr. G. P. C. NAYAR

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Editorial



The articles featured in this issue of the SCMS Journal of Indian Management reflect the dynamics of the contemporary management landscape and offer valuable insights into emerging managerial, organisational, and policy concerns across diverse contexts.

A recurring theme across several contributions is the growing importance of governance and decision-making under uncertainty. The first study presented examines how board-level oversight mechanisms influence corporate risk outcomes, highlighting the role of specialised committees on market and economic measures. Complementing this perspective, another paper synthesises behavioural finance literature to demonstrate how cognitive biases continue to shape investment decisions, often distorting the interpretation of financial information despite increasing market sophistication.

Technological disruption and digital transformation also feature prominently in this issue. Research on the Indian banking sector explores the relationship between fintech adoption and profitability, revealing the differentiated benefits of technological intensity across banking institutions of varying sizes. A study on employee effectiveness in the Indian IT sector demonstrates how competency development, change management, and employee empowerment can be strategically leveraged to enhance organisational performance in knowledge-intensive environments.

Sustainability and responsible consumption emerge as another significant area of inquiry. An investigation into consumer adoption of refurbished digital products underscore the growing relevance of circular economy principles and the need for organisations to align environmental objectives with consumer expectations. Career sustainability is an important issue addressed in a study that explores the determinants of teacher's work life balance in the Indian higher education sector.

Several articles extend the geographical and contextual scope of management research. Contributions exploring SME performance in Oman and regional economic development in Meghalaya demonstrate how local socio-economic realities shape business outcomes and policy effectiveness. Meanwhile, studies on brand personality in the passenger car sector and service quality assessment in higher education contribute valuable methodological advancements and practical tools for researchers and practitioners alike.

Collectively, the articles in this issue illustrate the richness and diversity of contemporary management scholarship. They highlight the need for interdisciplinary approaches that integrate behavioural insights, technological developments, governance mechanisms, and sustainability considerations. We trust that these contributions will stimulate further research, inform managerial practice, and encourage meaningful dialogue among scholars, practitioners, and policymakers

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Does Board Oversight Reduce Corporate Risk? Evidence from Audit, Risk Management, and Compensation Committees

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Abstract

The objective of this study is to measure the relative impact of audit, risk, and compensation committees on risk reduction among publicly traded pharmaceutical and energy firms in the US. The SeekEdgar and COMPUSTAT databases were used to extract data on 7,739 pharmaceutical and energy firms in the United States from 2010 to 2022. Risk measures, including insolvency risk, systematic risk, and ROA volatility, and control measures of leverage, tangibility, and firm size, were extracted from the COMPUSTAT database. The results of the multivariate linear regression analysis show that the audit committee reduces systematic risk and ROA volatility, and that the risk management committee reduces systematic risk. We employ novel oversight measures based on the frequency with which the terms audit committee, risk management committee, and compensation committee are mentioned in annual reports and Form 10-Ks. This study supports the notion that board committee oversight has a stronger influence on market measures, such as systematic risk, than accounting measures, such as bankruptcy risk.

Keywords: *Audit Committee, Risk Management Committee, Compensation Committee, Insolvency Risk, Systematic Risk*

1. Introduction

As the top decision makers of the firm, the board of directors are responsible for objectively evaluating management's performance, thereby ensuring compliance with regulations (Ridwan & Mayapada, 2022), maintaining a balance among the needs of stakeholders, and acting ethically and responsibly as they jointly achieve the wealth maximisation goal (Pathak & Chandani, 2023). The board uses committees such as audit, risk management, and compensation to implement the tenets of corporate governance. The audit committee hires an audit firm to verify the accuracy of financial reporting (Cohen et al., 2014; Kao et al., 2021). The risk management committee identifies sources of excessive risk-taking and curbs this by directing management and the board to them (Jia & Bradbury, 2021). The compensation committee oversees the compensation paid to management, ensuring it is equitable and reflects rewards for true performance (Anderson & Bizjak, 2003; Hall et al., 2016). All three of these committees may be needed to control reckless risk-taking in firms. Agency theory holds that managers are not owners; rather, they are agents (representatives) of shareholders (Jensen & Meckling, 1976). This division of ownership and control may lead managers to engage in risky behaviour for personal gain, thereby detracting from shareholder wealth maximisation (Cole et al., 2011; Salehi et al., 2021). Audit committees can reveal such opportunistic conduct (Beasley et al., 2009). An examination of financial reports may reveal overstatement of profits (earnings management), excessive accruals and discretionary expenses to conceal private expenses, and excessive debt use. Empirically, Abraham et al. (2024a) observed that audit committee oversight reduced debt capacity (i.e., the propensity to borrow excessively), increased firm value, and increased return on equity. Risk management committees, by name, are charged with identifying sources of risk and presenting them to the board. Yet there is a paucity of research regarding the risk-reducing actions of risk management committees. The pay-performance literature suggests that employees who are fairly compensated strive to improve their job performance as the psychological contract that binds them to the firm is strengthened through the perception that the firm values their efforts on behalf of the organisation (Hu et al., 2024). The compensation committee is likely to curb managers' risk-taking by compensating them adequately through salaries and bonuses linked to prudent performance targets that discourage reckless risk-taking.

This study examines how oversight by audit, risk management, and compensation committees influences

insolvency risk, systematic risk, and return-on-asset volatility in US pharmaceutical and energy firms (2010–2022). Insolvency risk is the risk of bankruptcy. We set forth that if risk-taking is excessive in terms of debt usage, non-synergistic acquisitions, and wastage of resources that yield private benefits, bankruptcy could result (Perry, 1998). Risk-reduction measures from these three board committees could reduce the risk of insolvency. Systematic risk is the inherent risk of the organisation that portfolio diversification cannot reduce (DesJardine et al., 2023; Zaimovic et al., 2021). Board committees, if effective in reducing risk, may reduce the correlation between firm risk and market risk or systematic risk. The market will perceive that the firm's risk is less dependent on market price fluctuations, given its strong internal controls. Finally, greater accountability from management due to board oversight will result in less earnings management, or manipulation of earnings to window-dress performance, thereby reducing the volatility of profits and ROA volatility (Peasnell et al., 2005).

We employ novel oversight measures for the audit, risk management, and compensation committees. From the "SeekEdgar database", we extract the frequency of these terms across annual reports and Form 10-Ks. If the term 'audit committee' is mentioned 10,000 times, that becomes the measure of audit oversight, as it indicates the committee is highly active and engaged in oversight. The second measure is the frequency of a committee name in long paragraphs and indicates oversight in key, weighty decisions. We find only a single reference that employs these measures, namely Abraham et al. (2024b), which examines audit committee oversight of price ratios and stock returns.

Board oversight was most effective in reducing systematic risk (Abraham et al., 2024a). Oversight from all three committees reduced systematic risk. ROA volatility was reduced by the audit committee. Board oversight had no impact on insolvency risk.

This paper advances knowledge in three ways. It adds to the literature on the oversight provided by the risk management and the compensation committee. This is an addition to the literature on corporate governance, as we identify the sources of board oversight that influence three forms of firm risk: insolvency, systematic, and ROA volatility. Muqorobin et al. (2023) confirmed that risk management committees reduced firm risk-taking; however, their measures of risk-taking of leverage, capital intensity, and R&D intensity differ from this study's measures of insolvency risk, systematic risk, and ROA volatility. Karim et al. (2022)

observed that risk management committees improved firm performance, though that may or may not have been due to a reduction in risk-taking behaviour. Kalelkar and Nwaeze (2023) observed that compensation committees reduced CEO pay, particularly when they had financial expertise. However, they did not measure the risk-taking behaviour mitigated by the compensation committee that may have led to the reduced CEO pay. Second, this article adds to the literature on corporate governance effects on firms' risk-taking. There is an intuitive acceptance of the risk-reduction benefits of board oversight, in that holding management accountable for its actions would make managers less likely to engage in risky acquisitions, cash misuse, and earnings manipulation. This paper provides empirical support for this conjecture. Third, the use of data from the pharmaceutical and energy industries does not preclude extending the study to other industries. It is recommended that the study's results be employed as a starting point for further investigation of board oversight in other industries.

2. Literature Review

2.1 Theoretical Framework

2.1.1 Theories Underlying the Oversight of Board Committees

Three theories, viz., agency, stewardship, and resource dependence, underpin the oversight of management by board committees. Agency conflicts arise when management uses cash and other resources for private benefit rather than for wealth maximisation (Jensen & Meckling, 1976). They may reward themselves with perks, or engage in unprofitable acquisitions, or ill-advised foreign expansions, or appear to be working toward firm goals with the expectation of bonuses and promotions, even though these investments fail to yield profits. In the context of this study, agency conflicts are viewed as increasing risk, so that increased monitoring by the board is expected to reduce reckless risk-taking.

Davis et al. (1997) set forth stewardship theory, which holds that CEOs are responsible stewards of the firm. As stewards, they are required to engage in prudent decision-making that avoids risky borrowing, makes responsible long-term investments, and resolves conflicts among multiple stakeholders, including vendors, unions, environmentalists, customers, and employees. For example, stewardship was displayed when Ford Motor Company arranged short-term credit while its chief competitors were seeking government bailouts.

Pfeffer and Salancik (2006) proposed resource dependence theory. Organisations depend on external resources, including labour, capital, and raw materials. Criticality and scarcity suggest that certain scarce resources are essential for production. A firm that has easy access to these resources enjoys a competitive advantage. For example, technology firms that can readily access programming talent, or manufacturing firms that can locate suppliers of specialised raw materials. The compensation committee may provide appropriate oversight by ensuring that managers with the specialised skills to ensure these scarce inputs are appropriately rewarded in recognition of their specialised capabilities.

2.1.2 Audit Committee Oversight, Risk Management Committee Oversight, and Compensation Committee Oversight

Contemporary research highlights the positive impact of the audit committee's size, independence, and meeting frequency on firm performance (Habtoor, 2022). Larger audit committees tend to have wider knowledge and competencies, enabling them to more effectively oversee various aspects of corporate governance. Independence, typically ensured by the inclusion of external members, enhances objectivity in evaluating both management and the external auditors. According to Ghafran and Yasmin (2018), frequent meetings serve as an indicator of the audit committee's proactive involvement in monitoring management activities. Empirical evidence from developed economies supports this view. For instance, Alzeban (2023) analysed UK non-financial firms and found a positive correlation, while Gani et al. (2017) studied Australian materials companies, and Barka and Legendre (2017) examined firms listed on the French equity index, all demonstrating that these audit committee attributes are linked to improved financial performance.

Research in risk management committee oversight shows that the presence of risk management committees mitigates firm risk while improving performance. Risk measures vary, from a more nebulous measure of global risk to specific definitions, such as debt usage or capital intensity. Almulhim et al. (2024) found that the presence of risk management committees, especially those with financial expertise, was significantly negatively associated with agency costs among Saudi firms. (Aldhamari et al., 2020) found that the independence, qualifications and gender of risk management committee members reduced financial performance due to increased monitoring. The political

connections of board members significantly reduced the monitoring capabilities of the risk management committee. Muqorobin et al. (2023) measured risk-taking as leverage, capital intensity, and research and development intensity in manufacturing firms in Indonesia. The presence of risk management committees moderated risk-taking behaviour, indicating that they mitigated these risks by restricting debt use, reducing capital intensity, and reducing Research and Development expenses. In Malaysian firms, Karim et al. (2022) found that board size reduced risk-taking (decreased debt and capital intensity) by increasing the number of board members who questioned the effectiveness of risky strategies, i.e., by holding management accountable for risk-taking.

Compensation committees are charged with curbing excessive pay for managers. The managerial power hypothesis posits that CEOs demonstrate their power by being overcompensated for their services (van Essen et al., 2015). Bebchuk et al. (2002) argue that weak corporate governance led the board to accept excessive CEO compensation, which acts as a rent that depresses firm performance. Empirically, Shabbir et al. (2024) and Chang et al. (2011) found that independent compensation committees restrained managerial power by reducing CEO pay. Chang et al. (2011) conjectured that reducing CEO remuneration by curtailing equity-based compensation would curb CEO risk-taking, as CEOs could not benefit from higher stock prices resulting from investments in risky ventures. Pryshchepa (2021) extended Chang et al.'s (2011) findings to managers at lower organisational levels than the CEO, observing that managerial entrenchment led to overpayment and, in turn, increased risk-taking. The Sarbanes-Oxley Act of 2002 mandated the use of independent directors and required the implementation of measures to promote corporate governance. However, these studies did not measure the risk highlighted by the present study.

2.1.3 Insolvency Risk, Systematic Risk, and ROA Volatility

Edward Altman examined insolvency risk and developed the Altman Z score, a composite of accounting measures and a single market measure. The accounting measures included liquidity (assets/total assets), earnings (earnings/total assets), and sales (sales/total assets). The market measure is market value as a percentage of assets. In essence, Altman-Z is primarily an accounting measure, as it relies on income statement and balance sheet data. Altman demonstrated the

measure's effectiveness in predicting bankruptcy for manufacturing firms (Altman et al., 2017).

Systematic risk is non-diversifiable when a portfolio is composed of negatively correlated securities (Sharpe, 1964). The Capital Asset Pricing Model (CAPM) proposed the stock's beta coefficient as a measure of systematic risk. The beta coefficient is the correlation between a firm's prices and the prices of the securities that form the market portfolio. CAPM has been tested extensively, with empirical results supporting its basic structure: the expected security return equals the risk-free rate plus the beta-weighted excess market return over the risk-free rate. However, certain CAPM anomalies have been identified, particularly regarding firm size and book-to-market (Bornholt, 2012; Fama & French, 2004).

ROA volatility, the third measure of risk in this study, is the volatility of profitability, or the risk that profit targets will not be achieved. Abraham El Chaarani et al. (2024) found that, for large firms, audit oversight reduced ROA, or profitability. This finding may be due to the audit committee's detection of earnings management, which involves delaying discretionary expenses and accruals to show higher profitability. Audit oversight reduces the incidence of earnings management by mandating accurate financial reporting, thereby reducing profitability estimates to realistic levels (Lin & Hwang, 2010; Sun et al., 2014). The effects of risk management committee oversight and compensation committee oversight of ROA volatility are unknown.

2.2 Hypotheses Development

2.2.1. Audit Committee Oversight and Firm Risk

Audit committees employ audit firms to detect financial irregularities in the financial statements. Agency theory and stewardship theory provide the basis for excessive risk-taking. As agents of the firm, managers wish to demonstrate competence. This goal could be achieved by making large, visible acquisitions in areas in which the firm lacks managerial expertise and therefore cannot operate effectively. For example, an oil producer acquired an office equipment manufacturer. Management was accustomed to the lengthy business cycles of oil detection, drilling, and refining in a less competitive business environment. Management was unprepared to operate in the office equipment industry, characterised by intense competition and short business cycles. Such non-synergistic

acquisitions often require substantial debt accumulation, thereby increasing bankruptcy risk. Audit firms can detect excessive debt acquisition in their financial statement reviews and report it to the audit committees that supervise them. Audit committees may strengthen their monitoring of management's use of debt and its ability to generate earnings to service that debt, thereby reducing insolvency risk (Appiah & Amon, 2017).

Systematic risk, measured by a stock's beta coefficient, is a non-diversifiable risk that reflects a stock's correlation with market returns. Securities with high beta coefficients have uncertain cash flows and earnings. Accordingly, they are considered to be high-risk. For example, treasury bills, as risk-free assets, have a beta of 0. Utility stocks, with constant cash flows, have low betas (< 1). Financial company stocks, with less certain cash flows, have high beta values. Audit committee members act as stewards of the firm by discouraging strategic decisions that lead to volatile cash flows and variable earnings. As audit committees examine the patterns of net income and operating cash flows, they may detect high variability in both earnings and cash flows. They may query management about the sources of this variability and recommend that corrective action be taken to reduce earnings variability.

Volatility of cash flows is caused by fluctuations in net income (Ikromov & Yavas, 2012; Zobi & Al-Dhaimesh, 2021). High interest payments on debt, seasonal sales, and uncertain production costs may be the causes of volatile net income. Audit committee oversight may include identifying sources of fluctuations in net income and passing that information to management for corrective action. Thus, audit oversight may reduce inflated net income figures to realistic levels. As such figures are reduced, quarter after quarter, to a lower, steady level, the fluctuations in net income are reduced.

Hypothesis 1: Audit committee oversight reduces insolvency risk, systematic risk, and ROA volatility.

2.2.2 Risk Management Committee Oversight and Firm Risk

The risk management committees' presence moderated risk-taking behavior, indicating that risk-management committees mitigated these forms of risk by restricting use of debt, reducing capital intensity, and reducing Research and Development expense in Malaysian firms (Karim et al., 2022) revealed a reason for risk-reduction by risk management committees as by adding more board members questioning the efficiency of risky strategies, i.e. by holding

management accountable for risk-taking strategies. We surmise that the risk management committee's risk-reduction capabilities may stem from their questioning of management's excessive use of debt, capital investments, and possible wastage of research and development resources. As these resource misuse cases could jeopardise firm solvency, the risk management committee's control of this excess reduces insolvency risk.

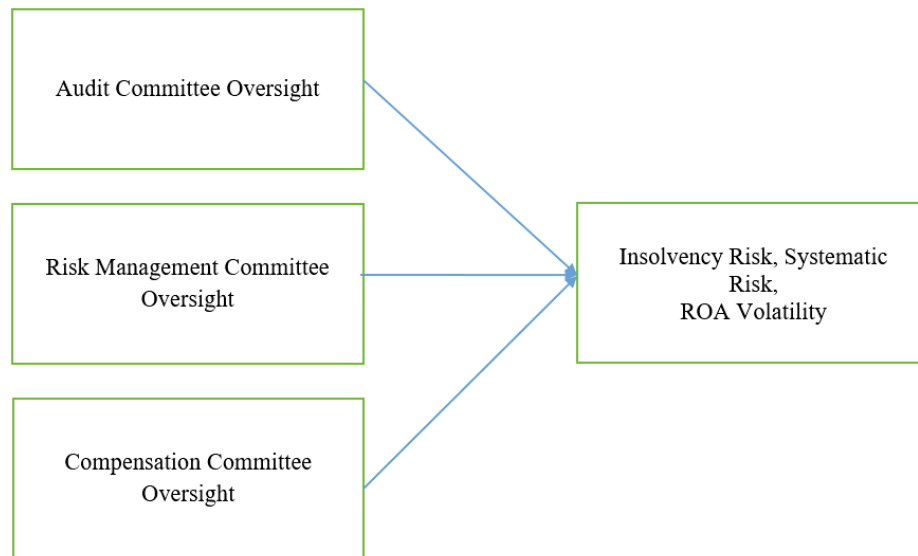
Systematic risk arises from unexpected movements in the market; it is measured by beta, which is the correlation between a stock's price and an index. The aforementioned risky strategies of excessive debt usage, increased capital intensity, and increased R & D intensity may be observed by the audit committee's examination of financial statements. By requiring management to reduce these inflated amounts, audit oversight reduces the excessive debt and expenses that increase systematic risk.

Resource dependence theory posits that CEOs and other members of the top management team have relationships with key entities in the firm's environment that provide crucial resources (Pfeffer & Salancik, 2006). Two of these entities are suppliers of crucial inputs and lenders. If the firm does not have relationships with these entities, it may not have a steady source of the input (say, steel, for automobile production) or a source of cheap capital. By highlighting these deficiencies, the risk management committee may force the firm to seek managers with the skills to interact with suppliers and lenders who can provide these critical resources, thereby reducing ROA volatility.

Hypothesis 2: Risk management committee oversight reduces insolvency risk, systematic risk, and ROA volatility.

2.2.3 Compensation Committee Oversight and Firm Risk

Laux and Laux (2009) observed that compensation committees were effective in reducing excessive CEO pay. It follows that the compensation committee acts as a check on unbridled risk-taking, such as acquiring excessive debt for non-synergistic acquisitions, or investing in the development of new products with uncertain profit potential. If management believes their compensation will be reduced as a result of the compensation committee's identification of sources of excessive risk-taking, they will be reluctant to engage in highly risky strategies (Bolton et al., 2011). In such a manner, the compensation committee can curb agency costs (Florackis, 2008). It may be in managers' personal interests to make questionable decisions



(Source. Author's Representation)

Figure 1. Hypothesized Relationships between Board Oversight and Firm Risk

to give the false impression that they are actively engaged and, therefore, deserve bonuses and perks. However, if compensation committees question the wisdom of these decisions by demanding justification, management will be required to eliminate unnecessary expenses. Thus, compensation committee oversight will reduce insolvency risk. Reducing unnecessary expenses will reduce market uncertainty, thereby decreasing systematic risk. Finally, eliminating unnecessary expenses reduces fluctuations in net income from these expenses, thereby reducing ROA volatility.

Hypothesis 3: Compensation committee oversight reduces insolvency risk, systematic risk, and ROA volatility.

The hypothesised relationships are shown in Figure 1.

3. Materials and Methods

3.1 Data Collection

The SeekEdgar database was used to provide measures of oversight. The dataset comprises 7,739 U.S.-based pharmaceutical and energy firms, covering the period from 2010 to 2022. The oversight measure was the total number of times the words ‘audit committee,’ risk management committee,’ or ‘compensation committee’ appeared in each firm’s annual report, Form 10K, or DEF13A. The use of word count to measure variables is widely reported in the literature (see Abraham et al., 2024b; Ashraf et al., 2024).

Risk measures, including ‘insolvency risk’, systematic risk’, and ‘ROA volatility’, and control measures of ‘leverage’, ‘tangibility’, and ‘firm size’, were extracted from the COMPUSTAT database. The Covid dummy variable was set to 1 for 2020-2021 observations and 0 for all other years. The COVID-19 dummy was deemed necessary because COVID-19 caused significant disruptions. The oversight measures, risk measures, and control variables were subjected to panel-data fixed-effects model regressions, as described in Section 4.2.

3.2 Data Analysis

A set of multivariate linear regression models is used in this investigation. The use of a linear regression framework is appropriate as the study’s goal is to quantify the marginal relationship between committee oversight measures and continuous company-level risk and performance variability indicators while adjusting for other firm variables. Empirical research on risk management and corporate governance frequently employs this methodology. To examine the relationship between dependent variables, i.e., ‘insolvency risk’, ‘systematic risk’ and ‘ROA volatility’, and independent variables, i.e., ‘audit committee oversight’, ‘risk management committee oversight’, and ‘compensation committee oversight’, the following regression equations were estimated:

$$\text{Insolvency Risk} = \alpha + \beta_1 \text{Audit Committee Oversight Measure} + \beta_2 \text{Leverage} + \beta_3 \text{Tangibility} + \beta_4 \text{Covid dummy} + \beta_5 \text{Firm Size} \quad (1)$$

$$\text{Systematic Risk} = \alpha + \beta_1 \text{Audit Committee Oversight Measure} + \beta_2 \text{Leverage} + \beta_3 \text{Tangibility} + \beta_4 \text{Covid dummy} + \beta_5 \text{Firm Size} \quad (2)$$

$$\text{ROA Volatility} = \alpha + \beta_1 \text{Audit Committee Oversight Measure} + \beta_2 \text{Leverage} + \beta_3 \text{Tangibility} + \beta_4 \text{Covid dummy} + \beta_5 \text{Firm Size} \quad (3)$$

$$\text{Insolvency Risk} = \alpha + \beta_1 \text{Risk Management Committee Oversight Measure} + \beta_2 \text{Leverage} + \beta_3 \text{Tangibility} + \beta_4 \text{Covid dummy} + \beta_5 \text{Firm Size} \quad (4)$$

$$\text{Systematic Risk} = \alpha + \beta_1 \text{Risk Management Committee Oversight Measure} + \beta_2 \text{Leverage} + \beta_3 \text{Tangibility} + \beta_4 \text{Covid dummy} + \beta_5 \text{Firm Size} \quad (5)$$

$$\text{ROA Volatility} = \alpha + \beta_1 \text{Risk Management Committee Oversight Measure} + \beta_2 \text{Leverage} + \beta_3 \text{Tangibility} + \beta_4 \text{Covid dummy} + \beta_5 \text{Firm Size} \quad (6)$$

$$\text{Insolvency Risk} = \alpha + \beta_1 \text{Compensation Committee Oversight Measure} + \beta_2 \text{Leverage} + \beta_3 \text{Tangibility} + \beta_4 \text{Covid dummy} + \beta_5 \text{Firm Size} \quad (7)$$

$$\text{Systematic Risk} = \alpha + \beta_1 \text{Compensation Committee Oversight Measure} + \beta_2 \text{Leverage} + \beta_3 \text{Tangibility} + \beta_4 \text{Covid dummy} + \beta_5 \text{Firm Size} \quad (8)$$

$$\text{ROA Volatility} = \alpha + \beta_1 \text{Compensation Committee Oversight Measure} + \beta_2 \text{Leverage} + \beta_3 \text{Tangibility} + \beta_4 \text{Covid dummy} + \beta_5 \text{Firm Size} \quad (9)$$

Where,

Dependent Variables:

This study's dependent variables reflect three different but complementary aspects of performance uncertainty and business risk. The Altman Z-score is a commonly used composite measure of a company's financial difficulty that represents insolvency risk. The market beta coefficient, which gauges how sensitive a company's stock returns are to fluctuations in the market as a whole, is used to quantify systematic risk. The standard deviation of return on assets is employed to quantify ROA volatility. This metric measures the firm's operational and earnings risk and highlights the volatility and unpredictability of operating performance over time.

Independent Variables:

Three important board committees: the audit, risk management, and remuneration committees, are represented by the primary independent variables of interest. The number of times each committee name appears in a company's SEC filings is used as a proxy for committee supervision.

Control Variables:

To separate the impact of committee oversight from other known factors that influence business risk, several firm-level control variables are included. The debt ratio is used to calculate leverage, a measure of the firm's financial risk arising from its capital structure. Tangibility, which is used to regulate a company's asset structure, is calculated by

dividing fixed assets by total assets. Total assets are used as a proxy for firm size, included to account for scale effects. Larger companies typically enjoy better access to external finance, engage in more varied activities and markets, and are more closely watched by investors and regulators. In the end, a dichotomous variable, COVID-19, is introduced. It has a value of one during the pandemic and zero otherwise.

4. Results and Discussions

4.1 Descriptive Statistics

On average, firms exhibit an Audit Oversight score of 1,390.10, indicating a generally high level of audit oversight across the sample companies. The mean score for the risk management committee is 18.70, suggesting that most firms maintain minimal risk management structures. Firms report a mean Compensation Committee score of 0.89, suggesting that the sample companies maintain minimal oversight by their compensation committees. The average leverage of the sample companies is 0.30, suggesting conservative financing with modest use of debt in the capital structure. The average Fixed-asset tangibility for the sample companies is 43.68%, suggesting that they hold a substantial tangible asset base. The average company size for the sample companies is 7,281.93, suggesting that the sample includes mostly larger-sized companies. The mean Z-score is 5.99. The average market beta among sample companies is 0.97. Return-on-assets volatility averages at 11.61. Descriptive statistics of all variables are listed in Table 1.

Table 1. Descriptive Statistics of Variables

Variable	Mean	Variance	Standard Deviation	Skewness	Kurtosis
Audit Oversight Measure	1390.10	77.15	8.78	7.44	128.00
Risk Management Committee Oversight Measure	18.70	18.25	4.27	82.41	7089.12
Compensation Committee Measure	0.89	0.80	0.89	8.47	94.94
Leverage	0.30	282.23	16.80	-13.91	936.37
Tangibility	43.68	20.19	4.49	5.34	34.62
Covid Dummy	1	0	0	0.00	0.00
Firm Size	7281.93	541.06	23.26	5.34	34.61
Altman Z	5.99	3.57	1.89	0.00	0.00
Beta Coefficient	0.97	0.04	0.20	-0.33	6.3
ROA Volatility	11.61	13.31	3.65	14.63	229.85

(Source: RATS Output)

4.2 Results of Hypotheses Testing

The present study estimated separate regressions for the three risk outcomes, allowing the analysis to examine whether committee-level governance mechanisms are differentially associated with insolvency risk, systematic risk, and earnings volatility. The regression results in Table 2 show that audit oversight is negatively associated with insolvency risk; however, this relationship is not significant, whereas audit oversight is negatively associated with systematic risk and ROA volatility (Abraham, El-Chaarani, et al., 2024). These findings suggest that stronger audit oversight may not directly reduce the probability of distress. However, it can reduce earnings instability and limit exposure to market-wide fluctuations by improving financial discipline, reporting quality, and internal monitoring.

Table 3 reveals that while risk management committee oversight shows a negative link with insolvency risk and ROA volatility, these findings are statistically insignificant. However, a significant negative relationship with systematic risk indicates that the committee's more effective at recognising and addressing external and macro-level

uncertainties than at altering short-term firm-level distress indicators. This finding suggests that risk committees contribute to governance by strengthening the firm's ability to identify, assess, and respond to broader market risks.

The regression results in Table 4 indicate that compensation committee oversight is negatively associated with insolvency risk and ROA volatility, but these associations are not significant. However, the relationship between compensation committees' oversight and systematic risk is negatively and significantly associated. This finding suggests that compensation committee oversight on executive pay can reduce a firm's exposure to market-wide movements.

Governance mechanisms do not affect all types of risk equally. Audit, risk management, and compensation committees each appear to operate through distinct channels, with some more effective at constraining market volatility and others more relevant to strategic exposure or downside distress. This suggests that governance is not a single control system with uniform effects across various forms of risk; it varies depending on the type of risk under examination.

Table 2. Regressions of Audit Oversight on Insolvency Risk, Systematic Risk, and ROA Volatility

Variable	Insolvency Risk	Systematic Risk	ROA Volatility
Constant	6.09	0.98***	13.91***
Audit Committee Oversight Measure	-1.11	-.000039***	-0.001***
Leverage	3.02	-.000064	-0.03
Tangibility	-4.36	.000060	-0.02
Covid Dummy	9.12	.003	0.47
Firm Size	2.62	-.000038	0.01
N	7,739	7,751	7,751
R ²	0.001	0.96	0.01

* $p < .05$, ** $p < .01$, *** $p < .001$

(Source: RATS Output)

Table 3. Regressions of the Risk Management Committee Oversight Measure on Insolvency Risk, Systematic Risk, and ROA Volatility

Variable	Insolvency Risk	Systematic Risk	ROA Volatility
Constant	30.26	0.94	3.94***
Risk Management Committee Oversight Measure	-0.15	-0.0001***	-0.003
Leverage	-0.05	-0.0001	-0.0006
Tangibility	-0.50	0.0001	-0.0050
Covid Dummy	-11.50	0.006	0.166
Firm Size	0.29	-0.0001	0.003
N	3,258	3,260	3,260
R ²	0.001	0.94	0.04

* $p < .05$, ** $p < .01$, *** $p < .001$

(Source: RATS Output)

Table 4. Regressions of the Compensation Committee Oversight Measure on Insolvency Risk, Systematic Risk, and ROA Volatility

Variable	Insolvency Risk	Systematic Risk	ROA Volatility
Constant	5.04	0.98***	12.83***
Compensation Committee Oversight Measure	-7.56	-0.000004***	-0.001
Leverage	2.82	-0.00007	-0.04
Tangibility	-3.79	0.00007	-0.017
Covid Dummy	7.94	0.00361	0.35
Firm Size	2.27	-0.00004	0.01
N	7,745	7,757	7,757
R ²	0.001	0.96	0.011

* $p < .05$, ** $p < .01$, *** $p < .001$

(Source: RATS Output)

4.3 Robustness Check and Endogeneity Testing

The first test assessed the robustness of the audit oversight, risk management committee oversight, and compensation committee oversight measures. A global measure of corporate governance was obtained from Institutional Shareholder Services and regressed on the same risk criteria used in the fixed effects regressions of oversight measures. Table 5 shows the results of the robustness check. The global governance measure significantly reduced all three risk measures, including insolvency risk, systematic risk, and ROA volatility. Given similar results from this study's regressions on audit oversight, risk management committee oversight, and compensation committee oversight, we surmise that both the global governance measures and this study's oversight measures capture the same underlying governance construct. This suggests that the oversight measures are robust, as they are true indicators of governance. Additionally, the model exhibits strong explanatory power as reflected in the high R^2 . This indicates that the combined governance and firm-level variables explain a substantial proportion of variation in systematic risk.

4.4 Endogeneity Testing

Two-stage least squares regressions were performed for the audit oversight, risk management committee oversight, and compensation committee oversight measures. In the first stage, the independent variables of leverage, COVID dummy, firm size, and tangibility were regressed on audit oversight as the dependent variable. The disturbance term was the variance in audit oversight explained by leverage, a COVID dummy, firm size, and tangibility. In the second stage, this disturbance term was regressed on firm risk as the independent variable. If audit oversight were endogenous with respect to the control variables, the disturbance term would have been significant. This process was repeated with the risk management committee measure and the compensation committee measure as dependent variables in the first stage.

The disturbance term did not significantly explain ROA volatility, systematic risk, or insolvency risk in any of the regressions. We conclude that the oversight measures do not capture variance in the control variables, or that endogeneity of the independent variable does not adversely affect the results. Results are not reported here to maintain brevity.

Table 5. Robustness Test of Board Oversight Committee Measures

Variable	Insolvency Risk	Systematic Risk	ROA Volatility
Constant	-3.37	0.98***	17.92***
Governance	3.39***	-0.002**	-2.29***
Leverage	3.00	0.00007	-0.04
Tangibility	2.40	0.00007	-0.02
COVID-Dummy	8.08	0.003	0.25
Firm Size	1.44	-0.00004	0.01
N	7,745	7,757	7,757
R^2	0.003	0.96	0.01

* $p < .05$, ** $p < .01$, *** $p < .001$

(Source: RATS Output)

5. Implications

5.1 Theoretical Implications

5.1.1. Contributions to Corporate Governance Literature

It has been found that oversight by three board committees reduces firm risk. Rarely do researchers examine the oversight of three board committees concurrently, as is done in this study. All three committees reduced systematic risk. The audit committee was the only committee that reduced ROA volatility. Systematic risk is non-diversifiable, so firms cannot reduce it by holding portfolios of negatively correlated securities (Sharpe, 1964). However, as this study has shown, systematic risk can be reduced by all three oversight measures. It follows that the required return for a security (the minimum return to add security to a portfolio) can be reduced with sufficient board committee oversight, as the required return in the CAPM equation decreases with a lower beta. The reduction in required return suggests that securities that were hitherto rejected for failure to meet the threshold return for inclusion in a portfolio may be accepted if there is sufficient board committee oversight to reduce their beta coefficients sufficiently to lower the threshold return below the original value.

The audit committee was the only committee whose oversight reduced ROA volatility. ROA volatility is based on the volatility of net income or seasonality in income, fluctuations in debt, and fluctuations in expenses. Oversight by the audit committee reduces earnings management, which is the practice of inflating earnings to present management in a positive light. By providing accurate measures of earnings, audit committee oversight removes the conflated earnings figures associated with earnings management. Thus, earnings volatility is reduced, in turn reducing ROA volatility (Abraham et al., 2024a). They found that audit oversight reduced debt capacity. This finding suggests that firms with accurate debt measures are less likely to increase borrowing, thereby maintaining debt at a low, steady level. This smoothening of debt reduces ROA volatility. By revealing accurate expense figures, audit oversight reduces the tendency to incur unnecessary expenses, including perks and special rewards for management. Reducing expenses to a low, steady state reduces fluctuations in net income and, in turn, ROA volatility.

5.1.2 Reduction of Agency Costs and Improvement of Resource Dependence

This study adds to the literature on the reduction of agency costs and the application of resource dependence theory.

Agency costs occur when management takes actions that yield private benefits while diminishing shareholder wealth maximisation. Actions such as earnings manipulation and increasing accruals can be curbed by audit oversight. Actions such as making non-synergistic acquisitions, hiring based on nepotism, and other agency-cost behaviours can be highlighted by the risk management committee, thereby leading to their elimination. Muqorobin et al. (2023) identified increased leverage, increased capital intensity, and increased R&D intensity as agency costs that were reduced by risk management committees in Indonesia. This study can add systematic risk and ROA volatility as risky agency cost-inducing behaviours that are reduced by the different committees under study.

Resource dependence theory maintains that ensuring a steady supply of production inputs and a steady supply of capital is essential for the effective conduct of business. The provision of these inputs can be the responsibility of members of management who expect to be adequately compensated for their efforts. The compensation committee is charged with ensuring equitable and just compensation, so that oversight by this committee can reveal violations of pay equity that fail to reward managers for ensuring steady supplies of production inputs and capital. Corrective action is likely to ensue, suggesting that compensation committee oversight supports resource dependence.

5.1.3 Board Committee Oversight Impacts Market Measures More Than Accounting Measures

The board committee oversight was found to contain systematic risk, measured by the security's beta coefficient, a market-based measure of risk that reflects the market's valuation of firm risk based on the correlation of security price movements with the overall market. All three committees provided oversight to reduce systematic risk.

In contrast, board committee oversight had a lesser impact on accounting risk measures. The Altman Z formula is used to measure insolvency risk, which is the first accounting measure of risk. The Z formula is composed of four liquidity measures: retained earnings, EBIT, and sales. The only market measure is the market value of equity divided by the book value of total debt, with the numerator itself a market measure. Committee oversight by all three committees failed to find any significant reduction in insolvency risk. The other accounting measure of risk is ROA volatility. Only the third measure of audit oversight reduced ROA volatility.

5.2 Policy Implications

5.2.1 Generalizability of Results

The sample used in this study comprised pharmaceutical and energy firms in the United States. The question arises whether similar results can be obtained by replicating the study in other industries and countries. We argue that similar results may be obtained, and that future studies must replicate this study in other industries and countries. If board committee oversight can reduce risk from non-compliance with regulation in heavily regulated industries, it follows that board committee oversight may be even more effective in reducing the risk of regulatory non-compliance in industries that are less regulated, as the task of ensuring compliance with less stringent regulatory requirements is less challenging than ensuring compliance with highly restrictive regulatory requirements.

5.2.2 Managerial Implications

It is in management's interest to maintain low levels of systematic risk, as this increases the likelihood that the firm's securities will be selected for portfolios by pension fund and mutual fund managers. Therefore, managers should support the board in encouraging oversight by the board committees. Managers should fully cooperate with the implementation of corrective actions by all three committees. For the audit committee, managerial action includes refraining from earnings manipulation, excessive debt use, and increasing accruals and discretionary expenses by rewarding themselves with perks and special benefits. For the risk management committee, managerial action includes refraining from actions that increase systematic risk, such as acquiring risky debt and making non-synergistic acquisitions. For the compensation committee, managerial action includes supporting the compensation committee's recommendation to reduce excessively unjust rewards and compensation, as such measures increase employee confidence in the organisation.

6. Conclusion

This study explored the critical issue of oversight by the committees and its impact on firm risk, focusing on a sample of pharmaceutical and energy firms in the USA. The results of the study show that systematic risk is reduced by the audit and risk management committee, and the earlier it is, the greater its impact on reducing volatility in ROA.

The audit committee is responsible for overseeing financial reporting, internal controls, internal auditors, compliance,

disclosure, and ethical behaviour, among others, and results show that audit committee oversight helps reduce the firm's overall risks. The risk management committee is responsible for formulating a risk management framework to guard against risks arising from the internal and external environments. The compensation committee ensures that executive compensation includes salary and all other perks, while considering regulations and the firm's culture. Oversight by the Risk Management and Compensation Committee does not help reduce ROA volatility.

In conclusion, the committees are vital for ensuring effective corporate governance. These committees help the firm to reduce the risk by ensuring financial integrity, proper risk management, and compensation.

7. Research Limitations

The first research limitation is that three oversight measures from board committees were used to assess their impact on risks. Future research may consider alternate measures of board oversight.

The second research limitation is that the effect of board oversight on liquidity risk was not considered. As increased competition in a variety of industries renders it more challenging to maintain cash levels due to lost sales to competition, it behoves future research to consider liquidity risk.

Seasonal effects were assumed to be smoothed. Significant seasonal effects on firm risk and returns occur during holidays, so future research should consider including seasonal effects.

Yet another limitation of the study is the choice of the committee, where future researchers can include a nomination committee, a standing committee, a stakeholders relationship committee, among others.

A final limitation may be that reckless risk-taking is assumed, even though entrepreneurial risk-taking results in new products, innovation, and new technologies, i.e., such risk is beneficial to the firm. Future research must separate entrepreneurial risk-taking from reckless risk-taking.

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The Role of Cognitive Biases in Investment Decision-Making: A Systematic Review of Accounting-Information Literature

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A b s t r a c t

This study conducts a systematic literature review (SLR) to investigate the psychological determinants and theoretical frameworks that influence investment decision-making. By synthesising 46 peer-reviewed articles from SINTA-indexed and leading international databases via the PRISMA protocol, the research maps the evolution of behavioural finance and identifies critical gaps in existing theoretical models. The findings reveal that Behavioural Finance Theory remains the dominant framework, with overconfidence, anchoring, and herding behaviour identified as the most prevalent biases leading to suboptimal investment outcomes. Crucially, this study makes a novel contribution by integrating an accounting-based perspective to evaluate how financial information serves as a cognitive anchor and how psychological heuristics distort the interpretation of financial statements. The results offer a robust foundation for future researchers to develop integrative models that harmonise psychological dimensions with accounting-based decision-making processes, providing strategic insights for both practitioners and regulators in mitigating irrational investment behaviour.

Keywords: *Accounting Information, Systematic Literature Review, Cognitive Bias, Herding Behaviour, Overconfidence Bias, Financial Literacy*

1. Introduction

According to the latest data from the Indonesian Central Securities Depository (KSEI), covering the end of 2024 through projections for the first quarter of 2026, the Indonesian capital market shows a significant growth trend among retail investors. This phenomenon is a crucial foundation for why the study of cognitive bias in investment decisions is so relevant today.

The surge in the number of capital market investors, reaching 14.50 million by the end of 2024 and continuing to grow exponentially in 2025, indicates a massive democratisation of investment in Indonesia. KSEI data shows that the current investor profile is dominated by individuals under 30 (Gen Z), with often immature financial literacy. This "stock fever" and digital asset investment phenomenon create academic urgency because new retail investors tend to be more susceptible to cognitive biases, such as herding behaviour and overconfidence, due to exposure to unfiltered social media information. The integration of this statistical data into the research strengthens the argument that investment decision-making in Indonesia is no longer driven solely by fundamental analysis or rational accounting information, but has shifted toward complex psychological behaviour under conditions of information uncertainty.

Investment decisions are crucial in the economic life of both individuals and companies. Every investment decision has a direct impact on wealth management, financial well-being, and the achievement of long-term economic goals. The evolution of Indonesia's investment landscape is exhibiting a progressively favourable trend, alongside a rising influx of investors in the capital market. The expansion of the Indonesian stock exchange is evident in the rising number of investors participating in it. This is evidenced by the

quantity of Single Investor Identifications (SIDs) recorded with the Indonesian Central Securities Depository (KSEI). As of July 2024, the number of SIDs reached 13,324,560. This number represents an increase compared to the previous total number of stock exchange investors. The 2024 Financial Services Authority (OJK) survey revealed that the national financial literacy index had only reached 65.43%, while the financial inclusion index was higher at 75.02%, suggesting that many people have accessed financial services without fully understanding how to utilise them wisely. This increases the risk of making incorrect investment decisions and of being trapped in inappropriate products (Audini et al., 2020). The simplicity of stock investing is expected to drive the growth of capital market investors in Bali, predominantly Gen Z.

Traditionally, investment decision models have often been based on the principle of economic rationality, which assumes that individuals will act logically and optimally to maximise their utility. Theories such as the Capital Asset Pricing Model (CAPM) (Sharpe, 1964), Portfolio Theory (Markowitz, 1952), and the Theory of Market Efficiency (Fama, 1970) teach that investment decisions can be made using appropriate data and analysis, allowing individuals to choose optimal portfolios considering risk and expected return. However, in practice, many investment decisions are not based solely on rationality or economic analysis. Behavioural finance elucidates this phenomenon by positing that investing decision-making is frequently swayed by diverse psychological biases and emotions that are not invariably rational. Phenomena such as herding behaviour (Bikhchandani et al., 1992), overconfidence bias (Odean, 1998), and loss aversion (Kahneman & Tversky, 1979) often lead to wrong investment decisions, which, although they can be profitable in the short term, can be high risk and detrimental in the long term.

Table 1. Growth in the Number of Indonesian Capital Market Investors (2021–2025)

Years	Number of Investors (SID)	Annual Growth (%)	Retail Investor Dominance
2021	7.49 Million	93.00%	Millennial & Gen Z
2022	10.31 Million	37.70%	Millennial & Gen Z
2023	12.17 Million	18.00%	Millennial & Gen Z
2024	14.50 Million	19.10%	Gen Z & Gen Alpha (Early)
2025 (Est)	16.80 Million	15.80%	Gen Z & Gen Alpha

Source: Data processed from KSEI Public Statistics (2024) and Capital Market Projections 2025/2026

Existing literature has identified numerous psychological biases that interfere with investor decision-making. Herding behaviour transpires when investors conform to the choices of the majority or the market, despite these choices lacking rational reasoning or enough information. Investors often feel pressured to follow market trends without considering fundamentals or long-term risks (Banerjee, 1992). Similarly, overconfidence bias can lead investors to feel overly confident in their abilities, causing them to make high-risk decisions, such as overtrading or selecting investments with highly uncertain returns (Barberis & Thaler, 2003). Numerous studies have shown that financial literacy is essential for individuals to make informed and sensible decisions. Proficient financial literacy empowers investors to comprehend the risks and benefits of diverse investment products, while also recognising and mitigating biases that may obstruct their decision-making. A study by Lusardi and Mitchell (2014) found that individuals with greater financial literacy are more likely to make informed, judicious investment decisions. In addition to financial literacy, self-review or self-reflection is also considered a tool that can help investors improve their decision-making. By conducting self-reviews, investors can evaluate past investment decisions, learn from mistakes, and avoid repeating them (Odean, 1999). Self-reviews help them overcome biases and make more objective decisions based on more rational judgment.

The expansion of behavioural finance theory and a deeper understanding of psychology's impact on investment decisions have broadened our understanding of the decision-making process in financial markets. This study will further examine how investment decision models have evolved, both those based on economic rationality and those that acknowledge the role of psychology in influencing individual decisions. This study is highly relevant, given the increasing importance of rational decision-making in the complex context of financial markets. Investment decision models grounded in economic theory are essential for assessing sensible investment choices. A comprehensive study of the impact of psychological factors on investment decisions is essential, given the biases that may lead to suboptimal choices. This study seeks to elucidate the aspects that affect investment decision-making in volatile markets. This research can offer significant guidance to investors in making more informed and sensible decisions, establishing a basis for further inquiry in this domain.

A literature evaluation encompassing 46 papers, covering the period from 2007 to 2025 and before 2000, was

undertaken based on a summary of past research findings. The aim was to identify early articles on investment decisions influenced by psychological factors that could inform future research. The following review is structured as follows: Section 1 explains the importance of investment decisions and the influence of psychological factors on these decisions. Section 2 defines the concepts and theoretical developments related to investment decisions and psychological factors. Section 3 presents the approach used to identify studies and analyse research developments on investment decisions and psychological factors. Section 4 reviews key topics and provides an analysis of current research and guidelines for further research. Section 5 presents the results of the literature review. Conclusions are presented in Section 6.

2. Literature Review

Investment decisions are a crucial area of study in finance and behavioural economics. Theoretically, the foundation for understanding investment decision-making stems from Herbert Simon's (1955) decision theory, which posits that individuals make decisions through a process of gathering information, evaluating alternatives, and selecting the best option based on specific objectives. In financial markets, investors are expected to behave rationally and evaluate all accessible information. Moreover, standard financial theory posits that investors are rational, risk-averse, and want to maximise utility. This idea, initially presented by Von Neumann and Morgenstern (1944) in the Expected Utility framework, underpins classical investment models, including Markowitz's Modern Portfolio Theory (MPT), which underscores the importance of diversification to mitigate risk and optimise returns. MPT also assumes that investors act rationally in selecting the optimal combination of assets based on their desired levels of risk and return. This idea then evolved into the more intricate Capital Asset Pricing Model (CAPM) by Sharpe (1964), which associates systematic risk with an asset's expected return.

Although this theory is mathematically robust, it has been criticised for often failing to reflect the more complex human behaviour in investment decisions, particularly under conditions of uncertainty and imperfect information (Hirshleifer & Teoh, 2024). This paved the way for the development of Behavioural Finance theory, which is influenced by psychological factors and cognitive biases. Thaler (1993) and Barberis & Thaler (2003) emphasise that investors often misjudge information due to influences such as overconfidence, anchoring, and herding behaviour. One

key contribution came from the heuristics and biases framework introduced by Kahneman and Tversky (1974), which explained that individuals tend to use mental shortcuts, such as anchoring and availability, when assessing information, leading to biased decisions. This approach underpins Prospect Theory (Kahneman & Tversky, 1979), which posits that humans often exhibit irrationality when confronted with risk and show heightened sensitivity to potential losses relative to equivalent gains (loss aversion).

However, understanding investment decisions can also be viewed from a more normative and social perspective through the Theory of Reasoned Action (TRA) developed by Fishbein and Ajzen (1975). TRA emphasises that investment behaviour is based on intentions influenced by an individual's attitude toward investment and the subjective norms of their social environment. Although TRA emphasises rationality in the formation of investment intentions, in practice these intentions are often not realised due to the influence of cognitive biases and risk perceptions, as the behavioural approach explains. This theory then developed into the Theory of Planned Behaviour (TPB) by adding the variable of control over one's behaviour. This variable is considered capable of understanding the limitations of an individual's behaviour (Ajzen, 1991).

Research related to investment decisions that are also influenced by psychological factors has been widely conducted by researchers from various countries around the world, including in Saudi Arabia conducted by (Seraj et al., 2022), China (Wang & Zou, 2024; Lu et al., 2023), Indonesia (Yuana et al., 2024; Kartini & Nahda, 2021; Kufepaksi, 2011; Rahayu et al., 2021; Suartana, 2007; Purbasari et al., 2020; Rijalul Fikri et al., 2022), India (Kumar et al., 2024; Jain et al., 2023; Adil et al., 2022; Sathya & Prabhavathi, 2024; Kumar & Prince, 2023; Suresh, 2021), Pakistan (Ahmad & Shah, 2022; Ahmad, 2020; Ahmed et al., 2021), Japan (Takahashi & Terano, 2007; Takahashi, 2013; Inaishi et al., 2010), Romania (Pochea et al., 2017), Germany (Schmitt & Westerhoff, 2017), America (Olsen, 1996), Greece (Gavrilakis & Floros, 2025), Kuwait (Hassanein et al., 2024); Africa (Erasmus & Matsimela, 2021). More than 10 countries have been studied regarding investment decisions and psychological factors between 2007 and 2024, as well as before 2000.

2.1 Accounting Information

The use of accounting information in investment decision-making is no longer viewed as a purely rational, mechanical

process, but rather as a complex, interpretive process. Recent literature shows that the quality of financial reporting and sustainability disclosure (ESG) play a crucial role in reducing information asymmetry that often triggers irrational behaviour (He et al., 2022). However, the complexity of accounting data often exceeds the processing capabilities of individual investors, resulting in financial reports that sometimes serve as confusing rather than enlightening stimuli (Kovermann & Velte, 2023). Furthermore, the adoption of digital reporting standards and transparency of accounting information has been shown to mitigate the risk of stock price volatility caused by investor overreaction (Ameeri et al., 2024). Furthermore, the value relevance of accounting information remains a key anchor for institutional investors in asset valuation amid market uncertainty (Nandari & Oncioiu, 2022). Recent research also emphasises that narratives in annual reports can be used to manage investor impressions, which, if left unchecked, can lead to suboptimal investment decisions (Al-Hadi et al., 2023).

2.2 Cognitive Bias

Cognitive bias remains a key determinant that obscures investor objectivity in evaluating risk and return. Recent research confirms that overconfidence bias and herding behaviour are among the most persistent factors driving market bubbles across global exchanges (Abbas et al., 2024). The anchoring bias is also particularly strong when investors are confronted with historical price information or accounting book values, which often prevents them from reacting appropriately to the latest market news (Gherghina et al., 2022). In addition to traditional biases, recent literature has begun to explore "digital bias," where social media algorithms exacerbate investor confirmation bias through information echo chambers (Kansal et al., 2023). These biases collectively create deviations from efficient market theory, where emotions such as the fear of missing out (FOMO) override fundamental analysis (Sreeram et al., 2022). Therefore, mapping these various heuristics is crucial to understanding why investors often hold onto losing assets but sell profitable ones too quickly, a phenomenon known as the disposition effect (Baker et al., 2023).

2.3 Financial Literacy

Financial literacy is recognised as a key defence mechanism for investors to mitigate the negative impacts of cognitive biases. High levels of financial literacy are positively correlated with an individual's ability to interpret complex

accounting information and effectively diversify their portfolio (Lusardi et al., 2024). Conversely, investors with low financial literacy tend to be more susceptible to fraudulent investment schemes and high-risk speculative behaviour (Goyal et al., 2022). In the digital context, financial literacy has evolved into digital financial literacy, where an understanding of financial technology (FinTech) is essential to avoid poor decision-making in the crypto asset market and on independent trading platforms (Panos & Wilson, 2023). In addition to technical knowledge, the attitudinal and behavioural dimensions of financial literacy also play a crucial role in shaping long-term investment discipline (Siddiqui et al., 2022). Global studies emphasise that targeted financial education can reduce investors' reliance on simple heuristics, thus creating a more stable and inclusive capital market (Hasan et al., 2023).

3. Methodology

This research employs the Systematic Literature Review (SLR) methodology. A literature review is a methodological approach that finds current research, assesses its significance, analyses and synthesises data, and presents findings to formulate conclusions. SLR can be applied in various research methods, including both qualitative and quantitative approaches, as well as in accounting research, where both methods are generally accepted (Massaro et al., 2016). A systematic literature review (SLR) is essential for evaluating scientific evidence on cognitive biases in investment decision-making. This process allows for objective synthesis of findings, avoiding selective bias. An SLR is particularly important for understanding how accounting information interacts with investors' psychological biases and identifying research gaps in accounting and behavioural finance. It helps establish a solid theoretical foundation and practical implications for standard setters and investors. By analysing biases such as

overconfidence and confirmation bias, the SLR enriches behavioural accounting theory and offers recommendations to improve information disclosure, financial education, and regulatory frameworks, ultimately fostering market efficiency and rational investment decisions. A systematic literature review (SLR) was selected for its qualitative approach to explore cognitive biases in accounting-based investment decision-making. Bibliometric analysis was deemed insufficient for deeper insights, whereas meta-analysis requires a uniform dataset, which is often unavailable in behavioural research. SLR allows synthesis of diverse evidence types to create a comprehensive understanding and identify nuanced research gaps in this field. Although the SLR methodology presented is capable of systematically mapping psychological factors, the narrative does not explicitly detail specific data extraction criteria for analysing how financial statement elements trigger specific cognitive biases. Consequently, there is a procedural disconnect, in which the focus on accounting information appears more the result of theoretical synthesis than a primary analytical instrument integrated into the methodological steps.

This study examines research articles on investment decisions from a psychological perspective, published in peer-reviewed journals indexed in Scopus and Sinta. Articles were collected using Publish or Perish software and Google Scholar. This study employed two key search terms to identify relevant articles: "Investment decisions and psychological factors" to refine the search. The researchers then conducted a filtering process to generate a high-quality data set. After reviewing all obtained articles, 46 articles published between 2007 and 2025 and before 2000 were systematically analysed. The identities of these articles are shown in Table 1.

Table 2. Articles Reviewed

No.	Journal Name	Author Name	Title
1	Journal of Law and Sustainable Development	(Paul & Sundaram, 2023)	"Behavioral Biases (Overconfidence and Herding Bias)"
2	Environment and Social Psychology	(Wang & Zou, 2024)	"Financial literacy, Cognitive bias, and personal investment decisions: A new perspective in behavioral finance"
3	Edelweiss Applied Science and Technology	(Yuana et al., 2024)	"View of The Behavioral Biases on Investment Decision Behavior: Evidence from Indonesia"

4	Global Business Review	(Jain et al., 2023)	“Shaping Investment Decisions Through Financial Literacy: Do Herding and Overconfidence Bias Mediate the Relationship?”
5	Journal of Financial Regulation and Compliance	(Kumar et al., 2024)	“All are interesting to invest in, but I fear missing out (FOMO): a comparative study among self-employed and salaried investors”
6	Frontiers in Psychology	(Seraj et al., 2022)	“The roles of financial literacy and overconfidence in investment decisions in Saudi Arabia”
7	Journal of Asian Finance	(Kartini & Nahda, 2021)	“Behavioral Biases on Investment Decision: A Case Study in Indonesia”
8	Journal of Indonesian Economy and Business	(Kufepaksi, 2011)	“Do Overconfident Investors Trade Excessively in the Capital Market? Evidence in an Experimental Research Setting”
9	Asian Journal of Accounting Research	(Adil et al., 2022)	“How does financial literacy moderate the association between behaviour biases and investment decisions?”
10	International Journal of System Assurance Engineering and Management	(Sathya & Prabhavathi, 2024)	“The influence of social media on investment decision-making: Examining behavioral biases, risk perception, and mediation effects”
11	Journal of Asian Finance, Economics and Business	(Rahayu et al., 2021)	“Herding Behavior Model in Investment Decision on Emerging Markets: Experimental in Indonesia”
12	Journal of Economics and Administrative Science	(Ahmad & Shah, 2022)	“Overconfidence heuristic-driven bias in investment decision-making and performance: mediating effects of risk perception and moderating effects of financial literacy”
13	Journal of Economics and Administrative Science	(Kumar & Prince, 2023)	“Overconfidence Bias in Investment Decisions: A Systematic Mapping of Literature and Future Research Topics”
14	Journal of Finance and Accounting	(Suresh, 2021)	“Impact of Financial Literacy and Behavioural Biases on Investment Decision-making”
15	Physica A: Statistical Mechanics and its Applications	(Takahashi&Terano, 2007)	“Analysing the Influence of Overconfident Investors on Financial Markets Through Agent-Based Model”
16	Journal of Behavioural Finance	(Pochea et al., 2017)	“Herding Behavior in CEE Stock Markets Under Asymmetric Conditions: A Quantile Regression Analysis”
17	Quantitative Finance	(Schmitt & Westerhoff, 2017)	“Herding behaviour and volatility clustering in financial markets”

18	Journal of Economic Interaction and Coordination	(Takahashi, 2013)	“Analysing the Influence of Overconfident Investors on Financial Markets Through Agent - Based Model”
19	Journal of Advanced Computational Intelligence and Intelligent Informatics	(Inaishi et al., 2010)	“Effect of overconfident investor behavior on the stock market”
20	Financial Analysts Journal	(Olsen, 1996)	“Implications of herding behavior for earnings estimation, risk assessment, and stock returns”
21	Journal of Industrial and Management Optimization	(Jiang et al., 2023)	“Strategy Selection of Inventory Financing Based on Overconfident Retailer”
22	Euromed Journal of Business	(Gavrilakis & Floros, 2025)	“Sustainable finance, herding behavior and risk aversion during market volatility”
23	Journal of Financial Reporting and Accounting	(Hassanein et al., 2024)	“Do Overconfident CEOs Add to Corporate Stock Returns Through Their Risk Reporting Practice?”
24	Management Decision	(Ahmad, 2020)	“Does Underconfidence Matter in Short-Term and Long-Term Investment Decisions? Evidence from an Emerging Market”
25	The Singapore Economic Review	(Lu et al., 2023)	“Learning To Be Overconfident and Underconfident”
26	Journal of Finance and Accounting	(Ahmed et al., 2021)	“What Explains the Investment Decision-Making Behaviour? The Role of Financial Literacy and Financial Risk Tolerance”
27	National Accounting Symposium X	(Suartana, 2007)	“Upaya Meningkatkan Kualitas Pertimbangan Audit Melalui Self Review: Kasus Going Concern Perusahaan. [in English: Efforts to Improve the Quality of Audit Considerations Through Self-Review: The Case of a Going Concern Company]”
28	Journal of Economics, Finance and Management Studies	(Purbasari et al., 2020)	“Analysis of overconfidence, herding, and anchoring in investment decisions among ESOP at PT Bank Central Asia”
29	Jurnal Akuntansi, Bisnis dan Ekonomi Indonesia	(Rijalul Fikri et al., 2022)	“Pengaruh Herding Factor dan Overconfidence terhadap Kualitas Pengambilan Keputusan Investasi Saham pada Generasi Z (Studi pada Mahasiswa Jurusan Akuntansi Program Studi D-IV Akuntansi Politeknik Negeri Padang). [In English: The Influence of Herding Factor and Overconfidence on the Quality of Stock Investment Decision Making in Generation Z (A Study on Accounting Students of the D-IV Accounting Study Program, Padang State Polytechnic)].”

30	Journal of Business and Banking	(Theressa & Armansyah, 2022)	“Pengaruh herding, overconfidence, dan endowment bias pada keputusan investasi investor pasar modal. [In English: The influence of herding, overconfidence, and endowment bias on investment decisions of capital market investors].”
31	Selekta Manajemen: Jurnal Mahasiswa Bisnis & Manajemen	(Hanum Pertiwi & Panuntun, 2023)	“Pengaruh Herding Behavior, Cognitive Bias, dan Overconfidence Bias terhadap Keputusan Investasi. [In English: The Influence of Herding Behavior, Cognitive Bias, and Overconfidence Bias on Investment Decisions]”
32	Jurnal Visioner & Strategis	(Putri et al., 2024)	“Pengaruh Herding Behaviour, Regret Aversion Bias, Overconfidence, Dan Risk Tolerance Terhadap Keputusan Investasi Pada Generasi Milenial (Studi Kasus Pada PT. Phintraco Sekuritas Pojok Bursa FEB UNIMAL). [In English: The Influence of Herding Behavior, Regret Aversion Bias, Overconfidence, and Risk Tolerance on Investment Decisions in the Millennial Generation (Case Study at PT. Phintraco Sekuritas Pojok Bursa FEB UNIMAL)].”
33	Jurnal Investasi dan Pasar Modal	(Fikri, R. 2022)	“Perilaku overconfidence, loss aversion, dan herding bias dalam pengambilan keputusan investasi pasar modal pada generasi Z. [In English: Overconfidence, loss aversion, and herding bias behavior in capital market investment decision making in generation Z].”
34	Jurnal Bina Bangsa Ekonomika	(Salsabila & Arifin, 2024)	“Pengaruh Herding Behavior, Overconfidence dan Risk Tolerance Terhadap Keputusan Investasi Dengan Financial Literacy Sebagai Variabel Moderasi: Studi Kasus Pada Mahasiswa Fakultas Ekonomi dan Bisnis Universitas Muhammadiyah Surakarta. [In English: The Influence of Herding Behavior, Overconfidence and Risk Tolerance on Investment Decisions with Financial Literacy as a Moderating Variable: A Case Study on Students of the Faculty of Economics and Business, Muhammadiyah University of Surakarta].”
35	Jurnal Ekonomi dan Akuntansi	(Puspita & Novianty, 2024)	“Pengaruh Bias Overconfidence Serta Herding Terhadap Keputusan Investasi. [In English: The Influence of Overconfidence Bias and Herding on Investment Decisions].”
36	Jurnal Manajemen dan Organisasi Review	(Yuwono & Altiyane, 2023)	“Pengaruh Overconfidence, Herding, Availability Bias, Risk Aversion, dan Personal Information Terhadap Keputusan Investasi. [In English: The Influence of Overconfidence, Herding, Availability Bias, Risk Aversion and Personal Information on Investment Decisions].”

37	Manor: Jurnal Manajemen Dan Organisasi Review	(Prasetyo & Prawidya, 2024)	“Determinan Keputusan Investasi Investor di Pasar Modal: Overconfidence Bias, Herding Behavior, dan Financial Literacy. [In English: Determinants of Investor Investment Decisions in the Capital Market: Overconfidence Bias, Herding Behavior, and Financial Literacy].”
38	Jurnal Ekonomi Manajemen	(Salvatore & Esra, 2020)	“Pengaruh Overconfidence, Herding, Regret Aversion, Dan Risk Tolerance Terhadap Pengambilan Keputusan Investasi Investor. [In English: The Influence of Overconfidence, Herding, Regret Aversion, and Risk Tolerance on Investor Investment Decision Making].”
39	Jurnal Kajian Bisnis STIE Widya Wiwaha	(Kuasa & Tjahjono, 2023)	“Pengaruh Herding, Overconfidence, Risk Perception, Dan Accounting Knowledge Terhadap Keputusan Investasi di Bursa Saham. [In English: The Influence of Herding, Overconfidence, Risk Perception, and Accounting Knowledge on Investment Decisions on the Stock Exchange].”
40	E-Jurnal Ekonomi Dan Bisnis Universitas Udayana	(Milati & Zen, 2022)	“Financial Literacy, Overconfidence, Dan Herding Pada Keputusan Investasi di Pasar Modal. [In English: Financial Literacy, Overconfidence, and Herding in Investment Decisions in the Capital Market].”
41	Jurnal Ekonomi dan Bisnis Indonesia	(Nurhayati & Dwi, 2024)	“Pengaruh Overconfidence Dan Herding Terhadap Dinamika Keputusan Investasi Pada Saham Berisiko Tinggi. [In English: The Effect of Overconfidence and Herding on the Dynamics of Investment Decisions in High-Risk Stocks].”
42	Jurnal Manajerial dan Kewirausahaan	(Gunawan & Wijayanto, 2022)	“Pengaruh Overconfidence, Representativeness dan Herding Behavior terhadap Keputusan Investasi Saham Generasi Milenial di Jakarta. [In English: The Influence of Overconfidence, Representativeness and Herding Behavior on Stock Investment Decisions of the Millennial Generation in Jakarta].”
43	Jurnal Manajerial dan Kewirausahaan	(Valentina & Pamungkas, 2022)	“Pengaruh Financial Literacy, Herding Behavior Dan Overconfidence Terhadap Investment Decision. [In English: The Influence of Financial Literacy, Herding Behavior and Overconfidence on Investment Decisions].”
44	Jurnal Maksipreneur: Manajemen, Koperasi, Dan Entrepreneurship	(Adielyani & Mawardi, 2020)	“The Influence of Overconfidence, Herding Behavior, and Risk Tolerance on Stock Investment Decisions: The Empirical Study of Millennial Investors in Semarang City.”
45	Prosiding Seminar Nasional Akuntansi Dan Manajemen	(Akbar et al., 2023)	“Pengaruh Overconfidence dan Herding Terhadap Keputusan Investasi Reksadana di Livin by Mandiri. [In English: The Influence of Overconfidence and Herding on Mutual Fund Investment Decisions at Livin by Mandiri].”
46	Southern African Business Review	Erasmus & Matsimela, 2021)	“The Municipal Audit Committee Self-review Threat: The South African Dilemma.”

Source: Scopus, Google Scholar Index (reprocessed, 2025).

4. Results

4.1 Article Classification

Investment decisions are a key determinant of financial market development, particularly in developing countries. Numerous studies, including those by Barberis and Thaler (2003), have demonstrated that investor decisions are not solely based on rational considerations but are also influenced by complex psychological and behavioural factors. This review presents an overview of previous research by examining several key research findings. This review references 46 articles published between 2007 and 2025 and before 2000.

Based on the number of publications, 2023 had the most, with 10 articles (21.74%), followed by 2024 (19.57%). Publication productivity in 2020 increased due to technological advances and easier access to market data, enabling researchers to conduct more in-depth, real-time

analysis. The post-pandemic surge in mass investment, particularly among retail investors, has also been a significant driver of research examining motivations and biases in investment decision-making.

Based on the type of research and research model used in articles on investment decisions and psychological factors, among the 46 articles cited, 41 (89.13%) employed a quantitative approach, 4 (8.7%) a qualitative approach, and 1 (2.2%) a mixed-methods approach. Based on the research method, 39 articles (84.78%) cited used survey-based methods, 4 articles (8.70%) used experimental methods, 2 articles used interviews, and 1 article used SLR.

Based on the research locations of the 46 cited articles, the majority of studies were conducted in Asia (41 studies), with Indonesia as the most frequent location, accounting for 25 studies. Europe followed this (3 studies), Africa (1 study), and North America (1 study).

Table 3. Classification Of Investment Decision Articles From 46 Reviewed Articles

Category	N	%
Year of Publication		
1996	1	2.17
2007	3	6.52
2010	1	2.17
2011	1	2.17
2013	1	2.17
2017	2	4.35
2020	4	8.70
2021	5	10.87
2022	8	17.39
2023	10	21.74
2024	9	19.57
2025	1	2.17
Total Data	46	100%
Research Type		
Qualitative	4	8.70
Quantitative	41	89.13
Mix Method	1	2.17
Total Data	46	100%
Research Method		
SLR	1	2.17
Survey	39	84.78
Experiment	4	8.70

Interview	2	4.35
Total Data	46	100%
Research Location		
Continent Asia	41	89.13
Saudi Arabia	1	
Cina	2	
Indonesia	25	
India	6	
Pakistan	3	
Japan	3	
Kuwait	1	
Europe	3	6.52
Germany	1	
Greece	1	
Romania	1	
Africa	1	2.17
Uganda	1	
North America	1	2.17
United States	1	
Total Data	46	100

Table 4. The Main Theories Used in The Reference Articles

No	Theory Used	Total	Percentage (%)
1	Prospect Theory	4	6.35%
2	Heuristics and Biases Framework	2	3.17%
3	Herding Theory	1	1.59%
4	Dual Process Theory	1	1.59%
5	Theory of Planned Behavior	3	4.76%
6	Cognitive Load Theory	1	1.59%
7	Behavioural Biases Theory	2	3.17%
8	Behavioral Finance Theory	38	60.32%
9	Risk Perception Theory	2	3.17%
10	Expected Utility Theory	1	1.59%
11	Financial Literacy Theory	1	1.59%
12	Agent-Based Modelling (ABM)	2	3.17%
13	Reputation and Incentive Theory	1	1.59%
14	Behavioural Economics Theory	1	1.59%
15	Inventory Management & Newsvendor Theory	1	1.59%
16	Herding Behaviour Theory	2	3.17%
17	Risk Aversion Theory	1	1.59%
18	Upper Echelons Theory	1	1.59%
19	Self-Serving Bias Theory	1	1.59%
20	Motivated Beliefs Theory	1	1.59%
21	Bayesian Learning Theory	1	1.59%
22	Model Belief Adjustment	1	1.59%
23	Agency Theory	2	3.17%
24	Regret Theory	1	1.59%
25	Role-Conflict Theory	1	1.59%
26	Self-Review Threat Concept	1	1.59%

Source: Processed Data (2025)

4.2 Theories and Variables

Based on the main theories, 26 main theories were used in the 46 articles referenced. Behavioural Finance Theory was the most frequently used as a main theory, with 38 articles. Other theories frequently cited as main theories were Prospect Theory (4 articles), Theory of Planned Behavior (3 articles), Heuristics and Biases Framework (2 articles), and Behavioral Biases Theory (2 articles). Furthermore, the other theories were only used in one article. On average, researchers in this field have applied Behavioural Finance Theory in their articles.

Regarding the use of variables, all 46 referenced articles used investment decision variables as their dependent variables. Meanwhile, the independent variables were grouped based on factors influencing investment decisions, specifically from a behavioural (psychological) perspective.

Table 4 shows that, out of 46 articles, the independent variables used in the reference articles, namely, the Overconfidence bias variable, which is part of the behavioral factor, is the variable most frequently used in research, namely 22 articles each, followed by the Herding bias variable as many as 13 articles, Herding behavior as many as 10 articles, Financial literacy 8 articles, Behavioral bias 7 articles and the remaining other independent variables range from 4 to 1 article. Overall, in addition to the dependent and independent variables, several articles also use moderating variables, namely Financial literacy (in 3 articles), Cognitive biases (in 1 article), Overconfidence bias (in 1 article), Financial risk tolerance (in 1 article), and Risk perception (in 1 article). Some use mediating variables, namely Risk perception (in 2 articles), Herdi; herdingOverconfidence bias, Fear of Missing Out (FOMO), and investment intention (in 1 article each)articles on Table

Table 5. List of Research Variables

No.	Variable X	Total	Total Moderation	Total Mediation
1	Behavioural bias	7		
2	Financial literacy	8	3	
3	Cognitive biases	2	1	
4	Herding bias	13		1
5	Loss aversion bias	1		
6	Overconfidence bias	22	1	1
7	Social media use	1		
8	Social influence	1		
9	Overconfidence heuristic	1		
10	Overconfidence investors	4		
11	Herding behaviour	10		
12	Overconfidence retailer	1		
13	Underconfidence bias	2		
14	Self-review	1		
15	Loss aversion	2		
16	Anchoring	1		
17	Representativeness	2		
18	Availability	2		
19	Endowment bias	1		
20	Regret aversion bias	2		
21	Financial risk tolerance	4	1	
22	Risk aversion	1		
23	Personal information	1		
24	Risk perception	1	1	2
25	Accounting knowledge	1		
26	The role of the audit committee	1		
27	Fear of Missing Out (FOMO)			1
28	Investment Intention			1

Source: Processed data (2025)

4, which can be seen that of the 46 articles, the independent variables used in the reference articles, namely, the Overconfidence bias variable which is part of the behavioral factor is the variable most frequently used in research, namely 22 articles each, followed by the Herding bias variable as many as 13 articles, Herding behavior as many as 10 articles, Financial literacy 8 articles, Behavioral bias 7 articles and the remaining other independent variables

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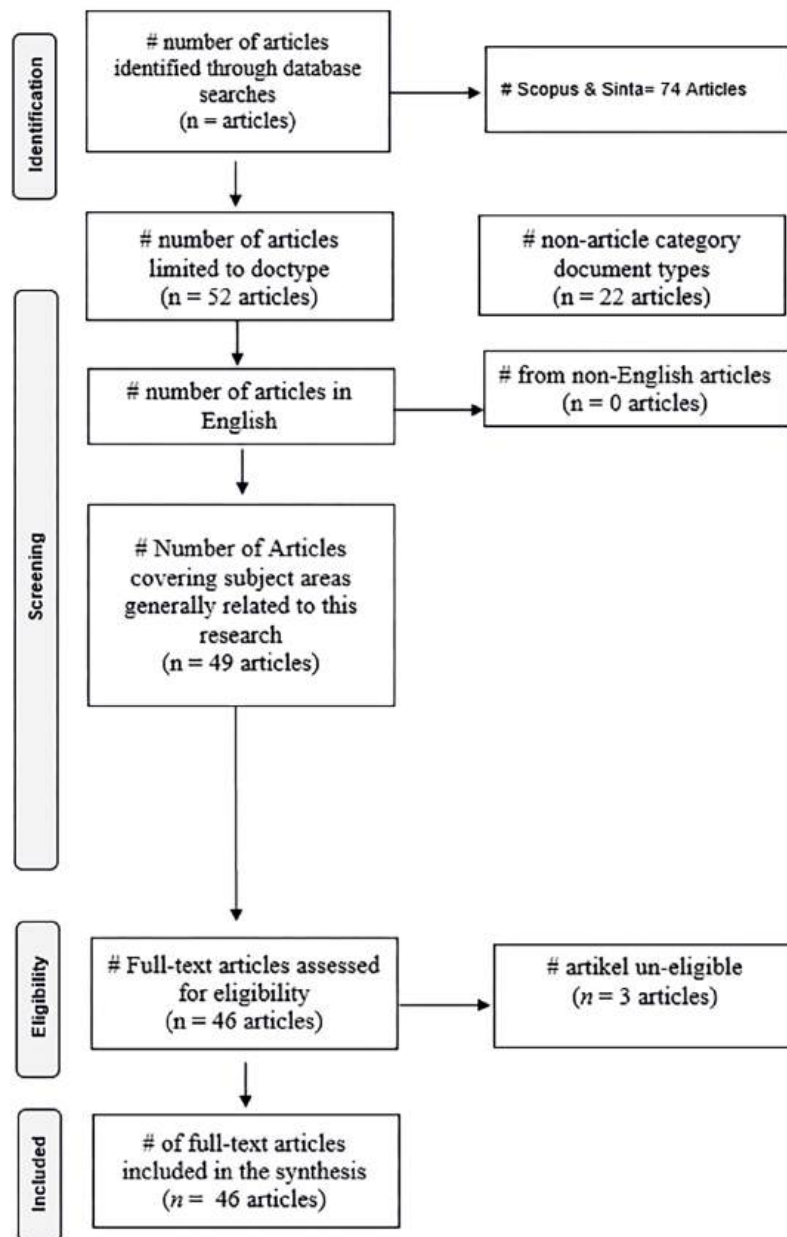


Figure 1. Article Selection Process

The article selection process for this systematic literature review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure transparency, reproducibility, and rigour (Figure 1). A total of 74 articles identified through a systematic search of various academic databases were screened based on established eligibility criteria. After deduplication, title and abstract suitability assessment, and full manuscript eligibility assessment, articles were excluded for documented reasons, such as not meeting the accounting-based scope, irrelevant methodology, or being duplicate publications. Thus, 46 articles meeting all inclusion criteria were ultimately selected for in-depth synthesis and analysis in this review, establishing a solid empirical foundation for subsequent discussion.

Based on the distribution of identified variables, key inclusion criteria for this systematic literature review were formulated to ensure that selected articles were directly relevant to the core research question. These criteria explicitly included: (1) empirical or theoretical articles examining the relationship between at least one cognitive bias or behavioral factor (such as overconfidence, herding, or financial literacy) and investment decision-making; (2) research contexts that explicitly discuss or imply the use of accounting or financial information as a basis for decisions, thus strengthening an accounting-based perspective; and (3) articles published in accredited or reputable scientific journals within a specified timeframe, to ensure the academic quality and relevance of the findings. The focus on variables such as overconfidence and herding, which dominated the final sample, naturally arose as a consequence of the application of these stringent inclusion criteria, as these studies most directly address the review's objectives.

Conversely, exclusion criteria were applied to filter out articles that did not meet the required thresholds of relevance and analytical depth. Articles were excluded for the following reasons: (1) they did not specifically address cognitive biases or behavioral factors in the investment context, although they may address decision-making in general; (2) they examined investments in non-financial assets (such as social or educational investments) without a connection to capital markets and accounting information; (3) they were secondary literature studies (such as previous narrative reviews) without contributing new primary data or analysis; (4) they were not available in full text or were written in a language beyond the researcher's competence;

and (5) they only mentioned variables such as cognitive biases in passing without testing or analysing them as core constructs. This screening process resulted in 28 ineligible articles, ensuring that only the 46 most robust and relevant articles served as the basis for the synthesis analysis in this study.

Utilising the TCCM (Theory, Context, Characteristics, Methodology) framework, an examination of the 46 chosen articles uncovered numerous important research gaps that future studies could explore. In terms of theory, while prospect theory and the heuristics and biases framework are prevalent in the theoretical foundation, there exists a lack of more thorough theoretical integration. Many studies merely embrace a single theoretical viewpoint, focusing exclusively on aspects such as overconfidence or herding, without striving to unify different cognitive biases into a cohesive theoretical framework that clarifies the hierarchical relationships and dynamics among them. This gap calls for research that can develop or evaluate a comprehensive theoretical framework linking cognitive biases, the processing of accounting information, and additional psychological factors such as emotions (e.g., FOMO) within a unified causal framework.

Regarding Context and Characteristics, earlier studies have primarily focused on individual investors in developed-country capital markets, while emerging markets have attracted comparatively less attention. Moreover, factors related to investors, such as generational identity (Generation Z/millennials), gender, and professional expertise (analyst vs retail investor), have yet to be thoroughly investigated as moderators of bias. An important gap is the lack of research examining the influence of cognitive biases on investment decisions that rely on non-traditional accounting data, such as sustainability reporting, integrated reporting, or ESG disclosures.

Within the Methodology domain, a notable disparity is the prevalence of quantitative techniques reliant on surveys and secondary market information, with a limited presence of qualitative methods or experimental approaches that could more effectively reveal fundamental cognitive processes. Moreover, studies that explicitly include accounting variables as either moderating or mediating factors are still quite uncommon. Consequently, there is a notable opportunity for research employing experimental or mixed-methods approaches to investigate how various formats,

complexities, and framings of accounting information might enhance or diminish the impact of specific cognitive biases on investment choices.

The potential impact of this research would be significantly enhanced if an integrative model that synergises accounting and psychological variables were proposed, as it could offer an operational framework that goes beyond a mere descriptive literature review. Such a model would not only bridge the theoretical gap between standard and behavioural finance but also serve as a diagnostic tool for regulators designing "cognitively friendly" accounting disclosure systems to mitigate market anomalies. For practitioners in emerging markets, this integrative model could provide strategic guidance in developing investment algorithms or financial literacy curricula that specifically target biases in interpreting financial data, thereby creating a more resilient and efficient decision-making ecosystem.

5. Discussion

Upon reviewing 46 linked publications, it can be stated that the Behavioural Finance hypothesis is the predominant hypothesis, as it elucidates numerous market abnormalities that standard financial theory fails to account for. Behavioural finance has become a widely used approach in investment decision-making research. Behavioural finance theory, as a branch of science, began to develop formally from the late 1970s to the early 1980s. However, its main roots date back to 1979 with the introduction of Prospect Theory by Daniel Kahneman and Amos Tversky. This theory suggests that individuals do not always act rationally when making financial decisions but are heavily influenced by psychological processes, such as risk perception, fear of loss, and the way information is processed in the mind. This methodology facilitated the integration of finance and psychology, yielding a more thorough understanding of investor behaviour in volatile markets.

Furthermore, in terms of methodology, surveys are a popular choice among researchers compared to experiments and interviews. Surveys can be conducted on a large scale without the need for artificial conditions (Creswell, 2014). While interviews or case studies are in-depth but limited in the number of participants, surveys allow for the collection of data from hundreds to thousands of respondents more efficiently in a time- and cost-effective manner (Sekaran & Bougie, 2016). Furthermore, because many psychological factors, such as herding behaviour, overconfidence, and financial literacy, are latent and cannot be directly observed,

surveys using scale instruments (such as the Likert scale) are an appropriate tool for measuring these variables (Hair et al., 2019). Field and Hole (2003) suggest that experimental methods are also an excellent choice in investment decision research, especially when the objective is to test the causal relationship between psychological variables and investment behaviour. This method allows researchers to create controlled conditions in which one or more variables are manipulated to observe their impact on participant decisions. Experiments, as compared to surveys, produce results closer to the actual situation.

Based on the use of variables, overconfidence bias is the most widely used variable in research due to its significant influence on investor behaviour. This bias occurs when individuals have excessive confidence in their abilities or knowledge, leading to irrational decision-making, such as excessive transactions or inaccurate risk assessments (Odean, 1998). Research indicates that overconfident investors often hold unrealistic expectations, which can impact the overall market (Barber & Odean, 2001). Therefore, overconfidence bias is an important variable in behavioural finance research due to its significant impact on investment decisions. Based on research locations, Indonesia is the most researched location. This is because Indonesia has a developing, relatively active stock market, such as the Indonesia Stock Exchange (IDX), which offers opportunities to study investor behaviour in a dynamic market context often influenced by psychological factors (Suartana, 2007).

Given the results of the studies conducted, investment decisions and psychological factors still require considerable attention from future researchers, who should employ quantitative, qualitative, and experimental approaches. For example, Glaser and Weber (2007) suggest that further research can re-examine the overconfidence bias variable, which is the most widely used independent variable in this reference, along with other variables such as Herding bias, Herding behaviour, Financial literacy, and Behavioural bias. In addition, regarding research methods, it can follow Field and Hole's (2003) suggestions by using experimental or mixed-methods approaches to obtain stronger causal evidence, especially when measuring the direct influence of overconfidence and other psychological variables on decision-making. Development can also be facilitated by using moderating variables. Of the 46 cited studies, financial literacy is the most prevalent, since persons possessing strong financial acumen are generally

more adept at managing the effects of psychological bias (Lusardi & Mitchell, 2014; Rahayu et al., 2021). In addition, self-control is also considered important because it can restrain impulsive urges in speculative decision-making (Tangney et al., 2004; Pompian, 2012). Risk tolerance is a crucial component, suggesting that persons with elevated risk tolerance are more susceptible to overconfidence (Grable, 2000; Kannadhasan, 2015).

To strengthen the urgency of this research, the development of the Integrated Accounting-Cognitive Bias Model (IACB Model) can be proposed as a theoretical novelty that positions accounting information not merely as input data, but as a primary "cognitive stimulus." This model conceptualises the relationship between financial statement structures, such as footnote complexity and earnings volatility, with specific bias triggers such as anchoring and information overload. By providing a formal name and a clear diagrammatic framework, this research not only contributes to the descriptive literature but also offers a new paradigm in behavioural accounting that explains how financial information architecture can be modified to mitigate investors' cognitive distortions.

6. Conclusion

Research on investment decisions involving psychological factors remains highly relevant and interesting because they are not solely influenced by rational or economic information but also by psychological factors such as emotions, risk perception, and cognitive biases. A review of 46 articles published from 2007 to 2025, as well as research published prior to 2000, was conducted to identify early articles on investment decisions influenced by psychological factors that could inform future research. This review was conducted to evaluate and provide an overview of research on investment decisions influenced by psychological factors. Based on the review results, quantitative research using survey methods was the most popular research approach among researchers. Furthermore, among the primary theories, Behavioural Finance Theory was the most widely used, followed by Prospect Theory and the Theory of Planned Behaviour. In terms of variables, overconfidence bias was the most frequently chosen variable, followed by herding bias and herding behaviour. Related to variable selection, some researchers also use moderating variables such as financial literacy, cognitive biases, overconfidence bias, financial risk tolerance, and risk perception. Based on research location, Asia, particularly Indonesia, is the most frequently referenced research location.

The literature review supports behavioural finance theory, emphasising cognitive biases such as overconfidence and herding that challenge the rationality assumptions of traditional finance. Empirical data underscores the need for a theoretical model that integrates psychological heuristics, the presentation of accounting information, and market dynamics. This fresh theory views financial statements as skewed cognitive triggers, accounting for asset price anomalies and irrational trading actions. Financial literacy serves as an essential moderator, suggesting that models should incorporate cognitive skills to improve predictions of investor behaviour. Theoretically, this study redefines accounting information as a cognitive anchor that actively shapes the boundaries of investor rationality, going beyond the traditional view of it as merely passive data. These findings contribute to the evolution of behavioural finance theory by proposing that the accounting conceptual framework should integrate psychological mechanisms to explain persistent market anomalies. Thus, this study challenges the classical utility model and encourages a paradigm shift toward a more holistic "behavioural accounting" approach to predicting investment decision-making dynamics in the digital information age. In practical terms, the results assist regulators in creating financial disclosures that account for biases and prompt capital market participants to promote investor education about cognitive biases. For individual investors, the analysis emphasises systematic decision-making and the application of checklists to mitigate overconfidence. Furthermore, research from developing markets such as Indonesia underscores the need for customised instruments that align with local investor behaviour, with the goal of stabilising markets and minimising losses from irrational investment decisions. This review certainly has limitations. First, the article collection relied solely on Publish or Perish and Google Scholar to track used and unpaid articles, potentially leaving other articles unanalysed. Second, the article review relied solely on manual mapping in Excel, without using analysis tools such as NVivo or bibliometrics. This, due to limited user understanding, potentially introduced bias in data collection.

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What Makes Consumers Choose Refurbished Digital Products? A Fuzzy AHP-Based Prioritisation of Key Adoption Dimensions

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A b s t r a c t

The rapid growth in digital consumption has intensified the challenge of electronic waste (e-waste), underscoring the need for sustainable alternatives, such as refurbishment. Refurbished digital products extend product lifecycles, reduce environmental impact, and offer affordable access to technology. However, consumer adoption remains limited due to perceived risks and trust issues. This study identifies the critical dimensions influencing consumers' intention to purchase refurbished digital products using an extensive literature review and expert evaluation. A total of 7 key dimensions were identified, namely value consciousness, retailer's reputation, discount attractiveness, warranty assurance, green consumption value, product aesthetics, and perceived risk. Further, the study prioritises the identified dimensions using the Fuzzy Analytic Hierarchy Process. The results revealed *value consciousness* as the most influential factor, followed by *retailer's reputation* and *discount attractiveness*, underscoring the dominance of economic and trust-related motivations over environmental or aesthetic considerations. These results suggest that businesses should strategically emphasise competitive pricing, credible retail channels, and transparent value communication to enhance consumer confidence in refurbished products. Additionally, policymakers can promote adoption by strengthening quality assurance standards and awareness of sustainability benefits. The study contributes to consumer behaviour and circular economy literature by offering a structured prioritisation framework that integrates behavioural insights with multi-criteria decision-making.

Keywords: *Refurbished digital products, Consumer purchase intention, Fuzzy Analytic Hierarchy Process, Prioritisation, Circular Economy, Sustainable consumption*

1. Introduction

The escalating consumption of digital products such as smartphones, laptops, and tablets has led to an unprecedented surge in electronic waste (e-waste) generation worldwide (Kumar et al., 2024; Awasthi et al., 2025). The rapid pace of technological advancement and frequent product launches encourage consumers to upgrade to newer models more often, even when their existing devices are still functional (Kapoor et al., 2021; 2022a). As a result, a significant volume of digital products is prematurely discarded, creating severe environmental challenges, including land pollution, toxic chemical leaching, and resource depletion (Baldé et al., 2017). The *Global E-waste Monitor (2020)* highlights that worldwide e-waste amounted to 53.6 million metric tonnes in 2019, with formal collection and recycling accounting for merely 17.4%, and forecasts indicate a rise to 74.7 million metric tonnes by 2030. (Forti et al., 2020). Refurbishment of digital electronic goods, defined as the process of restoring used, returned, or damaged products to a fully functional state for resale, has emerged as a key strategy within the circular economy framework (Nasiri & Shokouhyar, 2021; Joshi & Nikhade, 2024). It not only helps minimise environmental harm by extending product lifecycles but also addresses affordability concerns by offering consumers high-quality devices at lower prices (Khan et al., 2025; Su et al., 2025). Moreover, refurbished products help reduce pressure on natural resources by lowering demand for virgin materials and the energy used to manufacture new devices (Bigliardi et al., 2022; Sadanand, 2025). In recent years, the refurbished digital product market has experienced remarkable growth, driven by rising consumer awareness of sustainability, increased digital penetration, and the proliferation of e-commerce platforms specialising in refurbished goods. According to Counterpoint Research (2023), the global refurbished smartphone market grew by 5% in 2022, reaching approximately 282 million units. Emerging economies, particularly India, have played a pivotal role in this expansion due to a price-sensitive consumer base and rapidly expanding internet access (Seifian et al., 2024; Sharma & Jayswal, 2025). Additionally, government initiatives such as India's "Digital India" program and circular economy roadmaps have further encouraged sustainable consumption and the reuse of digital products (Dhiman et al., 2024; Shukla et al., 2024). E-commerce platforms and large technology firms are increasingly formalising refurbishment operations to assure quality and build consumer trust. For example, Apple and Samsung have introduced certified refurbished product lines, while Indian platforms like Amazon Renewed and

Cashify have witnessed a surge in consumer engagement. Moreover, the growing emphasis on environmental responsibility has led to the integration of green marketing strategies and quality certifications to improve consumer confidence in refurbished products (Abbey et al., 2017; Confente et al., 2021). Despite this positive momentum, consumer perceptions of product quality, risk, and value continue to significantly shape market performance.

Although the refurbished product market has been expanding rapidly, scholarly research on consumers' intention to purchase refurbished digital products remains fragmented and limited. Existing studies have primarily focused on environmental benefits, product recovery mechanisms, and supply chain operations (Han et al., 2020; Abbasi et al., 2022; Russell & Nasr, 2023; Li et al., 2025). Research examining consumer adoption has predominantly emphasised isolated factors, such as price sensitivity, perceived risk, and environmental concern, without systematically identifying the key dimensions that influence consumers' purchase intentions.

Furthermore, most empirical studies have been conducted in developed economies, leaving a contextual gap in understanding consumer behaviour in emerging markets such as India, where socio-economic, cultural and technological conditions differ significantly. Another important gap lies in the lack of prioritisation of critical factors influencing consumer purchase intention. Consumer perceptions regarding refurbished digital products are often subjective and involve uncertainty, making traditional evaluation approaches insufficient. To address this, the present study adopts the Fuzzy Analytic Hierarchy Process. This multi-criteria decision-making technique integrates fuzzy logic with hierarchical structuring to handle ambiguity and imprecision in human judgment. This approach enables a more robust and realistic prioritisation of factors influencing consumer purchase intention, thereby offering deeper insights for both theory and practice. Accordingly, this study adopts a structured multi-criteria decision-making framework to systematically identify and prioritise the key dimensions influencing consumer purchase intention toward refurbished digital products.

In light of the above gaps, this study aims to:

1. Identify the critical dimensions influencing consumers' intention to purchase refurbished digital products, based on an extensive review of the existing literature.
2. Prioritise the identified critical dimensions using a structured multi-criteria decision-making approach, namely the fuzzy Analytic Hierarchy Process.

This study makes several significant contributions to the existing body of knowledge. First, it addresses the fragmented literature by systematically identifying and prioritising key dimensions that influence consumers' intention to purchase refurbished digital products, providing a more structured understanding of the phenomenon. Second, by focusing on the Indian market, the study fills a critical contextual gap, offering insights that reflect the unique economic, cultural and technological dynamics of an emerging economy. Third, the application of a prioritisation technique bridges the gap between theoretical identification of factors and their practical relevance, enabling policymakers, marketers and other stakeholders to make evidence-based strategic decisions. Finally, by examining consumer behaviour in the refurbished digital product market, the study contributes to the broader discourse on circular economy and sustainable consumption, positioning consumer intention as a key lever for advancing sustainable market practices.

The chapter proceeds in a structured manner. Section 2 provides a detailed review of prior research on consumer adoption of refurbished digital products and highlights the critical dimensions shaping purchase intentions. Section 3 presents the methodological framework, followed by Section 4, which discusses the data collection process and the techniques used to prioritise the identified dimensions. Section 5 discusses the results, while Section 6 emphasises the study's theoretical contribution. Section 7 highlights practical implications. Section 8 concludes the study, and Section 9 presents limitations and avenues for future research.

2. Literature Review

2.1 Identification of critical dimensions influencing consumers' intention to purchase refurbished digital products

The identification of critical dimensions influencing consumers' intention to purchase refurbished digital products was grounded in a comprehensive review of prior literature. For this purpose, scholarly articles were sourced from leading academic databases, including Emerald Insight, Wiley, ScienceDirect, Sage, Taylor & Francis, and Springer. A structured and systematic search strategy was employed to retrieve relevant studies. The search string combined key terms as follows: “(‘adopt*’ OR ‘accept*’) AND (‘critical’ OR ‘key’) AND (‘drivers’ OR ‘factors’ OR ‘dimensions’) AND (‘refurbish’ OR ‘remanufacture’) AND (‘digital’ OR ‘electronic’) AND (‘product’).” The initial

search yielded a broad corpus of studies. Subsequently, publications such as opinion pieces, pilot studies, conference proceedings, grey literature, non-English articles, editorials, discussion papers and commentaries were excluded to enhance the quality and relevance of the dataset. This filtering process resulted in a preliminary pool of 404 peer-reviewed articles. Further refinement was carried out using the “Tollgate Approach” (Afzal et al., 2009; Kapoor et al., 2024a), as illustrated in Figure 1.

In the first stage, titles and abstracts were screened, resulting in the removal of 293 articles that did not primarily focus on consumer purchase behaviour of refurbished digital products. The remaining 111 studies were then evaluated based on their introductions and conclusions, and 42 articles were excluded for failing to align with the objectives of the present study. The final screening involved a detailed full-text review of 69 articles to identify high-quality research characterised by well-defined problem statements, sound methodological designs, rigorous data analysis, and clearly articulated results. This step led to the exclusion of eight additional studies, yielding a final sample of 61 articles. These selected articles were examined in depth to extract the key dimensions influencing consumers' purchase intention toward refurbished digital products. The identified drivers were subsequently discussed with an academic expert, and through detailed deliberation, seven critical dimensions were finalised. These proposed dimensions are depicted in Figure 2 and are briefly explained in the following section.

2.1.1 Value Consciousness

Value consciousness reflects a consumer's concern about paying a lower price for a product's perceived quality (Lichtenstein et al., 1990). Consumers with high value consciousness seek the best trade-off between quality and price and are more inclined to consider refurbished products, as these offer functional benefits at reduced costs (Wang & Kuah, 2018). Prior studies have shown that value-conscious consumers are motivated by the perceived economic advantage of refurbished electronics compared to new ones (Wallner et al., 2024; Alam et al., 2025). Such consumers evaluate refurbished products through a cost-benefit lens, in which the utility of acceptable quality at a lower price increases purchase intention.

2.1.2 Discount Attractiveness

Discount attractiveness refers to the perceived appeal and persuasive power of promotional price reductions

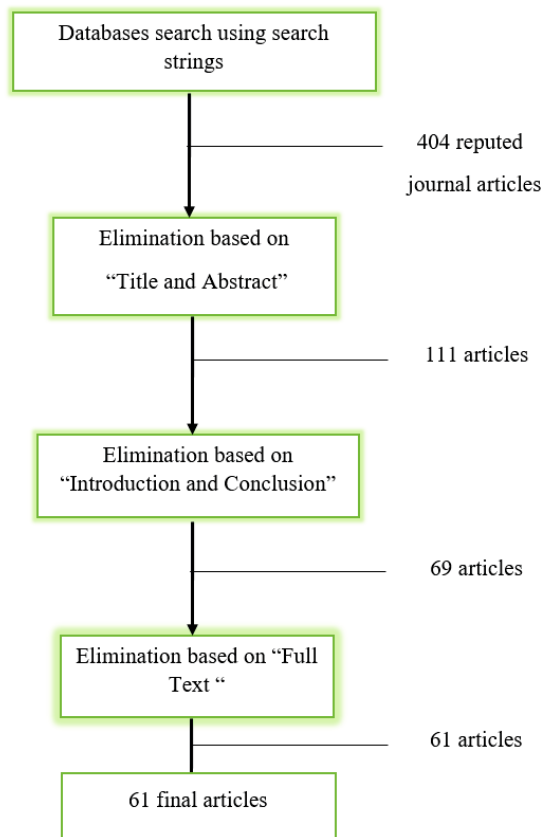


Figure 1. Tollgate approach

(Singhal et al., 2019). In the context of refurbished digital products, discounts often play a decisive role in drawing attention and mitigating initial hesitation. Attractive discounts can enhance perceived value and trigger both impulse and planned purchases (Kapoor et al., 2022b). Studies indicate that consumers perceive discounted refurbished products as “smart buys,” leading to higher purchase intentions when discounts are framed clearly and credibly (Zhang et al., 2025).

2.1.3 Retailer's Reputation

Retailers' reputations signal reliability, authenticity, and post-purchase support, all of which are crucial in the refurbished product market, where product quality uncertainty is high (Agostini et al., 2021). A well-established retailer can build trust through transparent processes, certifications, and high-quality customer service.



Figure 2. Critical dimensions influencing consumers' intention to purchase refurbished digital products

Empirical evidence suggests that trusted platforms and certified refurbishers positively influence consumers' willingness to buy refurbished electronics by reducing information asymmetry and perceived risk (Sharifi & Shokouhyar, 2021; Barkhi et al., 2024).

2.1.4 Warranty Assurance

Warranty assurance serves as a quality signal that addresses consumers' concerns about product performance and reliability (Alyahya et al., 2023). Providing warranties on refurbished digital products instils confidence that any post-purchase issues will be resolved, thereby mitigating perceived functional and financial risks. Several studies have confirmed that the availability of warranties significantly enhances consumer trust and increases their intention to purchase refurbished products (Ghosh et al., 2023; Wallner et al., 2024).

2.1.5 Perceived Risk

Perceived risk encompasses the consumer's subjective expectations of potential losses associated with a purchase (Van Weelden et al., 2016). In refurbished products, perceived risks may be functional (performance failures), financial (wasted money), and social (negative image). High perceived risk has been consistently found to deter purchase intentions for refurbished products (Zhang & Luo, 2021). Conversely, mechanisms such as clear return policies, warranties, and trustworthy retailers can mitigate these risks and encourage adoption (Kapoor et al., 2023, 2024 b).

2.1.6 Green Consumption Value

Green consumption value reflects the extent to which a consumer considers environmental consequences when making purchasing decisions (Haws et al., 2014). Refurbished products align strongly with sustainability goals by extending product lifecycles and reducing e-waste (Zhang et al., 2025). Environmentally conscious consumers view refurbished digital products as a means of practising eco-friendly consumption, which positively affects their purchase intentions (Bailey et al., 2018; Yan et al., 2021). This dimension is becoming increasingly influential as consumer awareness of environmental issues rises.

2.1.7 Product Aesthetics

Product aesthetics refer to the visual appeal, design, and overall physical appearance of a product (Kapoor et al., 2024c, 2025a, b). Even in refurbished products, aesthetics plays a role in consumer evaluations, as cosmetic conditions influence perceived quality and desirability (Wallner et al., 2024). Consumers may reject otherwise functional refurbished products if they exhibit visible wear or lack visual appeal. Therefore, maintaining or enhancing the aesthetic quality of refurbished electronics can significantly increase their market acceptance (Hazen et al., 2017).

2.2 Theoretical Support

Consumer adoption of refurbished digital products can be understood through established behavioural and technology adoption theories. The Theory of Planned Behaviour (TPB) suggests that behavioural intention is influenced by attitudes, subjective norms, and perceived behavioural control, which, in this context, relate to consumers' evaluations of product value, perceived risk, and trust in sellers. Similarly, the Technology Acceptance Model (TAM)

highlights perceived usefulness and perceived ease of use as key determinants of adoption, which can be extended to refurbished products in terms of functional value and usability. Additionally, perceived risk theory explains consumers' hesitation toward refurbished products, driven by uncertainty about product quality and reliability. At the same time, value-based adoption models emphasise the role of economic benefits, such as price advantage and value consciousness, in shaping purchase decisions. Furthermore, the concept of green consumption behaviour supports the inclusion of environmental considerations as a motivating factor. Drawing on these theoretical perspectives, the present study identifies and prioritises key dimensions influencing consumer purchase intention toward refurbished digital products.

3. Research Methodology

3.1 Fuzzy AHP

The Fuzzy Analytic Hierarchy Process (Fuzzy AHP) is an extension of the traditional AHP that incorporates fuzzy logic to handle the vagueness and uncertainty inherent in human judgment. Unlike conventional AHP, which uses precise numerical values, Fuzzy AHP employs triangular fuzzy numbers to better capture subjective preferences. This makes it particularly suitable for decision-making contexts involving qualitative assessments, such as consumer perception studies. This approach breaks down complex decisions involving multiple criteria into a hierarchy (Saaty, 1980; Panchal & Shrivastava, 2022). It allows decision-makers to rank alternatives and select the best (Lentswe & Molwalefhe, 2020; Liu et al., 2020; Ekmekcioğlu et al., 2021). This approach has been widely employed by researchers globally for selecting alternatives, allocating resources, prioritising barriers and performing cost-benefit analysis (Achu et al., 2020; Das, 2020; Zabihi et al., 2020). Although the analytic hierarchy process is less effective at reducing inherent ambiguity and imprecision when mapping decision-makers' perspectives to precise numbers (Guo et al., 2020; Yariyan et al., 2020; Ponsiglione et al., 2022). Thus, fuzzy logic has been used to address data ambiguity. Fuzzy set theory was developed by Zadeh in 1965 (Kaur et al., 2020; Gündoğdu et al., 2021; Pande et al., 2021). It aims to select a limited set of options by evaluating predefined criteria. A linguistic variable is "a variable whose values are presented in natural language words" (Zadeh, 1965; Arshad et al., 2020; Waqus et al., 2021). "Fuzzy Weight," for instance, is a linguistic variable having values of "Very High," "High," "Medium," "Low",, "Very

Table 1. Fuzzy pairwise linguistic scale

“Linguistic Scale”	“Inverse of Fuzzy AHP Scale”	“AHP Scale”	“TFN (l, m, u)”
“Equally Important”	“(1, 1, 1)”	“1”	“(1, 1, 1)”
“Weakly Important”	“(1/4, 1/3, 1/2)”	“3”	“(2, 3, 4)”
“Fairly Important”	“(1/6, 1/5, 1/4)”	“5”	“(4, 5, 6)”
“Strongly Important”	“(1/8, 1/7, 1/6)”	“7”	“(6, 7, 8)”
“Absolutely Important”	“(1/9, 1/9, 1/9)”	“9”	“(9, 9, 9)”
“The intermittent values between two adjacent scales”	“(1/3, 1/2, 1)”	“2”	“(1, 2, 3)”
	“(1/5, 1/4, 1/3)”	“4”	“(3, 4, 5)”
	“(1/7, 1/6, 1/5)”	“6”	“(5, 6, 7)”
	“(1/9, 1/8, 1/7)”	“8”	“(7, 8, 9)”

Source: Jain et al. (2022); Kapoor and Sindwani (2025)

Low”, etc. In the present study, linguistic variables were defined using a triangular fuzzy scale (TFS). It has been exhibited in Table 1. It has been utilised for analysing criteria. Membership function $\mu_{\tilde{A}}(x)$ transform component x in X to a real number having a value between 0 and 1 (eq. 1).

$$\mu_{\tilde{A}}(x) = \begin{cases} 0, & x < l \\ \frac{(x-l)}{(m-l)}, & \text{if } l \leq x \leq m \\ \frac{(u-x)}{(u-m)}, & \text{if } m \leq x \leq u \\ 0, & x > u \end{cases} \quad (1)$$

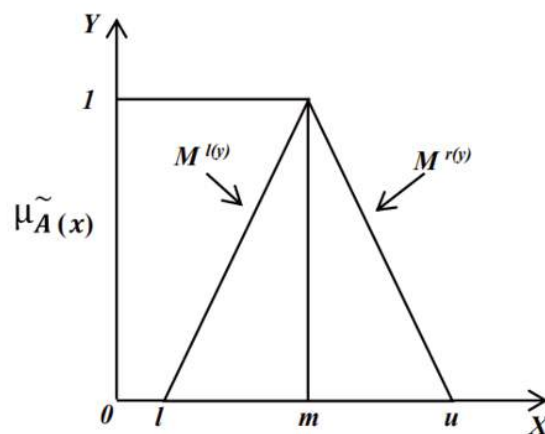


Figure 1. Triangular fuzzy number

The identified dimensions influencing consumers' intention to purchase refurbished digital products must be prioritised. The following steps are employed to prioritise the identified inhibitors (Sood et al., 2023).

Step 1: Linguistic terms, as shown in Table 1, are used to create a pairwise comparison matrix for the identified criteria (eq. 2 and 3).

$$\tilde{P} = \begin{bmatrix} 1 & \tilde{a}_{12} & \dots & \tilde{a}_{1n} \\ \vdots & 1 & \ddots & \vdots \\ \tilde{a}_{31} & \tilde{a}_{32} & 1 & \tilde{a}_{3n} \\ \tilde{a}_{n1} & \tilde{a}_{n2} & \dots & 1 \end{bmatrix} = \begin{bmatrix} 1 & \tilde{a}_{12} & \dots & \tilde{a}_{1n} \\ \vdots & 1 & \ddots & \vdots \\ \frac{1}{\tilde{a}_{31}} & \frac{1}{\tilde{a}_{32}} & 1 & \tilde{a}_{3n} \\ \frac{1}{\tilde{a}_{n1}} & \frac{1}{\tilde{a}_{n2}} & \dots & 1 \end{bmatrix} \quad (2)$$

$$\tilde{a}_{ij} = \left. \begin{cases} \tilde{1}, \tilde{3}, \tilde{5}, \tilde{7}, \tilde{9} \text{Criteria 'i' is of relative importance to criteria 'j'} \\ li = j \\ \tilde{1}^{-1}, \tilde{3}^{-1}, \tilde{5}^{-1}, \tilde{7}^{-1}, \tilde{9}^{-1} \text{Criteria 'j' is of relative importance to criteria 'i'} \end{cases} \right\} \quad (3)$$

Step 2: The reliability of the decision-makers' preference structure was assessed by computing the consistency index (CI) and consistency ratio (CR) using standard equations, as indicated in Equations (4) and (5). A matrix is deemed consistent if CR is 0.1 or lower, and perfectly consistent if CR is 0 (Saaty, 1980).

$$\text{ConsistencyIndex}(CI) = \frac{\lambda \text{max} - n}{n - 1} \quad (4)$$

Where max/represents "the greatest eigenvalue of the comparison matrix" and n exhibits "its component". CR calculated as follows:

$$\text{ConsistencyRatio}(CR) = \frac{CI}{RI} \quad (5)$$

where "CI= Consistency Index"
 "RI= random Index"

Step 3: To synthesise the evaluations provided by multiple experts, their judgments were combined using the geometric mean approach, as shown in Equations (6) and (7).

$$l_{ij} = \left(\prod_{k=1}^k l_{ijk} \right)^{1/k}, m_{ij} = \left(\prod_{k=1}^k m_{ijk} \right)^{1/k}, u_{ij} = \left(\prod_{k=1}^k u_{ijk} \right)^{1/k} \quad (6)$$

$$\tilde{r}_i = (\tilde{a}_{i1} * \tilde{a}_{i2} * \tilde{a}_{i3} * \dots * \tilde{a}_{in})^{1/n} \quad (7)$$

Step 4: The fuzzy weight corresponding to each criterion is derived using Equation

$$\tilde{w}_i = \tilde{r}_i * (\tilde{r}_1 + \tilde{r}_2 + \tilde{r}_3 + \dots + \tilde{r}_n)^{-1} \quad (8)$$

\tilde{w}_i exhibit "fuzzy weights of identified criterion."
 "Where represents lower fuzzy weight, represents middle fuzzy weight and represents fuzzy weight's upper value".

Step 5: To derive the best non-fuzzy performance outcome, the centre-of-area approach was employed. (Eq. 9)

$$w_i = \frac{(u_{wi} - l_{wi})}{3} + \frac{(m_{wi} - l_{wi})}{3} + l_{wi} \quad (9)$$

Step 6: Matrix iw was converted into a matrix N iw to normalise iw the matrix (Eq. 10)

$$Nw_i = \frac{w_i}{\sum_{i=1}^n w_i} \quad (10)$$

Table 2 presents the pairwise comparison matrix of the identified inhibitors, while Table 3 reports the corresponding normalised criterion weights.

4. Analysis

The identified critical dimensions influencing consumers' intention to purchase refurbished digital products were weighted using fuzzy AHP. A total of five domain experts, comprising three academicians and two industry professionals, were carefully selected. The inclusion criteria were designed to ensure domain relevance. Each expert possessed a minimum of ten years of professional experience in academia or industry related to consumer behaviour, e-commerce and refurbished digital product markets. Academic experts were identified based on their scholarly publications and teaching experience in consumer behaviour, whereas industry experts were selected for their managerial roles and active involvement in refurbished digital products. Experts were approached through professional networks, LinkedIn groups, and academic associations, and their participation was voluntary and obtained with informed consent. This purposive selection strategy ensured that all experts could provide informed, experience-based and contextually rich evaluations of proposed factors (Kapoor et al., 2026a, b). Experts evaluated proposed dimensions using triangular fuzzy scales (TFS), as shown in Table 1. Based on these responses, aggregated pairwise comparison matrices were developed to capture the relative importance of each criterion with respect to the others, which are reported in Table 2. The outcomes of the fuzzy AHP analysis are summarised in Table 3, presenting the derived priority weights, rankings, and consistency ratio (CR) values for all criteria. The results indicate that higher weight values

correspond to greater relative importance among the proposed dimensions. Accordingly, the dimensions were ranked in the following order: value consciousness, retailer's reputation, discount attractiveness, warranty assurance, green consumption value, product aesthetics and

perceived risk. Furthermore, the calculated CR values for all dimensions were below the acceptable threshold of 0.10, confirming the consistency and reliability of the expert judgments.

Table 2. Fuzzy pairwise judgment matrix of critical dimensions influencing consumers' intention to purchase refurbished digital products

Main Criteria	Value Consciousness	Discount Attractiveness	Retailer's Reputation	Warranty Assurance	Perceived Risk	Green Consumption Value	Product Aesthetics
Value Consciousness	(1.0000,1.0000, 1.0000)	(3.5652, 4.5731, 5.5780)	2,3,4	3,4,5	(6.3816,7.38 41,8.3859)	2,3,4	3,4,5
Discount Attractiveness	0.1814, 0.2187, 0.2794	(1.0000,1.00 00,1.0000)	1,2,3	2,3,4	4,5,6	1,2,3	2,3,4
Retailer's Reputation	0.25,0.33, 0.50	0.33,0.50, 1	(1.0000,1.00 00,1.0000)	2,3,4	4,5,6	3,4,5	4,5,6
Warranty Assurance	0.20,0.25,0.33	0.25, 0.33, 0.50	0.25,0.33,0.5 0	(1.0000,1.00 00,1.0000)	1,2,3	2,3,4	1,2,3
Perceived Risk	0.1159, 0.1359, 0.1573	0.17, 0.20, 0.25	0.17,0.20,0.2 5	0.33,0.50,1	(1.0000,1.00 00,1.0000)	0.1573,0.1 874,0.2287	0.2287,0.29 53,0.4234
Green Consumption Value	0.25, 0.33, 0.5	0.33, 0.50, 1	0.20, 0.25,0.33	0.25,0.33,0.5 0	4.3734,5.378 3,6.3816	(1.0000,1.0 000,1.000)	2,3,4
Product Aesthetics	0.20, 0.25, 0.33	0.25, 0.33, 0.50	0.17,0.20,0.2 5	0.33, 0.50,1	2.3522,3.365 9,4.3734	0.25,0.33,0 .50	(1.0000,1.00 00,1.0000)

Source: The Authors

Table 3. Normalised weights and ranking of critical dimensions influencing consumers' intention to purchase refurbished digital products

Critical Dimensions	Normalised weights of the dimensions	Ranking
Value Consciousness	0.3539	1
Discount Attractiveness	0.1803	3
Retailer's Reputation	0.1923	2
Warranty Assurance	0.0938	4
Perceived Risk	0.0314	7
Green Consumption Value	0.0906	5
Product Aesthetics	0.0578	6

CR= 0.097. 0.097 < 0.10

Source: The Authors

The prioritisation results indicate that consumer purchase intention toward refurbished digital products is primarily influenced by economic and trust-related factors. Dimensions such as value consciousness and retailer's reputation play a crucial role in shaping consumer confidence and perceived value, thereby directly impacting purchase decisions. In contrast, factors related to sustainability and aesthetics exhibit comparatively lower influence, suggesting that functional and financial considerations dominate consumer evaluation in this context.

5. Discussion

The fuzzy Analytic Hierarchy Process (AHP) results reveal critical insights into the factors influencing consumers' intention to purchase refurbished digital products. Among the seven identified dimensions, value consciousness emerged as the most significant determinant, followed by retailer's reputation, discount attractiveness, warranty assurance, green consumption value, product aesthetics and perceived risk. This ranking structure reflects both the economic and psychological considerations that shape consumer decision-making in the refurbished digital product market, particularly within the Indian context.

The prominence of value consciousness underscores the decisive role of perceived economic benefit in shaping purchase intentions. Consumers in emerging markets such as India are typically price-sensitive and actively seek optimal trade-offs between quality and affordability (Wang & Kuah, 2018). Refurbished digital products offer functional equivalence at a significantly reduced cost, making them an attractive option for value-conscious consumers (Wallner et al., 2024; Alam et al., 2025). This finding is consistent with prior research indicating that economic considerations often outweigh other evaluative criteria in consumer decision-making for refurbished or remanufactured goods (Lichtenstein et al., 1990).

The retailer's reputation ranked second, highlighting the importance of trust and credibility in a market where product quality is uncertain. In the refurbished product segment, consumers often rely on reputational signals to mitigate perceived risks associated with product performance and post-purchase support (Agostini et al., 2021; Sharifi & Shokouhyar, 2021). Well-established retailers and certified refurbishment programs (e.g., Apple Certified Refurbished, Amazon Renewed) offer consumers a sense of assurance, thereby fostering purchase intention. This result aligns with studies indicating that brand or retailer credibility serves as a

surrogate for quality assessment in contexts where product inspection is difficult prior to purchase (Barkhi et al., 2024).

The third-ranked factor, discount attractiveness, further reinforces the economic motivations underlying consumer choices. Prior literature has shown that price promotions and discounts act as powerful persuasive tools that can both trigger impulse purchases and enhance perceived value (Singhal et al., 2019; Kapoor et al., 2022b). For refurbished products, attractive discounts may compensate for the lack of novelty and help overcome initial hesitation (Zhang et al., 2025).

Warranty assurance ranked fourth, indicating that while quality guarantees are important, they are secondary to value and trust considerations in the Indian context. Previous research has emphasised that warranties function as quality signals that reduce perceived functional and financial risks (Ghosh et al., 2023; Alyahya et al., 2023). Similarly, green consumption value, ranked fifth, suggests that environmental motivations are gaining importance but remain less influential than economic factors. Although studies have found that environmentally conscious consumers view refurbished products as eco-friendly alternatives (Haws et al., 2014; Yan et al., 2021), such motivations may still be secondary in price-sensitive markets (Bailey et al., 2018).

Interestingly, product aesthetics ranked sixth, indicating that while cosmetic appeal influences evaluations, it is not a primary driver. Consumers may be willing to compromise on minor aesthetic imperfections if economic benefits and trust factors are strong (Hazen et al., 2017). Finally, perceived risk ranked lowest, which may reflect growing consumer confidence in structured refurbishment programs, transparent return policies, and warranties that effectively mitigate traditional concerns (Van Weelden et al., 2016; Zhang & Luo, 2021).

Overall, these findings suggest that in emerging economies like India, economic value and trust-related factors outweigh environmental or aesthetic considerations in influencing consumer intentions. This contrasts slightly with some studies in developed economies, where green consumption values play a more central role (Wallner et al., 2024). The results highlight the need for marketers and policymakers to emphasise price-value propositions, trust-building through certified refurbishments, and strategic discounting, while simultaneously cultivating environmental awareness to support long-term sustainable consumption patterns.

6. Theoretical Contribution

This study makes several noteworthy theoretical contributions to the literature on consumer behaviour and sustainable consumption in the context of refurbished digital products. First, by systematically identifying seven critical dimensions—value consciousness, retailer's reputation, discount attractiveness, warranty assurance, green consumption value, product aesthetics, and perceived risk—this research provides a comprehensive, structured framework that advances the fragmented body of knowledge on consumer purchase intentions for refurbished products. While prior studies have often examined isolated factors such as price sensitivity or environmental concerns, this study integrates multiple economic, psychological, and environmental dimensions, thereby offering a holistic theoretical understanding.

Second, the application of the fuzzy Analytic Hierarchy Process (AHP) adds methodological rigour to consumer behaviour research by moving beyond mere identification of factors toward systematic prioritisation. This approach enables the relative importance of each dimension to be quantified, bridging the gap between theoretical constructs and their practical salience.

Third, by focusing on the Indian market, this study extends the applicability of existing theories of consumer adoption—often developed in Western contexts—to emerging economies, where socio-economic and cultural dynamics significantly shape consumer behaviour. This contextual contribution enriches the global literature by highlighting how value-oriented and trust-related factors dominate environmental and aesthetic considerations in price-sensitive markets. Overall, the study contributes a contextually grounded, methodologically robust, and theoretically integrated perspective to the growing discourse on circular economy and refurbished product adoption.

7. Practical Implication

The findings of this study offer several actionable implications for businesses, policymakers, and marketers seeking to enhance the adoption of refurbished digital products and promote sustainable consumption patterns, particularly in emerging markets such as India.

First, the prominence of value consciousness as the most critical dimension underscores the need for firms to design compelling value propositions for refurbished digital

products. Businesses should focus on competitive pricing strategies that clearly communicate the cost savings of new products without compromising quality. Highlighting the price–quality trade-off through transparent marketing campaigns can strengthen consumer confidence in refurbished goods. For example, clear product grading systems and side-by-side price comparisons can help value-conscious consumers make informed decisions.

Second, the high ranking of retailers' reputation indicates that trust-building measures are central to influencing consumer adoption. Firms should invest in building strong brand identities and certification mechanisms that signal quality and authenticity. Collaborations with credible third-party refurbishers, adherence to industry standards, and the use of certified refurbished labels (e.g., Amazon Renewed, Apple Certified Refurbished) can significantly reduce perceived uncertainty. Furthermore, e-commerce platforms should ensure transparent product descriptions, verified customer reviews, and responsive post-purchase support to strengthen their reputation and consumer trust.

Third, since discount attractiveness emerged as a key driver, businesses should strategically use price promotions, exchange offers, and seasonal discounts to increase consumer interest and accelerate product movement. However, these promotions should be framed credibly to avoid scepticism. Limited-time offers, bundle deals, or loyalty-based discounts can be particularly effective at attracting first-time buyers and building repeat-purchase behaviour.

Fourth, warranty assurance ranked as an important factor, indicating that quality guarantees and after-sales services are crucial for encouraging adoption. Firms should offer standardised warranties, flexible return policies, and easy replacement procedures to alleviate concerns about product performance and reliability. These measures not only build consumer confidence but also position refurbished products as trustworthy alternatives to new ones.

Fifth, while green consumption value was not the top driver, it still plays a meaningful role, particularly among environmentally conscious segments. Policymakers and businesses can collaborate to strengthen environmental messaging and promote sustainability education to increase awareness about the ecological benefits of refurbished products. Campaigns emphasising the role of refurbishment in reducing e-waste and conserving resources can enhance consumers' environmental self-identity and, in turn, boost

adoption. Incorporating sustainability labels and certifications can further appeal to green consumers.

Sixth, product aesthetics, although lower in ranking, should not be neglected. Firms can enhance cosmetic appeal through professional refurbishment techniques, standardised grading of product conditions, and attractive packaging. Marketing strategies should clearly communicate the product's physical condition to set realistic expectations and avoid disappointment.

Finally, the lowest ranking of perceived risk indicates that current market mechanisms—such as warranties, return policies, and trusted retail platforms—are effectively mitigating consumer concerns. However, businesses must maintain consistency in quality control and service reliability to prevent any erosion of this trust. Policymakers can support these efforts by establishing regulatory frameworks and quality standards that protect consumers and hold refurbishers accountable.

Collectively, these implications highlight that a balanced strategy that focuses on economic value, trust-building, and sustainability communication is essential to boosting the adoption of refurbished digital products. Firms should integrate these elements into their marketing strategies, while policymakers should facilitate supportive ecosystems through standards, certifications, and consumer awareness programs. By doing so, both stakeholders can advance circular economy goals and sustainable digital consumption in emerging economies.

8. Conclusion

The rapid expansion of digital consumption has amplified the urgency of sustainable solutions, with refurbishment emerging as a critical strategy to address environmental challenges while meeting consumer needs. This study systematically identified and prioritised seven critical dimensions influencing consumers' intention to purchase refurbished digital products—value consciousness, retailer's reputation, discount attractiveness, warranty assurance, green consumption value, product aesthetics, and perceived risk—through a rigorous fuzzy Analytic Hierarchy Process (AHP) approach. The findings reveal that economic and trust-based factors—particularly value consciousness and retailer reputation—play a more dominant role than environmental or aesthetic considerations in shaping consumer intentions, especially in price-sensitive markets like India.

Theoretically, this research contributes by integrating fragmented factors into a structured prioritisation framework and extending consumer adoption theories to the context of emerging economies. In practice, the study offers actionable insights for businesses and policymakers to enhance adoption through strategic pricing, trust-building mechanisms, quality assurance, and sustainability communication.

As the refurbished digital product market continues to expand globally, understanding consumer priorities becomes essential for advancing circular economy objectives. By focusing on these critical dimensions, stakeholders can create robust, consumer-centric strategies that not only drive market growth but also support broader environmental sustainability goals. Future research could further examine behavioural dynamics over time, incorporate cross-country comparisons, or explore technological enablers such as AI and blockchain in refurbishment processes, thereby enriching both theoretical and practical understanding of this evolving domain.

9. Limitations and Areas for Future Investigation

While this study provides valuable theoretical and practical insights into consumers' intention to purchase refurbished digital products, certain limitations should be acknowledged to guide future research.

First, the study focused exclusively on the Indian market, which, while offering a rich context for understanding consumer behaviour in emerging economies, may limit the generalizability of the findings to other cultural or economic settings. Consumer priorities may vary significantly in developed economies, where environmental consciousness and product aesthetics may play a more prominent role. Future research should consider cross-country comparative studies to identify similarities and differences across diverse markets.

Second, the study used a fuzzy AHP for prioritisation, which is inherently reliant on expert judgments. Although this approach provides methodological rigour, the subjectivity of expert opinions may influence the weight allocations. Future studies could incorporate alternative multi-criteria decision-making (MCDM) techniques, such as fuzzy DEMATEL, Best-Worst Method (BWM), or hybrid models, to validate the prioritisation results.

Third, this study examined seven critical dimensions identified through an extensive literature review and expert

consultation. While these dimensions capture key drivers, other relevant factors, such as technological trust, peer influence, and digital literacy, may also influence consumer intentions. Future research should expand the framework to include these additional dimensions and examine their relative importance.

Lastly, this study adopted a cross-sectional design, which provides a snapshot of consumer priorities at a specific point in time. Given the rapidly evolving nature of digital consumption and sustainability awareness, longitudinal studies could offer deeper insights into how consumer preferences shift over time. Additionally, future research could integrate behavioural data and experimental designs to validate stated intentions with actual purchasing behaviour.

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Technology Intensity and Returns: An Empirical Study on the Impact of FinTech on Profitability of Indian Banks

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A b s t r a c t

The technological landscape of the global economy has evolved rapidly, particularly with the emergence of artificial intelligence (AI) in the last decade. It plays a decisive role in transforming the banking sector, influencing both profitability and efficiency. In India, its effects on bank profitability remain underexplored. Accordingly, the present study examines the impact of FinTech on the profitability of commercial Indian banks over the period 2015-2024. The study considers a sample of 30 banks and further conducts a size-wise bank profitability analysis. A composite index, derived from Principal Component Analysis (PCA) of ROE, ROA, and NIM, has been used as a proxy for bank profitability. At the same time, RTGS-NEFT transaction values, Debit and Credit card transaction values, and Mobile banking transaction values represent FinTech intensity. Panel regression models are employed, including pooled OLS with bank-clustered robust errors, and are supported by fixed- and random-effects specifications. The findings indicate that mobile banking and card transactions have a positive impact on banking profitability, whereas RTGS-NEFT transaction values have a negative impact. In the size-wise analysis, the large banks emerge as the principal beneficiaries of fintech adoption, followed by mid-sized banks. Small banks, however, exhibit limited gains. These findings highlight the roles of Fintech intensity and bank size in determining the profitability of Indian banks and offer valuable implications for policymakers, regulators, and bank management.

Keywords: *FinTech intensity, Bank profitability, Indian banking sector, Digital transformation, Panel data analysis, Fixed and random effects model*

1. Introduction

Global context

Financial technology (FinTech) has emerged as both a disruptive force and a collaborative partner to traditional commercial banks, quickly transforming the global financial services landscape. FinTech encompasses mobile banking, electronic banking, digital wallets, peer-to-peer payments, blockchain, robo-advisors, and open banking (Schueffel, 2016). FinTech innovations have helped fill financial inclusion gaps by leveraging mobile technologies in emerging economies. On the other hand, in developed economies, Fintech firms have developed innovative business models that challenge market incumbents. (Frost, 2020; Arner et al., 2015). Increased internet penetration, smartphone adoption, and supportive regulatory frameworks created novel opportunities for financial inclusion, cost reduction, and enhanced service delivery, accelerating the global FinTech revolution (Philippon, 2016).

Indian context

In India, initiatives such as the Aadhaar-enabled biometric identity system, the Unified Payments Interface (UPI), and the government's push toward a "Digital India" fuelled the proliferation of FinTech. This led to a surge in digital wallets, mobile banking, electronic banking and real-time payments, placing India among the fastest-growing FinTech markets globally (PwC 2023, EY 2022). The pandemic further acted as a catalyst, pushing both customers and banks toward digital adoption, thereby expanding the reach and scale of FinTech services in the Indian financial ecosystem (RBI, 2022).

FinTech has emerged as a double-sided sword for the banking industry. In the first case, collaboration with Fintech firms and the adoption of digital technologies allow banks to reach distant populations, reduce operational costs, and improve the customer experience. (Vives, 2017). On the other hand, such intense FinTech disruption intensifies competition, possibly eroding traditional revenue streams. Thus, the interaction between banks and FinTech firms is evolving from competition to "cooperation," where collaboration and digital integration play a central role in shaping the future of financial services (Nicoletti, 2017). FinTech's impact on bank profitability is being critically examined. Though such innovations may improve margins through cost reductions and enable new revenue streams, they may pressure profitability through heightened

competition and investment in technological infrastructure (Naceur et al., 2023). Understanding this relationship becomes particularly important in India, where the banking sector faces structural challenges such as rising NPAs, regulatory pressures, and the need for greater efficiency. Gauging how FinTech adoption influences bank profitability provides valuable insights into the resilience and adaptability of financial institutions in a swiftly digitising environment.

The banking sector is the main pillar of any economy. A robust banking system ensures sound fund management and investment, thereby driving the nation's development (Isayas, 2022). The rise of financial technology is a strong force in the global banking landscape, one that traditional financial institutions must take note of, especially in rapidly developing economies like India (Asif et al., 2023). Key players, including regulators, traditional banks, and FinTech firms themselves, are being influenced by FinTech innovations, leading to changes in the financial sector's operational dynamics (Asif et al., 2023). In India, the central bank, i.e., the RBI, is actively supporting the FinTech industry.

Gaps identified

This paper aims to examine the impact of FinTech adoption on the profitability of Indian banks, focusing on both the opportunities and challenges of these technological shifts. This study examines how various FinTech payment modes affect the profitability of Indian banks (ROA, ROE, and NIM). This study will incorporate a robust methodological framework, utilising financial reports from 2015-2024 and data from the Reserve Bank of India, to assess the impact of various FinTech metrics, including mobile banking, NEFT, RTGS, and card payments, on banking profitability indicators. Further, it will examine the mechanisms by which FinTech adoption in banks can improve or reduce the profitability of traditional banking models, given the increased competition and market disruption observed in other economies (Tarawneh, Rehman, et al., 2024). An efficient banking system ensures proper appropriation and management of funds, leading to a secure and robust banking system that promotes economic growth (Tarawneh, Rehman, et al., 2024). New-age innovations such as blockchain, artificial intelligence, big data analytics, and the Internet of Things have revolutionised traditional banking operations by enhancing information transfer, improving data processing speeds, and reducing transaction costs. Banks, backed by these advancements, can offer more

sophisticated and personalised financial services to customers, thereby increasing customer engagement and market share. However, the empirical evidence concerning the impact of Fintech on bank profitability remains divided globally. While some studies suggest a positive impact of FinTech adoption on bank profitability, others share a negative effect, necessitating a detailed examination within the Indian context (Wu & Yuan, 2021).

2. Literature Review

A broad spectrum of technological advancements, including electronic payment systems such as UPI, QR codes, blockchain, AI, and big data analytics, represents Financial Technology (FinTech). It has been a disruptive force in the banking landscape, affecting their profitability (Chhaidar et al., 2023a; Nguyen, 2025). A few fundamental theories explain Fintech's impact, as identified in the literature review. The theories are Transaction cost and Agency theory, which postulate that Fintech reduces transaction, monitoring, and agency costs in banking firms, thereby increasing operational efficiency and profitability (Tarawneh, Abdul-Rahman, et al., 2024; Chhaidar et al., 2023b). The Disruptive Innovation Theory assumes that fintech is a disruptive force, disrupting incumbents' established revenue models and market positions. Banks are forced to strategically innovate in order to maintain profitability in a shifting competitive environment (Tarawneh, Abdul-Rahman, et al., 2024; Berisha & Rayfield, 2025). Lastly, Technology Acceptance and Innovation Theories emphasise the roles of organisational preparedness and stakeholder acceptance in successfully adopting fintech, which, in turn, affect key financial performance (Berisha & Rayfield, 2025).

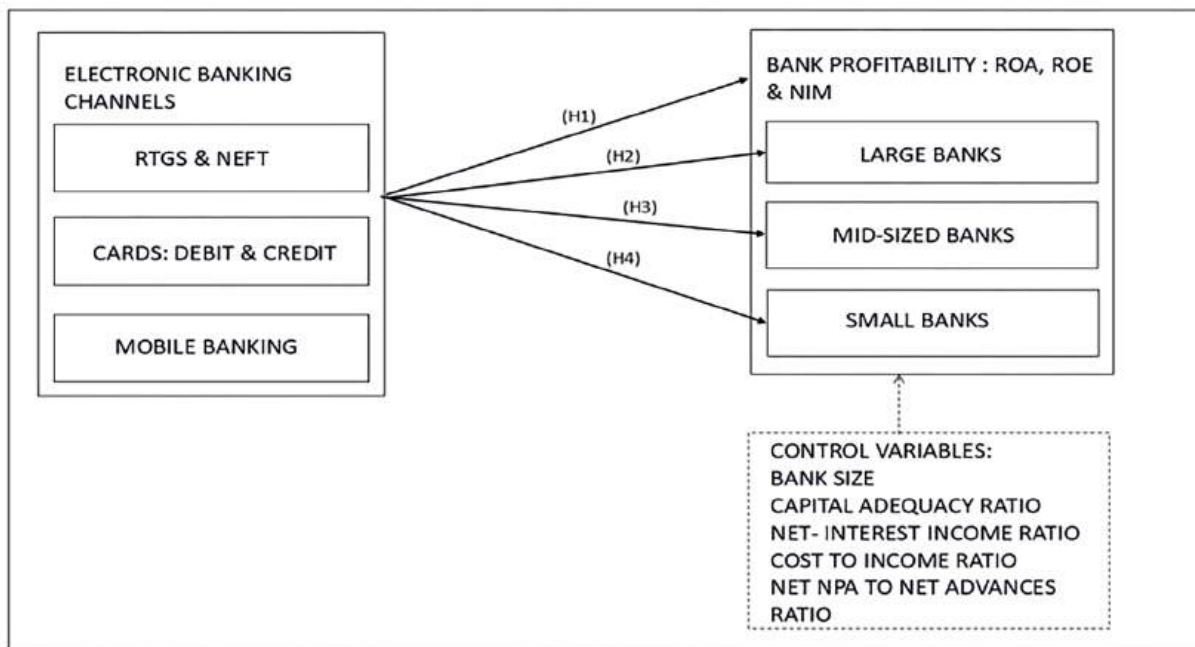
Tarawneh, Abdul-Rahman et al. (2024) highlight the immense potential of fintech to improve bank profitability, with digitalisation, e-payments, mobile banking, and crowdfunding leading the way in terms of efficiency and customer traction. Research also points to major bank-level (size, liquidity, NPLs) and macroeconomic (GDP, inflation) drivers of profitability, giving policymakers a template for creating enabling regulatory systems that promote stability, consumer protection, and the growth of the financial sector. There are various studies attesting to the effective influence of FinTech investments on bank performance. Chhaidar et al. (2023a) found that fintech investments have a positive effect on the profitability of European banks, with larger banks gaining greater benefits from scale economies. Employing cointegrated panel data (2010–2019) and fully

modified OLS, the findings confirm that the impact grew stronger over time, particularly during the COVID-19 era, highlighting fintech's contribution to promoting efficiency and guiding policy towards digital adoption and regulation. This paper analyses the most significant determinants of bank profitability in the EU and US from the post-2008 financial crisis era. It determines that operational efficiency, risk exposure, and diversification are the key drivers of profitability in both markets, with these drivers having higher explanatory power for US banks. The analysis partially supports the bank risk hypothesis as an explanation for higher US bank profitability but cannot account for all the differences. Mijoč et al. (2025) urges further exploration of other variables and, more importantly, the influence of digital transformation and the post-COVID-19 setting on the dynamic determinants of bank profitability.

Specifically, Chhaidar et al. (2023a), an empirical study of European banks for 2010–2019, confirmed that investments in FinTech are positively and strongly related to higher profitability, as measured by return on equity. The study also indicates that this positive relationship was further strengthened for the 2015–2019 period, an indicator of the growing salience of digitalisation for banking functions. Furthermore, bank size also turned out to be an important moderator that facilitates the relationship between digital investment and financial performance. However, Tarawneh, Abdul-Rahman, et al. (2024) surveyed Malaysian banks for 2010–2022 and confirmed that whereas IT investments strengthened net interest margins, the overall nation-level FinTech index—led by ATM dissemination, internet penetration, and mobile adoption—negatively affected main proxies for profitability (ROA, NIM, Tobin's Q) with the increase for system security, infrastructures, and compliance costs. India's payment system reform demonstrates how innovations such as UPI, digital wallets, and mobile banking enable faster payments, greater convenience, and greater inclusivity. The Reserve Bank of India's regulatory regime and initiatives under Digital India and PMJDY led to a rise in digital payments. However, among the problems are cybersecurity and compliance issues, highlighting the need for future studies to examine emerging tech trends in blockchain and DLT, as well as the effectiveness of policies for facilitating a safe and efficient payment system. Mishra et al. (2024); Vora et al. (2021); Venkata Janardhan Rao & Anil Kumar, n.d.; Ovenc & Nabiyevev (2025) examined bank–FinTech collaboration for Türkiye (2013–2021) and

found that these types of collaboration are inferior and mixed for the performance of the commercial bank, with bank size and the performance indicator varying. The larger banks benefited from an increase in the ROE indicator, while the smallest banks experienced no meaningful gain. The study also noted that the rapid growth of fintech services, especially prepaid credit cards, poses competitive challenges by reducing traditional banks' profitability. It recommends that banks—particularly small ones—proactively engage with fintech firms through strategic alliances and digital transformation to remain competitive in the evolving financial landscape. Berisha and Rayfield (2025) studied the banks in Kosovo to examine the impact of internal fintech adoption on profitability, finding mixed results depending on strategic focus. Adoption aimed at improving business opportunities, customer insights, and revenue generation had a positive effect on profitability, while fintech use solely for operational efficiency had a negative impact. Notably, older banks benefited more from fintech adoption than younger ones. The study emphasises that banks should prioritise internal fintech solutions that enhance customer engagement and revenue, rather than focusing only on cost-cutting measures. It highlights the need for supportive regulatory frameworks and continued investment in technology to remain competitive. Despite the

general positive trend, fintech at the systemic or industry-ecosystem level can intensify competition and put pressure on margins. Nguyen (2025), based on data from the Industrial and Commercial Bank of China (ICBC), reveals a U-shaped relationship between fintech proliferation and bank profitability (ROE). Initially, fintech development negatively affects profitability due to technological integration challenges and disruptions to the business model. However, over time, benefits such as reduced transaction costs and improved customer experience lead to enhanced profitability. The study also finds a two-way Granger causality between fintech development and bank profitability and highlights that asset size, net interest margin, and credit risk significantly influence profitability dynamics. Lv et al. (2022) find that fintech development negatively impacts Chinese commercial banks' profitability, as competitive pressures outweigh technological spillovers. The effect is weaker for banks with greater market power and under flexible monetary policies, which help mitigate the impact by enabling increased lending and financial innovation. Mansour (2024) highlights the need for strategic fintech collaboration and supportive regulation, but it is limited by its focus on ROA and ROE and its sole examination of Chinese banks.



Source: Author's compilation

Fig 1. Research Framework

2.1 Research Gap

Prior studies have examined the relationship between fintech adoption and bank profitability globally, but only a few emphasise bank size (Ovenc & Nabiyev, 2025). There is a lack of research focusing especially on Indian banks, especially in a size-wise context. Most studies gauge the overall impact of fintech adoption on bank profitability without segregating banks by size, thereby missing out on potentially significant heterogeneous effects across large, mid-sized, and small banks. Furthermore, while studies from other geographical areas state mixed results—ranging from positive impact (Chhaidar et al., 2023a) to U-shaped or negative effects (Nguyen, 2025; Pham et al., 2023), no all-inclusive study has tested whether these relationships hold in India, where regulatory support (e.g., Digital India, PMJDY) and unique market dynamics may produce different outcomes. This highlights a critical research gap: gauging whether fintech adoption impacts bank profitability differently across bank sizes in the Indian banking sector, particularly given key fintech measures such as mobile banking, NEFT, RTGS, and Cards. The proposed hypotheses (H1–H4) aim to fill this gap by systematically testing both the overall and size-based effects of fintech adoption on bank profitability in India. This is depicted in Figure 1.

H1: No significant relationship exists between Indian banks' fintech adoption and their profitability

H2: No significant relationship exists between large-sized Indian banks' fintech adoption and their profitability

H3: No significant relationship exists between mid-sized Indian banks' fintech adoption and their profitability

H4: No significant relationship exists between small-sized Indian banks' fintech adoption and their profitability

2.2 Research Methodology

In the current study, we have systematically examined the relationship between fintech adoption and bank profitability across Indian banks of different sizes. Secondary data for the decade 2015-2024 have been obtained from RBI data repositories, and a quantitative panel data approach has been employed. This approach allows for the integration of both bank-specific and macroeconomic variables, along with accounting for unobserved heterogeneity across banks and over time. By adopting appropriate econometric techniques, the methodology ensures robust testing of the stated hypotheses, thereby providing credible evidence on the impact of fintech adoption on profitability in the Indian banking sector.

2.3 Sample and Data Source

We used a balanced panel of 300 bank-level observations (30 banks over 10 years: 2014-15 to 2023-24), comprising 18 public-sector banks (PSBs) and 12 domestic private banks (PBs). Of the 98 scheduled commercial banks for 2023-24, our sample banks account for 94% of the deposits in the entire banking sector. During data filtering, 68 banks were excluded either because data for certain variables were unavailable across some years or because they had merged with other banks. Thus, only those banks were retained for which complete data on all variables were available for the entire period under study (2015-2024), resulting in a final sample of 30 banks (Kanoujiya et al., 2023). The data on banks' balance sheets were taken from the Reserve Bank of India's 'Statistical Tables Relating to Banks in India'. Data regarding the transaction values (RTGS, NEFT, DEBIT CARD, CREDIT CARD, Mobile Banking) are taken from the monthly Data Releases by the RBI on its official website. The releases are titled 'Bankwise Volumes in NEFT/RTGS/Mobile Transactions/Internet Banking Transactions' (RBI, 2024c) and Bankwise ATM/PoS/Card Statistics (RBI, 2024a).

2.4 Variables Description

This section discusses the dependent, independent and control variables used in the present study.

Dependent Variables

This study uses bank profitability as the dependent variable. As proxies for bank profitability, we use ROA, ROE, and NIM for each bank (Kebede, 2025; Berisha & Rayfield, 2025; Thakur et al., 2023).

ROA measures the net income generated by the company's total assets during the year. This ratio assesses the firm's performance and effectiveness in engaging the resources to achieve benefits for the future (Gupta et al., 2020). It represents the *firm's operational profitability*.

ROE measures how effectively the company manages the funds shareholders have contributed to the organisation's operations. Basically, it measures the company's profitability relative to shareholders' equity and represents the *firm's capital efficiency* (Gupta et al., 2020).

Net Interest Margin (NIM) is a key measure of a bank's profitability from its *core lending business*. It tells us how much net interest income a bank earns as a percentage of its interest-earning assets (Bennaceur & Goaid, 2008).

These ratios capture overlapping dimensions of a bank's financial performance. To simplify the study, a Principal Component Analysis was conducted upon them, and a single variable was formed and named 'Profitability'. PCA helps reduce multicollinearity while preserving the maximum variance across indicators. A similar interpretation was applied to the independent variables. Thus, PCA was applied to the combined RTGS transaction values, NEFT transaction values, debit card transaction values, and credit card transaction values.

Independent Variables

The present study uses the following as independent variables

- 1) MB_VAL, representing Mobile banking transactions value (Vora et al., 2021; Prasad, 2022)
 - 2) RTGS_NEFT, representing combined RTGS and NEFT transaction values (Shaikh & Anwar, 2023)
 - 3) CARDS, representing combined credit card and debit card transaction values (Mishra et al., 2024)
- Although mobile banking, Real-Time Gross Settlement (RTGS), National Electronic Funds Transfer (NEFT), debit cards, and credit cards all represent electronic channels for monetary transactions, they differ substantially in terms of usability, cost, availability, accessibility, transaction size limits, settlement speed, and purpose of use. In fact, mobile banking is also a delivery channel that integrates multiple services, such as bill payments, card management, and value-added services, as well as NEFT-RTGS transactions and card payments, which are also under study. RTGS and NEFT are primarily fund transfer services, regulated by the Reserve Bank of India (RBI). RTGS enables high-value, real-time transfers, and NEFT supports lower-value, batch-settled transfers on a 24*7 basis. On the other hand, debit and credit cards are primarily designed for retail and merchant transactions, including both point-of-sale (POS) and online payments. Both categories use similar internal usage and security protocols. Due to these overlaps, studies have frequently grouped RTGS and NEFT and considered debit and credit cards as a single category. We analyse mobile banking transaction values separately due to their broader scope, reliance on digital literacy and connectivity, and their significant role in promoting financial inclusion. The perceived security and settlement speed further influence adoption of transaction types (Silambarasi & Maya, 2024; Saroy et al., 2023; Dheyvendhren & K P, 2025)

Normalised Data

When the variables under study, independent variables in this case, have varied scales and units, it is imperative to normalise the data to ensure comparability across coefficients. It also improves numerical stability, especially when variables include both large transaction values and ratios. It aligns with best practices in multivariate analysis, such as PCA and regression.

In this study, we use the Min-Max method to normalise the independent variables (Aini & Nasrudin, 2023). Using this procedure ensures that all indicator values fall between 0 and 1. Because all the independent variables under study have a direct relationship with bank profitability, so

$$I_{itn} = \frac{I_{it} - \text{Min}(I_i)}{\text{Max}(I_i) - \text{Min}(I_i)}$$

Here, I_{itn} is the value of individual indicator i^{th} in the year t^{th} that has been normalised, I_{it} is the value of individual indicator i^{th} in the year t^{th} , $\text{Max}(I_i)$ is the highest value of indicator i^{th} during the observation period, and $\text{Min}(I_i)$ is the lowest value of indicator i^{th} during the observation period.

Control Variables

Commercial banks of varying sizes and ownership types are likely to experience differential impacts from FinTech development. Therefore, regression models must account for bank-level heterogeneity to accurately assess how FinTech-related variables influence profitability across diverse banking segments. We include the following as control variables in our models. Normalisation has not been applied to any of these variables, as they were already in ratio form, eliminating bias due to scale or transaction frequency.

CAR: It is calculated as Capital to Risk-Weighted Assets, controlling for a bank's financial strength and regulatory compliance, which affects profitability, regardless of FinTech adoption by the bank (Berisha & Rayfield, 2025)

NET_NPA_TO_NET_ADVANCES: It is calculated as the ratio of Net Non-Performing Assets to Net Advances, accounting for the asset quality and credit risk, which has a direct correlation with profitability, independent of digital transformation (Upadhyay & Kumar Kurmi, 2025)

COST_TO_INCOME_RATIO: Calculated as the ratio of operating expenses and operating Income, it is often used to measure a bank's cost management capacity, and it helps control for cost-related impacts on profitability (Lv et al., 2022)

NIIR: It is the ratio of Net Interest Income to Total Operating Income, capturing the core income-generating efficiency of a bank, controlling for the effect of interest-based profitability.

Bank_size: Measured using the natural log of total assets. It is used to control the effect of firms' size on the firms' performance (Gupta et al., 2020)

3. Regression Models

The banks under study differ in management style, technology adoption and customer profiles. Panel data allows for controlling for unobserved heterogeneity across banks and for capturing time-series variation. Panel data models improve estimation efficiency and reduce omitted variable bias by accounting for individual-specific effects (Wooldridge, 2010; Baltagi, 2005). We initially employed a Random Effects (RE) specification, as panel data on banks can exhibit intra-bank error correlation over time, which RE is designed to address (Baltagi, 2021). However, the Breusch–Pagan Lagrange Multiplier test yielded $\rho \approx 0$ for all four models, indicating negligible bank-specific variance. Consequently, the RE estimator converges to the pooled OLS estimator, and the two models produce nearly identical results. For robustness, we report both RE and pooled OLS estimates in the Appendix (Tables A1 and A2), but follow the literature's convention by focusing on the pooled OLS (or RE) specification when $\rho \approx 0$ (Hsiao, 2014; Wooldridge, 2021). This study proposes 4 models for testing the hypotheses outlined above. The first model tests the impact of FinTech on the profitability of all the banks. The second, third and fourth models examine the same relationship for large, mid-sized and small banks, respectively.

$$\text{Model 1: Profitability}_{i,t} = \alpha + \beta_1 (\text{MB_VAL}_{i,t}) + \beta_2 (\text{CARDS}_{i,t}) + \beta_3 (\text{RTGS_NEFT}_{i,t}) + \gamma (\text{Controls}_{i,t}) + \epsilon_{i,t}$$

$$\text{Model 2: Profitability}_{i,t} = \alpha + \beta_1 (\text{MB_VAL}_{i,t}) + \beta_2 (\text{CARDS}_{i,t}) + \beta_3 (\text{RTGS_NEFT}_{i,t}) + \gamma (\text{Controls}_{i,t}) + \text{Large Bank Dummy} + \epsilon_{i,t}$$

$$\text{Model 3: Profitability}_{i,t} = \alpha + \beta_1 (\text{MB_VAL}_{i,t}) + \beta_2 (\text{CARDS}_{i,t}) + \beta_3 (\text{RTGS_NEFT}_{i,t}) + \gamma (\text{Controls}_{i,t}) + \text{Mid-sized Bank Dummy} + \epsilon_{i,t}$$

$$\text{Model 4: Profitability}_{i,t} = \alpha + \beta_1 (\text{MB_VAL}_{i,t}) + \beta_2 (\text{CARDS}_{i,t}) + \beta_3 (\text{RTGS_NEFT}_{i,t}) + \gamma (\text{Controls}_{i,t}) + \text{Small Bank Dummy} + \epsilon_{i,t}$$

where Profitability is the Principal Component Analysis of ROA, ROE and NIM, α is a constant, β_1, \dots, β_8 are coefficients calculated for bank i (1, 2, ...30) for the time period t (2015, 2010, ...2024), ϵ is the error term, and other variables are discussed above. For card transactions (CARDS), one factor emerged (eigenvalue = 1.30) with equal loadings of 0.806 and KMO = 0.50. Similarly, RTGS and NEFT transactions formed a single factor (eigenvalue = 1.91) with very high loadings of 0.978 and KMO = 0.50. For profitability measures (ROA, ROE, NIM), one dominant factor (eigenvalue = 2.29) was extracted with high loadings for ROA (0.979) and ROE (0.938), moderate for NIM (0.671), and overall KMO = 0.576. Likelihood ratio tests were significant ($p < 0.001$) in all cases, confirming the suitability of PCA, and factor scores were used to construct the indices.

4. Findings and Discussions

4.1 Descriptive Statistics

The overall summary statistics, i.e. standard deviation, mean, maximum and minimum values, for all the variables used in the analysis have been summarised in Table 1. The mean profitability index (Profitability) is 4.15, with a substantial standard deviation of 9.32, indicating substantial heterogeneity in bank profitability across the sample. The mean of NIIR is relatively low at 0.30, indicating thin interest spreads across banks. Other control variables exhibit moderate variation. Among the FinTech variables, the mean value of MB_VAL, representing mobile banking usage, is 4.01, with a maximum of 100, indicating a range in mobile adoption levels. On similar lines, RTGS-NEFT and CARDS also show high standard deviations (20.37 and 21.55, respectively), suggesting a considerable range in digital transaction values.

For a robust study, we present the same descriptive statistics by bank categories: Large, Mid-sized and Small-sized banks in Table 2. Large banks exhibit higher profitability (6.81), accompanied by higher digital adoption (MB_VAL: 11.70, RTGS_NEFT: 23.38, CARDS: 30.56), compared to much lower MB_VAL (1.74) for Mid-sized banks and a minuscule 0.28 for small banks. Mid-sized banks report a small mean of 3 for both RTGS_NEFT and CARDS, whereas small banks report much lower means of 0.46 and 1.21, respectively. It indicates a more intensive use of digital transaction platforms of large banks, as compared to those of Mid-sized and small banks. On the other hand, small banks report higher CAR values and a marginally

better asset quality than Large and Mid-sized banks. Mid-sized banks exhibit higher risk and operational volatility, with a high standard deviation of 10.91 and the highest NPA ratio of 3.74. The CTI Ratio deteriorated from 0.47 in large banks to 0.58 in small banks, indicating a decline in cost efficiency with bank size. NIIR is relatively stable across groups.

Large banks clearly enjoy the benefits of scale, enabling greater FinTech integration and increased profitability, while smaller banks are less tech-savvy but have relatively stable risk metrics. The overall heterogeneity across segment statistics justifies the size-based modelling strategies in the empirical analysis.

Table 1. Summary Statistics of all Variables

Variables	Obs	Mean	Std Dev.	Min.	Max.
Profitability	300	4.15	9.32	-42.35	16.34
CAR	300	14.92	3.34	7.51	29.37
NPA Ratio	300	3.07	2.91	0.12	16.69
CTI Ratio	300	0.52	0.11	0.35	1.01
NIIR	300	0.30	0.07	0.13	0.64
Bank_size	300	12.31	1.37	9.38	15.64
RTGS_NEFT	300	7.93	20.37	0.00	141.40
CARDS	300	10.28	21.55	0.72	137.51
MB_VAL	300	4.01	10.49	-	100.00
Large_Bank_dummy	300	0.27	0.44	-	1.00
Midsized_Bank_dummy	300	0.47	0.50	-	1.00
Small_Bank_dummy	300	0.27	0.44	-	1.00

Source: Researcher's calculations

Table 2. Size-wise Summary Statistics of Variables

Variable	Large Banks- Obs 80				Midsized Banks- Obs 140				Small Banks- Obs 80			
	Mean	SD.	Max.	Min.	Mean	SD.	Max.	Min.	Mean	SD.	Max.	Min.
Profitability	6.81	6.49	14.88	(17.50)	1.75	10.91	16.34	(42.35)	5.69	7.59	14.90	(23.74)
MB_VAL	11.70	17.75	100.00	0.01	1.74	3.17	24.54	0.00	0.28	0.60	3.49	0.00
RTGS_NEFT	23.38	34.54	141.40	0.17	3.37	4.85	25.81	0.01	0.46	0.63	2.79	0.00
CARDS	30.56	34.12	137.51	1.64	3.87	3.44	21.56	0.82	1.21	0.50	2.91	0.72
CAR	15.54	2.84	22.69	9.20	13.97	2.66	22.26	8.46	15.98	4.31	29.37	7.51
NPA Ratio	2.53	2.37	11.24	0.25	3.74	3.54	16.69	0.12	2.42	1.67	8.03	0.35
CTI Ratio	0.47	0.06	0.67	0.35	0.52	0.08	0.77	0.35	0.58	0.15	1.01	0.38
NIIR	0.31	0.05	0.47	0.20	0.31	0.08	0.64	0.13	0.26	0.05	0.47	0.13
Bank_size	13.82	0.76	15.64	11.57	12.39	0.74	14.15	10.21	10.66	0.72	11.90	9.38

Source: Researchers Calculations

4.2 Correlation Matrix

Table 3 presents the correlations between bank profitability and the independent variables under study. Among the control variables, CAR is positively associated with profitability and FinTech adoption, whereas NPA and the CTI ratio are negatively associated with them. Bank size is highly correlated with all the FinTech measures, which in turn are strongly interrelated, reflecting integrated digital adoption. Profitability is positively correlated with all the FinTech variables. Correlation matrices were also computed

for each bank size category to ensure consistent patterns across groups. As no major deviations were observed, only the overall matrix is presented to maintain parsimony.

In the present study, a few variables exhibit correlations exceeding 0.8, which may raise concerns about multicollinearity (Gujarati & Porter, 2009). Thus, the Variation Inflation Factor (VIF) has been calculated for all the variables. The values have been reported in Tables 3 and 4. All the reported values are less than 10, denoting that the model is free of multicollinearity.

Table 3. Spearman Correlation between Independent Variables

Variables	Profita- bility	MB_VAL	Cards	RTGS_NEFT	NIIR	CAR	CTI Ratio	NPA Ratio	Bank_size
Profitability	1	0.30***	0.15**	0.20***	-0.13**	0.64***	-0.42***	-0.86***	-0.01
MB_VAL		1	0.85***	0.92***	0.14**	0.54***	-0.31***	-0.35***	0.68***
CARDS			1	0.84***	0.35***	0.30***	-0.37***	-0.18***	0.86***
RTGS_NEFT				1	0.18***	0.51***	-0.26***	-0.28***	0.72***
NIIR					1	-0.05	-0.29***	0.14**	0.27***
CAR						1	-0.29***	-0.65***	0.05
CTI Ratio							1	0.22***	-0.36***
NPA Ratio								1	0.02
Bank_size									1

Source: Researcher's Calculations

Table 4. Multicollinearity Test Result: VIF and Tolerance

Variable	VIF	1/VIF
RTGS_NEFT	6.9	0.144957
CARDS	5.85	0.170888
MB_VAL	4.71	0.212191
Bank_size	2.23	0.448909
NPA Ratio	1.71	0.586255
CAR	1.66	0.602486
CTI Ratio	1.57	0.63502
NIIR	1.25	0.800464

Source: Researcher's Calculations

4.3 Diagnostic Tests

Along with multicollinearity, we also conducted the Baltagi-Wu Locally Best Invariant (LBI) test to detect serial correlation in the panel data, yielding LBI values of approximately 2 for all three, indicating mild autocorrelation. In order to test the data for heteroscedasticity, White's test was applied. It yielded p-values of 0, indicating heteroscedasticity. Although all three bank sizes showed mild autocorrelation, this is not a concern, as the regression models were estimated with cluster-robust standard errors, which account for both autocorrelation and heteroskedasticity.

4.4 Panel Data Regression Analysis

Panel data regression analysis was employed to investigate the impact of FinTech on the profitability of Indian banks. The independent variables are RTGS_NEFT, MB_VAL, and CARDS, representing transaction values for RTGS-NEFT, Mobile banking, and debit-credit cards, respectively. Out of these, RTGS-NEFT have been around for much longer than the other two forms of digital transactions. With mobile banking and card transactions at customers' disposal, it is imperative to assess banks' profitability amid the changing dynamics of digital transactions. We have used five control variables (bank size, CAR, NIIR, Cost-to-income ratio, Net NPA to Net Advances Ratio) in the present study. In panel data, both fixed- and random-effect models are applied. The Hausman Test is used to determine which model is better suited for the data under study. To evaluate the impact of FinTech on the profitability of Indian banks, four regression models were developed. One for all the 30 banks under the present study and three separate models, one for each bank size, that is, Large, Mid-sized and Small banks, to understand the impact of FinTech on banks with respect to their size. We used average asset size across years to categorise banks (Ovenc & Nabiyevev, 2025).

Models 1, 2, 3, and 4 examine the impact of the values of Mobile banking, RTGS, NEFT, Credit card, and Debit card transactions on the profitability of Overall banks, Large, Mid-sized, and Small-sized Banks, respectively, and the results for the same are presented in the table below. The suitability of the Random effects and fixed effects models is confirmed by chi-square (χ^2) and p-value results of the Hausman test. The Hausman Test, tabulated in Table 5 below, fails to reject the null hypothesis and confirms the appropriateness of the RE model for all four models.

All four models are found to have an overall fit, as shown by the Wald χ^2 statistic, which is statistically significant at the 1 per cent level. The LM test indicates (rho) $\rho \approx 0$, suggesting that once we control for FinTech indicators and other bank-level characteristics, there is no significant unobserved heterogeneity across banks. This implies that the observed variation in profitability is primarily explained by the included covariates themselves rather than by persistent, unmeasured bank-specific effects. Therefore, pooled OLS estimates reliably capture the impact of FinTech on bank profitability for Indian banks during the study period.

The coefficients of MB_VAL and CARDS are found to be positive and significant at the 1 per cent and 5 per cent levels, respectively. In contrast, the coefficient of RTGS_NEFT is negative and significant at the 1 per cent confidence level across all four models. It aligns with the view that digital banking channels reduce operational costs and improve efficiency, thereby enhancing profitability. But large payment systems like RTGS-NEFT put pressure on operational costs and suppress profitability. Among the control variables, NIIR, CAR, CTI ratio, and NPA Ratio are significant across all four models. Bank_size, on the other hand, is not significant in models 1, 3, and 4, but is significant at the 5 per cent level in model 2, which is for large banks in India. Therefore, it can be concluded that all four hypotheses, i.e, H1, H2, H3 and H4, stand rejected. The proposed models explain the bank's profitability well.

The models show similar results throughout the models but also highlight some heterogeneities across bank sizes. Mobile banking transactions and the capital adequacy ratio strongly drive profitability across all bank sizes. In contrast, RTGS-NEFT transactions, which are the big-ticket transactions, are negatively related to profitability, indicating that higher transfer activity may dilute profitability margins. These findings are consistent across large, medium and small banks, suggesting common structural effects in the sector.

Digital card transactions, represented by CARDS, a comparatively mature transaction channel, are also significant in the models under study, but their impact is not uniform across all sizes. While the impact (t-value) is more robust for both small and large banks, it is only marginally significant for mid-sized banks. It points to the possibility that digital retail transactions have different impacts on banks of different sizes and marketing positions.

Table 5. Impact of Fintech on Bank Profitability: OLS Regression Models (Models 1,2,3,4)

Independent Variables	Model 1: All banks	Model 2: Large banks	Model 3: Mid-sized banks	Model 4: Small banks
	OLS Coefficient (t-value) [SE]	OLS Coefficient (t-value) [SE]	OLS Coefficient (t-value) [SE]	OLS Coefficient (t-value) [SE]
Constant	28.51 (4.31) [6.62]***	31.16 (4.41) [7.07]***	28.16 (4.33) [6.50]***	26.80 (4.05) [6.61]***
MB_VAL	0.10 (2.81) [0.04]***	0.11 (2.97) [0.04]***	0.10 (2.91) [0.04]***	0.10 (2.83) [0.04]***
CARDS	0.06 (2.40) [0.02]**	0.04 (2.07) [0.02]**	0.04 (1.78) [0.02]**	0.05 (2.09) [0.03]**
RTGS_NEFT	-0.09 (-2.85) [0.03]***	-0.09 (-2.89) [0.03]***	-0.09 (-2.73) ***	-0.09 (-2.75) [0.03]***
NIIR	-17.06 (-1.83) [9.30]**	-17.16 (-1.89) [9.08]*	-16.70 (-1.82) [9.16]*	-16.80 (-1.77) [9.47]*
CAR	0.36 (2.09) [0.17]**	0.35 (2.00) [0.18]**	0.33 (1.86) [0.18]*	0.35 (1.91) [0.18]*
CTI_RATIO	-24.86 (-6.03) [4.13]***	-24.94 (-5.84) [4.27]***	-24.80 (-5.80) [4.27]***	-24.79 (-5.97) [4.15]***
NPA_RATIO	-1.95 (-14.26) [0.14]***	-1.94 (-13.95) [0.14]***	-1.96 (-13.80) [0.14]***	-1.96 (-13.64) [0.14]***
Bank_size Dummy	-0.48 (-1.33) [0.37]	-0.71 (-1.77) [0.40]**	-0.40 (-1.09) [0.36]	-0.35 (-0.89) [0.39]
R²	0.549	0.551	0.549	0.548
rho	0	0	0	0
F-Statistic/ Wald χ^2	1505.06, Prob > χ^2 = 0.0000	1365.58, Prob > χ^2 = 0.0000	1446.58, Prob > χ^2 = 0.0000	1503.99, Prob > χ^2 = 0.0000

Notes: t-values are reported in parentheses. Standard errors are robust and clustered at the bank level. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Source: Researcher's Calculations

The net interest income ratio (NIIR) has a negative coefficient and is only marginally significant across all the bank groups. It hints at a plausible, weak role for traditional lending margins in affecting profitability once digital and structural variables are considered.

Bank size shows a very interesting trend, showing a significant negative effect among only the large banks, which disappears in the overall regression. This shows how aggregate models can mask nuanced differences, especially in cases of scale economies or diseconomies. The constants also reveal a profitability trend, highest for large banks and lowest for small banks, but this trend is obscured when all the banks are pooled together. This is in line with past studies that reported that larger banks enjoy greater profitability due to scale effects (Katsiampa et al., 2022; Zhao et al., 2022). To gain a deeper understanding of the trend, we further analysed data from the annual reports of the 30 banks in our sample on the average age of mobile applications and the frequency of app revamps (Table 6). We find that large banks exhibit the highest average app age of

10.63 years, followed by small and mid-sized banks, both around 8 years. The app revamp rate is also the highest for large banks, at 88%, followed by mid-sized banks at 71% and small banks at 50%. These results indicate both early adoption and continual upgrading for large banks. The disparity in the app revamp rate of mid-sized and small banks shows that although small banks adopted mobile apps at a comparable pace, they were less proactive in refreshing and upgrading their digital platforms. We also introduced interaction terms between MB_VAL and the bank-size dummies to test the robustness of the current regression models. We proceeded to re-estimate Models 2, 3, and 4, only to find that the results did not yield any statistically significant differences in interpretation compared to the baseline models. Thus, we proceeded with the original OLS results, without the interaction terms. Moreover, it is imperative to understand the critical role of Unified Payments Interface (UPI) in reshaping the digital payments scenario in India and thereby affecting bank profitability. Even though bank-level UPI data was not available, it is

Table 6. Average Mobile Application Age and Revamp Rate

Banks	Avg App Age (years)	App Revamp Rate
All banks	9.03	70%
Large	10.63	88%
Mid-sized	8.21	71%
Small	8.88	0.5

Source: Researcher's Calculations

essential to recognise that UPI transaction values are part of mobile-banking transaction values. Thus, we examined the share of UPI in the overall mobile banking payments and found it to be approximately 65%. Given the substantial number, we argue that MB_VAL adequately captures the impact of UPI, and thus a separate variable for UPI was unnecessary. The data on MB_VAL and UPI were sourced from the RBI Payment Systems Statistics. (RBI, 2024b)

In conclusion, although the overall bank regression captures the dominant effects of variables such as CAR and RTGS-NEFT transaction values, the bank-size-wise analysis reveals heterogeneous effects of CARDS and bank size across the three bank sizes. This underlines the importance of disaggregated analysis when studying the profitability implications of FinTech adoption in banking.

5. Conclusion and Policy Implications

In this study, we examined the impact of FinTech on bank profitability, using digital transactions as a proxy for FinTech. To measure the impact of FinTech on bank profitability, an OLS panel regression model has been used, and thus, the hypothesis regarding the relationship between FinTech and banks' profitability has been scrutinised. Researchers widely accept this model, as it provides insights into the efficiency of the entity's assets. The main advantage of the model is the clarity of its component calculations, which, in turn, is based on the banks' financial statements. ROA, ROE, and NIM were used as proxies for bank profitability, and a PCA was conducted to derive an integrated variable. The study was conducted on a sample of 30 Indian banks over 10 years (2015–2024), and all stated hypotheses were tested.

Four models were formulated to study the impact. The first model represented the overall banks, regardless of their size, and the other three models studied the impact of FinTech on bank profitability size-wise, namely, Large, mid-sized and

small banks. The results indicated that mobile banking transactions consistently impact profitability positively across all the models, indicating their efficiency, low-cost structure and rising customer adoption. The results of this study are in line with the results of previous studies, such as Prasad (2022). Card transactions also enhance profitability, although the effect is weaker for the mid-sized banks, reflecting the impact of scale and customer base on digital adoption benefits. On the other hand, RTGS and NEFT transactions showcase a negative association with profitability, suggesting that such high-value and low-margin transfers may be imposing additional operational costs on the banks and not really improving the banks' profitability. We would like to highlight that, by definition, mobile transactions may be counted separately, but card transactions and RTGS/NEFT transactions can also be done through mobile banking apps. With this information, it can be highlighted that mobile banking, as a mode of transaction, is more efficient and cost-effective because transactions conducted through apps put much less pressure on banks' operations. This finding is in line with the results of Prasad (2022).

This study has various implications for stakeholders such as managers, policy makers, regulators and investors. As the paper draws the inference that mobile banking has the strongest positive association with profitability, regulators should continue to promote mobile-based channels through financial literacy campaigns and rural digital penetration. Banks should also prioritise investment in mobile banking apps and aim to enhance customer experience to strengthen revenue streams. RBI doesn't charge any fee from the banks for RTGS-NEFT transactions and has mandated banks not to charge any fee from the customers for inward RTGS-NEFT transactions and outgoing online transactions. A meagre fee of not exceeding Rs 50 and Rs 25 can be charged for offline outgoing RTGS and NEFT transactions, respectively. Looking at the negative relationship of

RTGS-NEFT transactions with bank profitability, regulators may consider a differentiated pricing structure or incentivising banks for maintaining these critical payment channels, as these services are utility-driven but with limited revenue benefits. Managers of small and mid-sized banks should focus on targeted FinTech partnerships to improve profitability and gain scale benefits. This trend is highlighted by the data gathered on the average app age and app revamp rate of the banking mobile apps. Large banks, having access to greater resources, are able to continually reform their digital platforms, possibly translating into stronger customer retention and higher profitability. Mid-sized banks showcased medium-paced app revamp activity, but the comparably lower revamp rate among smaller banks may suggest resource constraints, possibly leading to lower profitability. Policymakers such as the RBI and SEBI should incentivise such collaborations.

6. Limitations and Future Research Scope

The current study unveils important trends influenced by FinTech in the banking landscape, but unfortunately, due to the unavailability of data on significant digital innovations like API-based payments and internet banking, we could only focus on major digital transaction values of Mobile banking, RTGS-NEFT and Card payments. As the bank-wise data for UPI transactions was not available for all the years, we could not capture the pre- and post-COVID-19 digital trends in India. Although FinTech is affecting all the areas of banking from operations to profitability, banks' annual reports fail to report important indicators like API platforms, due to no standard guideline available on such reporting. It leads to the lost chance of in-depth study by researchers and highlights the future scope for the same. Additionally, a cross-country analysis could be performed to compare the impact of FinTech on bank profitability across different nations. This study is limited to examining profitability, while future research could expand on this by investigating the effects of FinTech on productivity, market valuation, and the overall economic performance of banks or firms.

List of abbreviations

ROE: Return on Equity
 ROA: Return on Assets
 NIM: Net Interest Margin
 MB_VAL: Mobile banking transactions value
 RTGS-NEFT: Real Time Gross Settlement- National Electronic Funds Transfer transaction values

CARDS: Debit and credit card transaction values
 NIIR: Net Interest Income Ratio
 CAR: Capital Adequacy Ratio
 CTI Ratio: Cost to Income Ratio
 NPA Ratio: Net NPA to Net Advances Ratio
 NPA: Non- Performing Assets

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Brand Personality Scale Development and Validation for Passenger Cars: A Study in the High-Involvement Product Context

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A b s t r a c t

Brand personality is a key component of a brand's identity. Despite the proliferation of brand personality scales since Aaker's (1997) seminal work, a validated, context-specific scale for high-involvement products such as passenger cars remains absent from the literature. This study develops and validates a brand personality scale for passenger cars in India. The cars represent a high-involvement, high-value product category. The study employs a rigorous two-phase mixed-methods approach grounded in the Big Five personality framework. The first qualitative phase focused on trait generation. The second quantitative phase involved participants drawn from India's major urban car markets. Data analysis employed SPSS for exploratory factor analysis (EFA) and AMOS for confirmatory factor analysis (CFA).

The results revealed four distinct brand personality dimensions. These are particularly salient in the passenger car context. Psychometric validation demonstrated high reliability and construct validity across all recommended thresholds. The resulting ten-item scale is concise, context-sensitive, and psychometrically robust. For scholars, it provides a reliable instrument for examining brand personality in passenger cars and a methodological template for scale development in other high-involvement categories. For practitioners, it enables brand benchmarking, competitive comparison, and targeted brand positioning. The study contributes to the literature by introducing a validated, car-specific brand personality scale.

Keywords: Brand Personality; Scale Development; Passenger Cars; High-Involvement Products; Consumer Behaviour; Psychometric Validation

1. Introduction

Today, brands are more than just names. They have personalities like people. Personality traits shape how consumers perceive, relate to, and ultimately choose among competing offerings. In high-involvement product categories, purchase decisions are complex, risky, and significant. Brand personality is a critical lever for differentiation and emotional connection. Ideally, marketers and researchers should possess robust, context-sensitive tools to measure and manage brand personality, enabling brands to cultivate enduring relationships and loyalty in high-stakes markets.

However, the reality is less than ideal. Despite the proliferation of brand personality scales since the late 1990s, conceptual and methodological challenges persist. Aaker's (1997) foundational work with the five-dimensional Brand Personality Scale provided a springboard for research and practice, but has faced substantial criticism on multiple fronts. First, Azoulay and Kapferer (2003) argued that Aaker's definition conflates brand personality with broader brand identity constructs. It includes functional attributes and brand image. Thus, it thereby compromises the conceptual definition. Second, a research study by Austin, Siguaw, and Mattila (2003) demonstrated poor model fit when applied to specific product categories. Their study reported GFI, AGFI, and NFI below 0.90; whereas RMSEA exceeded 0.08. Thus, the author challenged its cross-category generalizability. Third, Ross (2008) found that three of the five factors lacked convergent validity. Moreover, the research revealed that all five factors failed to demonstrate discriminant validity in a sports brand context. Fourth, cross-cultural replications have consistently required structural modifications. Aaker et al. (2001) replaced ruggedness with peacefulness in Japan and Spain, while studies across India, China, Chile, and Russia report markedly divergent factor structures. These cumulative limitations are the conceptual overreach, poor category-level fit, and cultural non-invariance. These make a compelling case for context-specific scale development rather than continued reliance on a generic instrument.

Passenger cars represent a theoretically well-motivated and practically important context for this investigation. Cars are expensive, infrequently purchased, require extensive information search, and carry significant social and self-expressive meaning. This is a hallmark of high-involvement consumer behaviour (Zaichkowsky, 1985; Chitturi et al., 2008). In such contexts, brand personality plays an

amplified role. It helps consumers reduce perceived risk, express self-identity, and form enduring brand relationships. The absence of a validated, car-specific brand personality scale therefore carries both theoretical and practical consequences. Theoretically, it hampers the development of nuanced consumer-brand relationship models in high-involvement settings. Practically, it constrains brand managers' ability to craft and benchmark brand personalities in categories where consumer stakes and emotional investment are highest. This study directly addresses this gap by developing and validating a brand personality scale for passenger cars in India. The study draws on advances in personality psychology, scale development methodology, and consumer behaviour theory.

This study is anchored in two complementary theoretical traditions. The first is the Big Five personality framework (Costa & McCrae, 1992), which posits that human personality can be reliably described across five broad dimensions: Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism (OCEAN). Brand personality theory, following Aaker (1997), extends this paradigm to commercial entities by proposing that consumers perceive and describe brands in ways analogous to human personality. The process is called brand anthropomorphism. The second tradition is high-involvement consumer behaviour theory (Zaichkowsky, 1985), which holds that for products requiring substantial cognitive and financial commitment, consumers engage in deeper information processing and rely more heavily on symbolic brand attributes, including personality. Consumers prefer to reduce perceived risk and affirm self-concept. Together, these frameworks generate the expectation that brand personality traits salient to car consumers will be empirically distinct from those identified in generic, multi-category studies. The study's objectives are accordingly both academic and practical; to advance theoretical understanding of brand personality in a high-involvement product context, and to equip practitioners with a validated, actionable measurement tool for the passenger car category.

2. Literature Review

The concept of brand personality is rooted in human psychology. Researchers in the 1950s first acknowledged its power to depict brands (Aaker, 1997). Early brand personality studies were ad hoc, with disagreements regarding their definitions. Scholars have been unable to

distinguish between brand personality and related concepts. Aaker (1997) attributed this to scholars confusing concepts with human personality and brand image. Figure 1 depicts the history of brand personalities.

Aaker (1997) defined brand personality as "the set of human characteristics associated with a brand." She developed a comprehensive measurement scale. She used personality traits derived from human personality scales and practitioner-adopted ones. In addition, she generated traits through projective techniques. The factor analysis yielded a

five-factor brand personality scale. The resulting factors were sincerity, excitement, competence, sophistication, and ruggedness. The five factors comprised 15 facets, totalling 42 traits. Aaker claimed these factors were "reliable, valid, and generalisable." Moreover, these factors are universally applicable across brand categories and industries. "Despite the dominance of the scale proposed by Aaker (1997), the academic world remains divided on its use. There is no consensus on the number of dimensions, as shown in Table 1.

Table 1. Summary of Brand Personality Scales

Authors	Countries	No of Dimensions
(Ahmad and Thyagaraj, 2017)	India	6
(Aziz, Ghani and Niazi, 2010)	Pakistan	7
(Bosnjak, Bochmann and Hufschmidt, 2007)	Germany	4
(De Moya and Jain, 2013)	Brazil	3
(Muller and Bevan-Dye, 2016)	South Africa	4
(Muniz and Marchetti, 2012)	Brazil	5
(Smit, Van Den Berge and Franzen, 2003)	Netherland	6
(Sung and Tinkham, 2005)	USA	8
(Supphellen and Grønhaug, 2003)	Russia	5
(Toldos-Romero and Orozco-Gómez, 2015)	Mexico	7
(Venable, 2005)	USA	2

Source: Authors and adapted from (Lara-Rodríguez et al., 2019)

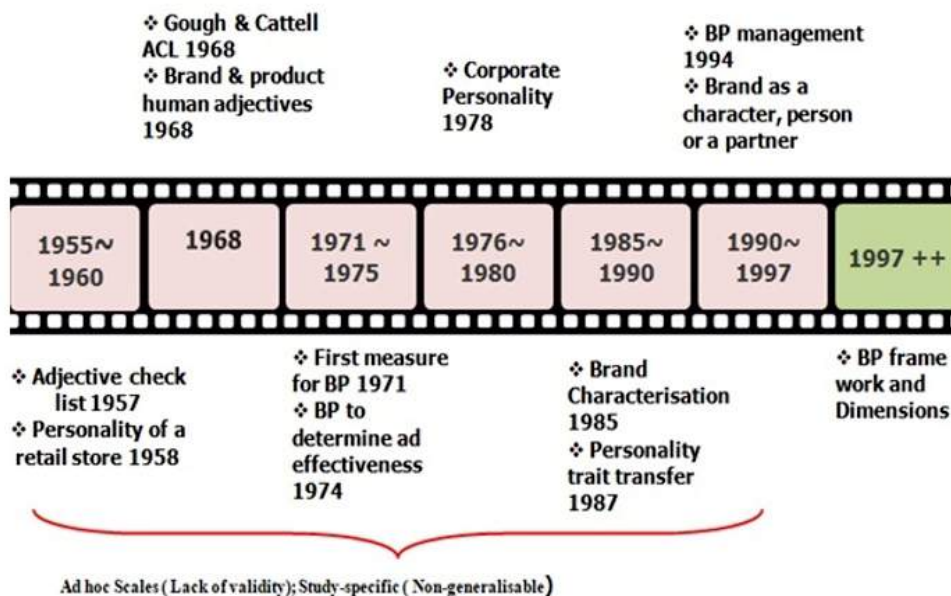


Figure 1. History of Brand Personality

Aaker (2001) extended her study to Japan and Spain. The findings suggested that excitement, sincerity, and sophistication were common across all three countries (the USA, Japan, and Spain). Meanwhile, ruggedness was replaced by peacefulness in Japan and Spain because of cultural differences. Several subsequent studies have questioned the universal applicability of Aaker's scale.

Table 2 below, curated from Austin et al. (2003), lacks generalizability, as claimed by Aaker's study. This outcome held at both the individual-brand and aggregate levels. Thus, the authors questioned the scale's reliability for specific product categories.

In contrast, Ross's (2008) study revealed that three of the five factors lacked convergent validity. All five factors failed to demonstrate discriminant validity in the sports brand context. Thus, the study highlighted structural problems. These findings underscore those of Azoulay and Kapferer (2003). Major shortcomings identified were the "loose definition of brand personality," "non-generalizability of factor structure," and "non-replicability cross-culturally."

Studies conducted by authors employing Aaker's scale dimensions for automobiles have yielded mixed results. The mixed findings are as follows. Rojas-Méndez, Erenchun-Podlech, and Silva-Olave (2004) found the ruggedness dimension unreliable when investigating Ford's brand personality in Chile. Lau and Phau (2007) found that ruggedness was unrelated to BMW and Volkswagen brands, supporting the findings of Rojas-Méndez, Erenchun-Podlech, and Silva-Olave (2004). In contrast, Wang and Yang (2008) found ruggedness to be of little relevance in the Chinese automobile industry.

Despite significant contributions to the literature, brand personality remains at developmental stages (Llanos-

Herrera & Merigo, 2018). The growing body of literature has not reached a consensus on the definitions. Therefore, empirical research on the antecedents of brand personality is needed (Llanos-Herrera, 2022).

Cowan and Kostyk (2023) asserted that high-value brands with personalities are favourably received. Furthermore, brand personality perception may help overcome negative brand behaviour (Yadav, 2024). In addition, consumer relationships are affected by evolving social and technological changes (D. Carvalho et al., 2021; Llanos-Herrera, 2022). These studies suggest that brand personality remains relevant.

Hence, there is a need to examine the brand personalities of high-involvement products, such as cars. The study defines brand personality as "the human personality trait apposite to car brands." This study focuses on car users in India's top 10 car markets. These markets have high per capita GDP and educational attainment levels.

3. Methodology

This study adopted the best practices for measurement scale development, as suggested by Churchill (1979), to produce a reliable, valid, and generalisable scale for brand personality. The study of the brand personality scale demands a "mixed-method approach." (Creswell, 2003) postulated that "mixed methods research design may combine two or more methodologies." The studies may be concurrent or sequential." The qualitative phase involves exploring and identifying items that qualify as traits. Figure 2 shows the two-phase process. The first phase was qualitative and exploratory. The second is an instrument (or quantitative feature). The second phase assessed the scale's reliability and validity.

Table 2. Model Fit Indices (Aaker, 1997) BP factor hospitality sector

	χ^2 /df	RMSEA	NNFI	CFI	GFI
Grouped					
QSR (3)	5.294	0.084	0.74	0.75	0.76
CD (6)	10.778	0.091	0.74	0.75	0.74
QSR and CD (9)	20.018	0.11	0.7	0.71	0.67

Source: Compiled by authors

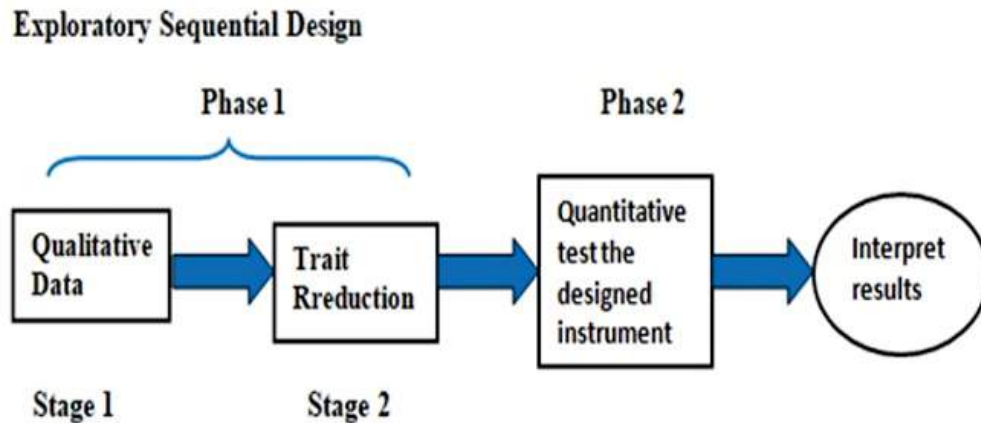


Figure 2. Two-phase study

In addition to traits from the literature, the researcher also employed projective techniques and qualitative studies to generate traits (primary data). The generated traits were then reduced to a manageable pool using factor analysis.

3.1 Generation of Items (Traits)

Three hundred traits emerged from a review of existing human and brand personality scale items. This analysis was performed after removing redundancies and duplicate traits from the literature. Four English language experts scrutinised 303 traits. They dropped words at low frequency. In addition, words that were not understandable in the average Indian language were omitted. The list contained 180 items.

This study employed projective techniques. Projective techniques are indirect methods of eliciting thoughts and feelings." This is a prominent method for measuring consumer perceptions of a brand (Plummer, 2000). Understanding consumer perceptions and motivations is complex. This includes both intrinsic and extrinsic needs. Therefore, projective techniques facilitate consumers' metaphorical thinking, allowing them to express their underlying attitudes and emotions.

Figure 3 presents the projective techniques used in this study: semi-structured interviews, free elicitation technique, and content analysis.

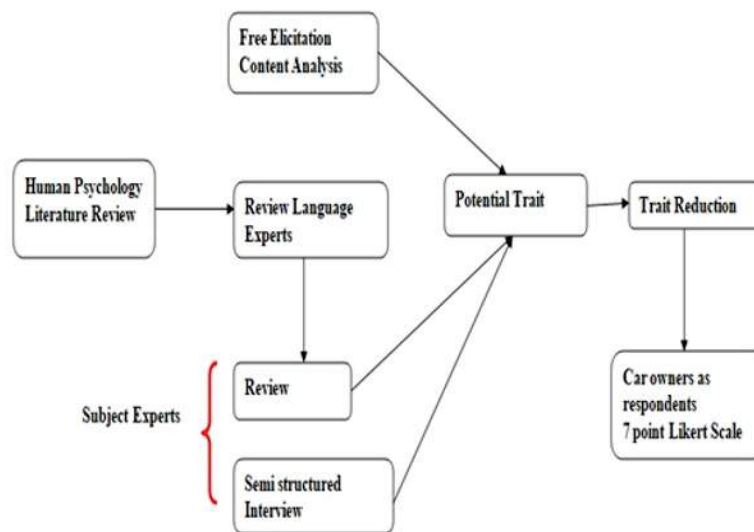


Figure 3. Techniques for trait generation

The primary goal of this study was to identify personality traits that are specific to cars. (High-value and high-involvement products). This qualitative study adopted three techniques: (1) involvement of subject experts, (2) free elicitation method, and (3) content analysis.

Subject experts: Seven respondents participated in the semi-structured interviews. All subject experts had more than 20 years of experience. Two were from the passenger car industry with leadership roles, and one was from auto-component with marketing. Two were from the advertising and communication industries. Two were academics teaching MBA students. Four participants were interviewed over the phone, and three responded via email. In their interviews, the subject experts identified 57 traits after excluding duplicates. They also reviewed a list of traits that language experts scrutinised. The subject experts reduced it to 130 items to confirm content validity.

The semi-structured interview provides informative, valuable, and helpful data as the interviewer controls the interview process. The interview process minimises the risk of ambiguity and misconceptions about the questions, leading to meaningful outcomes. In addition, semi-structured interviews allow the researcher to change the sequence of questions. They can seek clarification if necessary. A semi-structured interview mode allows the researcher to be flexible in addressing relevant issues specific to the participants.

Free elicitation: 21 respondents participated in this study. They were asked to imagine a car as a person. They then described the personalities of their car brands in their own words. (n = 21; Mean Age= 35.25 years; F = 10 & M = 11). Six respondents worked for a car manufacturing firm, and five worked for a car dealership. Additionally, three were from the media and communication industry, and seven were actual car users. After removing duplicates, free elicitation yielded 102 traits.

The advantages of the free-elicitation method are its ease of data collection and analysis. It is an inexpensive and simple way to find traits from customers' opinions or potential customers' perspectives. The free elicitation technique allows participants to describe the target stimulus (cars) in salient terms. It is convenient for respondents to describe their car brands in this way. Respondents were directly oriented toward the brand through their own experiences or indirectly through their families and friends.

Content Analysis:

Content analysis is a research technique for the objective, systematic, and quantitative description of the manifest content of communication. Krippendorff (2004) stated that *"it is potentially one of the best research methods available, and the most under-utilised."* Data analysed by content analysts included *"a representation of texts, images, and expressions designed to be seen, read, interpreted, and acted on for their interpretations."*

Content analysis of documentary material, whether electronic (websites, television commercials) or printed (newspapers, magazines), describes the process. This study conducted a website content analysis of advertisements for car manufacturers in India. The Indian websites of car manufacturers, namely Maruti Suzuki, Toyota India, Ford India, Hyundai India, Tata Motors, and Volkswagen, were analysed.

3.2 Trait Reduction

The resultant pool of latent traits was derived from two sources: initial traits from human psychology and brand personality trait studies. A qualitative approach (a projective technique) yielded a pool of traits from the literature. Three experts vetted the common traits that emerged from the two lists. These items were candidates for the next step of trait reduction.

A total of 305 participants evaluated the 64 items. Participants responded to an online questionnaire using a Likert-type scale. (1= "Not at all Descriptive"; to 7= "Extremely Descriptive"). Of the 305 respondents, 77% were men and 23% were women. Of the respondents, 87.5% were car owners, 61.4% had more than 10 years of driving experience, and 11.5% used a driver. The percentage of respondents who bought two or more cars was 65%. The participants' profiles suggested that they were familiar with cars. The participants were educated and understood the meaning of the items under evaluation. Thus, the responses were considered valid.

The cut-off value for traits rated on a 7-point Likert scale was five or above. (Descriptive to Extremely Descriptive). The researcher computed the mean for all items. The mean score with one standard deviation reduced the pool of traits to 28 (Figure 4). These input traits were used in this quantitative study.

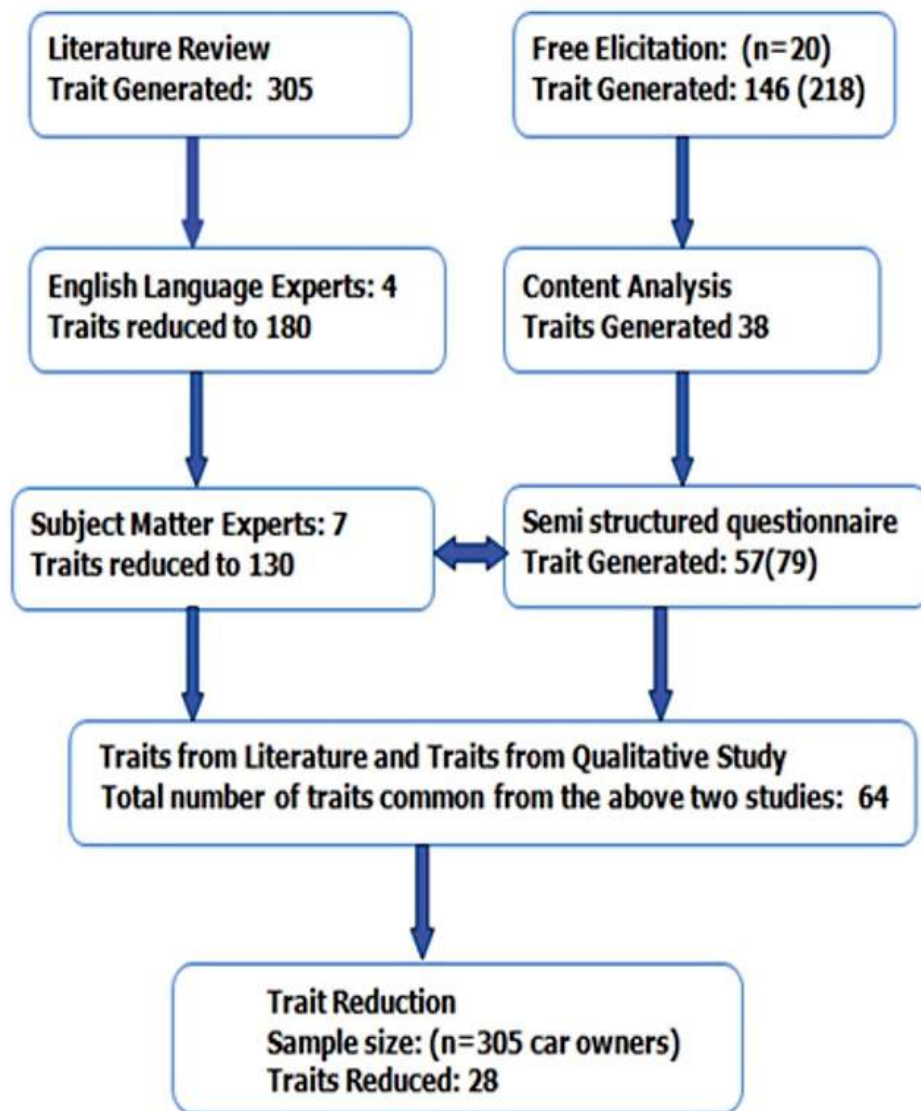


Figure 4. Trait Generation and Reduction

3.3 Sampling

The data analysis method was used to estimate the suggested sample (Malhotra, 2018). This study used structural equation modelling (SEM) for data analysis. However, this technique is sensitive to sample size. Scholars have proposed 10:1 or 20:1 respondent-to-item ratios as appropriate for SEM studies (Hair et al., 2022). Other researchers (Given, 2012) have proposed a 5:1 subject-item ratio.

Phase 2 of the study employed paper-and-pencil techniques for data collection. The measurement instrument had seven response options, according to Su and Reynolds (2019), that are suitable for identifying variance. The questionnaire used a 7-point Likert scale (1 = "not at all applicable," 2= "applicable," 3= "somewhat applicable," 4= "cannot say," 5= "somewhat applicable," 6= "somewhat agree" 7="strongly agree")

Of the 900 questionnaires distributed, 686 respondents returned the completed questionnaires. Fifty-seven questionnaires were returned unanswered, and 41 were unusable; hence, they were dropped. The remaining 589 questionnaires were usable, and 117 participants responded online. Therefore, 706 responses were included in the analysis.

The sample comprised 75.35% males and 23.78% females, with ages ranging from 21 to 60 years (mean age = 32.76, SD = 11.66). Of the 706 respondents, 60.2% were salaried, 8.6% were self-employed, 10.6% were professionals, 2.8% were retired, and 17.7% did not answer. More than 90% of the sample had a graduate degree. The sample profiles comprised 41.75% graduates, 47.67% master's degrees, 1.13% doctoral degrees, an equal number of high school graduates, and 8.32% with professional degrees. Geographically, 44%, 34.3%, 14.4%, and 7.2% of the respondents were from Pune, Mumbai, Delhi, and Surat, respectively.

These cities collectively represent India's largest passenger car markets and account for a disproportionate share of national automobile sales. Respondents from these markets are therefore most likely to possess the brand exposure and product experience necessary to form differentiated brand personality perceptions. While this limits cultural breadth, it reflects a deliberate choice to anchor scale development in the most appropriate consumer population rather than pursuing nominal geographic diversity at the cost of construct validity. The age profile (mean age 32.76 years; a significant proportion of millennials aged 22–37) is well-suited: this cohort is the fastest-growing car-buying segment in India and is most actively engaged with brand symbolism and identity signalling. The 12.5% of respondents who did not own a car at the time of the survey were retained because many had regular car use through family vehicles or were actively considering a car purchase. Nonetheless, the geographic scope and ownership profile are acknowledged as limitations, and future research should replicate the scale with broader, multi-regional Indian samples.

3.4 Data Collection

Convenience sampling was used for data collection. The participants were working executives with at least 3 years of follow-up. Nine hundred questionnaires were distributed physically, and 686 were returned. Of those, 57 were returned unanswered, and 41 were unusable because of incompleteness. An additional 120 participants responded via the Internet. A total of 709 responses were available for analysis.

4. Results

The first step was to "detect outliers," which are "score(s) different from the rest of the data" (Field, 2019). "Extreme scores can occur for any univariate or multivariate variable" (Kline, 2016). Univariate outliers are cases that fall "outside the maximum and minimum ranges by examining the observations per variable" (Hair et al., 2022). Box plots visually detect univariate outliers. The values ranged from 1.5 to 3 times the interquartile range (beyond the whiskers) were considered outliers.

Kline (2016) advocated the use of Mahalanobis distance for multivariate outliers. According to Hair et al. (2022), "Mahalanobis distance evaluates the degree of freedom (D^2/df) as the criterion for detecting multivariate outliers. The threshold value is 2.5 for small samples (up to 200) and 3–4 for large samples." Multivariate outliers were detected using a threshold of $D^2/df \geq 3.5$.

This study excluded extreme multivariate outliers with D^2/df exceeding 3.5. The resulting 665 samples were used for further analysis. The skewness varied from -1.55 to -.48. The kurtosis values ranged from 2.58 to -.56. Kline (2016) suggested an acceptable skewness and kurtosis of ± 3 . All skewness and kurtosis values fall within these parameters.

SPSS collinearity diagnostics test multicollinearity using regression to examine tolerance and VIF. (Hair et al., 2022) recommend this as "an essential and reliable test of multicollinearity." The tolerance ranged from 0.50 to 0.84, which was higher than the recommended value of 0.1. The VIF ranged from 1.18 to 1.99, which is below 10; thus, it was accepted.

4.1 Exploratory Factor Analysis

In SPSS, the Kaiser-Meyer-Olkin (KMO-test) "measures sampling adequacy and offers a convenient option to check whether the sample is adequate." A KMO value ≥ 0.60 indicates a good criterion for factorability" (Tabachnick & Fidell, 2018). The KMO "measure of sampling adequacy" was .903 (values above 0.9 are superb), exceeding the minimum threshold value of .60. The threshold value for the Bartlett test was 0.05; therefore, the data ($\chi^2 (378) = 6199.88, p < .00$) were valid.

Previous studies on brand personality (Aaker, 1997; Bosnjak et al., 2007) have used principal component analysis (PCA). It is appropriate for summarising the data (Hair et al., 2022). Principal component analysis (PCA) was used for the factor extraction.

Field (2019) suggested that "problematic items are those traits whose factor loading or communality is lower than 0.4 and 0.5, respectively." In addition to cross-loading values exceeding 0.4 for more than one factor, these are also problematic. Items with low (< 0.5) and high (> 0.40) cross-loadings were excluded. Low communalities (< 0.50) were

considered for elimination. After inspecting all items, 12 failed to qualify for further analysis and were removed. The study extracted five factors with eigenvalues greater than unity. This explained 66.2% of the variance (refer to Table 3 below). The five-factor model had 16 items with communalities ranging from 0.55 to 0.77.

Table 3. Exploratory Factor Analysis

Rotated Component Matrix		Component				
	Mean	1	2	3	4	5
Durable	6.39	.791				
Engineered	6.32	.753				
Reliable	6.41	.715				
Trustworthy	6.38	.700				
Genuine	6.32	.694				
Attractive	5.96		.832			
Prestigious	5.75		.711			
Appealing	5.77		.700			
Status	5.19			.859		
Stylish	5.37			.724		
Premium	5.72			.649		
Innovative	5.95				.843	
Elegant	6.09				.702	
Classy	5.72				.661	
Rugged	4.80					.856
Tough	5.07					.830
Eigenvalue		5.14	1.91	1.4	1.11	1.04
% of Variance	32.1	11.9	8.7	6.95	6.50	
Cumulative %	32.1	44	53	59.7	66.2	

4.2 Internal Consistency Assessment

Reliability refers to the accuracy or precision of a measuring instrument. This is a necessary condition for the validity of the model. Internal consistency reliability is one of several ways to calculate the most acceptable measure. Internal consistency reliability was measured using Cronbach's alpha" (Cortina, 1993). An alpha of 0.70 indicates strong item covariance (Hair et al., 2022). This suggests that the sampling domain has been captured.

The scale had good internal consistency (Cronbach's alpha = .836). All items were worthy of retention; the minimal increase in alpha resulting from deleting the item rugged was negligible (.009).

4.3 Factor Naming

To balance the scale, the researcher reviewed the item meanings. The item reliably captures "trustworthy and genuine." Merging these three items into a single item, reliable," would not change the scope and meaning of the dimension (Geuens et al., 2009). Furthermore, all dimensions will have 2 or 3 items and will appear balanced.

Factor naming is a subjective process. Researchers should be thoughtful when deciding on factor names. Factor names may influence future interpretations. A panel of four experts was consulted to address subjectivity—an indicative list of

factor names and items was presented to a panel of experts. Figure 5 shows the five-factor model of the car brand personality. This was based on the inputs received from the experts.

4.4 Confirmatory Factor Analysis (CFA)

AMOS version 21 was used to conduct a confirmatory factor analysis (CFA). CFA helps determine the robustness of the factor structure. The CFA model had an acceptable fit. The indicated fit indices were: $\chi^2 = 285.284$ (df =67, p = .000), TLI = .9, CFI = .927, GFI = .943, AGFI = .91, RMSEA = .07 p close (0), and SRMR = .058. Although the model fit was acceptable, it was advisable to exclude the problematic indicators. This may further purify these new measures.

4.4.1 Elimination of Problematic Indicators

Hair et al. (2022) state that "sometimes, the first re-specification may be necessary to respond to non-convergence or an improper solution. Non-convergence can occur because of an incongruent sample covariance pattern. Alternatively, it is caused by sampling error in conjunction with a properly specified model or by misspecification."

This study evaluated and eliminated problematic indicators, as suggested by Mackenzie (2011). Problematic indicators with "non-significant ($z < 1.96$) or weak (standardised

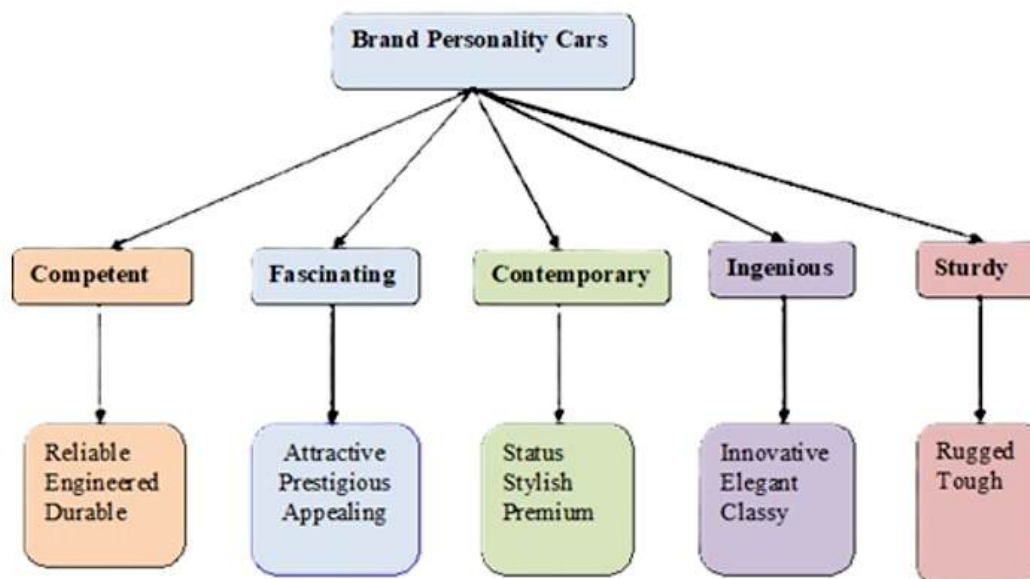


Figure 5. Brand Personality Traits (EFA)

loadings below .60)" were identified. The rugged item had a standardised loading of .552. The variance error term had a CR (z-score) of 1.493 with a p-value of .136. The reliability analysis results indicated a corrected item-total correlation of .236. The value was below 0.3, which is an acceptable threshold. Thus, dropping the item and the sturdy dimension from the scale, which had two items, was appropriate. This finding supports the findings of Aaker et al. (2001). Their rugged dimensions were replaced.

Kline (2016) stated, "residuals are the difference between the observed and estimated covariance." According to Hair et al. (2022), "residuals have either positive or negative values. They represent the error in covariance prediction with acceptable values of standardised residuals to $\geq \pm 2.58$."

The authors indicated that values between 2.5 and 4 are problematic. However, values greater than 4 are unacceptable. The study matrix found that item (classy) had three items (premium 3.0, 2.98 stylish, durable -3.17). Another item (premium) had two items (reliability 2.65, engineered 2.78) with values above 2.58. The investigation of the modification indices revealed that these two items created disturbances in the table. Hence, they are worth dropping. After removing these two items, the second run of the re-specified CFA model (Figure 6) improved model fit.

All model fit values were within the recommended thresholds and were acceptable. Figure 7 illustrates the revised scale.

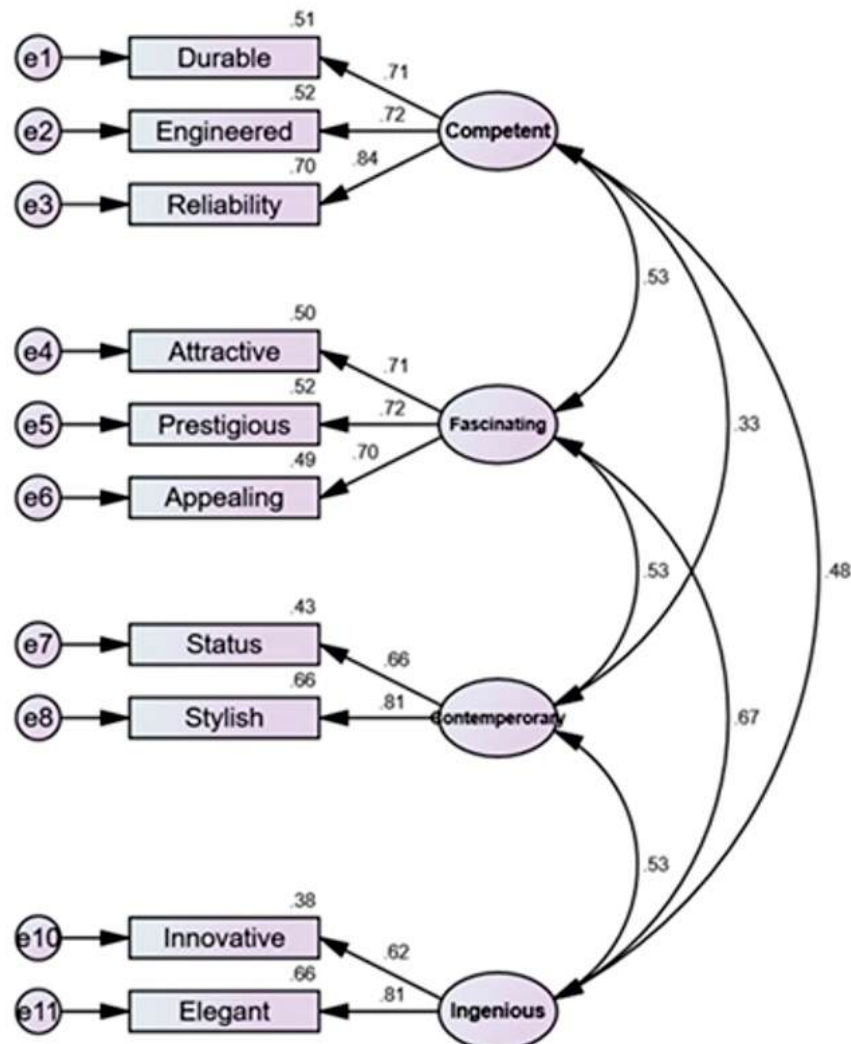


Figure 6. Confirmatory Factor Analysis Model

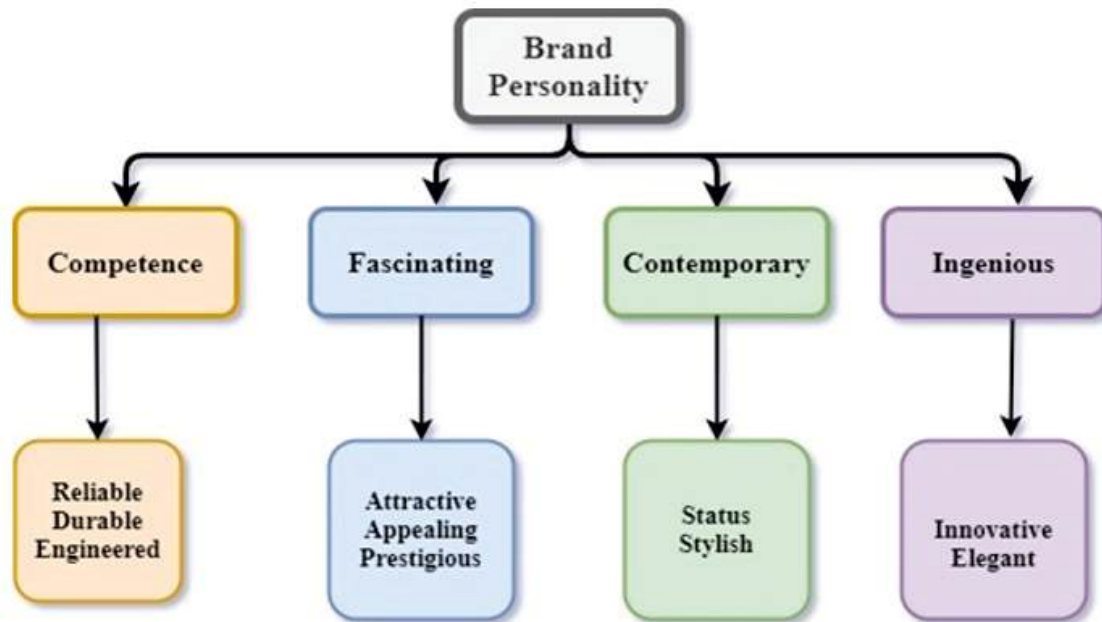


Figure 7. Revised Brand Personality Scale after (CFA)

4.5 Construct Reliability

Hair et al. (2022) defined construct reliability as the "reliability and internal consistency of the measured variables representing a latent construct." Construct reliability (CR) measures internal consistency. SEM assists researchers in computing composite reliability. Hair et al. (2022) suggested a "reliability of 0.7" as good. Further, 0.6 is acceptable" if all other constructs in the model have good reliability" (Bagozzi & Yi, 2012). They reckon that composite reliability values of 0.6 or higher are helpful in this regard.

The "composite reliability" of the four dimensions ranged from 0.704 to 0.804, indicating good reliability. The CR values observed were 0.804, 0.755, 0.704, and 0.722 for competent, fascinating, contemporary, and ingenious, respectively. All composite reliabilities were ≥ 0.70 . According to Hair et al. (2022), the construct exhibited good reliability.

4.5.1 Validity Assessment

Construct validity is a central concept in psychometric analyses. According to Westen and Rosenthal (2003),

convergent and discriminant validity facilitate the establishment of construct validity.

As per Churchill (1979), the estimation of correlations between a measure of a construct and other measures should be associated with it (convergent validity) or vary independently of its discriminant validity. The author states, "a measurement instrument is valid if it is free of random errors and is conceptually correct." An instrument is considered valid if it measures what it is supposed to measure.

4.5.2 Convergent Validity

This measures the degree of correlation among indicators of the same construct (Ashill & Jobber, 2010). Ashill and Jobber (2010) assessed convergent validity using three measures.

An AVE of 0.50 or more and a composite reliability (CR) above .6 confirm convergent validity (Bagozzi & Yi, 2012) and suggest that Cronbach's α should be at least .70 to show convergent validity. The results of this study fulfilled these criteria (See Table 4).

Table 4. Convergent and Discriminant Validity

	CR	AVE	MSV	MaxR (H)	Competent	Fascinating	Contemporary	Ingenious
Competent	0.8	0.58	0.281	0.819	0.761			
Fascinating	0.76	0.51	0.419	0.755	0.530***	0.712		
Contemporary	0.7	0.55	0.276	0.73	0.328***	0.526***	0.739	
Ingenious	0.72	0.57	0.419	0.77	0.460***	0.647***	0.509***	0.722

(† $p < 0.100$; * $p < 0.050$; ** $p < 0.010$; *** $p < 0.001$)

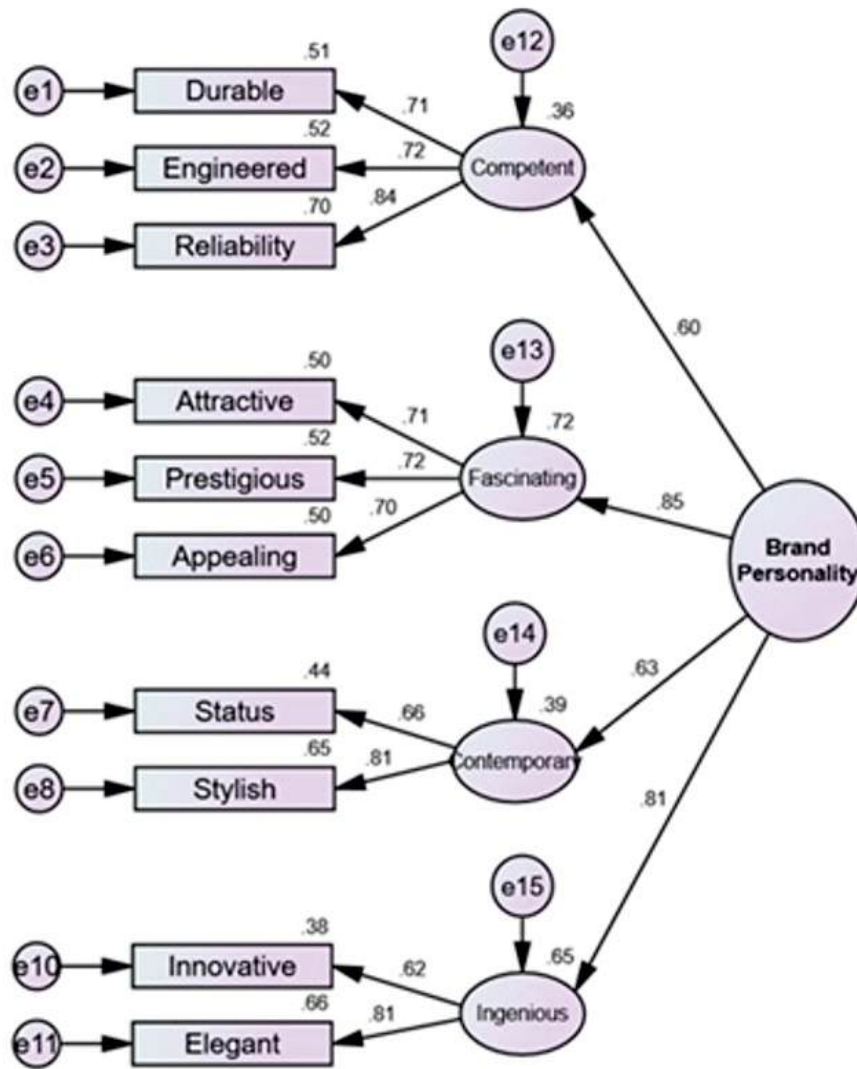


Figure 8. Brand Personality Second Order

4.5.3 Discriminant Validity

According to Hair et al. (2022), discriminant validity indicates the extent to which one construct differs from another. It also measures the degree of difference between overlapping constructs.

This study used the "Master Validity Tool," an AMOS plug-in by Gaskin (2016). This helped to test "composite reliability (CR)," "average variance extracted (AVE)," and "maximum-shared variance (MSV)." Table 4 presents the results.

The four factors reported average variance extracted (AVE) values higher than .50. The construct reliabilities of all factors were higher than .70, indicating "adequate convergent or internal consistency" (Bagozzi & Yi, 2012). The correlations among the factors, "between factors," and "squared correlation estimates" provide evidence of discriminant validity. (Refer to Table 4)

The results confirmed the distinct representation of the second-order construct. These findings follow "standard practice in the scale development process" (Ramani & Kumar, 2008). These findings suggest that the brand personality scale is a second-order factor. It is characterised by first-order factors of competence, fascination, contemporaneity, and ingenuity.

5. Discussions

This study employed a two-phase mixed methods approach to investigate brand personality in cars. The first qualitative phase focused on trait generation, employing semi-structured interviews, free elicitation techniques, and systematic trait reduction procedures. The second quantitative phase involved the empirical validation of the generated personality dimensions.

4.6 Second-Order Construct

The 4-factor brand personality scale for cars demonstrated convergent and discriminant validity. This method was established using EFA and CFA. The model achieved all recommended fit indices, with all t-values above 1.96. Following Brakus et al. (2009), this study tested a second higher-order construct. (As shown in Figure 8 below)

The factor loadings for competent, fascinating, contemporary, and ingenious were 0.60, 0.85, 0.62, and 0.77, respectively. The R values for all sub-constructs were (0.36, 0.73, 0.38, and 0.60). This reflects that the contribution of brand personality to its four sub-constructs is good to moderate. The second-order construct of brand personality for cars was a good fit for the data. All fit statistics were above .95, while RMSEA values were .057 ($p < .179$) and SRMR .04. All t-values were higher than 1.96. Refer to Table 5 below.

This study conducted a comprehensive review of the existing literature. The review included both human and brand personality conceptualisation and measurement. The Big Five factor model is the most appropriate. The OCEAN (openness, conscientiousness, extraversion, agreeableness, and neuroticism) factors form a reliable framework. The labels of these five factors may vary among researchers. However, their fundamental content remains consistent (Digman, 1990).

Aaker's (1997) seminal data-driven study emerged as the most representative work in the reviewed literature. The analysis revealed two primary approaches to identifying brand personality traits. The human psychology-driven approach. The other was projective techniques, including semi-structured interviews, free elicitation, and content analysis.

Table 5. Model Fit Indices Brand Personality second order

Measure	Estimate	Threshold
CMIN/DF	3.138	Between 1 and 3
CFI	0.969	> 0.95
TLI	0.954	> 0.95
GFI	0.971	> 0.95
SRMR	0.04	< 0.08
RMSEA	0.057	< 0.06
P Close	0.179	> 0.05

Source: Authors

Phase One: Trait Generation and Reduction

The initial trait-generation process yielded 303 items from the existing literature. These traits were derived from the Big Five model and established brand personality scales. Language and subject matter experts refined this collection to 130 items. They dropped low-frequency and inappropriate terms from their original list.

Subsequently, semi-structured interviews, free elicitation techniques, and content analysis generated 118 items. The cross-referencing of items from both sources resulted in a consolidated list of 64 traits. A sample of 305 car owners (representing 87.5% of the respondents) evaluated the 64 items on a 7-point Likert scale. This enabled a further reduction to a manageable set of 28 items in the quantitative phase of the study.

Phase Two: Quantitative Validation

The quantitative study involved 665 participants who evaluated 28 statements assessing brand personality. Exploratory Factor Analysis (EFA) revealed five salient personality dimensions. The five dimensions—Competent, Fascinating, Contemporary, Ingenious, and Sturdy—comprise 14 items.

Confirmatory Factor Analysis (CFA) was employed to re-examine the identified brand personality factors. This study eliminated problematic indicators. Thus, enhancing the validity and reliability of both the scale and individual indicators. The sturdy dimension reported inadequate statistical significance ($t\text{-value} < 1.96$ and $p\text{-value} > .05$). The sturdy dimension was in line with the concept of ruggedness.

This finding aligns with previous research on automotive brand personalities. Ranjbar (2010) found that ruggedness was unreliable in Iranian car brand studies. This supported the finding that ruggedness was inappropriate for automobiles in China. Similarly, Rojas-Méndez et al. (2004) applied Aaker's scale to investigate Ford's brand personality in Chile. Their study failed to achieve reliability and validity, particularly for the ruggedness factor. Aaker (1997) reported a low mean of 2.49 on a 5-point scale for the rugged dimension, and in subsequent research, Aaker et al. (2001) replaced this dimension with ruggedness.

Methodological Innovation

A significant methodological distinction in this study was the approach to brand selection. This was performed for both

trait generation and evaluation. Previous scholars (Aaker, 1997; Caprara et al., 2001; Sung & Tinkham, 2005) asked respondents to evaluate well-known, pre-selected brands. The brands selected for trait generation often differed from those used in empirical studies. For instance, Aaker (1997) used Saturn, Camry, and Mercedes vehicles to generate traits. However, they employed different brands in subsequent studies. Similarly, George and Anandkumar (2018) selected Toyota cars for trait generation but used Hero Honda motorcycles for their final study in India.

In contrast, this study asked participants to evaluate their preferred car brands. No predetermined brands were mentioned to the respondents in the questionnaire. Researchers have consistently applied this approach across both the trait generation and empirical study phases.

Findings and Factor Definitions

The analysis revealed that brand personality functioned as a second-order construct. Four first-order factors—competence, fascination, contemporary, and ingenious—represent brand personality. This hierarchical structure represents the original contribution of the present study. The factors are defined as follows:

A key question raised by the results is whether the four identified factors represent a genuinely novel structure or a relabelling of Aaker's (1997) dimensions. We argue that the four factors are substantively distinct. The Competent dimension echoes Aaker's Competence factor, confirming reliability and quality as stable cross-context attributes. However, the remaining three factors diverge meaningfully. The Fascinating dimension defined by attractiveness, appeal, and prestige integrates aesthetic judgement with aspirational social signalling, absent from Aaker's Sophistication, which focuses narrowly on upper-class elegance.

The Contemporary dimension captures status and style. This reflects the prominent role of car ownership as a socio-economic status marker in India's aspirational urban markets. Hence, the factor contemporary is more socially grounded than Aaker's Excitement.

The Ingenious dimension encompasses innovation and elegance. It truly reflects the premium Indian consumers place on technological sophistication and design creativity. This is not distinctly captured in any single Aaker factor.

The consistent elimination of the Rugged/Sturdy dimension across multiple automotive studies (Rojas-Méndez et al., 2004; Ranjbar, 2010; present study) further confirms that

durability is subsumed into Competent rather than forming a separable rugged identity. The four dimensions are defined as follows.

- a) Competent: encompasses reliability, engineering quality, and durability, foundational trust attributes for automobiles, paralleling Conscientiousness in human personality.
- b) Contemporary: captures status and style, reflecting the car's role as a social identity marker.
- c) Fascinating: represents aesthetic judgement characterised by attractiveness, appeal, and prestige.
- d) Ingenious: encompasses innovation and elegance, representing the desire for technological sophistication and creativity in automotive design.

6. Implications

6.1 Theoretical Contribution

The resulting brand personality scale had ten items; hence, it was short and easy to use. The scale was consistent and passed various psychometric reliability and validity tests. The identified personality factors align with both utilitarian and hedonic considerations. Chitturi, Raghunathan, and Mahajan (2008) suggested that these characteristics reflect car owners' personalities and behaviours. The personality factors corresponding to hedonic benefits are fascinating, contemporary, and ingenious. In contrast, the competent factor relates to utilitarian benefits.

Drawing on established psychological theories of personality and brand personality research, this study offers fresh perspectives on how academic researchers approach scholarly advancement. The primary focus was on understanding why consumers develop stronger connections with certain brands than with others. These findings extend beyond traditional consumer behaviour frameworks.

The mixed-methods approach combines qualitative and quantitative techniques. This study was instrumental in developing a tool for measuring brand personality. It validated Aaker's (1997) seminal framework in the context of Indian consumers. This study makes a significant contribution to the literature by introducing a scale specifically for high-involvement products. The free elicitation study played a crucial role in item generation. The authors found that Indian consumers attributed distinct

personality traits to brands, consistent with previous research findings. This confirms consumers' natural tendency to anthropomorphise brands and treat them as entities with human-like characteristics.

The resulting measurement scale consists of four dimensions and ten items, representing a significant advancement in brand research. This streamlined instrument has substantial potential for both academic and industry practitioners. For researchers, the scale serves as a reliable tool for examining high-involvement products, with passenger cars exemplifying a context that embodies both high-involvement and high-value product categories. These implications also extend to methodological considerations. Theoretically, this study reinforces the cross-cultural applicability of brand personality concepts and underscores the importance of context-specific validation. These findings suggest that while fundamental personality attribution processes may be universal, their manifestations can vary across cultural boundaries. Therefore, careful adaptation of measurement tools for different markets is necessary.

6.2 Managerial Implications

The car brand personality scale can replace the provisional measures that are currently in use. Existing players can use this new measure for individual sub-car brands. Additionally, it helps compare brands across categories and with competitors. Marketing managers can establish differentiation points. Managers can do this by evaluating and assessing the brand's intended personality traits. Thus, they can contrast the intentions and personalities of competing car brands. Practitioners may adopt a scale at the individual brand and industry levels. This may help with between-brand, within-category comparisons. Global firms may use the scale to determine the degree to which "their brands" have a "global brand personality."

Brand personality enhances the perception of an offering (Coelho et al., 2020; Kolbl et al., 2020). The level of brand involvement also impacts brand personality. Thus, this scale may be beneficial for other high-involvement products. Practitioners can use the brand personality scale to assess other related variables in future studies. The related variables included loyalty, attachment, and brand preferences.

Practitioners can use new measures to assess the influence of these factors on various variables. These may be financial, reputational, or brand performance. Furthermore, the scale may help firms target appropriate segments.

7. Limitations and Future Research

This study has several limitations that define the scope of its findings and motivate future research. First, the sample was drawn exclusively from four major urban centres (Pune, Mumbai, Delhi, and Surat), which, while representative of India's primary automobile markets, do not capture the linguistic, cultural, and socio-economic diversity of the country as a whole. India's vast regional heterogeneity spans tier-2 and tier-3 cities, rural markets, and distinct cultural subgroups, which means that pan-Indian generalisation of the scale requires additional validation with broader, multi-regional samples. Second, the study focuses exclusively on passenger cars, and the factor structure identified here should not be assumed to transfer automatically to other high-involvement categories such as consumer electronics, luxury goods, or financial services — each of which may produce different constellations of salient personality traits. Third, 12.5% of respondents were not car owners at the time of the survey; while retained on grounds of experiential familiarity, this warrants investigation in future studies. Fourth, the sample skews male (75.35%), which may not fully capture the growing proportion of female car buyers in urban India.

Notwithstanding these limitations, this study introduces the first psychometrically validated brand personality scale specifically designed for passenger cars in India. Future research should seek to: (a) replicate the scale's factor structure across broader Indian regional markets; (b) validate it in international automobile markets, particularly other emerging economies; (c) test the scale in other high-involvement product categories; (d) examine sub-brand level personality (e.g., Maruti Suzuki Baleno, Volkswagen Polo) rather than company-level brands; and (e) explore consequences of car brand personality on brand loyalty, attachment, purchase intention, and willingness to pay a premium.

8. Conclusion

This study developed and validated a four-dimensional brand personality scale for passenger cars in India. The study adopted a rigorous two-phase mixed-methods design. The underpinning theories that guided the research were grounded in the Big Five personality framework and high-involvement consumer behaviour theory. The resulting scale has Competent, Fascinating, Contemporary, and Ingenious dimensions across ten items. These findings depart from Aaker's (1997) five-factor model in theoretically substantive ways. The composite reliability for the scale ranged from 0.704 to 0.804, and AVE exceeded 0.50 for all constructs. Both first-order and second-order

CFA models achieved acceptable fit across all recommended indices. Thus, the scale demonstrated strong psychometric properties. Researchers such as Bosnjak et al. (2007), Herbst and Merz (2011), Muller and Bevan-Dye (2016), Ahmad and Thyagaraj (2017) have similarly challenged Aaker's five-factor universality. The present study, like several prior findings, extends this literature by offering a contextually validated and empirically grounded alternative. The scope of these conclusions is explicitly bounded as the scale was developed and validated in the passenger car category. The samples drawn were from major urban markets in India. It should be treated as a validated instrument for passenger car brand personality measurement in this context, with promising but as-yet-unconfirmed applicability to other high-involvement categories and national markets. Within its established scope, however, the scale provides car manufacturers and marketers with a concise, context-sensitive tool to benchmark brand personality, identify competitive differentiation opportunities, and devise targeted positioning strategies in India's rapidly evolving automobile market.

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Modelling Employee Effectiveness in the Indian IT Sector Using an Integrated DEMATEL–PLS–SEM–ANN Approach

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A b s t r a c t

Amid rapid digital transformation in the Indian Information Technology (IT) sector, enhancing employee effectiveness (EE) through structured competency skills interventions (CSI) has emerged as a strategic imperative. This study proposes an integrated analytical framework combining decision-making trial and evaluation laboratory (DEMATEL), partial least squares structural equation modelling (PLS-SEM), and artificial neural networks (ANN) to evaluate the causal, structural, and nonlinear effects of CSI on EE. The mediating roles of change management (CM) and employee involvement (EI), along with the moderating effect of employee empowerment (EEmp), are explored through the theoretical lenses of the resource-based view (RBV), the job demands–resources (JD–R) model, and organisational change theory. A structured instrument, validated using Lawshe's content validity ratio (CVR), yielded 27 items across five constructs. Survey data from 412 IT professionals across major Indian tech hubs were analysed. DEMATEL results classified CSI and CM as primary causal drivers, while PLS-SEM confirmed all direct, mediating, and moderating hypotheses ($R^2 = 0.853$; SRMR = 0.062). ANN results demonstrated strong predictive performance ($R^2 = 0.872$), identifying CSI, EI, and CM as key predictors. The proposed hybrid DEMATEL–PLS–SEM–ANN framework offers methodological rigour and actionable insights for optimising employee effectiveness through strategic competency development in high-skill, knowledge-intensive environments.

Keywords: *Competency Skills Intervention; Employee Effectiveness; Change Management; Employee Involvement; Employee Empowerment.*

1. Introduction

In today's rapidly evolving digital economy, employee effectiveness (EE) has become a cornerstone of organisational success, particularly in knowledge-intensive sectors like Information Technology (IT) (Torkabadi et al., 2025). The Indian IT sector, ranked among the top global outsourcing hubs, is experiencing unprecedented transformation driven by automation, hybrid work models, global competition, and continuous innovation (Vohra, Patwardhan, and Upadhyay 2025). Amid this flux, organisations are increasingly recognising human capital as a strategic asset and seeking ways to enhance employee performance through targeted learning and development strategies (Kumar & Shankar, 2007). One such strategy, the competency skills intervention (CSI), involves systematic efforts to upskill and reskill employees and align their capabilities with dynamic organisational goals (Kaur & Kumar, 2023; Shieh et al., 2010). However, the success of CSI does not rely solely on the design of training programs; it critically depends on the organisational ecosystem within which it is deployed (Qasem et al., 2020).

Key organisational enablers, such as change management (CM) and employee involvement (EI), often mediate the translation of CSI into actual performance outcomes (Johnson et al., 2013; Torkabadi et al., 2025). Moreover, the extent to which employees feel empowered, reflected in their autonomy, confidence, and control over their work, can further moderate these relationships, making employee empowerment (EEmp) an important contextual factor (Torkabadi et al., 2025). Despite this complex interplay, most empirical studies focus only on direct, linear relationships between training and outcomes, neglecting the mediating and moderating mechanisms that operate in real-world organisational settings (Jain & Jeppesen, 2013; Si et al., 2018). Furthermore, conventional statistical approaches such as regression or structural equation modelling (SEM) may not fully capture the nonlinear, interaction-driven nature of behavioural outcomes in dynamic work environments like the Indian IT sector (Kaur & Kumar, 2023; Shieh et al., 2010).

There is a pressing need for integrated, system-oriented research that considers CSI not in isolation but as part of a broader behavioural and organisational process. Current literature also lacks sector-specific evidence from the Indian IT domain, where high employee turnover, distributed teams, and continuous learning pressures make CSI both

vital and contextually challenging (Li, Ali, and Ryu, 2019; Liou & Tzeng, 2012; Mishra & Sharma, 2021). Addressing these limitations, this study proposes a novel hybrid analytical framework that integrates decision-making trial and evaluation laboratory (DEMATEL), partial least squares structural equation modelling (PLS-SEM), and artificial neural networks (ANN) to investigate the causal, structural, and nonlinear effects of CSI on EE.

DEMATEL identifies causal interdependencies among constructs, PLS-SEM tests hypothesised direct and indirect relationships, and ANN captures nonlinear patterns and variable importance (Boyatzis, 2008; Wilson et al., 2009). This triangulated design enables a holistic understanding of how CSI influences EE through CM and EI, and how EEmp conditions these effects (Chun & Nam, 2020; Jain & Jeppesen, 2013; Sharma & Singh, 2025). The research is grounded in a multi-theoretical foundation, i.e., resource-based view (RBV) for strategic competencies (Cahyono, 2018), Job Demands–Resources (JD-R) model for performance under pressure (Venkatesh & Zhang, 2024), organisational change theory for successful transitions (Armenakis & Harris, 2009), and social cognitive theory (SCT) for modelling empowerment and self-efficacy (Si et al., 2018).

Given the rapid digital transformation, high attrition rates, and continuous upskilling demands in the Indian IT sector, examining the effectiveness of competency-based interventions within this context becomes critically important. The rest of the paper is structured as follows: the literature review develops key constructs and hypotheses; the methodology outlines CVR-based tool validation, sampling, and the hybrid DEMATEL–PLS-SEM–ANN approach; the results present causal mapping, structural model findings, and ANN predictions; the discussion interprets theoretical and practical implications; and the conclusion highlights contributions, limitations, and future research directions.

2. Literature Review and Theoretical Foundation

2.1 Concept of Competency Skills Intervention (CSI) and its Impact on Employee Effectiveness

The CSI has been widely acknowledged as a strategic mechanism for enhancing employee performance and organisational agility in dynamic, skill-intensive industries such as IT (Rodriguez et al., 2002). Defined as a set of

structured, systematic efforts aimed at developing employee capabilities through training, upskilling, and learning programs aligned with organisational goals, CSI plays a critical role in shaping individual and collective work outcomes (L. Y. Leong et al., 2019). Empirical studies have shown that when competency-based programs are well-structured and linked to job requirements, they lead to improved employee adaptability, technical proficiency, and task completion efficiency (Liu et al., 2013; Lynch et al., 2013). Moreover, CSI initiatives that include ongoing support, feedback, and alignment with performance expectations tend to generate higher employee commitment and output (Meyerson & Dewettinck, 2012; Pourkhodabakhsh et al., 2022). In light of this, the first hypothesis of this study is proposed:

H1: *Competency Skills Intervention (CSI) has a positive and significant effect on Employee Effectiveness (EE).*

2.2 Role of Change Management and Employee Involvement

The CSI is rarely effective in isolation; its impact on organisational outcomes, such as employee effectiveness (EE), is often contingent on the presence of key mediating mechanisms, most notably employee involvement (EI) and change management (CM) (Sun et al., 2013). These constructs serve as organisational enablers that bridge the gap between skill-building initiatives and actual performance improvements (Ployhart & Moliterno, 2011; Pollack Porter et al., 2010; Rao & Kumar, 2020).

The EI refers to the extent to which employees are engaged in decision-making processes, take initiative, and contribute actively to organisational tasks beyond their formal roles (Fernandez & Moldogaziev, 2013; Gupta & Sahoo, 2021). Empirical studies suggest that when employees are involved in meaningful ways, interventions such as CSI are more likely to translate into enhanced motivation, learning ownership, and ultimately better performance outcomes (Morgan & Zeffane, 2003; Tsai, 2014). In the context of Indian IT organisations characterised by distributed teams and high learning pressures, such involvement is crucial for aligning competency development with day-to-day operational realities (Duncan et al., 2011; Potnuru et al., 2021).

Similarly, the CM plays a pivotal role in the successful implementation of CSI programs. CM encompasses leadership communication, change readiness, support

mechanisms, and the systematic handling of transitions (Torkabadi et al., 2025). Organisations with strong change management practices are more likely to internalise and institutionalise CSI efforts, thereby enhancing their influence on employee behaviour and outcomes (Byun & Mills, 2011; Vohra et al., 2025). Prior literature has affirmed that both EI and CM not only improve organisational alignment and adaptability but also serve as mediating constructs that facilitate the pathway from CSI to EE (Hochart & Lang, 2011; Singh & Sanjeev, 2013). This study integrates these insights by proposing the following hypotheses:

H2: *Competency Skills Intervention (CSI) has a positive and significant effect on Employee Involvement (EI).*

H3: *Competency Skills Intervention (CSI) has a positive and significant effect on Change Management (CM).*

H4: *Employee Involvement (EI) has a positive and significant effect on Employee Effectiveness (EE).*

H5: *Change Management (CM) has a positive and significant effect on Employee Effectiveness (EE).*

H6: *Employee Involvement (EI) mediates the relationship between CSI and EE.*

H7: *Change Management (CM) mediates the relationship between CSI and EE.*

2.3 Moderating Effects of Employee Empowerment

While the EI and CM serve as mediators in the pathway from CSI to EE, the strength of this relationship is es variables into cause-effect groups (Li et al., 2019), PLS-SEM estimates direct and indirect effects (Podsakoff, MacKenzie, and Podsakoff, 2012), while ANN models complex nonlinear relationships and variable importance (Sabraz Nawaz & Thelijagoda, 2025). In HR contexts, such hybrid frameworks have been successfully used to analyse competency development, employee engagement, and innovation readiness (Askar et al., 2021; Seibert et al., 2004). This triangulated methodology enhances model robustness and predictive capability, aligning well with the multi-dimensional nature of employee effectiveness explored in the current study (Malik & Garg, 2017; Sutarman et al., 2024).

2.4 Theoretical Framework

This study integrates four complementary theories to construct a robust framework linking Competency Skills

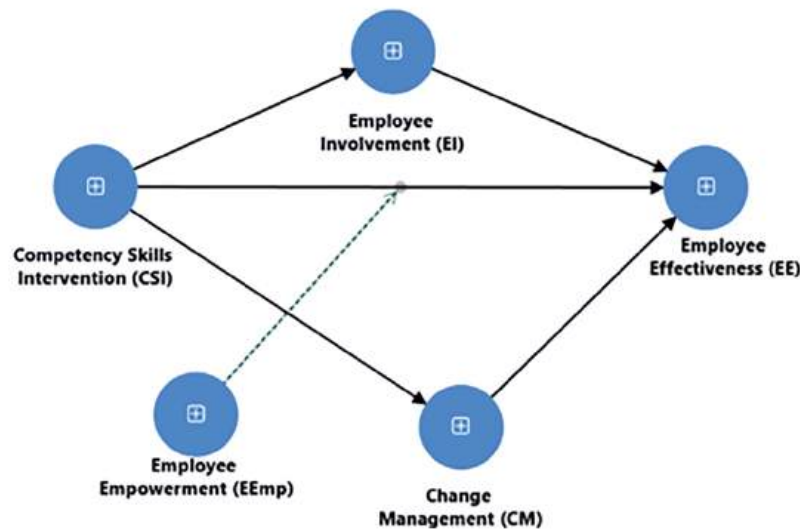


Figure 1. Proposed Theoretical Model

Intervention (CSI) to Employee Effectiveness (EE). The Resource-Based View (RBV) treats CSI as a strategic internal capability that enhances organisational performance (Barney, 1991). Organisational Change Theory identifies Change Management (CM) and Employee Involvement (EI) as key mediators facilitating transformation (Armenakis & Harris, 2009). The Job Demands–Resources (JD-R) model positions CSI, CM, and EI as job resources that reduce strain and enhance performance (Bakker & Demerouti, 2017). Social Cognitive Theory (SCT) supports the inclusion of Employee Empowerment (EEmp) as a moderator, highlighting the role of self-efficacy and autonomy (Bandura, 1986). These theories collectively underpin the integrated research model illustrated in Figure 1, supporting direct, mediating, and moderating pathways.

2.5 Identification of Research Gaps

Despite growing interest in competency development and HR analytics, several gaps remain. First, existing literature often treats CSI as a standalone training input without exploring its dynamic role within broader organisational change mechanisms (Butt & Khan, 2022; Rafiei & Pourreza, 2013). Second, while the CM and EI are acknowledged as drivers of effectiveness, their mediation roles between CSI and EE remain underexplored, especially in the Indian IT

context (Chong et al., 2018; Ibrahim & Gidh, 2014). Third, limited studies incorporate EEmp as a moderator in HR models, thereby ignoring its amplifying effects (Hair et al., 2019). Fourth, few frameworks combine causal–structural–nonlinear modeling (DEMATEL–PLS–SEM–ANN) for comprehensive analysis (Podsakoff et al., 2012; Thite & Russell, 2010). This study addresses these gaps with a triangulated, theory-driven framework to deepen understanding of how CSI translates into EE via CM, EI, and EEmp.

3. Research Methodology

3.1 Research Design Overview

This study adopts a robust quantitative multi-method design integrating three complementary techniques, i.e., DEMATEL, PLS-SEM, and ANN, to examine the impact of CSI on EE through the mediating influence of CM and EI and the moderating role of EEmp. This integrated methodology ensures comprehensive insight by combining causal structural exploration (DEMATEL), hypothesis testing (PLS-SEM), and nonlinear predictive modelling (ANN), offering both explanatory and predictive rigour (Prakash, 2019). The stepwise workflow followed in this research is illustrated in Figure 2, which outlines the sequence from construct validation and DEMATEL analysis to SEM estimation and ANN deployment

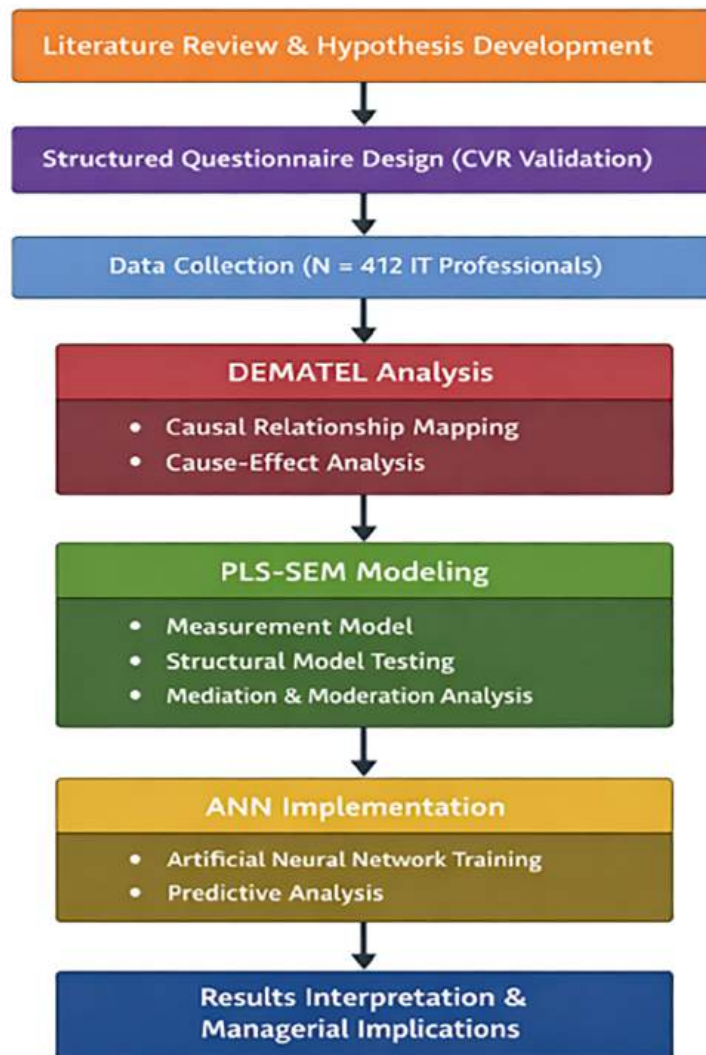


Figure 2. Study Flowchart

3.2 Instrument Development and Validation

The research instrument was a structured questionnaire developed from previously validated scales to measure five constructs. Specifically, competency skills intervention items were adapted from Mishra and Sharma (2021), while change management items were derived from Panda and Rath (2021). Measures for employee involvement were based on Mattar (2021), employee empowerment items on Sahai et al. (2024), and employee effectiveness items on Wanberg and Banas (2000). Each item was rated on a 5-point Likert scale ranging from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*). To ensure content validity, the CVR

method proposed by Lawshe (1975) was employed. A panel of 15 subject-matter experts rated the essentiality of each item. According to Lawshe's table, a CVR threshold of 0.49 was used for 15 experts, and items below this threshold were excluded.

Out of the original 30 items, 27 were retained after CVR-based screening. Specifically, one item each from CSI (CSI4), EI (EI6), and EEmp (EEmp6) was dropped for not meeting the CVR threshold. The retained items showed CVR values ranging from 0.60 to 1.00, indicating strong consensus on their essentiality. The item-wise CVR calculations and decisions are summarised in Table 1, which also includes construct sources and expert ratings.

Table 1. Construct-wise Item Description, CVR Validation, and Retention Status

Construct	Item Code	Measurement Statement	Source	n_c	N	CVR	Decision
Competency Skills Intervention (CSI)	CSI1	The organisation provides regular competency-based training programs.	(Belbag 2025; Mishra and Sharma 2021; Pourkhodabakhsh et al. 2022)	15	15	1.00	Retained
	CSI2	Training programs are aligned with job requirements.		14	15	0.87	Retained
	CSI3	Skill development enhances technical and soft skills.		13	15	0.73	Retained
	CSI4	Feedback and coaching are provided during training.		11	15	0.47	Not Retained
	CSI5	The organisation promotes continuous learning and upskilling.		14	15	0.87	Retained
	CSI6	Competency initiatives support organisational goals.		12	15	0.60	Retained
Change Management (CM)	CM1	Organisational changes are clearly communicated to employees.	(Gupta and Sahoo 2021; Qasem et al. 2020; Sutarman et al. 2024; Venkatesh and Zhang 2024)	15	15	1.00	Retained
	CM2	Employees are informed in advance about upcoming changes.		13	15	0.73	Retained
	CM3	Management provides support during change implementation.		15	15	1.00	Retained
	CM4	Leadership explains purpose and benefits of change.		14	15	0.87	Retained
	CM5	Employee concerns are addressed during change.		12	15	0.60	Retained
	CM6	Change initiatives are managed effectively.		13	15	0.73	Retained
Employee Involvement (EI)	EI1	I am involved in decisions that affect my work.	(Panda and Rath 2021; Srivastava and Agrawal 2022; Venkatesh and Zhang 2024)	15	15	1.00	Retained
	EI2	My suggestions are valued by management.		15	15	1.00	Retained
	EI3	I actively participate in team decisions.		13	15	0.73	Retained
	EI4	I am encouraged to take initiative in my role.		12	15	0.60	Retained
	EI5	I contribute beyond my formal duties.		14	15	0.87	Retained
	EI6	My involvement improves work processes.		11	15	0.47	Not Retained

Employee Empowerment (EEmp)	EEmp1	I have autonomy in making decisions.	(L. Y. Leong et al. 2019; Qasem et al. 2020; Sahai et al. 2024; Sharma and Singh 2025; Venkatesh and Zhang 2024)	15	15	1.00	Retained
	EEmp2	I feel confident in handling work challenges.		15	15	1.00	Retained
	EEmp3	I have influence over how my work is carried out.		14	15	0.87	Retained
	EEmp4	My supervisor trusts my judgment in tasks.		13	15	0.73	Retained
	EEmp5	I am accountable for outcomes in my role.		12	15	0.60	Retained
	EEmp6	I am free to try new methods.		10	15	0.33	Not Retained
Employee Effectiveness (EE)	EE1	I consistently meet my performance targets.	(Kaur and Kumar 2023; Pourkhodabakhsh et al. 2022; Sutarman et al. 2024)	15	15	1.00	Retained
	EE2	I complete assigned tasks on time.		15	15	1.00	Retained
	EE3	My work contributes to team performance.		15	15	1.00	Retained
	EE4	I adapt effectively to organisational changes.		14	15	0.87	Retained
	EE5	My performance adds value to organisational goals.		13	15	0.73	Retained
	EE6	I proactively improve efficiency and quality.		12	15	0.60	Retained

3.4 Sampling Frame, Study Context (Indian IT Firms), and Data Collection

This study was conducted within the Indian Information Technology (IT) sector, a globally competitive and dynamic industry marked by rapid digital transformation, hybrid work environments, and a growing emphasis on human capital development (NASSCOM, 2023). The sector's reliance on continuous upskilling and adaptability made it a suitable context for examining the impact of CSI on EE. The target population included mid- and senior-level professionals employed in IT organisations across six major Indian tech hubs, i.e., Bengaluru, Pune, Hyderabad, Chennai, Gurugram, and Noida, who had at least one year of professional experience and were actively involved in organisational training or change initiatives. A stratified purposive sampling method (Chahal et al., 2023) was adopted to ensure representation across roles, locations, and organisation types, while eligibility screening was embedded within the online questionnaire to ensure data relevance and validity.

Data were collected using Google Forms over a 14-week period (August–November 2025), leveraging professional email networks, LinkedIn groups, and HR forums to disseminate 650 structured questionnaires. A total of 465 responses were received, of which 412 were complete and valid, yielding a response rate of 63.4%. This sample size exceeded the minimum threshold suggested by Hair et al. (2021) for PLS-SEM, which recommends 10–15 respondents per observed variable, translating to a required range of 270–405 for 27 items. Moreover, it met the criteria for robust testing of moderated mediation models and nonlinear predictive modelling (ANN), as supported by Chahal et al. (2023). The sampling strategy and response adequacy ensured sufficient statistical power, analytical precision, and generalizability of results within the Indian IT context.

Table 2 presents the demographic profile of the 412 valid respondents from Indian IT firms who participated in the study. The sample includes 247 males (59.95%) and 165

females (40.05%), ensuring gender diversity. In terms of age, the majority were between 31–40 years (44.90%), followed by 21–30 years (33.50%), 41–50 years (16.75%), and above 50 years (4.85%). The respondents held diverse job roles: senior developers (27.91%), team leads (25.73%), project managers (19.90%), HR/L&D professionals (10.68%), and other technical/support roles (15.78%). Work experience was well distributed, with 30.58% having 4–6 years, 27.18% with 7–10 years, and equal proportions (21.12%) having 1–3 years and above 10 years. Company type was varied, with respondents from MNCs (47.09%), mid-tier IT firms (29.37%), and startups (23.54%), reflecting different organisational scales. Geographically, most responses came from Bengaluru (26.21%), followed by Pune (19.90%), Hyderabad (16.26%), Chennai (13.59%), Gurugram (13.11%), and Noida (10.92%), capturing the key IT hubs across India. This diverse and stratified sample ensures robust capture of perspectives on competency interventions, change management, and employee outcomes in the Indian IT sector.

3.4 Statistical and Computational Tools

The present study employed a triangulated analytical framework integrating DEMATEL, PLS-SEM, and ANN to

comprehensively examine both causal and predictive relationships among the study constructs. DEMATEL was used to model and visualise the interdependencies among the latent constructs, enabling the identification of cause-and-effect groupings critical for subsequent model design (Sharma & Singh, 2025; Venkatesh & Zhang, 2024). This technique provided an empirical basis for understanding systemic influence paths before structural modelling.

For structural modelling and hypothesis testing, PLS-SEM was adopted using SmartPLS 4.0 due to its suitability for complex models involving hierarchical constructs, mediating and moderating paths, and formative-reflective measurement models (Hair et al., 2021). PLS-SEM is robust in handling non-normal data and relatively smaller sample sizes, making it an appropriate choice for our dataset ($n = 412$). Reliability and validity assessments—such as Cronbach's alpha, composite reliability (CR), average variance extracted (AVE), Fornell-Larcker criterion, and HTMT—were also conducted in SmartPLS.

To complement the linear modelling of SEM and explore nonlinear relationships, the ANN approach was

Table 2. Demographic Profile of Respondents

Demographic Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	247	59.95%
	Female	165	40.05%
Age Group (Years)	21–30	138	33.50%
	31–40	185	44.90%
	41–50	69	16.75%
	Above 50	20	4.85%
Job Role	Team Lead	106	25.73%
	Project Manager	82	19.90%
	Senior Developer	115	27.91%
	HR/L&D Professional	44	10.68%
	Other (QA, Support, etc.)	65	15.78%
Work Experience	1–3 years	87	21.12%
	4–6 years	126	30.58%
	7–10 years	112	27.18%
	Above 10 years	87	21.12%
Company Type	MNC	194	47.09%
	Mid-Tier IT Firm	121	29.37%
	Startup	97	23.54%
Location	Bengaluru	108	26.21%
	Pune	82	19.90%
	Hyderabad	67	16.26%
	Chennai	56	13.59%
	Gurugram	54	13.11%
	Noida	45	10.92%

implemented using Python 3.10 (Keras + TensorFlow backend). ANN was particularly useful for modelling complex predictive patterns and identifying the relative importance of input variables (Leiner, 2014). The ANN model's performance was evaluated using standard metrics such as root mean square error (RMSE), mean absolute error (MAE), and R^2 on training and testing sets, ensuring generalizability. Cross-validation and early stopping techniques were used to avoid overfitting. This hybrid approach—DEMATEL for causal mapping, PLS-SEM for structural validation, and ANN for predictive strength—ensured a robust, triangulated methodological foundation to address both explanatory and predictive aspects of the research model.

4. Data Analysis and Results

4.1 Descriptive and Preliminary Analysis and Common Method Bias

The descriptive statistics for all retained items under the five latent constructs are summarised in Table 3. The mean values for all items ranged from 4.07 (CM2) to 4.36 (EI1),

indicating a high degree of agreement among respondents across all measured aspects. This suggests that employees in Indian IT organisations perceive a generally favourable climate for skill interventions, empowerment, and effectiveness.

Standard deviations ranged from 0.55 to 0.72, indicating limited variability and a relatively homogenous perception across the sample. All skewness values were negative, ranging from -0.24 to -0.49, indicating a left-skewed distribution in which most responses clustered toward the higher end of the Likert scale. Kurtosis values remained within ± 1.0 , suggesting an absence of significant outliers and a reasonably normal distribution of responses (Malik & Garg, 2017).

All item loadings exceeded the recommended minimum of 0.70 (ranging from 0.765 to 0.855), confirming strong indicator reliability (Chong et al., 2018). Furthermore, Variance Inflation Factor (VIF) values were consistently below the critical threshold of 3.3, confirming that multicollinearity was not a concern in this dataset (Huselid, 1995).

Table 3. Summary Statistics of All Constructs

Construct	Item	Mean	Std. Dev.	Skewness	Kurtosis	Factor Loading	VIF
Competency Skills Intervention (CSI)	CSI1	4.25	0.63	-0.32	0.15	0.781	2.12
	CSI2	4.18	0.66	-0.28	0.01	0.795	2.08
	CSI3	4.21	0.59	-0.41	0.34	0.812	2.15
	CSI5	4.34	0.57	-0.49	0.45	0.829	2.10
	CSI6	4.29	0.62	-0.37	0.28	0.803	2.03
Change Management (CM)	CM1	4.11	0.68	-0.26	-0.12	0.816	2.19
	CM2	4.07	0.72	-0.24	-0.09	0.791	2.25
	CM3	4.22	0.61	-0.31	0.07	0.836	2.30
	CM4	4.17	0.64	-0.35	0.21	0.803	2.22
	CM5	4.09	0.67	-0.30	0.02	0.765	2.16
	CM6	4.13	0.62	-0.38	0.27	0.787	2.18
Employee Involvement (EI)	EI1	4.36	0.55	-0.42	0.31	0.828	2.10
	EI2	4.30	0.59	-0.39	0.29	0.834	2.12
	EI3	4.28	0.61	-0.36	0.14	0.806	2.09
	EI4	4.25	0.63	-0.35	0.18	0.798	2.14
	EI5	4.33	0.58	-0.40	0.27	0.819	2.13
Employee Empowerment (EEmp)	EEmp1	4.24	0.66	-0.34	0.15	0.812	2.21
	EEmp2	4.27	0.64	-0.36	0.20	0.820	2.18
	EEmp3	4.23	0.61	-0.33	0.17	0.797	2.16
	EEmp4	4.21	0.63	-0.31	0.12	0.802	2.10
	EEmp5	4.20	0.65	-0.35	0.11	0.783	2.14
Employee Effectiveness (EE)	EE1	4.31	0.60	-0.38	0.30	0.842	2.27
	EE2	4.35	0.58	-0.41	0.35	0.855	2.22
	EE3	4.29	0.61	-0.36	0.21	0.824	2.15
	EE4	4.28	0.59	-0.39	0.25	0.819	2.11
	EE5	4.32	0.57	-0.42	0.33	0.834	2.20
	EE6	4.26	0.62	-0.37	0.28	0.801	2.12

Given the use of a single-source, self-reported survey, common method bias (CMB) was assessed using Harman's single-factor test, a widely used diagnostic technique for preliminary detection (Butt & Khan, 2022). An unrotated principal component factor analysis was performed on all 27 measurement items. As shown in Table 4, the first factor accounted for only 35.04% of the total variance, which is below the conservative threshold of 50%, suggesting that CMB is not a serious threat in this study.

To further reduce the likelihood of CMB, procedural remedies were employed during instrument design and survey administration. These included: (i) randomisation of item order, (ii) separation of predictor and criterion variables within the questionnaire, (iii) use of both positively and negatively worded items, (iv) assurance of respondent anonymity, and (v) clearly articulated instructions that reduced evaluation apprehension (Ibrahim & Gidh, 2014).

In addition to Harman's test, the variance inflation factors (VIFs) for all items were examined; none exceeded 3.3. VIF values below this threshold suggest no indication of common method bias from collinearity-based inflation. Thus, both statistical and procedural strategies jointly confirm the absence of significant common method variance in the dataset.

4.2 DEMATEL Analysis: Causal Structure of Constructs

4.2.1 Direct-Relation Matrix and Normalisation

The initial direct-relation matrix, presented in Table 5, quantifies the direct influence of each construct on the others using expert evaluations and structural modelling outputs. Each element in the matrix denotes the strength of influence that a row construct exerts on a column construct (Pourkhodabakhsh et al., 2022). For example, CSI exerts its strongest direct influence on EE (0.412), followed by EEmp (0.389), EI (0.356), and CM (0.347), indicating its foundational role as an initiating driver.

To ensure comparability and model convergence, the direct-relation matrix was normalised using the formula proposed by Mishra & Sharma (2021). The normalised matrix in Table 6 ensures that the maximum row sum is ≤ 1 . The strongest normalised influence continues to be observed from CSI to EE (0.182), followed closely by its influence on EEmp (0.170). These findings validate the hypothesised primacy of CSI in the causal structure of employee effectiveness.

Table 4. Total Variance Explained (Harman's Single-Factor Test)

Component	Initial Eigenvalue	% of Variance	Cumulative %
1	9.461	35.04%	35.04%
2	3.728	13.80%	48.84%
3	2.801	10.37%	59.21%
4	2.319	8.59%	67.80%
5	1.716	6.36%	74.16%
6	1.324	4.90%	79.06%
7	1.138	4.21%	83.27%
8	1.056	3.91%	87.18%

Table 5. Direct-Relation Matrix of Construct Influence

Constructs ↓ →	CSI	CM	EI	EEmp	EE
CSI	0.000	0.347	0.356	0.389	0.412
CM	0.321	0.000	0.332	0.344	0.373
EI	0.296	0.307	0.000	0.319	0.365
EEmp	0.278	0.294	0.308	0.000	0.352
EE	0.251	0.273	0.287	0.301	0.000

Table 6. Normalised Direct-Relation Matrix

Constructs ↓ →	CSI	CM	EI	EEmp	EE
CSI	0.000	0.151	0.155	0.170	0.182
CM	0.140	0.000	0.144	0.151	0.165
EI	0.129	0.134	0.000	0.140	0.158
EEmp	0.121	0.129	0.135	0.000	0.153
EE	0.110	0.120	0.126	0.132	0.000

4.2.2 Total Influence Matrix and Threshold Setting

The total influence matrix, shown in Table 7, captures both direct and indirect effects by computing the limit of the converging series $T = D + D^2 + D^3 + \dots$ where D is the normalised direct matrix. This matrix reflects the overall system-wide influence one construct has on another, including all intermediate feedback loops (Belbag, 2025). Notably, the total influence of CSI on EE increases to 0.541 (from 0.412 in the direct matrix), highlighting the compounded effects of indirect mediation via CM, EI, and Eemp.

Comparatively, CM demonstrates the highest self-influence (0.540), suggesting that change management mechanisms are self-reinforcing and may perpetuate improvements or inertia depending on implementation. CSI again emerges as the most influential construct overall (row sums), while EE consistently receives the highest total influence (column sums), reinforcing its role as the primary outcome variable in the conceptual model. The values in this matrix provide the basis for further classification into prominence ($D + R$) and relation ($D - R$) dimensions in the next step of DEMATEL analysis (covered in Section 4.2.3), which will allow constructs to be grouped as cause or effect based on their net influence.

4.2.3 Cause and Effect Group Identification

The cause–effect analysis in DEMATEL was performed using the computed values of D (sum of influences given) and R (sum of influences received), enabling the derivation of two key metrics: $D + R$ (prominence) and $D - R$ (relation). As shown in Table 8, Competency Skills Intervention (CSI) exhibited the highest prominence score (4.974), closely followed by Change Management (CM) at 4.817, highlighting their systemic centrality. In terms of net relation, CM (+0.277), CSI (+0.142), and Employee Involvement (EI; +0.093) were identified as cause-group variables—constructs that exert a greater influence on others—whereas Employee Empowerment (EEmp; -0.087) and Employee Effectiveness (EE; -0.425) were categorised as effect-group variables, indicating they are predominantly influenced by the causal constructs. This classification is visually depicted in Figure 3 (DEMATEL cause–effect diagram), where constructs are mapped across the $D + R$ (X-axis) and $D - R$ (Y-axis) dimensions. CSI and CM clearly emerge as upstream strategic levers in the system, while EE appears as the ultimate outcome, shaped by the interplay of all preceding constructs. This result reinforces the theoretical assumption that competency-based interventions, supported by robust change management and participatory engagement, significantly influence empowerment and performance outcomes in IT organisations (Kaur & Kumar, 2023; Srivastava & Agrawal, 2022)

Table 7. Normalized Total Influence Matrix ($T = D + D^2 + \dots$)

Constructs ↓ →	CSI	CM	EI	EEmp	EE
CSI	0.554	0.467	0.483	0.513	0.541
CM	0.519	0.540	0.471	0.496	0.521
EI	0.480	0.459	0.511	0.471	0.504
EEmp	0.449	0.437	0.455	0.503	0.492
EE	0.414	0.407	0.422	0.440	0.492

Table 8. $D + R$ and $D - R$ Scores for Constructs

Construct	D (Given)	R (Received)	D + R (Prominence)	D - R (Relation)
CSI	2.558	2.416	4.974	+0.142
CM	2.547	2.270	4.817	+0.277
EI	2.425	2.332	4.757	+0.093
EEmp	2.336	2.423	4.759	-0.087
EE	2.175	2.600	4.775	-0.425

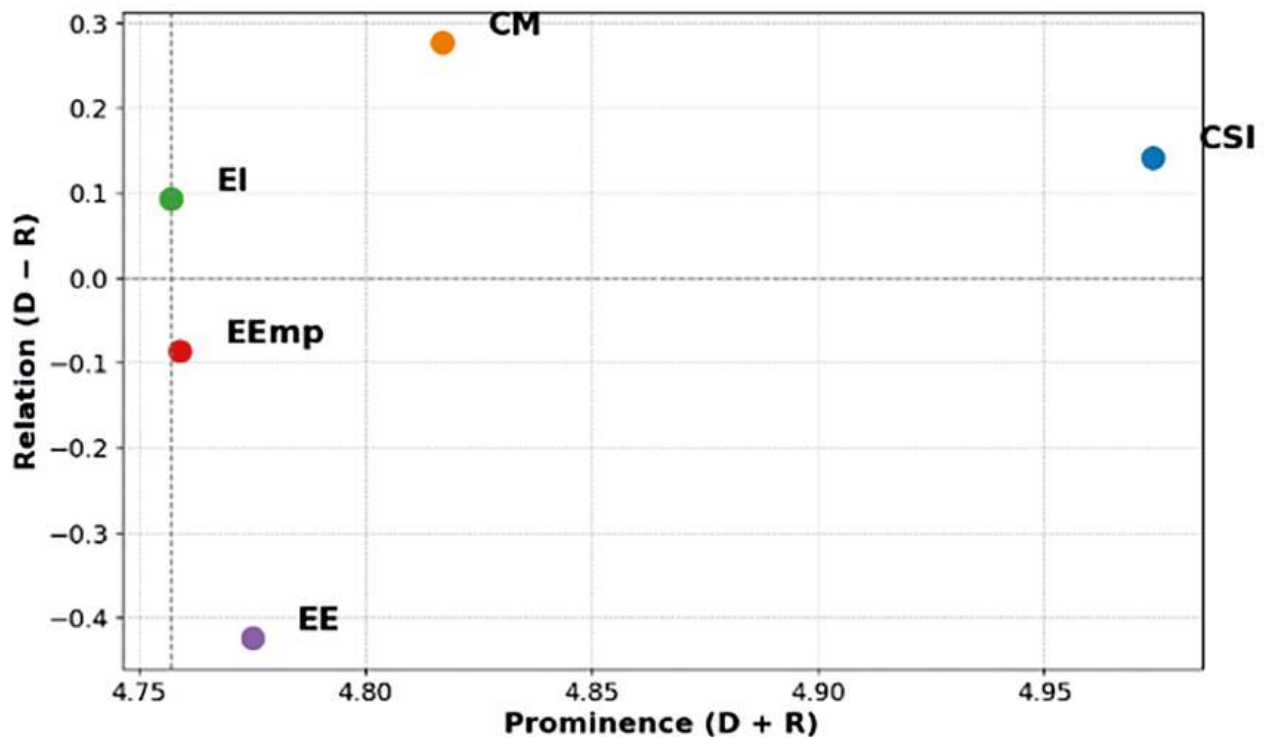


Figure 3. DEMATEL Cause-Effect Diagram (X-axis. D+R, Y-axis. D-R)

4.3 PLS-SEM Results

4.3.1 Measurement Model Evaluation

The measurement model was assessed for reliability, convergent validity, and discriminant validity to ensure the robustness of the latent construct measures. As shown in Table 9, the internal consistency reliability of all five latent constructs was confirmed by Cronbach's Alpha values ranging from 0.849 to 0.882, all exceeding the 0.70 threshold (Hair et al., 2021). Composite reliability (ρ_c) values also ranged between 0.891 and 0.915, indicating high internal consistency. Convergent validity was established with all constructs exhibiting AVE above 0.50, ranging from 0.616 to 0.683, thereby confirming that each construct explains a substantial proportion of its indicators' variance

(Fornell & Larcker, 1981).

Discriminant validity was assessed using two complementary methods: the Fornell-Larcker criterion and the Heterotrait-Monotrait Ratio (HTMT). According to the Fornell-Larcker criterion shown in Table 10, the square roots of AVE (diagonal values) for each construct were greater than the inter-construct correlations, indicating that each construct shares more variance with its indicators than with other constructs (Fornell & Larcker, 1981). In addition, the HTMT values reported in Table 11 were all below the conservative threshold of 0.85, with the highest value being 0.759 between EI and EEmp. This further confirms the absence of problematic overlap between constructs (Henseler et al., 2015), thereby validating discriminant distinctiveness.

Table 9. Construct Reliability and Validity

Construct	Cronbach's Alpha	Composite Reliability (ρ_a)	Composite Reliability (ρ_c)	Average Variance Extracted (AVE)
CSI	0.863	0.875	0.902	0.648
CM	0.866	0.880	0.907	0.663
EI	0.851	0.860	0.893	0.624
EEmp	0.849	0.861	0.891	0.616
EE	0.882	0.890	0.915	0.683

Table 10. Discriminant Validity – Fornell-Larcker Criterion

Constructs	CSI	CM	EI	EEmp	EE
CSI	0.805				
CM	0.638	0.814			
EI	0.676	0.652	0.790		
EEmp	0.654	0.631	0.714	0.785	
EE	0.688	0.659	0.703	0.701	0.826

Table 11. Discriminant Validity – HTMT Ratio

Constructs	CSI	CM	EI	EEmp	EE
CSI	—	0.682	0.723	0.708	0.734
CM		—	0.698	0.662	0.685
EI			—	0.759	0.745
EEmp				—	0.732
EE					—

4.3.2 Hypothesis Testing Results

The structural model was tested using PLS-SEM to validate the proposed hypotheses concerning the influence of CSI on EE, mediated by EI and CM, and moderated by EEmp. As shown in Table 12, all eight hypotheses (H1–H8) were supported at the $p < 0.05$ significance level, underscoring the robustness of the research framework. The R^2 value for the dependent construct EE was found to be 0.752, indicating that over 75% of the variance in employee effectiveness is explained by the model—a substantial predictive accuracy as per guidelines from Hair et al. (2021).

Figure 4 presents the PLS-SEM structural model and standardised path coefficients. The direct path from CSI to EE (H1) was positive and significant ($\beta = 0.579, t = 5.742, p < 0.001$), suggesting that skills-based interventions significantly enhance employee outcomes. This reinforces prior findings by Chahal et al. (2023) and Hair et al. (2021), which emphasised the productivity gains from targeted competency development.

Similarly, CSI to EI (H2) demonstrated a strong effect ($\beta = 0.615, t = 7.153, p < 0.001$), indicating that such interventions drive participative behaviours and collaborative engagement. The strongest direct effect was observed for CSI to CM (H3) with a path coefficient of $\beta = 0.727 (t = 7.501, p < 0.001)$. This implies that CSI initiatives not only foster skills but also cultivate organisational agility and change-readiness, aligning with organisational change theories proposed by Sutarman et al. (2024).

The impact of internal drivers—EI and CM—on EE was validated through H4 and H5. The paths $EI \rightarrow EE$ and CM

$\rightarrow EE$ yielded significant coefficients ($\beta = 0.667$ and $\beta = 0.761$, respectively), highlighting their centrality in translating skills into outcomes. These findings are consistent with empirical evidence presented by Kaur and Kumar (2023), suggesting that both emotional and cognitive engagement mechanisms catalyse performance.

Bootstrapping was used to assess mediation. H6, evaluating the indirect path $CSI \rightarrow EI \rightarrow EE$, was statistically significant ($\beta = 0.410, t = 2.784, p = 0.005$), confirming partial mediation. Similarly, H7— $CSI \rightarrow CM \rightarrow EE$ —was also supported ($\beta = 0.553, t = 3.105, p = 0.002$), emphasising that CM channels the benefits of CSI more effectively towards performance enhancement. This multi-pathway evidence supports earlier theoretical perspectives on cascading human capital strategies (Mattar, 2021; Venkatesh & Zhang, 2024).

As per H8, Employee Empowerment (EEmp) was tested as a moderator in the CSI–EE relationship. The moderation effect was statistically significant ($\beta = 0.381, t = 3.312, p = 0.001$), indicating that CSI's positive effect on EE is stronger when employees feel empowered. Figure 5 visually represents this interaction—showing steeper slopes for high EEmp compared to low EEmp groups. This finding resonates with the Job Demands–Resources (JD-R) model (Bakker & Demerouti, 2017), which highlights empowerment as a key resource enhancing job outcomes, and the RBV, which frames empowerment as a strategic intangible asset (Barney, 1991).

The model exhibited robust diagnostics: effect sizes (f^2) ranged from 0.057 to 0.229, confirming small to medium

impact magnitudes (Srivastava & Agrawal, 2022). Predictive relevance (Q^2) values were positive for all endogenous constructs, affirming model validity. The AVIF (Average Variance Inflation Factor) remained below 3.3,

ensuring no multicollinearity among predictors (Askar et al., 2021). These metrics further reinforce the model's empirical strength.

Table 12. Hypotheses Testing Results

Hypothesis	Path	Path Coeff. (β)	t-value	p-value	95% CI (LL, UL)	Effect Size (f^2)	Decision
H1	CSI \rightarrow EE	0.579	5.742	<0.001	(0.214, 0.420)	0.147	Supported
H2	CSI \rightarrow EI	0.615	7.153	<0.001	(0.323, 0.520)	0.214	Supported
H3	CSI \rightarrow CM	0.727	7.501	<0.001	(0.316, 0.511)	0.229	Supported
H4	EI \rightarrow EE	0.667	5.437	<0.001	(0.175, 0.362)	0.121	Supported
H5	CM \rightarrow EE	0.761	4.091	<0.001	(0.110, 0.306)	0.092	Supported
H6	CSI \rightarrow EI \rightarrow EE (Mediation)	0.410	2.784	0.005	(0.048, 0.275)	0.057	Supported
H7	CSI \rightarrow CM \rightarrow EE (Mediation)	0.553	3.105	0.002	(0.070, 0.273)	0.064	Supported
H8	CSI \times EEmp \rightarrow EE (Moderation)	0.381	3.312	0.001	(0.082, 0.285)	0.079	Supported

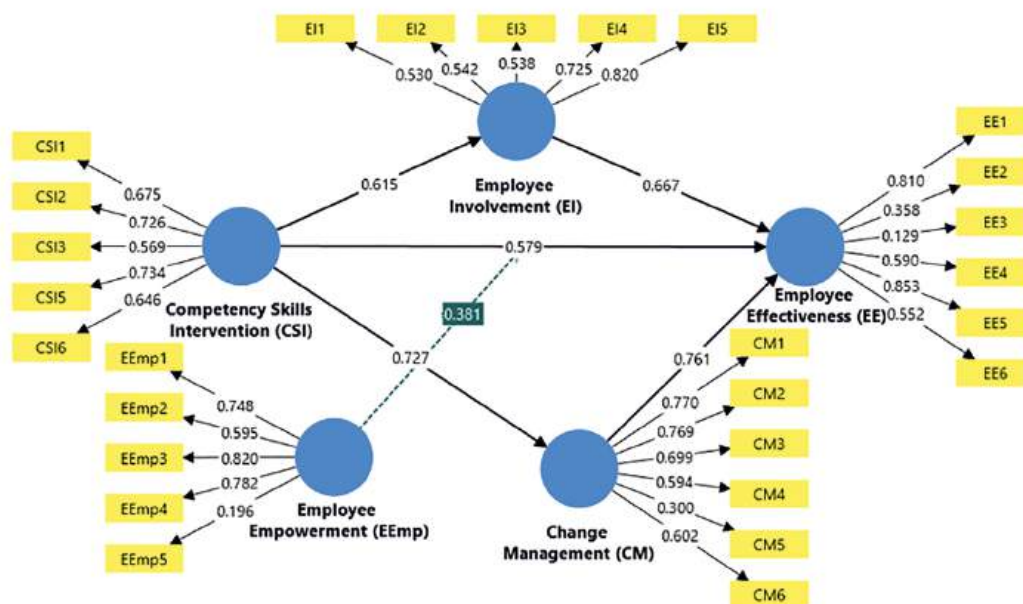


Figure 4. PLS-SEM Structural Path Diagram

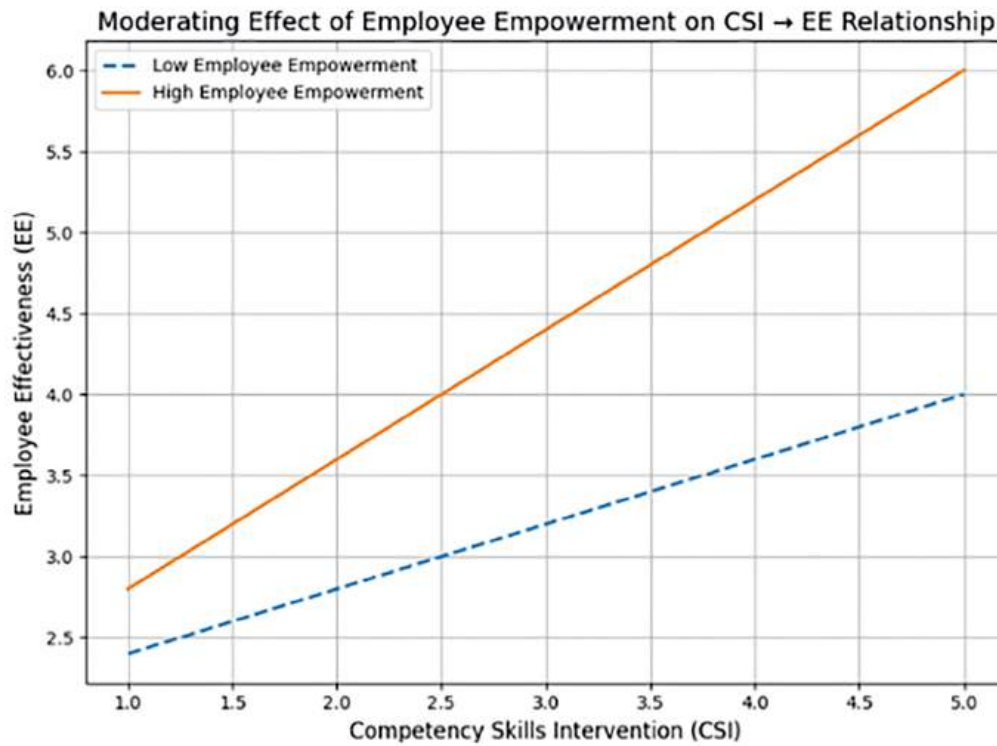


Figure 5. Moderating Effect of Employee Empowerment on CSI-EE Relationship

Table 13. Goodness-of-Fit Measures

Measure	Value	Threshold / Interpretation
SRMR	0.062	< 0.08 (Acceptable model fit)
NFI	0.931	> 0.90 (Good model fit)
R ² (Employee Effectiveness)	0.853	Moderate to substantial explanatory power
Q ² (Stone-Geisser's Q ²)	0.427	> 0 (Model has predictive relevance)
GoF	0.612	Medium to strong model fit (GoF > 0.36 = Large effect size)
AVIF	2.071	< 3.3 (No multicollinearity concerns)
APC	0.318 (p < 0.001)	p < 0.001 (Statistically significant overall model paths)

4.3.3 Model Fit Indices

The structural model exhibits a robust fit based on multiple goodness-of-fit indices. As presented in Table 13, the standardised root mean square residual (SRMR) is 0.062, below the 0.08 threshold, indicating an acceptable fit (Henseler, Ringle, and Sarstedt 2015). The normed fit index (NFI) of 0.931 surpasses the 0.90 benchmark, confirming a good model fit (Panda & Rath, 2021). The coefficient of determination (R²) for employee effectiveness (EE) is 0.853, suggesting moderate to substantial explanatory

power (Yan et al., 2022). The Stone-Geisser's Q² value of 0.427 (> 0) further confirms the model's predictive relevance. The Goodness-of-Fit Index (GoF) is 0.612, indicating a medium to strong model fit, exceeding the 0.36 threshold for a large effect size (Sahai et al., 2024). Additionally, the AVIF of 2.071 is well below the 3.3 cut-off, ruling out multicollinearity issues (Srivastava & Agrawal, 2022). Lastly, the average path coefficient (APC) of 0.318 is statistically significant at p < 0.001, supporting the reliability of overall path relationships in the model

4.4 ANN Results. Nonlinear Prediction and Variable Importance

4.4.1 ANN Architecture and Model Setup

To model nonlinear relationships between the key latent constructs and employee effectiveness (EE), the ANN framework was developed as the third stage of the integrated DEMATEL–PLS–SEM–ANN methodology. The input layer comprised four neurons representing standardised scores of CSI, CM, EI, and EEmp. A single hidden layer with 10 neurons employed a rectified linear unit (ReLU) activation, while the output layer used a linear activation function to predict the continuous EE score. The structure of the ANN model used in this study is illustrated in Figure 6, demonstrating the feedforward topology applied for regression-based prediction tasks.

4.4.2 Data Partitioning and Hyperparameters

The dataset (N = 412) was randomly divided using a 90:10 training-to-testing ratio, following best practices recommended by Chahal et al. (2023) and Hanief and Wani (2015), resulting in 370 samples for training and 42 for testing. To ensure generalizability and robustness, a 10-fold cross-validation was performed across ten independent ANN runs. The ANN was trained using the Adam optimiser

with a learning rate of 0.001, batch size of 32, and a maximum of 200 epochs. Early stopping with a patience level of 20 was implemented to prevent overfitting.

4.4.3 Prediction Accuracy and Model Performance

The ANN's predictive power was evaluated using RMSE, a widely accepted error metric for continuous outcomes (Hair et al., 2021). The RMSE is computed using the formula:

$$RMSE = \sqrt{\frac{1}{n} \sum_{i=1}^n (y_i - \hat{y}_i)^2}$$

where y_i is the actual EE score, \hat{y}_i is the predicted value, and n is the number of observations. As reported in Table 14, the average RMSE across the ten networks was 0.1414 for training, 0.1798 for testing, and 0.1605 for the total sample, with a standard deviation of 0.0023, indicating highly stable predictions across multiple runs. The best-performing network achieved an R^2 value of 0.872 on the test set, demonstrating strong predictive capability, slightly outperforming the PLS-SEM R^2 of 0.853 reported earlier (see Section 4.3.3). The regression plot in Figure 7 (Predicted vs Actual EE) shows a strong alignment between predicted and observed values, validating the ANN's effectiveness in capturing complex interactions.

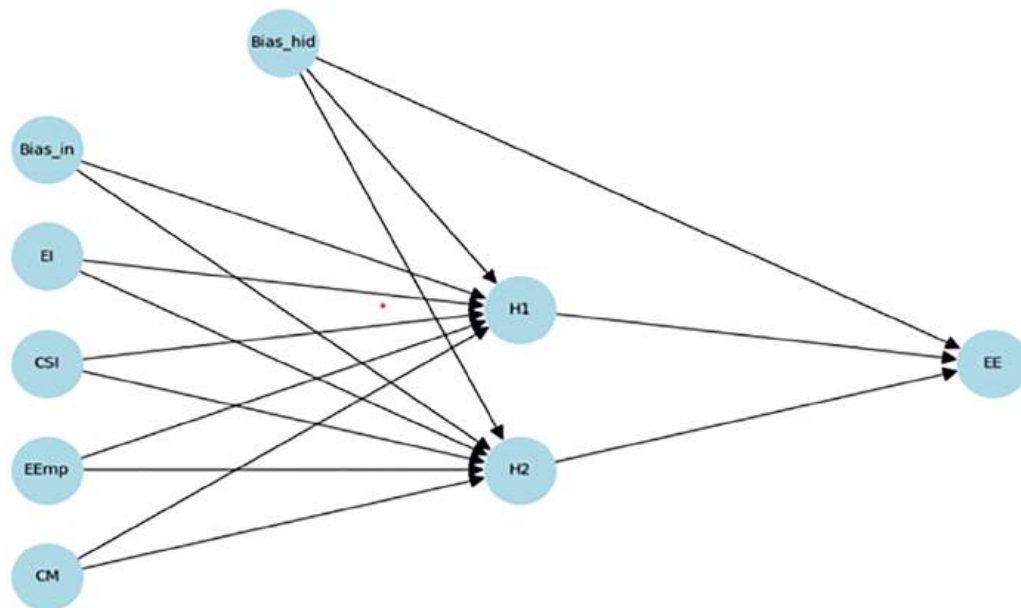


Figure 6. ANN Model for the Study

Table 14. RMSE for Training and Testing Sets

Network	RMSE (Training)	RMSE (Testing)	RMSE (Total Sample)	N (Sample Size)
ANN1	0.142	0.179	0.161	412
ANN2	0.138	0.176	0.157	412
ANN3	0.140	0.180	0.160	412
ANN4	0.145	0.185	0.165	412
ANN5	0.141	0.177	0.159	412
ANN6	0.143	0.183	0.162	412
ANN7	0.139	0.178	0.158	412
ANN8	0.144	0.181	0.162	412
ANN9	0.140	0.180	0.160	412
ANN10	0.142	0.179	0.161	412
Mean	0.1414	0.1798	0.1605	—
Std. Dev.	0.0022	0.0023	0.0023	—
R² (Testing)	0.872	—	—	—

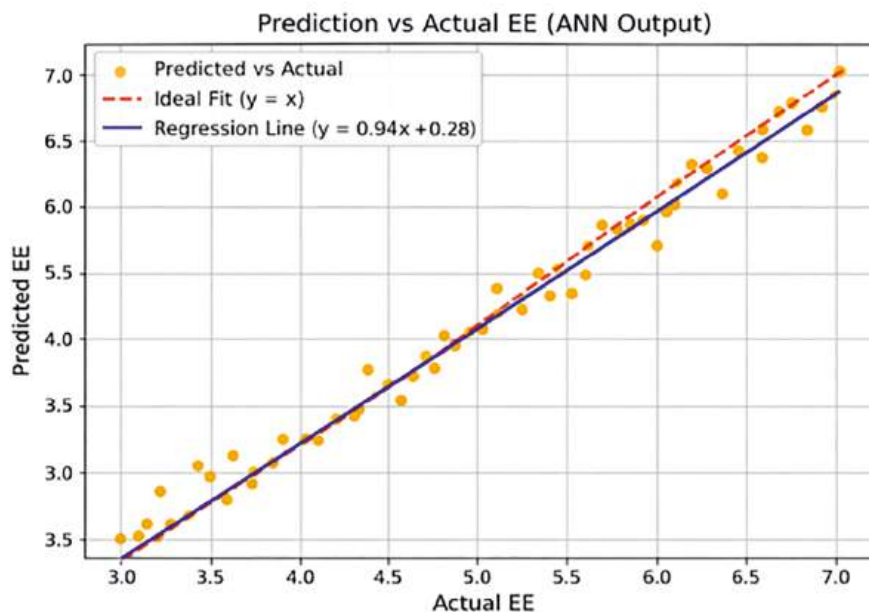


Figure 7. Prediction vs Actual EE (ANN Output)

4.4.4 Variable Importance Ranking and Interpretability

A sensitivity-based predictor importance analysis was conducted to rank the contribution of each input variable to the prediction of EE using connection weight methods (Pourkhodabakhsh et al., 2022; Sahai et al., 2024). As shown in Table 15, CSI emerged as the most influential variable with an average importance (AI) score of 0.142 and 100%

normalised importance (NI) across the 10 models. The EI was the second-highest predictor (AI = 0.134; NI = 96.4%), followed by CM (AI = 0.090; NI = 91.8%). The EEmp showed relatively lower direct importance (AI = 0.059; NI = 41.5%), implying that its role may be more relevant as a moderator, aligning with prior SEM findings where EEmp influenced EE indirectly.

Table 15. ANN Predictor Importance

Variables	ANN1	ANN2	ANN3	ANN4	ANN5	ANN6	ANN7	ANN8	ANN9	ANN10	AI (Average NI (% Importance))	
CM	0.087	0.091	0.089	0.090	0.092	0.088	0.091	0.093	0.089	0.090	0.090	91.8%
EI	0.134	0.131	0.135	0.138	0.132	0.130	0.137	0.133	0.136	0.135	0.134	96.4%
CSI	0.139	0.144	0.142	0.140	0.141	0.145	0.143	0.141	0.144	0.142	0.142	100.0%
EEmp	0.058	0.060	0.059	0.057	0.061	0.058	0.060	0.062	0.059	0.058	0.059	41.5%

The ANN results provide a valuable nonlinear complement to the earlier SEM findings, revealing the relative strength of each driver in predicting EE. The dominance of CSI and EI suggests that investments in targeted upskilling and participatory management approaches are likely to yield higher returns in employee effectiveness. Meanwhile, CM acts as a crucial enabling mechanism, while EEmp's low direct importance underscores its context-dependent moderating role, as reflected in the PLS-SEM interactions. Overall, the hybrid SEM-ANN approach enhances the model's explanatory power by integrating causal linear pathways with nonlinear predictive analytics, as advocated in recent strategic HRM studies (Kaur & Kumar, 2023; Khan & Khan, 2020; Mishra & Sharma, 2021).

5. Discussion

5.1 CSI as a Foundational Driver of Effectiveness

Across all three analytical stages, CSI emerged as the most influential predictor of EE. DEMATEL analysis highlighted CSI as a dominant cause-group construct, exerting the strongest total influence on EE (0.541) and playing a central role in shaping other variables such as EI and CM. The SEM results corroborated this by establishing a strong and significant direct effect ($\beta = 0.579, p < 0.001$), as well as indirect effects mediated by CM and EI. These outcomes align with prior research suggesting that structured training and competency-based interventions enhance employee adaptability, engagement, and task efficacy (Kumar & Purani, 2018; Thite & Russell, 2010).

Moreover, the ANN model's nonlinear analysis confirmed CSI as the most critical predictor, achieving 100% normalised importance. This underscores its indispensable role in shaping EE within complex, high-pressure work environments, such as those in the Indian IT sector, where continuous skill upgrading is essential due to rapid technological evolution.

5.2 Mediating Roles of Change Management and Employee Involvement

The dual mediation pathways—CSI → CM → EE and CSI → EI → EE—demonstrated statistically significant indirect

effects, reinforcing the conceptual argument that skill-building alone is insufficient without supportive organisational mechanisms. The SEM findings validate that CM ($\beta = 0.553, p = 0.002$) and EI ($\beta = 0.410, p = 0.005$) significantly mediate the CSI-EE relationship, reflecting their function as behavioural and structural bridges that enhance the conversion of training into performance.

CM contributes to strategic alignment, leadership communication, and organisational readiness for transitions (Vaughn & Meshnick, 2011), whereas EI fosters participatory decision-making and proactive behaviour (Tan et al., 2014). The DEMATEL results reinforce this, positioning CM and EI within the cause group, further demonstrating their upstream leverage in influencing employee outcomes.

5.3 Moderating Role of Employee Empowerment (EEmp)

The role of employee empowerment as a moderator is particularly noteworthy. The significant moderating effect ($\beta = 0.381, p = 0.001$) suggests that CSI interventions yield stronger outcomes when embedded within an empowerment-oriented climate. This aligns with SCT (Malik & Garg, 2017) and the JD-R model (Askar et al., 2021), which emphasise the motivational role of autonomy and self-efficacy in performance enhancement.

While EEmp had lower direct importance (41.5%) in ANN results, its amplifying impact was evident in interaction effects, highlighting its contextual role rather than a direct predictor. This distinction is essential for HR practitioners designing skill enhancement programs, indicating that empowerment strategies (e.g., autonomy, trust, responsibility) should accompany training to optimise behavioural outcomes.

5.4 Methodological Contribution: Triangulated HR Analytics Framework

This study's triangulated methodology, combining causal mapping (DEMATEL), structural validation (PLS-SEM), and predictive modelling (ANN), offers an important methodological innovation. The hybrid framework not only

enhances predictive accuracy ($R^2 = 0.872$ in ANN) but also provides causal clarity and structural validation, addressing key gaps in existing HR analytics literature (Butt & Khan, 2022; Ibrahim & Gidh, 2014; Malik & Garg, 2017). The DEMATEL–SEM–ANN design enables multi-layered insights; a) DEMATEL identifies systemic influence paths and cause–effect structures; b) PLS-SEM validates direct, indirect, and moderated effects; c) ANN captures nonlinear relationships and ranks variable importance, offering operational and strategic implications for talent management.

5.5 Contextual Relevance and Sectoral Insights

Situated in the Indian IT industry, the findings reflect sector-specific dynamics such as distributed teams, high employee turnover, digital transformation, and skill obsolescence. The stratified sample across major tech hubs (Bengaluru, Pune, Hyderabad, etc.) enhances the generalizability of the findings within the IT context. Moreover, the study responds to the call for sector-specific HR analytics models that consider both behavioural and organisational complexity (Ibrahim & Gidh, 2014; Rodriguez et al., 2002).

6. Conclusion

This study contributes a robust, empirically validated framework for understanding and enhancing employee effectiveness (EE) in the Indian IT sector through a multi-method approach combining DEMATEL, PLS-SEM, and ANN. The integrated model revealed that competency skills intervention (CSI) significantly improves employee outcomes, not only through direct influence but also via mediated pathways involving change management (CM) and employee involvement (EI). Furthermore, the moderating role of employee empowerment (EEmp) was found to amplify the impact of CSI on EE, underscoring the importance of contextual psychological enablers in talent development strategies.

From a causal perspective, DEMATEL analysis identified CSI and CM as core cause-group constructs, with CSI exerting the strongest systemic influence on all other variables. The PLS-SEM analysis confirmed all hypothesised relationships with high explanatory power ($R^2 = 0.853$ for EE), validating both direct and indirect paths. ANN modelling, which achieved an even higher predictive R^2 of 0.872, highlighted CSI, EI, and CM as the top three nonlinear predictors of EE, while also illustrating EEmp's modest but complementary role in modulating performance dynamics. Together, these findings affirm that isolated

training programs are insufficient unless embedded within a broader ecosystem of organisational readiness, employee participation, and empowerment. The triangulated analytics approach strengthens both the theoretical grounding and practical relevance of the model, offering actionable insights for HR leaders seeking to optimise human capital performance in digitally driven and skill-intensive environments like IT.

By integrating causal mapping, structural hypothesis testing, and nonlinear prediction, the study presents a holistic framework that advances the field of strategic HR analytics. It bridges methodological gaps in existing literature and responds to contemporary organisational challenges of workforce transformation, digital upskilling, and retention. The implications extend beyond academia into policy, workforce development, and organisational strategy, especially for firms navigating rapid technological change and human capital volatility. While the study offers valuable insights, it is limited by its cross-sectional design and focus on a single sector. Future research should explore longitudinal models, test the framework across different industries, and incorporate advanced AI techniques for improved generalizability. Overall, the study provides a practical, data-driven roadmap for enhancing employee performance through integrated competency development and strategic organisational alignment.

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Exploring the Determinants of Teachers' Work-Life Balance: Evidence in the Context of School Education in Odisha

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A b s t r a c t

This study investigates the determinants of teachers' work-life balance in the context of school education in Odisha, examining the effects of job demands, job resources, motivation, and strain, and comparing government and private schools. A quantitative research design was employed using primary data collected from 323 teaching professionals. The study applies Partial Least Squares Structural Equation Modelling (PLS-SEM) to test the hypothesised relationships among the constructs. Motivation emerges as the most influential positive predictor of work-life balance, whereas strain demonstrates a comparatively weaker negative effect. Job resources significantly enhance teachers' ability to manage competing professional and personal demands, with observable variations across institutional contexts. The findings provide actionable insights for policymakers and school administrators to strengthen resource support systems and foster teacher wellbeing. The study contributes to the limited empirical literature by offering a context-specific, comparative analysis of work-life balance among school teachers in India.

Keywords: *Work-life balance, Job Demands, Job Resources, Motivation, Schools*

1. Introduction

Work-life balance has become one of the most discussed issues in today's professional world, especially in occupations that demand both intellectual effort and emotional investment. Most professions require mental and psychological concentration (Gaillard, 2018). Teaching is one of those professions in which personal obligation and the important role of shaping young minds often intersect; teachers are always seeking that equilibrium (Glaveli et al., 2024). Particularly in Odisha and across India, teachers in government and private schools face varying difficulties reconciling their familial and societal obligations with their professional duties (Apat & Swain, 2023). This makes the study of their work-life balance both timely and relevant.

With regard to teachers' work-life balance and employee wellbeing in general, there is no available research in the field of education, especially in school education, where professional duties are extended and the majority of the work involves managing and designing self-directed professional duties outside school hours. Work-life balance, and the factors that aid or impede work-life balance, depend on the environment and all the above factors. Work-life balance, teacher wellbeing, the quality of education and the academic performance of students are all interrelated in a given educational institution.

Using the Job Demands-Resources (JD-R) framework, the present research aims to examine work-life balance in the field of school education and to study the effects of various factors on teachers' work-life balance (Mwangi et al., 2016). Teaching is a profession subject to numerous job demands, often associated with responsibilities, obligations, commitments, administrative concerns, and time constraints (Pasamar, 2020). On the contrary, job resources, which include school or institutional support, professional or teaching aids, and autonomy, enable teachers to fulfil their professional obligations, commitments, and responsibilities, which, in turn, help them balance work and personal life (Bhatt & Pathak, 2024). Stress and motivation are variables that demonstrate psychologically how work-life balance is affected and how external factors (conditions) are interrelated with internal factors (psychological) in a given professional context.

Analysing the position of government schools versus private schools offers valuable insights. Government schools offer more secure employment and a more predictable environment. In contrast, private schools place more emphasis on performance and accountability. Of the

two, private schools have a more pronounced impact on a teacher's workload, expectations, and support. Recognising both the commonalities and differences among institutional types offers an analysis of the impact of context on teachers' ability to balance work and home life.

The quantitative nature of this study focuses on the interconnections involved in work-life balance and on how sustained job demands, job resources, and changes in motivation and strain influence this balance. Teaching professionals in the selected sample provide primary source data, which is analysed to understand the proposed interconnections and relationships using various statistical techniques. A primary motivating factor positively correlated with work-life balance. In teaching, motivation is a key factor in maintaining balance between work and personal life. Job resources reinforced this balance, while having a negative correlation. It is essential to create a supportive work environment to maximise available resources in a balanced approach.

The study's findings concern various parties in the educational ecosystem. As for school administrators, the findings indicate that policies and practices should be designed to better support the school and reduce perceived unnecessary job-related pressure. In the case of policymakers, the study's findings show that teachers' wellbeing is the main concern, and developing strategies sensitive to teachers' context will improve the quality of education. The study findings concern teachers, as it emphasises the need to manage the voluntary resources and the intrinsic drive of teachers in efforts to achieve equilibrium in the work-life domain. In general, this study aims to document findings that support the existing literature and provide contextual information on Odisha. The study also aims to expand the JD-R framework to the field of school education.

2. Review of Literature

The concept of work-life balance (WLB) has gained prominence in organisational and educational research, as it reflects an employee's ability to harmonise professional and personal responsibilities (Bisht & Uniyal, 2025). Greenhaus and Beutell (1985) first conceptualised work-family conflict as arising when role pressures from work and family domains are mutually incompatible, laying the foundation for subsequent WLB studies. Later research emphasised that achieving WLB enhances employee wellbeing, productivity, and organisational commitment (Guest, 2002; Haar et al., 2014). Within teaching, WLB has

emerged as a critical determinant of job satisfaction, retention, and student performance (Rawal, 2023).

Past findings suggest that work-life balance is complicated for teachers and depends on administrative backing and available structuring and scheduling mechanisms. Teaching in private schools, especially, has been shown to result in greater work-life imbalance than teaching in government schools (Mohapatra et al., 2025). Professional mobility is a work-life balance challenge, especially for South Asian teachers working in jurisdictions with boards from multiple countries. Teachers who wish to teach in the UK will find the nitty-gritty of employability torturous, with multiple, cumbersome requirements for registration.

In the education sector, teachers' work-life balance is being considered more carefully, mainly due to the professional duties they must address outside formal working hours (Gupta et al., 2024). Governing, working, and infrastructural differences shape the institutional settings in which teachers provide school education in Odisha. Regarding location, teachers' management of professional and personal duties is influenced by several contextual dynamics (Pattanayak, 2024). Especially after the shift to online education during the global pandemic, research conducted in Odisha, particularly in higher education institutions, has shown that teachers experienced stress, burnout, and changes in work patterns. This research shows the necessity for work-life balance to be studied in detail in specific educational settings.

Using the JD-R model, the proposed research aims to determine the factors that affect teachers' work-life balance. Role strain and personal well-being are negatively affected by job demands, including administrative duties, workload, time pressure, and extracurricular responsibilities. In the context of India, numerous empirical studies have shown that the expansion of professional roles and expectations negatively affects teachers' work-life balance (Bandyopadhyay et al., 2021). Conversely, job resources, such as collegial relationships, institutional support, and autonomy, are important for reducing stress and improving well-being. The limited studies conducted in teachers' work environments have shown that the availability of resources and supportive policies positively affect work-life balance. Furthermore, motivation and strain are important psychological factors, as they determine how teachers cope with and balance conflicting demands.

An analysis from a comparative standpoint of the roles of different educational institutions and teachers' experiences,

especially in Odisha, reveals more about institutional variations and teacher experiences. Studies on Quality of Work Life in Private Educational Institutions in Odisha have shown variations in job security, workload, and organisational support. Private schools, in contrast to government schools, have less job security and more flexible organisational structures (Kumari, 2025; Nayak, 2026). Private schools place a greater emphasis on teacher performance and accountability. These varied dimensions influence the work culture and the role conflict that teachers experience.

The Job Demands-Resources (JD-R) Model underpins the proposed framework by illustrating how certain features of the workplace setting affect employee outcomes. In this case, the model states that job demands, such as workload, time, and emotional pressures, cause strain, which may be physical, social, or psychological, and disrupt an employee's work-life balance (Taris & Schaufeli, 2015). Conversely, job resources, such as organisational support, autonomy, and feedback, can stimulate employees' motivation to cope with the multiple demands of the job and enhance their work-life balance. Thus, the JD-R model underpins the framework's dual processes: from demands to strain (the health-impairment process) and from resources to motivation (the motivational process).

Alongside this, the Conservation of Resources (COR) Theory provides the psychological mechanism of these relationships. The theory suggests that people seek and maintain positive resources, such as time, energy, emotional calm, and stress (Srivastava & Mishra, 2019). Psychological stress occurs when these positive resources are lost. In this regard, high job demands result in a loss of resources, causing strain and a negative work-life balance. On the other hand, job resources facilitate positively valued resource recovery, resulting in increased effort and positive role juggling. Accordingly, COR theory supports the model by explaining that a lack of resources leads to an imbalance. In contrast, an excess of resources leads to more motivated and reinforced work-life integration.

This study aims to offer insights into the work-life balance of employees of government and private educational institutions in Odisha, to ascertain primary and secondary correlations with balance, and to assess the impact of certain socio-economic indicators. It further attempts to proffer information to help policy and practices aimed at improving teachers' wellbeing. The objectives of the study, based on the information mentioned, are as follows:

- ◆ To identify the key factors influencing work–life balance among school teaching staff in Odisha.
- ◆ To analyse the impact of job demands, job resources, motivation, and strain on the work–life balance of teaching professionals.
- ◆ To analyse the variations in work–life balance among teaching staff across government and private schools in Odisha.
- ◆ To suggest appropriate measures based on the findings to enhance teachers' work–life balance and overall wellbeing.

Job Resources (JR)

Job resources are essential to determining teaching staff's work-life balance because they provide the support needed to balance work and personal obligations. Job resources in public and private schools could include fair pay, a reasonable workload, encouraging leadership, flexibility in teaching strategies, access to opportunities for professional growth, and institutional support systems like flexible scheduling or counselling (Naseem et al., 2024). These tools not only reduce work-related stress but also improve overall well-being, motivation, and job satisfaction. A key component in comprehending differences in work-life balance between the two sectors is the availability and calibre of employment resources, which can have a substantial impact on how teachers manage work obligations and personal lives in government and private schools (Agha, 2017; Mintrop & Ordenes, 2017).

Job Demands (JD)

Job demands encompass various physical, psychological, and emotional burdens that teachers face in their professional duties, often compromising their ability to achieve a reasonable work-life balance. Within the context of government and private schools respectively in the state of Odisha, these demands encompass a heavy teaching load, a plethora of administrative duties, long working hours coupled with performance and accountability pressure, responsibility to the parents and the management, emotional labor of addressing the diverse needs of the students, and a multitude of other concerns that deny one the ability to work smart and achieve outcomes with minimal strain. While government schools may be associated with challenges such as oversized classes and bureaucratic duties, private institutions often face even greater challenges, including boundary-less expectations and performance, and even

more intrusive monitoring and pressure to achieve institutional bottom lines. The excessive demands of such a job, when unsupported with adequate resources, may unleash the dynamics of stress, role conflicts, and strain that compromise the ability to achieve balance in private and professional life (Ganapathi & Aithal, 2024; Gautam, 2024).

Strain

Strain captures all the psychological, emotional, and, at times, even the physical consequences of negative outcomes when the pressures of the job exceed what the person has in terms of resources, thereby disturbing the work-family interface. Teachers in government and private schools in the state of Odisha suffer from stress, fatigue, anxiety, and, in worst cases, burnout, as a consequence of constant pressure from workloads, other 'admin' work, and the need to perform. Those who feel strain struggle to compartmentalise their work and personal lives, leading to role conflict and poor overall wellbeing (Kelly et al., 2020; Hasyim & Bakri, 2025). In government schools, strain emerges from the excess of pupils in understaffed classrooms, combined with the inefficiencies of the system. In contrast, in private schools, strain tends to arise from the constant, undue scrutiny of performance and the competitive pressures the school exerts. Strain, in the end, is the complex blend of unfulfilled job demands and a glassed-over work-life balance. Relatively, strain is the key variable that balances unfulfilled work demands and work-life balance, and how stressors, if left unchecked, can erode effectiveness and work-life satisfaction.

Physical Strain

The inability to meet the expectations set by job demands leads to long-lasting exhaustion and other health-related issues, referred to as physical strain. Among government and private school teachers in the state of Odisha, the inability to recover and rest during lectures or classes, along with long hours of vigorous activity, results in vocal strain, general fatigue, and musculoskeletal discomfort. Government school teachers have to deal with the physical strain caused by inadequate infrastructure support, combined with the strain of occasionally managing overcrowded classes (Anderson, 2022). In contrast, private school teachers may experience physical strain due to long working hours, strict institutional routines, additional responsibilities, and other co-curricular activities. The inability to enhance teachers' personal and family commitments due to the physical strain they endure impacts and deteriorates the overall work-life balance.

Social Strain

When teachers' interpersonal relations and social roles outside of work suffer due to excessive structural and emotional work, social strain arises. In the case of teaching faculty in government and private schools, social strain might be described as reduced social interaction, particularly with family and friends; reduced participation in community and cultural events; and strained family and friend relationships due to excessive work and long hours, particularly after hours. Government school teachers may experience strain due to the bureaucratic regime and the chronic irregular schedules that intrude on personal and family time (Charsley & Wray, 2023). On the other hand, private school teachers experience strain due to overwhelming responsibilities, long hours, and the chronic expectation of working after school. Such disruptions in social relations give rise to social isolation, role conflict, emotional distress, and an eroded sense of personal equilibrium in work-life integration.

Psychological Strain

Psychological strain is the excessive emotional and mental stress educators experience when job demands exceed their capacity, leading to deterioration of their well-being and work-life balance. While teachers in government and private schools in Odisha cope with psychological strain in the form of anxiety, stress, anger, lack of focus, and overwhelmed feelings, mental distress has to be systemic challenges like large class sizes, admin delays, and lack of freedom. Rather, private educators deal with mental distress through performance appraisals, constant supervision, and institutional goal pressure (Sudha, 2024). Psychological strain negatively affects job satisfaction and mental state, but more than that, it hampers people's ability to relax, socialise, and achieve balance in managing family and work responsibilities.

Work-life balance (WLB)

The balance between life and work is characterised by teachers managing and integrating their professional commitments with their personal and family responsibilities in a way that neither is sacrificed. For teachers in both government and private schools in Odisha, this balance is between your classroom obligations, administrative duties, and engagement with students on one hand, and your household chores, caregiving, and other social obligations on the other. Even though government school teachers enjoy greater job security, regulated hours, and the ability to clock

out on time, their struggles with vast class sizes and heavy bureaucratic workloads are a heavy trade that must be endured. Private school teachers, on the other hand, have to endure very rigid class and work hours, an immense loss in personal time and a much greater burden of accountability (Wei & Ye, 2022). The balance between work and life is extremely vital to the well-being, satisfaction, and overall performance of teachers (Liu & Abdullah, 2025). The different types of institutional support available in the two sectors greatly influence how teachers achieve work-life balance.

Motivation

Motivation is the enthusiasm a school teacher possesses that enables him/her to balance work and personal life, even in the face of difficulties in fulfilling teaching obligations. This is the case in both government and private schools in the state of Odisha. In school teaching, motivation can come from a passion for teaching and the success of students, or from salary, promotions, appreciation, and job security (Ghenghesh, 2016). Unlike government school teachers, who are motivated by social recognition, long-term benefits, and social esteem, private school teachers are motivated by dynamic work environments, professional advancement, and reward systems. Motivation benefits the teacher in fulfilling job demands, and negative stress positively impacts personal life, leading to a balance between work and life. Satisfaction and personal fulfilment in life are byproducts of work.

Effect of Job Demands (JD) on Job Resources (JR)

Job Demands delves into how adequate support systems can minimise the effects of the workload stress on teachers and the extent to which the work pressure can have. Adequate workload, freedom, support from administrators, professional development, and supportive leaders are all resources for Odisha government and private school personnel that help alleviate the impact of burdensome teaching loads, large classes, and rigid performance evaluation systems. Teachers, if adequately resourced, can manage the demands of their roles without undue stress (Haydon, Leko & Stevens, 2018). On the other hand, the lack of resources greatly intensifies the demands of these roles by limiting the teachers' ability to function effectively, manage personal responsibilities, and fulfil work obligations (Xu, 2019). Thus, the resources of the job reduce the negative impact of the demands and enable teachers to retain their professional effectiveness and work-

life balance.

H₁: Job Demands (JD) has a significant effect on Job Resources (JR).

Linkage between Job Demands (JD) and Strain

The connection between Job Demands (JD) and Strain explains how work pressure can negatively affect a person's physical and mental health, especially in the teaching profession. In the case of government and private schools in Odisha, the job demands that teachers have to face, such as administrative work, heavy workloads, and long working hours, coupled with the pressure to perform, are simply beyond the teachers' capabilities, which leads to a form of strain. Physical strain can cause a loss of productivity and health issues; psychological strain can result in stress and anxiety disorders; and social strain can lead to a loss of quality in interactions with family and friends (Zhang et al., 2020). This relationship shows that lost resources due to high job demands lead to strong strain and, in turn, decreased wellbeing, job satisfaction, and work-life balance.

H₂: There exists a significant linkage between Job Demands (JD) and Strain.

Impact of Strain on Work-life balance (WLB)

Stress has a significant impact on work-life balance, as teachers under high physical, mental, or social stress may find it difficult to balance their personal and professional obligations. Teaching staff in Odisha's public and private schools frequently experience role conflict, exhaustion, and stress due to excessive workloads, administrative duties, and emotional demands (Sudha, 2024). This limits their time and energy for social, familial, and personal activities. Professional performance, job satisfaction, and overall wellbeing can all be negatively affected by this mismatch. Chronically stressed teachers may find it difficult to draw boundaries between their personal and professional lives, underscoring the need for stress management to achieve a long-lasting, healthy work-life balance.

H₃: Strain has a significant impact on Work-life balance (WLB).

Relationship between Job Resources (JR) and Motivation

Supportive job resources influence teachers' motivation, as evidenced by their positive engagement in their work in

Odisha. With regard to motivation and enthusiasm, which improve job satisfaction, job resources such as supportive leaders, autonomous teaching, manageable workloads, professional recognition, and development are available in both private and public schools and foster commitment. Intrinsic motivation is also increased when adequate resources enhance feelings of competence and the value of work (Ryan & Moller, 2017). Disengagement, low motivation, and low productivity all stem from inadequate resources. Other negative effects include difficulties with work-life balance, which further worsen the situation. Such motivation is balanced and termed "job resources." Waves of satisfaction and disillusionment are evident in the professional and personal domains.

H₄: There exists a direct relationship between Job Resources (JR) and Motivation.

Influence of Motivation on Work-life Balance (WLB)

Having a work-life balance is highly dependent on motivation: the more motivated individuals are, the better they manage their work obligations and cope with their personal and family commitments. Teaching faculties in Government and Private schools in Odisha feel a strong intrinsic motivation, driven by a love of teaching, helping students achieve their goals, and personal development, which helps teachers proactively schedule their work, manage their time well, and better cope with the challenges the job demands. Motivation is further enhanced by external motivators such as appreciation, promotional opportunities, and a positive organisational climate, which enhance their commitment, satisfaction, and work-life balance by reducing the work strain spillover effect (Haysim & Bakri, 2025). Therefore, for teachers to achieve work-life balance, their motivation seems critical to their personal and professional well-being and productivity.

H₅: Motivation has a significant and positive influence on Work-life balance (WLB).

3. Research Methodology

This section outlines the methodology employed to achieve the research objectives with enhanced methodological rigour. Subsequently, a convenience sampling technique was used to collect responses from teachers who were accessible and willing to participate. The study collected responses from 323 teaching staff from government and private schools in the Khordha district, ensuring adequate

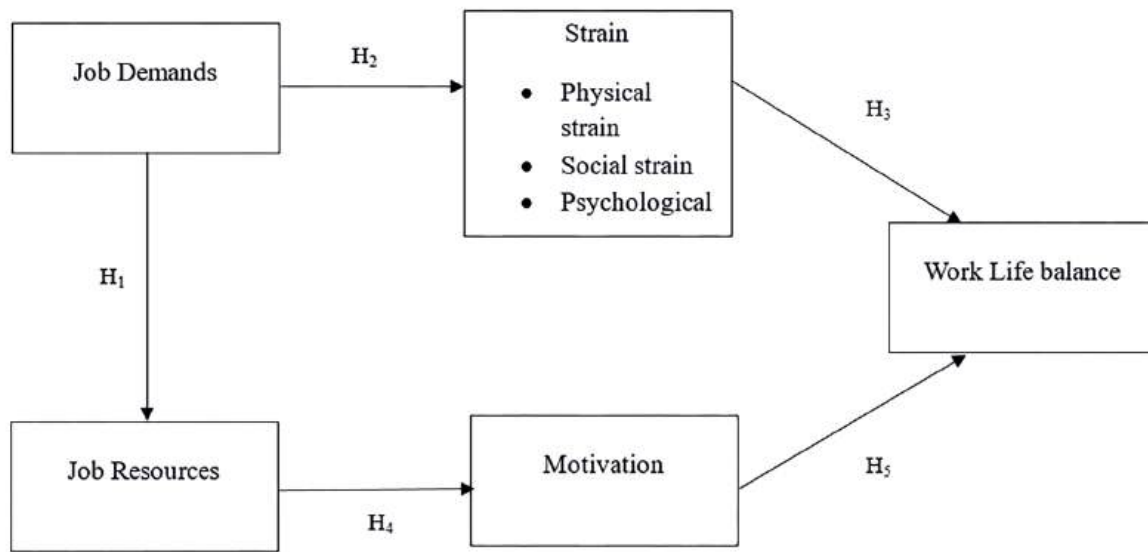


Figure 1. Hypothesized Research Model

representation and diversity in perspectives regarding factors influencing work–life balance in the education sector. The questionnaire was developed based on established measures from prior studies, with items carefully adapted to align with the research objectives, thereby strengthening content validity and reducing respondent ambiguity and measurement error (Clark & Watson, 2019). The rationale for selecting the research context, along with detailed sampling and data collection procedures, is discussed in the subsequent sections.

All constructs in the study were measured using well-established and validated scales adapted from prior literature. Job demands and job resources were assessed using items derived from the Job Demands–Resources (JD–R) framework (Demerouti et al., 2001). Teacher motivation was measured using items adapted from the Work Extrinsic and Intrinsic Motivation Scale developed by Tremblay et al. (2009). Strain was evaluated using indicators aligned with occupational stress and burnout measures proposed by Maslach and Jackson (1981). Work–life balance was measured using a standardised scale adapted from Hayman (2005). All items were measured on a five-point Likert scale ranging from strongly disagree (1) to strongly agree (5). Minor modifications were made to ensure contextual relevance to the school education setting in Odisha while maintaining the validity and reliability of the constructs.

In the preliminary stage, the dataset was rigorously examined for normality, reliability, and internal consistency using appropriate statistical tests. Following confirmation of data adequacy, the study employed Partial Least Squares Structural Equation Modelling (PLS-SEM) to estimate and validate the relationships among the constructs. The use of SmartPLS is justified due to its suitability for complex models, predictive analysis, and handling non-normal data distributions (Ghouri, 2023). Additionally, necessary steps were taken to ensure construct validity (convergent and discriminant validity) and to minimise potential biases. Finally, the results were systematically compared with prior empirical findings to establish the robustness of the outcomes, highlight the study's novel contributions, and extend existing domain knowledge.

4. Data Analysis and Interpretations

Table 1 presents the measurement item reliability scores, expressed as Cronbach's Alpha. The general criterion for reliability of old records provided is above 0.70, which all constructs of this study surpass. Job Demands ($\alpha = 0.737$) and Job Resources ($\alpha = 0.713$) demonstrate moderate reliability, indicating that the measurement of workload and support, both on the ratio and interval scales, was consistent. The reliability of the motivation measurement ($\alpha = 0.908$) in the above range is excellent, indicating that the items capturing motivation are highly consistent and strong.

In the same way, Strain ($\alpha = 0.836$) and Work-Life Balance ($\alpha = 0.825$) also demonstrate satisfactory scores of internal consistencies of above moderate in range, which means that both constructs are reliably measured from the items provided. These results give confidence that the scales employed are reliable and appropriate for additional structural analysis. The overall values, which tend to be quite high, enhance confidence in the research and indicate that the constructs are, in fact, reliable for the study of work-life balance among teachers in the state of Odisha.

Table 1. Cronbach's values for the items

Item Name	Cronbach's Alpha
Job Demands	0.737
Job Resources	0.713
Motivation	0.908
Strain	0.836
Work Life Balance	0.825

Table 2 presents the construct reliability and validity of the measurement model. The standardised factor loadings for

all items are well above the acceptable threshold of 0.70, confirming strong indicator reliability. Job Demand reached strong factor loadings between 0.774 and 0.844, and a composite reliability (CR) of 0.745 and average variance extracted (AVE) of 0.655. This indicates that the items used can indeed capture the construct with reasonable reliability and convergent validity. In the same manner, Job Resources showed loadings between 0.753 and 0.845, a CR of 0.729, and an AVE of 0.633, depicting consistent capture of the construct and adequate variance explained.

Motivation had particularly high factor loadings, ranging from 0.866 to 0.913, indicating high reliability. The CR of 0.909 and AVE of 0.784 indicate reasonable convergent validity, and thus, motivation is well represented in these indicators. Similarly, Strain displayed high loadings between 0.856 and 0.876, with a reasonable CR of 0.836 and AVE of 0.753, thus confirming strong construct reliability. Lastly, Work-Life Balance demonstrated loadings ranging from 0.855 to 0.869, with a CR of 0.828 and an AVE of 0.740, thus confirming reasonable reliability and validity for this study.

Table 2. Construct Reliability and Validity of the Measurement Model

Construct	Measurement item	Std. factor loadings	Composite Reliability	Average variance extracted
Job Demands	JD1	.844	.745	.655
	JD2	.808		
	JD3	.774		
Job Resources	JR1	.845	.729	.633
	JR2	.753		
	JR3	.789		
Motivation	MOT1	.866	.909	.784
	MOT2	.913		
	MOT3	.871		
	MOT4	.890		
Strain	ST1	.856	.836	.753
	ST2	.876		
	ST3	.871		
Work Life Balance	WLB1	.856	.828	.740
	WLB2	.869		
	WLB3	.855		

The effect sizes (f^2) for the structural associations in the model are presented in Table 3. The analysis reveals that Job Demands → Job Resources ($f^2 = 0.091$) and Job Demands → Strain ($f^2 = 0.101$) both exhibit small to moderate effects, suggesting that job demands and resources are important but not the primary factors in constructing resources and strain. Conversely, the relatively large value of Job Resources → Motivation ($f^2 = 0.320$) suggests that adequate resource provision significantly enhances motivation.

Regarding the outcome variable, Motivation → Work-Life Balance ($f^2 = 0.134$) suggests that motivated teachers are more effectively able to balance work and life, as reflected in the moderate effect size. Strain → Work-Life Balance ($f^2 = 0.050$), in contrast, has a much lower effect, suggesting that strain has a balance-inhibiting effect, but this effect is much lower than the effect of motivation. In summary, the results focus on the important issue of job resources and motivation for improving teachers' work-life balance.

Table 3. f^2 Effect Sizes of Key Predictors

Relationship	f^2 Effect Size
Job Demands → Job Resources	0.091
Job Demands → Strain	0.101
Job Resources → Motivation	0.320
Motivation → Work Life Balance	0.134
Strain → Work Life Balance	0.050

Table 4 presents the R^2 scores for the dependent constructs pertaining to the model's predictors, indicating the amount of variance explained by the predictors Job Resources ($R^2 = 0.091$) and Strain ($R^2 = 0.101$), which demonstrate weak explanatory power, indicating that the job demands at hand account to some extent for these outcomes. Motivation ($R^2 = 0.320$) exhibits a significantly higher explanatory power, suggesting that job resources for teachers' motivational level are appreciable.

The explanatory power of Work-Life Balance is the highest ($R^2 = 0.134$), albeit still low. This suggests that the motivation and strain together have a considerable explanatory power for how teachers integrate their professional and personal activities. These findings indicate that while the external factors (demands and strain) have some influence, it is the internal motivational factors which are primary in determining teachers' work-life balance.

Table 4. R^2 Values of Constructs

Constructs	R-square
Job Demands → Job Resources	0.091
Job Demands → Strain	0.101
Job Resources → Motivation	0.320
Motivation → Work Life Balance	0.134

The structural model shown in Figure 2 demonstrates the relationships among job demands, job resources, motivation, strain, and work-life balance. From the analysis, Job Demands is the primary independent variable, and it has direct relationships with Job Resources and Motivation. Job Demands can shape resources and motivation, albeit to a limited extent.

Among all the other predictors, Work-Life Balance is, however, the last to be predicted. It has the highest R^2 value among all the constructs in the model, that is, 0.262. This means Work-Life Balance is predicted to be 26.2 per cent, indicating Strain and Motivation. This value indicates a substantial and meaningful contribution of the two constructs towards reasons why teachers can balance work and life. Notably, the path loadings indicate that Motivation is the larger contributor to Work-Life Balance than Strain. This ability of teachers to balance work and personal life indicates that motivation is higher than the strain they face.

Regarding the factor loadings of the measurement items across the different constructs, the range of 0.74 to 0.91 indicates strong reliability and validity. All structural paths are statistically significant ($p = 0.000$), thus the proposed relationships are well supported. The figure thus aligns with the proposed framework. It shows that motivating teachers is important for improving their work-life balance, even amid the extrinsic constraints of work strain and demands.

Table 5 presents the statistical significance of the hypothesised structural paths. All paths are significant (p -values = 0.000), confirming full support for the proposed hypotheses. The Beta values indicate the strength of influence among the constructs.

The results reveal that Job Demands × Job Resources ($\beta = 0.289$) and Job Demands × Strain ($\beta = 0.303$) are both positive and significant, indicating that demands strongly influence the availability of resources and contribute to higher strain levels. The path from Job Resources → Motivation ($\beta = 0.493$) emerges as the strongest,

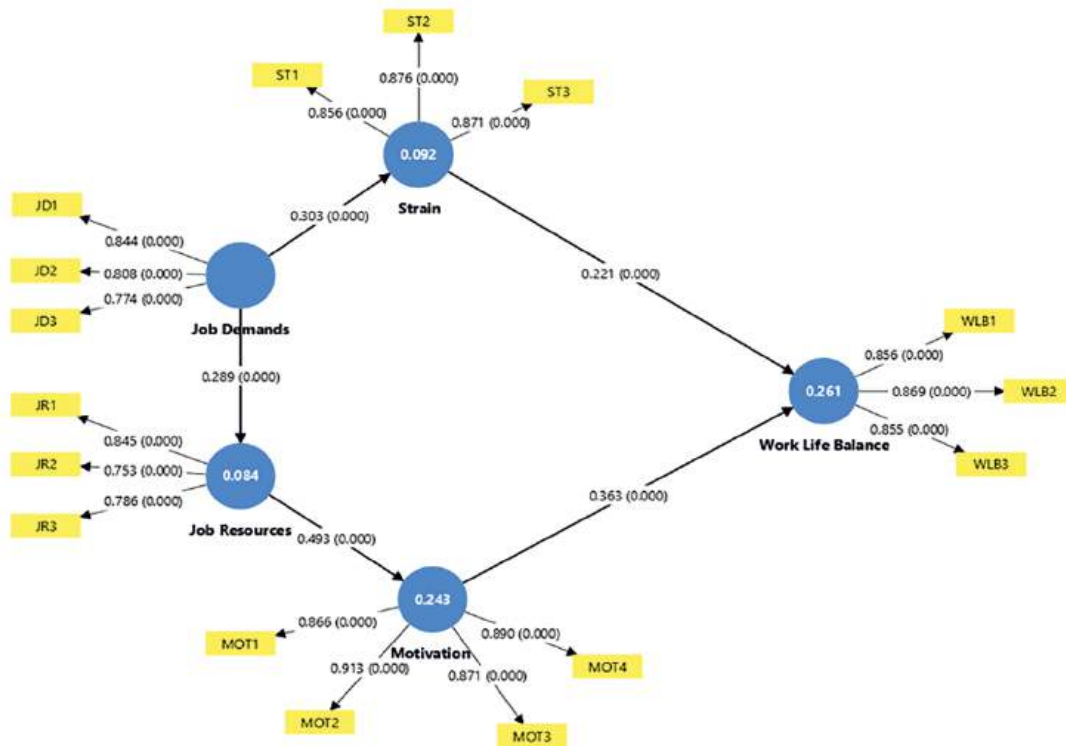


Figure 2. Structural Model with Path Coefficients

highlighting that when resources are adequate, teachers' motivation improves substantially.

For the outcome variable, Work-Life Balance, both Motivation ($\beta = 0.363$) and Strain ($\beta = 0.221$) have significant effects. Motivation has a stronger role in improving balance, while strain exerts a weaker but still meaningful influence.

In summary, all hypotheses are supported, reinforcing the idea that work-life balance is shaped by the interplay of demands, resources, motivation, and strain, with motivation standing out as the most influential driver.

The results presented in Table 5 confirm that all hypothesised relationships are statistically significant, with p-values at 0.000. This indicates strong empirical support for the proposed structural model. Job demands were found to significantly influence both job resources and motivation, while job resources effectively reduced strain. Furthermore, both motivation and strain emerged as significant predictors of work-life balance, with motivation exerting a stronger effect. Overall, these findings validate the research framework and demonstrate that the combined effects of demands, resources, motivation, and strain decisively shape teachers' work-life balance in the Odisha school context.

Table 5. Statistical significance of the structural model path with hypotheses

Hypothesis	Beta values	P values	Decision
Job Demands → Job Resources	0.289	0.000	Supported
Job Demands → Strain	0.303	0.000	Supported
Job Resources → Motivation	0.493	0.000	Supported
Motivation → Work Life Balance	0.363	0.000	Supported
Strain → Work Life Balance	0.221	0.000	Supported

Table 6

Objectives	Hypotheses	Result (β , p-value, decision)	Key Interpretations and Findings
To study the various factors affecting Work-Life Balance among school teaching staff in Khordha district	Job Demands → Job Resources	$\beta = 0.289$, $p = 0.000$ (Supported)	Job demands positively influence the utilization and perception of job resources, indicating that higher demands may encourage institutions or individuals to seek or activate supportive mechanisms.
To study the various factors affecting Work-Life Balance among school teaching staff in Khordha district	Job Demands → Strain	$\beta = 0.303$, $p = 0.000$ (Supported)	Increased job demands significantly lead to higher levels of strain among teaching staff, highlighting the pressure associated with workload and responsibilities in the education sector.
To study the various factors affecting Work-Life Balance among school teaching staff in Khordha district	Job Resources → Motivation	$\beta = 0.493$, $p = 0.000$ (Supported)	Job resources strongly enhance employee motivation, suggesting that support systems, autonomy, and organizational backing play a crucial role in motivating teachers.
To study the various factors affecting Work-Life Balance among school teaching staff in Khordha district	Motivation → Work-Life Balance	$\beta = 0.363$, $p = 0.000$ (Supported)	Higher motivation significantly improves work-life balance, indicating that motivated teachers are better able to manage professional and personal responsibilities.
To study the various factors affecting Work-Life Balance among school teaching staff in Khordha district	Strain → Work-Life Balance	$\beta = 0.221$, $p = 0.000$ (Supported)	Strain negatively affects work-life balance, implying that physical, emotional, and psychological stress disrupts balance between work and personal life.

The findings support empirically the factors that affect the work-life balance of school teaching staff in the Khordha district. The findings showed that job demands influence strain and the resources of the job, indicating that job demands have a dual effect. Job demands that increase workload may trigger or increase the use of job resources as a coping or adaptive mechanism in educational institutions. Job demands that increase workload also strain teachers, revealing the physical, emotional, and psychological suffering they endure due to workload and role expectations. This shows the job's stressful nature.

Additionally, this research outlines the importance of job resources and personal motivation in optimising work-life balance. The research shows that job resources motivate people. This means that positive work environments and clear institutional backing lead to significant increases in teacher engagement. In turn, motivated teachers find work-life balance and the ability to compartmentalise and manage their responsibilities of both job and personal life. On the other hand, work-related strain negatively impacts work-life balance. This reinforces the belief that stress is a major

contributor to an individual's deteriorating well-being. Overall motivation helps balance work and personal life. On the other hand, unmanaged work-related strain is an obstacle that limits people, underscoring the importance of effective job practices and good organisation.

5. Discussion and Conclusion

This study has revealed the importance of the interaction between job demands and job resources, and their effects on the motivation and job strain of teaching faculty in Odisha. Also, the work balance is influenced by motivation and strain. Among these, motivation emerged as the strongest predictor of work-life balance and strain, adding only marginally. These results imply that an individual may be facing strain, and that this motivational driver seems to be far more important in assisting teachers to maintain a balance between work and non-work than the pressures.

The findings are interpreted using the Job Demands-Resources (JD-R) Model and Conservation of Resources (COR) Theory. These frameworks help explain how job demands and resources affect individual outcomes. The positive impact of job demands and strain illustrates the health impairment process described in prior research. The positive impact of job resources on motivation is consistent with the literature on the motivation process. These interpretations explain the findings and show consistency with existing theories.

When we compare and contrast the results with previous empirical studies, we deepen the discussion. Previous studies in education and organisational behaviour have shown that the positive impacts of motivation and the negative impacts of strain result in better work-life balance, and vice versa. The positive correlation between job demands/resources is a new perspective, as it shows a compensatory or adaptive response within a system. Using details from the education sector demonstrates the depth of the study, and the positivity will show the improvement in teacher welfare and the organisational system.

There is evidence that teachers' motivation is influenced by employment opportunities within Odisha's educational system. This study is framed within this system. The results of this study corroborate the JD-R model, which states that, among teachers, job resources and motivation are positively correlated to work-life balance. Conversely, job strain is negatively correlated to work-life balance. These results are consistent with prior research, which indicates that institutional support, job autonomy, and collegial

relationships improve employees' work-life balance and their ability to personally manage non-work activities. The results are also consistent with prior research indicating the positive effects of both intrinsic and extrinsic motivation on employee wellbeing and resilience.

Government-operated schools in Odisha provide teachers with the utmost job security and a well-defined work structure. These two factors also contribute to a work environment with minimal uncertainty. On the other hand, private schools operate within a work structure that emphasises accountability and performance and subjects employees to long work hours. This environment leads to a marked increase in job demand and strain. These institutional factors help substantiate the work-life balance that teachers experience.

The results of the study also suggest that job resources are among the foremost factors that significantly enable teachers to manage role-related stress. This is especially important within the context of the public education system in Odisha. The major factors responsible for the infrastructure and resource disparity among the various schools are those that negatively influence teachers' work experience the most. The result showing the strain to be the least is indicative of the aforementioned factors and of teachers' strong professional commitment, which enables them to establish coping mechanisms and adapt to work-related stress.

The supported hypotheses collectively highlight the intricate dynamics influencing teachers' work-life balance. The first hypothesis confirmed that job demands significantly affect job resources, indicating that excessive workload makes available support feel insufficient, stressing the importance of balancing demands with resources. The second hypothesis established that job demands increase strain, underlining how pressure directly translates into stress and affects wellbeing. The third hypothesis emphasised the strong positive role of job resources in enhancing motivation, suggesting that when teachers are adequately supported, their commitment and enthusiasm rise. The fourth hypothesis showed that motivation is a key driver of work-life balance, reflecting that motivated teachers can better harmonise personal and professional lives. Finally, the fifth hypothesis confirmed that strain adversely affects work-life balance, albeit less strongly than motivation, highlighting the need for interventions to reduce stress. Together, these results underscore that reducing demands, enhancing resources,

and boosting motivation are critical strategies for sustaining teachers' balance and wellbeing.

This study concludes that work-life balance is more strongly associated with resources and motivation than with strain and negative demands. Teachers in both government and private schools benefit when engagement, autonomy, and acknowledgement are fostered in the work environment. Adding to this study's model, the variables of organisational culture, emotional intelligence, family support, and coping strategies would aid in further model development. Other than that, this area of work-life balance, job demands, and the evolution of resources would benefit from longitudinal research. Comparative research in other Indian states or other countries would further enrich this knowledge. Lastly, qualitative research focused on interviews with teachers would allow the collection of contextual quantitative data, illuminating the daily compromises and strategies teachers use to maintain balance.

In conclusion, the study establishes that a delicate interplay of job demands, resources, strain, and motivation shapes work-life balance among teaching staff in Odisha's schools. The findings confirm that while excessive demands can heighten strain and diminish available resources, strong institutional support significantly fosters motivation, which in turn becomes the most decisive factor in achieving balance. At the same time, unmanaged strain continues to negatively affect teachers' ability to maintain equilibrium between personal and professional spheres. These insights stress the importance of reducing unnecessary pressures, enhancing supportive systems, and prioritising motivational drivers to create healthier, more sustainable teaching environments.

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The Impact of Wasta on Business Performance of SMEs in Oman: The Role of Competitive Edge

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A b s t r a c t

This study examines the impact of *wasta* on the business performance of small and medium enterprises (SMEs) in Oman and investigates the mediating role of competitive edge in this relationship. A quantitative approach was adopted, using survey data collected from 268 SME owners and managers across Oman's different governorates. The data were analysed using SPSS and SmartPLS to test the proposed hypotheses and structural relationships. The findings reveal that competitive edge has a significant positive effect on business performance, while *wasta* does not have a significant direct influence on either business performance or competitive edge. Furthermore, the mediating role of competitive edge in the relationship between *wasta* and business performance was not supported. These results suggest that, although *wasta* remains embedded in the socio-cultural context, it does not significantly enhance firm performance in the current competitive business environment. The study highlights the importance of SMEs focusing on developing internal capabilities, such as innovation, adaptability, and strategic positioning, to achieve sustainable performance. The findings also provide policymakers with valuable insights for designing support mechanisms that strengthen competitiveness rather than relying on informal practices. This study contributes to the literature by offering empirical evidence from Oman and by re-evaluating the role of *wasta* in shaping SME performance.

Keywords: *Entrepreneurship, Business Performance, SMEs, Wasta, Competitive Edge, Oman, Emerging Economies.*

1. Introduction

Small and Medium Enterprises (SMEs) and entrepreneurship are key drivers of economic growth (Singh et al., 2022). SMEs employ many people and have the capacity to enhance people's quality of life. The innovative mindset, creativity, and self-reliance of entrepreneurs create new startups, which later transform into big enterprises offering significant employment opportunities (Al-Awlaqi et al., 2019). This study is conducted in Oman, where SMEs play a significant role in addressing unemployment and reducing reliance on external funding sources (Ramachandran & Yahmadi, 2019). Compared to its adjacent Arab countries, Oman has been taking efforts to extensively diversify its economy by strengthening tourism, agriculture, light manufacturing, and fishing. Despite global economic downturns, Oman maintained its resilience and is now a favourable destination for global investors. Oman attracts Foreign Direct Investment (FDI) in fields such as tourism, retail, real estate and entertainment (Shachmurove, 2019).

In this context, there is a growing need to research the untapped potential of SMEs and the factors driving their growth and business performance. This study examines this gap by investigating the relationship between *wasta* and the business performance of SMEs, and the mediating role of competitive advantage. *Wasta* is a concept that prevails in Arab culture, indicating a network of relationships that can be utilised to easily access resources and get things done faster than without it. In the words of Marktanner and Wilson (2016), *Wasta* is the use of personal networks to secure jobs, building permits, doctor appointments, college admissions, and similar matters. *Wasta* is criticised on many grounds due to its connection with nepotism. Those without good political relationships may be restricted in entry or permission, and those granted permission are expected to show loyalty, giving rise to a network of family members, friends, and allies that becomes increasingly closed to outsiders (Talib, 2017). *Wasta* in Arabian culture always contradicts the risk-taking concept in business. Entrepreneurship thrives when people are willing to take risks and act independently, whereas *wasta* facilitates easy coordination and convenient transactions. Hence, entrepreneurs are often challenged to balance exposing the basic qualities that drive innovation with satisfying societal expectations through *wasta*.

In Arab culture, it is common for entrepreneurs to hire family members, and this is regarded as a trusted alternative

to managing a business in the owner's absence. The Arab owner-managers consider *wasta* a crucial element for successful business and do not see any ethical conflict in showing nepotism (Talib, 2017). But building *wasta* has proved time-consuming, as owner-managers devote their time and resources to building social relationships. The time and effort that should be spent improving product and service quality are diverted to building social relationships with influential people. This is, in fact, a time-consuming necessity, as owner-managers must spend time engaging in social phone calls and conversations (Loewe et al., 2008).

The study of *wasta* becomes important when examining the challenges faced by SMEs in Oman. It has been reported that SMEs in Oman face many challenges related to management systems, finance, human resources, marketing strategy, and location, as well as effective support systems (Al Qubtan & Tha, 2020). These challenges vary by governorate where SMEs are located. Out of the 11 governorates in Oman, in some governorates the most prominent will be marketing challenges like high competitive pressures, high labor and marketing costs, high cost of capital, limited supply of raw materials, visa problems of expatriate employees, lack of skilled workers (Al-Maskari et al., 2019) while in others stiff government regulations, lack of information, delays in loan disbursements, delayed and complex procedures, lack of adoption of modern technologies, limited access to international markets (Ramchandran & Ali AL Yahmadi, 2019).

An in-depth study is required in this area to identify the key factors that can enhance SME performance and minimise the challenges they face. Some proposed solutions range from developing an SME-friendly regulatory framework (Blossom et al., 2014) to modifying commercial banking laws and adopting a bankruptcy code (Furr & Furr, 2013). These measures have the potential to reduce, to some extent, the challenges faced by SMEs. Supportive measures, such as a favourable legal and financial environment and efforts to build competitive advantage for SMEs, have the potential to foster innovation and improve business performance among SMEs.

Despite the growing body of literature on SMEs, entrepreneurship, and informal institutional practices such as *wasta*, several important gaps remain. First, existing studies provide mixed and inconclusive evidence regarding the impact of *wasta* on business performance, with some highlighting its facilitating role. In contrast, others

emphasise its negative implications for efficiency, innovation, and fairness. Second, limited research has examined *wasta* as an independent variable within a structured empirical model, particularly in relation to SME performance in the Omani context. Third, there is a lack of studies that explore the underlying mechanisms through which *wasta* may influence firm performance, especially the potential mediating role of competitive edge. Given the growing shift toward formalisation, competitiveness, and capability-driven growth in emerging economies, understanding whether informal practices such as *wasta* continue to play a significant role in shaping business outcomes is critical. Therefore, this study addresses these gaps by examining the direct effect of *wasta* on SME business performance and investigating the mediating role of competitive edge within the Omani context.

In this context, this study aims to examine the impact of *wasta* on the business performance of SMEs in Oman and the role that competitive edge plays in this relationship. Though numerous studies have been conducted in this field, very few studies analyse the specific influence of *wasta* on entrepreneurship. A notable research gap exists in studying *wasta* as an independent variable and its effect on business performance, and how competitive edge influences this relationship. Hence, the purpose of this relationship is to examine the impact of *wasta* on SME business performance (BP) and to analyse whether competitive edge (CE) serves as a mediating variable in this relationship. The study aims to test the following relationship:

H1: There is a significant positive relationship between *wasta* practices and SME's BP.

H2: There is a significant positive relationship between *wasta* practice and SME's CE.

H3: There is a significant positive relationship between SME's CE and BP

H4: There is a significant mediating role played by competitive edge on the above relationship.

Based on the literature review and identified research gap, the conceptual framework of this study is presented in Figure 1.

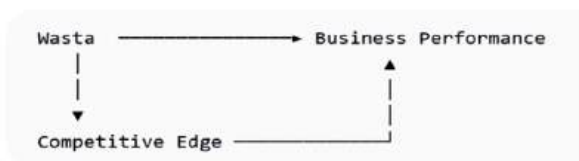


Figure 1. Conceptual model of the relationship between *wasta*, competitive edge, and business performance

2. Literature Review

2.1 *Wasta*

The origin of the name *wasta* comes from the Arabic word *واسطة* (*wāsiṭah*), meaning “medium” or “means”. Later, this word has evolved to refer to a personal connection utilised to gain something (Cown, 1961). The concept of *wasta* has been the subject of many studies and is simplified as a cultural element (Almutairi, 2022; Alsarhan, 2022; Tlais & Kauser, 2010; Barnett et al., 2015). Much literature addressed the concept as an important element in social networking, decision-making, and as a form of social capital.

Apart from the Arab world, the concept is widely observed in other countries, such as China, Indonesia, and Latin America. In China, known as Guanxi, is similar to the *wasta* in Arab culture and reflects a collectivist rather than a consultative approach seen in the Arab world (Hutchings & Weir, 2006). In Indonesia, this is known as KKK, which is an acronym of koneksi, kolusi, and nepotisme, meaning connection, collusion, and nepotism. While Arabian *wasta* is rooted in tribal connections, Indonesian KKK works outside such a framework. Attributed to improved communication and transport network, the sense of ethnic identity and community unity could decline in Indonesia (Azra, 2016). In Latin America, this is entirely different: it is known as *comadrado*, a sacred association developed outside the family. A person will serve as a religious sponsor, having the same roles and responsibilities as parents and will be considered the child's godfather. This develops a personal bond between them and may even lead to later business operations as “compadres” (Velez-Calle et al., 2015).

According to a study by Iles et al. (2012), *wasta* leads people to prioritise family commitments over business commitments, a trend deeply rooted in their culture. The article suggested a growing awareness among Arabs, especially those who conduct business within ethical boundaries, of how this is perceived by their foreign counterparts. It is important to understand that there is a strong need to discard outdated practices and focus more on approaches that enhance competency and merit-based performance, thereby giving rise to equal employment opportunities.

In a study conducted across manufacturing firms in South Korea, China, Jordan, and Egypt (Zhang et al., 2021), a strong positive correlation is observed between customer

loyalty and yongo, guanxi, and *wasta*. Though the relationship with *wasta* was found to be insignificant, it was positive in the case of yongo and guanxi. Some literature classifies *wasta* practice into different types, such as mediatory and intercessory *wasta* (Cunningham & Sarayrah, 1993). The term mediatory was adopted because it was traditionally used to describe a compromising guide between two parties in conflict to reach a compromise, and it holds the role of mediator or mediation. The mediatory concept originated in pre-colonial times, when the chiefs of tribal communities served as arbitrators in disputes. In contrast, intercessory *wasta* is similar to cronyism, nepotism, and favouritism. This form of *wasta* makes employees dependent on others for personal influence rather than focusing on their own skills or achievements. Relying on such a dependency reduces confidence and professionalism, which could otherwise be gained through experience, effort, and learning from mistakes. From the perspective of employees, this leads to risk avoidance, discourages independent decision-making, creativity, and innovation, impedes proper training implementation, hinders constructive feedback, and undermines employee motivation and discipline. This gradually hinders personal growth and organisational development over time (Cunningham et al., 1994).

This was supported by the studies by Alsarhan and Valax (2021), who argued that *wasta* adversely affects employee motivation and morale, job satisfaction, and job burnout, and results in employee turnover. In contrast, there are positive views about *wasta* as Sefiani et al. (2018) reported. Networking through *wasta* helps easily access finance, particularly through trade credit, stay up to date with information, build strong relationships with suppliers, find potential employees, and more. The same view was held by Talib (2017), who observed that *wasta* helps form a healthy group of family members, friends, and relatives, reducing the likelihood of new entrants.

Wasta is also widely prevalent in universities and colleges in other countries. Graduate students in certain countries use *wasta* to secure admission to colleges and universities. For instance, at the American University of Madaba in Jordan, due to the unequal opportunities in the job market and the lack of proper regulations, students justify the use of *wasta*. They also acknowledge that *wasta* has both negative and positive effects on them (Al-Twal & Aladwan, 2020). A trend was also observed in which eligible candidates are denied or rejected from suitable positions due to a lack of proper *wasta*. This results in resource waste (Makhoul &

Harrison, 2004) and is more evident during limited job opportunities. The entrepreneurs dedicate much of their time to building social connections and engaging in social calls rather than investing in productive capital (Loewe et al., 2008).

2.2 *Wasta and Business Performance*

Wasta, as a cultural phenomenon and its role in social networking, fostering social capital, decision-making, and similar factors, has been the subject of many studies (Barnett et al., 2013; Kropf & Newbury-Smith, 2016). Business performance is the means of achieving a business firm's manufacturing, service, and strategic goals (Wu, 2009). Some of the prominent literature in this field are the ones done by Arsi (2016) regarding innovation intensity in the Omani SME sector, Al-Mataani (2017) regarding the effect of organisational shortcomings and cultural factors on the entrepreneurial orientation of SMEs in Oman, and Al-Harhi (2016; 2017) investigating on the personal characteristics, faith in religion, support of family and work experience of SME entrepreneurs. Certain studies were conducted to examine the challenges faced, such as corruption (Dutta & Sobe, 2016), rigid regulations, unprofessional work attitudes, and lower commitment (Jumde, 2017).

Similar studies have also been undertaken in other culturally similar countries, for instance, in Saudi Arabia, which examined the relationship between SME growth and performance (Al Saleh, 2016), analysed entrepreneurial innovation in Middle Eastern countries (Sharpe & Schroeder, 2016), and studied the influence of institutional and cultural aspects on entrepreneurship in Oman and other GCC Countries (Biygautane, 2015). Sazegar et al. (2018) conducted a comparative study of Oman and Qatar on entrepreneurship and the endorsement of innovation in the context of transforming Oman into a knowledge-based economy from a rentier State.

Another similar study conducted in Jordan (Al-Ramahi's, 2008) highlighted the role of *wasta* in business transactions and conflict resolution. According to the study, *wasta* played a major role in Jordan's economic development during the period 1930- 1940. In the wider Middle Eastern community, *wasta* is an important factor in settling commercial disputes. Similar studies highlighting the influence of culture on entrepreneurship orientation have been conducted in countries such as Sweden, Australia, Norway, Costa Rica, and the Netherlands (Kreiser et al., 2010).

2.3 Competitive Edge and Business Performance

Omerzel and Gulev (2011) define competitive edge as the ability to deliver offerings more efficiently and effectively than competitors. It can be achieved through a low-cost structure, enhanced quality, better customer service, branding, and distribution, giving the company's offerings greater value at the same time and at a lower cost than its competitors. Numerous studies have examined the factors that can enhance a business's competitive edge, as this is a significant contributor to business performance. A strong association between competitive edge and profit gains has been reported by Majeed (2016). Udriyah et al. (2019) found a strong association between market orientation and innovation in enhancing competitive edge, together contributing to enhanced business performance. Sustainable competitive edge and business performance are strengthened by the impact of technical and social challenges.

The literature review reveals that, though many studies have been conducted to improve competitive edge and business performance, few have examined *wasta* as an independent variable influencing competitive edge or business performance. Hence, this study explores the effect of *wasta* on business performance and the role of competitive edge in this relationship.

3. Methodology

The study has been conducted among SMEs in Oman that meet the parameters set by 'Riyada', the Small and Medium Enterprise (SME) Development Authority in Oman. Simple random sampling was used to select entrepreneurs from those who met the above criteria. The study employed a correlational research design to examine the relationship between *wasta*, an independent variable, and business performance, the dependent variable. Whether the competitive edge exerts a mediating influence in this relationship is also examined. A correlational research methodology studies the association between two or more variables without manipulating them (Cooper & Schindler, 2014). When two variables are correlated, a prediction can be made with some accuracy, though it does not reveal a cause-and-effect relationship (Jackson, 2009).

The data were collected through self-administered questionnaires and used a quantitative approach. The questionnaire consists of demographic questions as the first section, followed by the company profile and scale items intended to measure *wasta*, business performance and competitive edge. The items used to measure *wasta* were

adopted from the scale developed by Alyahyaei et al. (2019). The items measure two aspects of *wasta* related to SMEs. The first three items address the importance of *wasta* in the context of SMEs, while the next five items measure the perceived effect of *wasta* on entrepreneurial values. The items that followed measured the entrepreneur's assessment of the *wasta* phenomenon in relation to the overall performance of their business.

Most items measuring business performance and competitiveness were adapted from Omar (2011), which examined Malaysian SMEs. Some items were developed by the researcher in line with the conceptualisation of business performance and competitive edge from the works of Porter (1985) and Barney (2003, 2007). The items were measured on a 10-point Likert scale, with the lowest score indicating strongly disagree and the highest indicating strongly agree (Awang et al., 2016). A sample of 268 respondents was randomly selected for data collection from a population of 31,835 SMEs registered with the SME Development Authority across the 11 governorates in Oman. The sample size was determined to be 98 respondents from 268 responses, based on the G*power software recommendation for a one-independent-variable design (Faul et al., 2009). The 3.1 version of G*power software is used, which is a stand-alone power analysis software for statistical analysis (Faul et al., 2007).

The use of simple random sampling in this study is appropriate as it ensures that each SME within the defined population has an equal probability of being selected, thereby reducing sampling bias and enhancing the representativeness of the sample. This approach is particularly suitable for quantitative studies aiming to generalise findings across a population of SMEs operating in different governorates in Oman. Furthermore, selecting respondents from diverse sectors and geographic locations enhances the external validity of the study. The sample size is considered adequate for the analysis conducted in this study. A total of 268 valid responses were obtained, exceeding the minimum sample size requirement of 98 as determined with G*Power software (Faul et al., 2009). According to Hair et al. (2019), Partial Least Squares Structural Equation Modelling (PLS-SEM) is suitable for studies with relatively small to medium sample sizes, and the current sample size meets the recommended threshold for achieving sufficient statistical power and reliable parameter estimation. Therefore, the sample size is deemed appropriate for testing the proposed hypotheses and structural model.

The items measuring finance examined profitability and cost-effectiveness. The items measuring sales incorporated market share, sticking to one-time delivery objectives, and sustained profitability. The items measuring human resources examined labour turnover and employee morale. Apart from the items measuring reputation, two aspects were measured- one related to maintaining a mutually valuable working relationship with the partners of a business, and the other related to the firm's respectability and goodwill.

The competitive edge was measured in three dimensions: operations, product, research, and human resources (Porter, 1985; Barney, 2003, 2007). The operations dimension measures the company's ability to offer products that are superior in value to competitors, its flexibility to adapt to sudden changes, and its proficiency in adopting new technology ahead of competitors through an efficient Research and Development (R&D) department. The product or service aspect measures the company's ability to offer distinct offerings compared to competitors. This involves how well the company can customise its product or service, and whether the firm systematically gathers and updates data to enhance offerings in response to customers' changing needs. The items measuring human resource-related dimensions ask respondents to assess the company's expertise and operational skills in delivering regular training and the required information to meet customer demands.

The questionnaire was checked for construct, convergent and discriminant validity. Construct validity was assessed by incorporating a panel of experts encompassing language experts in Arabic and English, entrepreneurs, and academicians, and by checking for biases that may influence responses. The reliability analysis was conducted using Cronbach's alpha, which yielded a value of 0.970 for the entire set of items. All items met the reliability range reported by Tavakol and Dennick (2011) and Cortina (1993).

The data collection posed many challenges in obtaining performance data, as there was reluctance to reveal financial data, such as sales, equity, and assets, to external parties. This challenge is commonly encountered in studies of business performance (Mahmood & Hanafi, 2013). The responses were subjective and confined to the options provided in the questionnaire.

4. Results

The survey questionnaire was distributed online to 268 SME entrepreneurs, randomly selected from a population of 31,835 SMEs registered with the SME Development Authority across the 11 governorates in Oman. The data screening process revealed that all 268 responses were complete and error-free, with no missing values. A boxplot analysis was conducted in SPSS to detect extreme outliers, and the results showed none; hence, all data sets were retained for further analysis. Common Method Variance (CMV) analysis was conducted to assess the accuracy and validity of the findings, and no serious common method bias was found, thereby confirming the validity of the constructs and the relationships under study. All variables were confirmed to have normal distributions by conducting tests of skewness (+/-3) and kurtosis (+/-10), as well as Q-Q Plots, and were found to fall within the required range. The data analysis was conducted using SPSS and SmartPLS. The descriptive statistics were analysed using SPSS, and the measurement model was tested using SMART PLS.

4.1 Descriptive Statistics

The descriptive statistics (Table 1) showed that the majority of respondents (53%) were from Muscat governorate, 47% were business owners, 30% were managers, and 24% were both owners and managers. The majority of the organisations were service-oriented (50%), followed by retail businesses (43%), manufacturing firms (11%) and wholesale businesses (6%). Of the total, only 18% of companies reported receiving assistance from government organisations. Considering the years in business, 28% of companies operated for 7 to 14 years, followed by 27% for 4 to 6 years, 26% for more than 15 years, and 19% for 3 years (Table 1).

Considering the descriptive analysis of *wasta*, three items scored above the mean (items 3,8,9) and two items scored less than the mean compared to all other scored items. Business Performance recorded an average mean score of 7.85 (1.967), and Competitive Edge recorded 7.55 (SD 2.275).

Table 1. Descriptive Statistics

Details	Frequency	Percentage (%)
Governorate		
AL Dhahira	7	2.6%
AL Dakhilya	35	13.1%
Al Wusta	4	1.5%
Batinah	31	11.6%
Buriami	6	2.2%
Dhofar	13	4.9%
Sharqiyah	27	10.1%
Musandam	2	0.7%
Muscat	143	53.4%
Status		
SME Owner	125	46.6%
SME Manager	79	29.5%
SME Owner and Manager	64	23.9%
SME Type		
Manufacturing	30	11.2%
Services	132	49.3%
Retail	91	34%
Wholesale	15	5.6%
Years in Business		
Three years	52	19.4%
Four to Six Years	71	26.5%
Seven to Fourteen Years	75	28%
Fifteen Plus Years	70	26.1%
Government Support		
Yes	49	18.3%
No	219	81.7%

Source: Survey Data

After analysing the descriptive statistics, the measurement model was tested using SmartPLS 3.0. Convergent and discriminant validity have been tested before the variables were subjected to model testing. Convergent validity was tested by measuring average variance extracted (AVE), and all variables showed factor loadings above the required threshold. Convergent validity can be confirmed if the AVE is greater than 0.50 (Hair et al., 2014). This indicates that the constructs and all measurement variables demonstrated strong correlations (Table 2). Some items with low loadings were eliminated. Discriminant validity has also been established using the Fornell-Larker criterion, in which the AVEs are compared with the shared variances among the

constructs. The test showed that all constructs exhibited strong correlations with their respective measures, compared with other constructs that satisfied the criteria (Hair et al., 2019).

4.2 Testing Hypotheses

According to Hair et al. (2014), path coefficients should be at least 0.1 to indicate an effect in the model. The hypothesis was tested by examining the path coefficients between the latent variables, with significance set at t-values greater than 1.96 and p-values less than 0.05. The results indicate that all relationships except H3 are not supported (Table 3)

Table 2. Reliability and Validity Tests

Construct	Items	Item Loading	Cronbach's Alpha	Composite Reliability (CR)	Average Variance Extracted (AVE)
<i>Wasta</i>	WA1	0.797	0.957	0.963	0.765
	WA 2	0.919			
	WA 3	0.869			
	WA 4	0.854			
	WA 5	0.919			
	WA 6	0.896			
	WA 7	0.866			
	WA 8	0.873			
Competitive Edge	CEP1	0.798	0.620	0.897	0.919
	CEP2	0.865			
	CEP3	0.810			
	CEH1	0.781			
	CEH2	0.789			
	CEO2	0.710			
	CEO4	0.750			
Business Performance	BE2	0.733	0.875	0.903	0.57
	BF1	0.774			
	BF2	0.77			
	BF3	0.816			
	BR2	0.705			
	BS1	0.728			
	BS3	0.755			

Source: Survey Data

Table 3. Results of Hypothesis Testing and Path Coefficients

Hypotheses	Path coefficient (B)	Standard deviation (sd)	t-value	p-value	Result
H ₁ <i>Wasta</i> -> BP	0.053	0.051	1.038	0.300	Not Supported
H ₂ <i>Wasta</i> -> CE	-0.079	0.048	1.621		Not Supported
H ₃ CE -> BP	0.479	0.061	7.809	0.000	Supported
H ₄ <i>Wasta</i> ->CE->BP	-0.038	0.023	1.602	0.110	Not Supported

Source: Survey Data

4.4 Testing the Mediating Role of Competitive Edge

To test hypothesis H3, a mediation analysis was done using the “Bootstrapping” method using SMART PLS. According to Ramayah et al. (2019), this is the best method for conducting mediation analysis using SMART PLS, and all established standards as prescribed by the authors were considered. Accordingly, the significance values were set at a t-value greater than 1.96 and a p-value less than 0.05. To demonstrate mediation, a path coefficient should be at least 0.1 to exert influence in the model. The results of the test conducted did not satisfy this criterion, and hence, no mediation role by the construct competitive edge is proved. The path coefficient (β) has shown a value of -0.038 with a standard deviation of 0.023, a t-value of 1.602, and a p-value greater than 0.05 (0.110). Hence, H4 is rejected.

5. Discussion

The study attempted to examine the relation between *wasta* and business performance and the mediating influence of competitive edge on this relationship. The data analysis showed a significant positive relationship between Competitive Edge and Business Performance. In contrast, the relationships between *Wasta* and Competitive Edge and Business Performance, and between *Wasta* and Business Performance were not supported.

The finding that *Wasta* does not have a significant influence on BP is a relevant finding as it contradicts the general notion that *Wasta* is detrimental to the BP of SMEs, as mentioned in the literature. To cite a few, it was reported that *wasta* led entrepreneurs to avoid risk and take independent decisions, resulting in poor implementation of human resource functions such as employee training, motivation, supervision, counselling, and the necessary termination and retention of employees (Cunningham et al., 1993). Loewe et al. (2008) argued that entrepreneurs concentrate more on investing in social capital for building up *wasta* rather than investing in productive capital. Oukil (2016) indicated that *wasta* could be detrimental to preventing innovative ideas. In contrast, some positive views about *wasta* highlighted that it is a particular way of doing business when entrepreneurs become overburdened with rigid compliance (Velez-Calle et al., 2015). In certain countries like Morocco, it is an important element for SME Business Performance (Seifani et al., 2018) and acts as a means of arbitration in dispute resolution (AL-Ramahi, 2008). Certain literature suggests that hiring relatives is a reliable alternative and that it improves SME Business Performance.

In conclusion, this study shows that entrepreneurs in Oman adopted the concept of *wasta* as a strategy for getting things done, and that it neither promotes nor hinders Business Performance. It is widely accepted as a *modus vivendi* (way of living) and is embedded in the cultural system, becoming a normal way of doing business for SMEs (Talib, 2017). *Wasta* practice might be perplexing for those who are unfamiliar with this cultural practice, and denotes the fundamental difference in the views between Eastern and Western societies. While Western societies practice what they recognise as efficient and fair business practices, Eastern societies align their business practices with cultural and political influences (Al-Ramahi, 2008).

The finding that *wasta* and competitive edge do not have any significant relationship was expected, as the competitive edge depends upon the possession of abilities like risk-taking, innovativeness, proactiveness, and independent thinking, which are inconsistent with the idea of *wasta*. While *wasta* emphasises building social relationships, competitive edge places emphasis on building up competencies that help a firm to outperform its competitors (Wang, 2014). It is a strategy to create more economic value than its competitors (Barney, 1999). The findings of this study that competitive edge is significantly associated with Business Performance are supported by the similar findings of Kamukama et al. (2016). In the data analysis, the item measuring R&D coming under the operation dimension of the variable competitive edge showed a mean score of 6.10 only, while the median showed a score of 6.96. However, the hypothesis validation is done based on the strong association of the three other questions in the construct. This highlights the fact that the challenges faced by the SMEs in terms of limited financial access can be overcome by applying competitive prices, adopting new technologies and being adaptable.

The nonexistence of mediating influence of competitive edge shows that the Business performance is solely dependent upon how the firm builds upon its competencies. At the same time, the *wasta* principle is found to be deeply rooted in the Arab culture and is considered an inevitable part of doing business.

6. Future Research Directions

While this study provides valuable insights into the relationships among *wasta*, competitive edge, and business performance among SMEs in Oman, several avenues for future research emerge. First, this study is limited to a single

country context, and future research may extend the analysis to other Gulf Cooperation Council (GCC) countries or emerging economies to enable cross-cultural comparisons and enhance the generalizability of the findings. Second, the study adopts a cross-sectional research design, which captures relationships at a single point in time. Future studies may consider longitudinal designs to examine how the influence of *wasta* and competitive edge evolves over time, particularly in light of ongoing economic reforms and increasing market competitiveness in the region. Third, this study focuses on competitive edge as a mediating variable; however, other potential mediators or moderators may further explain the relationship between *wasta* and business performance. Future research could explore variables such as innovation capability, digital transformation, organisational culture, or institutional support to provide a more comprehensive understanding of SME performance. Fourth, the study relies on self-reported data, which may be subject to respondent bias. Future research may incorporate objective performance indicators or mixed-method approaches to enhance the robustness of findings. Finally, sector-specific studies could examine whether the role of *wasta* varies across industries, such as manufacturing, services, or technology-intensive sectors. Such investigations would provide deeper insights into the contextual dynamics of informal practices and their impact on firm performance.

7. Conclusion and Study Contribution

The purpose of this paper was to examine the relationship between *wasta* and Business Performance and to determine whether competitive edge exerts a mediating influence in this relationship. The findings showed not only that *wasta* does not have a significant association with Business Performance, but also that the competitive edge does not mediate this relation. However, the association between competitive edge and Business Performance was strong, which is a significant contribution of this study, and this adds to the literature related to SMEs and *wasta*. This paper particularly contributes by treating *wasta* as a cultural variable and competitive edge as a mediating variable, though these constructs were studied in different contexts (Weir, Sultan & Van de Bunt, 2016; Oukil, 2016; Sidani & Thornberry, 2013; Ramady, 2016).

The study gives an insight into the SME entrepreneurs that, though *wasta* is perceived to be important in carrying out the business tasks easily, achieving a competitive edge is even more important to build up more economic value than the

competitors. Efforts have to be taken to overcome challenges and develop required competencies by addressing challenges, efficient allocation and utilising the available resources, developing creativity and innovation, effectively investing in Human Resource Development, and considering expanding to international markets in the context of economic diversification in Oman. Apart from these, fostering collaborations with government and private bodies, industry associations can also nurture the growth of SMEs.

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Assessing Service Quality in Higher Education Institutions using the Kano Model: A Bibliometric Analysis with Future Research Agenda

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A b s t r a c t

Purpose: This study is an attempt to identify, discover connections, and examine all relevant literature in the extensive field of appraising service quality in the higher education landscape. Special emphasis has been placed on the utilisation of the Kano Model, which is a highly compatible method for measuring stakeholder expectations. The data have been presented using a bibliometric analysis approach, by studying the evolution of research themes and trends over the last 15 years and outlining suggestions for unexplored areas of future research.

Design/methodology/approach: The data were derived from the Scopus and Web of Science databases using the inclusion/exclusion criteria prescribed by the PRISMA framework, which set the boundaries of the systematic literature review. A rigorous assessment of the screened data was conducted using VOSviewer. The techniques chosen to achieve the study's objectives include citation analysis, bibliographic coupling, and co-occurrence analysis of author keywords.

Findings: There has been a notable surge in post-pandemic publications examining the application of the Kano model within hybrid learning contexts, and emphasis is shifting from conventional service quality assessment to technology-driven experiences. The field is thematically fragmented, with one prominent cluster featuring methodological integrations, particularly the combination of the Kano Model with complementary frameworks like QFD, SERVQUAL, and IPA. A review of the existing literature indicates that most prior studies have failed to incorporate an inclusive perspective on all higher education stakeholders. The focal point has always circled the student's perspective. However, there should be an attempt to analyse the requirements and perceptions of each beneficiary stakeholder who plays a pivotal role in shaping the educational landscape.

Originality/value: The paper highlights gaps in the literature and identifies areas where meaningful, high-quality research can develop in this field.

Keywords: *Kano Model, Bibliometric analysis, higher education, service quality, stakeholder satisfaction, PRISMA, VOSviewer, QFD*

1. Introduction

In today's dynamic pedagogical landscape, assessing service quality has become a critical concern for researchers, legislators and governing bodies of institutions. Universities and colleges have evolved from traditional teaching-learning spaces into modern, competitive industries driven by several forces and benefiting multiple stakeholders. Not only that, the quality of academic programs offered by institutions is a primary catalyst for elevating student performance and satisfaction (Malik et al., 2010). Increasingly, higher education is perceived as a service-driven market, where the focus is directed toward meeting, and frequently exceeding, the expectations of its diverse stakeholders (Gruber et al., 2010).

If we pause to think about who the customers or stakeholders of higher education are, the answer is apparent. Students, the recipients of educational services, are first-rank customers who are kept satisfied by the institution so that they do not switch to another service provider (Gruber et al., 2010; Mahboube et al., 2012). There may be hesitation to address students as customers because of the symbiotic relationship between a teacher and a student. However, we cannot ignore the fact that, without students, there would be no colleges and no income for teachers (DeShields et al., 2005).

Therefore, appraising student satisfaction in institutions of higher education is crucial, as it helps institutions build a lasting bond with students. Moreover, learners who report high levels of fulfilment with their institutional experience will demonstrate loyalty to the institution (Alves & Raposo, 2007). A satisfied student will advocate for that service to other prospective students and will continue being a recipient of educational services from the service-providing institution (Munteanu et al., 2010).

Students' perceived satisfaction is largely influenced by frequent experiences in the campus environment. Moreover, it is not just the classroom experience but also the overall campus life that affects students' satisfaction levels (Elliott & Shin, 2010). Educational institutions can enhance their market position and student loyalty by improving the campus environment and building on their strengths to establish their institutional image and competitive advantages (Brown & Mazzarol, 2009).

Evaluation of student satisfaction can be based on two methods that coexist:

- An approach that focuses on teaching and learning
- An approach that focuses on the total student experience.

Although the former approach was previously widely acknowledged, there has been a shift in focus towards the

overall student experience when considering student satisfaction (Aldridge & Rowley, 1998).

Former studies clearly indicate that service experiences in higher education are not uniform; what delights one group of stakeholders may have little or no impact on others, and what dissatisfies one cohort may go unnoticed by another. This asymmetry in satisfaction calls for analytical models, such as the Kano Model, that can capture the nonlinear and multidimensional dynamics of perceived quality.

2. Understanding the Kano Model

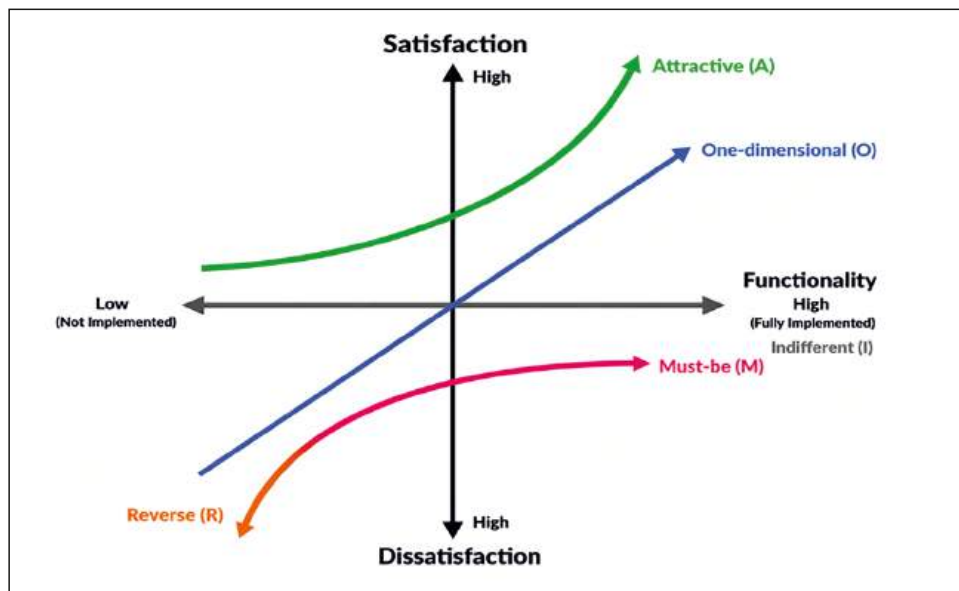
Dr. Noriaki Kano and his team of fellow associates designed the Kano Model and developed its framework (Kano et al., 1984). The idea of ranking service features based on how strongly they affect customer satisfaction is rooted in Herzberg's Two-Factor Theory (Herzberg et al., 1959), which explains what drives satisfaction and dissatisfaction. For a long time, it was assumed that higher quality would automatically lead to greater satisfaction. Recent research, however, shows that this link is not always straightforward. Constantly improving a product or service without paying attention to what customers truly value or to their real needs is not sufficient to increase satisfaction (Fig. 1). What is required is an understanding of the association between user satisfaction and product features (Chen & Chuang, 2008).

The Kano Model utilises a dual-axis methodology to distinguish how customers experience two situations: when a feature is present and works well (presence that delights); and when it is missing or doesn't work well (absence that frustrates) (Wang, 2013). Additionally, the customer satisfaction (CS) coefficient was used to determine whether an attribute could enhance satisfaction or merely mitigate dissatisfaction. The level of impact an attribute can have on customer satisfaction can also be determined using this model (Berger et al., 1993).

3. Synthesis of Existing Studies and Research Gap

3.1 *The application of the Kano Model to assess service quality in HEI*

Service quality can be enhanced by accelerating the functionality of its key features. Since not all features play the same role in satisfying stakeholder requirements, it is pertinent to determine the impact each attribute has on overall satisfaction. This indicates that if an institution wants to improve service quality, it must first determine the gravity of each service attribute and its impact on student satisfaction (Sulisworo & Maniquiz, 2012). The Kano Model starts from a simple but powerful idea: not every customer need carries the same weight, and their effect on satisfaction is not always balanced or predictable (Emery,



(Author's own computation based on Kano et al., 1984)

Figure 1. The Kano Model framework illustrating the association between service performance and satisfaction

2006). Some needs, when fulfilled, create delight, while their absence may not cause dissatisfaction; others, however, are the opposite. This is what gives the model its real strength. It helps sort out different service features and decide which deserve greater attention based on how stakeholders actually value them (Fig. 1). In real situations, organisations often face financial or technical constraints that make it impossible to meet every service requirement at once. In such cases, the Kano Model becomes especially valuable, as it provides a clear way to judge which requirement will have the stronger influence on stakeholder satisfaction and therefore should be given priority (Dash, 2017).

Building on this conceptual foundation, it is important to examine how the Kano Model has been applied to assess service quality, particularly in higher education. Accordingly, the TCCM framework has been applied to analyse existing literature on the deployment of the Kano Model in higher education. Former studies on this theme can be broken down into four components:

Theory: The Kano model is grounded on 'The theory of attractive quality' (Kano et al., 1984). This theory categorises and prioritises the features of a product or service based on their influence on stakeholder satisfaction. Building on this foundation, researchers have expanded the

literature on service quality assessment in higher education. The primary inspiration for the Kano framework is the 'Two-factor theory', also known as the 'Motivation-hygiene theory' (Herzberg et al., 1959), which is a widely referenced theory in this domain. The core conceptual basis of both theories is the same: the presence of some features enhances satisfaction (motivators/delighters) while the presence of others thwarts dissatisfaction (hygiene/must-be). Another theory highly relevant to the assessment of stakeholder satisfaction is 'Stakeholder theory' (Freeman, 1984). Just as a business must balance the interests of all its stakeholders, so too in the higher education domain the satisfaction of all concerned stakeholders should be evaluated. This includes both internal stakeholders, such as students, academic faculty, administrative members, and support staff, as well as external stakeholders, such as recruiters, regulatory bodies, parents, and alumni (Asiyai, 2015).

Context: The Kano Model has been implemented across diverse settings in higher education. There is substantial research conducted on the assessment of service quality in HEIs of emerging economies like Asian and Latin American countries, such as India, China, Iran, Mongolia, Peru, Brazil and so on (Mahboube et al., 2012; Taifa & Desai, 2016; Canciglieri Junior et al., 2019; Qiu, 2022; Ganbold, 2022; Barrios-Ipenza et al., 2024). Emerging economies like India have witnessed a significant surge of HEIs over the past few

decades, especially in the private education sector, significantly intensifying competition (Ministry of Education, 2024). Moreover, these institutions in emerging economies have limited financial and technical resources. Despite the constraints, they strive to improve their position in global rankings. Thus, the application of frameworks like Kano enables such sectors to prioritise requirements that have a stronger influence on enhancing service quality and satisfying stakeholders.

The existing literature also reveals the use of the Kano Model in context-specific applications. A considerable number of studies have assessed the quality of academic library services (Dominici et al., 2015; Li et al., 2020; Meng et al., 2021; Datta & Chaudhuri, 2022; Chen et al., 2022; Noh, 2025).

Many recent studies have also been oriented towards the exploration of online and digital learning environments, particularly following the notable transition to blended modes of pedagogy over the past five years (Um et al., 2021; Fujs et al., 2022; Pop et al., 2022; Theresiawati et al., 2023; Arafat, 2024; Rakhmadi et al., 2026). Traditional methods of evaluating service quality often fail to capture the dynamic, emotionally driven factors that satisfy stakeholders. The Kano method helps identify requirements that respondents overlook, take for granted, or don't raise in standard survey instruments. Thus, its application across contexts enables a sophisticated understanding of stakeholder needs and the identification of critical and unarticulated requirements.

Characteristics: Previous studies primarily focused on classifying and prioritising institutional features into Kano attributes. This classification yields five Kano categories: Must-be, performance, attractive, indifferent, and reverse (Kano et al., 1984). Most previous studies have placed strong emphasis on the student perspective, attempting to uncover the requirements that meet their expectations and those that disappoint (Voss et al., 2007; Violante & Vezzetti, 2015; Meng et al., 2021). However, this classification differs across different time periods and disciplines. Madzik (2019) classified research facilities as an attractive feature and staff quality as a one-dimensional feature in his study. On the contrary, Barrios-Ipenza et al. (2024) classified academic/research facilities as a one-dimensional requirement, whereas Chen (2023) classified staff quality as a must-be requirement. This highlights the dynamic nature of Kano attributes, which evolve over time. Most prior studies have adopted a cross-sectional design, reflecting stakeholder expectations at a single point in time and failing to capture longitudinal changes in stakeholder expectations.

Methodology: Most former studies have applied the Kano questionnaire to derive responses and analysed them using the Kano classification table. However, Kano has been integrated with multiple complementary methodologies by researchers (Fig. 2). Several studies have employed SERVQUAL in combination with Kano to design questionnaires and identify Kano attributes (Rahimi et al., 2015; Tehranineshat et al., 2022; Theresiawati et al., 2023). Few scattered studies have used Kano in conjunction with other service quality measurement scales, such as HESQUAL (Chavez & Namoco, 2026) and WEBQUAL (Esmaili Givi et al., 2023), to assess service quality in the higher education domain. Kano's integration with methods such as Quality Function Deployment (QFD) has been widely applied in the higher education domain to operationalise stakeholder needs into improvement actions (Apornak, 2017; Hurriyati et al., 2018; Ömürgönülşen et al., 2020). Few studies have also applied Kano to the classification process and Importance-Performance Analysis (IPA) to the prioritisation process (Wu & Zhou, 2019; Chen & Liu, 2023; Liu et al., 2025). A critical review of the literature reveals that research employing the Kano Model in HEIs is still scattered across disciplines and lacks an integrative synthesis. No comprehensive bibliometric study has yet mapped how the model has been adopted, which research themes dominate the field, or where theoretical and methodological gaps persist. As a result, the academic understanding of service quality in higher education through the Kano lens remains disjointed, limiting its practical value for institutional policy and management.

3.2 Research Gap

The TCCM synthesis highlights that utilisation of the Kano model as a diagnostic tool in the higher education domain remains largely confined to a limited set of theoretical and methodological approaches. Kano's theory of attractive quality is often used in isolation, with limited integration with broader service quality theories across disciplines. There is a clear lack of theoretical diversification. Even contextually, most prior studies have focused on the student perspective within specific institutional or regional settings, with very little attention to other stakeholders in higher education. Limited attention has been given to longitudinal studies. In terms of characteristics, institutional requirements such as research infrastructure, teaching quality, and other service functions have been studied. However, very little work has been dedicated to broader institutional dimensions such as governance, sustainability-oriented policies, and organisational culture. Methodologically, survey-based Kano applications

dominate the literature, whereas advanced synthesis techniques such as bibliometric mapping remain relatively rare (Widodo et al., 2025). These patterns collectively indicate fragmentation in the literature, reinforcing the need for a comprehensive bibliometric analysis to systematically map how the model has been adopted, which research themes dominate the field, and where theoretical and methodological gaps persist. As a result, the academic understanding of service quality in higher education through the Kano lens remains disjointed, limiting its practical value for institutional policy and management.

Given this background, the current study's bibliometric approach is not merely methodological; it is essential. Without such a comprehensive, data-driven analysis, understanding how the Kano framework has enhanced service quality in higher education would remain superficial and anecdotal. By systematically examining publication trends, thematic clusters, and citation networks, this study offers a panoramic view of global research activity in this area. The findings are expected to expose existing blind spots and provide a robust foundation for scholars seeking to expand this field with more inclusive, interdisciplinary, and stakeholder-sensitive research.

4. Objectives of the Study

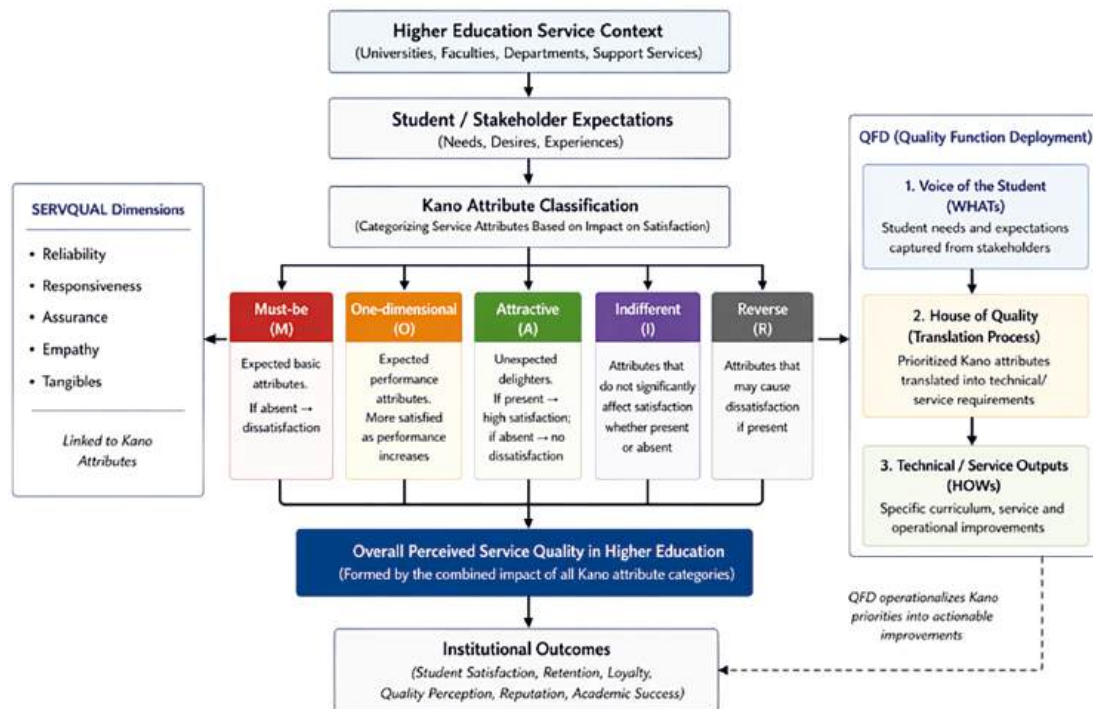
The study seeks to review and synthesise the existing literature on assessing service quality in higher education institutions (HEIs) using the Kano Model. Building on this foundation, the targeted objectives of the study are set out as follows:

1. To explore the pattern of research publications and the growth of open-access publishing in the domain of appraising service quality in HEIs through the application of the Kano Model.
2. To identify the most influential authors, countries, institutions, documents, and journals in the concerned subject area.
3. To determine the thematic clusters developed in this area through bibliographic coupling.
4. To discover the thematic trends of author keywords through co-occurrence analysis.

5. Research Methodology

5.1 Research Design

This study belongs to a highly specialised domain within the broader field of academic quality management. In this



Author's own computation

Figure 2. Conceptual linkage of SERVQUAL, Kano Model and QFD in assessing higher education service quality

paper, a systematic literature review was undertaken by closely examining bibliographic data from earlier research that looked into the adoption of the Kano framework in higher education institutions (HEIs). The review was designed not only to gather existing knowledge but also to trace how the model has been used and understood within the context of higher education. A systematic literature review has been preferred over a traditional literature review, as SLRs involve a structured process for presenting information and provide a more extensive and comprehensive review, thereby considerably minimising the researcher's bias (Pati & Lorusso, 2018).

The PICO framework has been applied to design the structure and define the boundaries of the review. The Population (P) of the study comprises stakeholders in higher education, including students, parents, teaching and non-teaching staff, administrative staff, recruitment companies, and anyone who identifies as a stakeholder in higher education. The Intervention/Interest (I) of the study is the adoption of the Kano Model as a framework to assess stakeholder satisfaction. The Comparison (C) has been made across three different time frames, examining the trend of author keywords across successive time periods. Finally, the Outcomes (O) of the study were to explore the evolution of research themes and trends over the last 15 years and to outline recommendations for unexplored areas of future research. The 5-step guide to conducting an SLR as prescribed by Khan et al. (2003) has been observed in this study, which begins with (a) defining the research goals; (b) extracting the data from appropriate databases, (c) refining the data by appraising its quality; (d) evaluating the data using quantitative and qualitative techniques of analysis; and concludes with (e) interpreting the findings.

5.2 Sources of Data

The data have been derived from the Scopus and Web of Science databases, as they provide better coverage of journals across almost all fields. Pranckutė (2021) calls these databases the 'titans of bibliographic information' because of their reliable data sources and high-quality content. These databases provide data in formats compatible with and that integrate smoothly with popular bibliometric software such as Gephi, Leximancer, and VOSviewer (Donthu et al., 2021). Other databases, such as Google Scholar, lack the curated metadata and robust export capabilities found in Scopus and WoS (Martín-Martín et al., 2018). Hence, to conduct rigorous bibliometric and science-mapping analyses, Scopus and WoS were the most suitable databases to proceed with.

The data have been extracted by applying the exclusion/inclusion criteria as prescribed in the PRISMA protocol to ensure that the work is transparent, credible and replicable. The keywords have been tailored to the study's requirements (Okoli, 2015), and the limits for year range, document type, and subject area have been clearly defined (Table 1). After extracting the file from both databases, the data have been cleaned and filtered to remove erroneous records, such as duplicate entries. Further, the content has been meticulously screened by manually reviewing the title, abstract, and keywords to eliminate documents that were not related to the theme.

5.3 Tools for Analysis

The study focuses on a narrowly defined domain centred on the application of the Kano Model. Hence, the volume of published literature in this niche area of research is relatively limited. After a thorough, transparent screening of the data, 58 documents were shortlisted and loaded into VOSviewer version 1.6.20 for further analysis. As VOSviewer is openly accessible to bibliometric scholars and can handle a large volume of data, its ability to perform a distinctive task in the construction of bibliometric maps and graphs is remarkable (Van Eck & Waltman, 2010). Hence, a comprehensive analysis of the bibliographic data in the current study was conducted using this software. Using the full-counting method, the citation analysis was conducted across five primary units: authors, organisations, countries, documents, and sources. Minimum thresholds were adjusted for each analysis to generate the top ten entities in each category. Bibliographic coupling was performed at the document level without a minimum citation threshold to maintain the integrity of a limited sample size (n=58). Co-occurrence analysis of author keywords was conducted with a minimum occurrence threshold of 3. These thresholds governed item selection for each analysis to maintain visual clarity and ease of interpretation.

The techniques chosen to accomplish the objectives of the study were:

- (a) Citation analysis of authors, organisations, countries, documents, and sources;
- (b) Bibliographic coupling of documents; and
- (c) Co-occurrence (co-word) analysis of author keywords.

Table 1. Filtering Criteria/Search Term and Inclusion and Exclusion of Document

Selection Criteria	Scopus		WOS		Total
	Exclude	Include	Exclude	Include	Included
Database: Scopus & Web of Science Search Date: 23-08-2025 Search Term: (“Kano model” OR “Kano method*” OR “Kano analysis” OR “Kano approach” OR “Kano-based”) AND (“Higher education” OR “HEI” OR “Higher learning” OR “tertiary education” OR “post-secondary education” OR “graduat*” OR “postgraduate*” OR “college*” OR “institut*” OR “Universit*”)	-	218	-	49	267
Year: 2010-2025	11	207	04	45	252
Subject Area: Scopus: “Social Sciences”, “Business, Management and Accounting”, and “Economics, Econometrics and Finance” Web of Science: “Management”, “Business”, and “Education”	94	113	32	13	126
Document Type: “Article” and “Review”	31	82	-	13	95
Language Screening: Include documents published in English only	06	76	01	12	88
Erroneous Records and Duplicates Screening: Include documents with valid information only	11	65	-	12	81
Content Screening: Include documents if “Title, abstract, and keywords” are relevant to the theme of the study	14	51	05	07	58

Author's own computation

6. Findings of the Study

6.1 Research Trend

The publication trend has been progressive from 2010 to 2012 (Fig. 3). This can be attributed to the need to assess service quality in HEIs, driven by the rapid expansion of private and state universities and increased competition in the private HEI sector. In 2014, there is a sudden drop in documents published on the subject, followed by a consistently declining number in the next quadrennial. In this phase, research efforts have largely concentrated on measuring service quality mostly in public or state-funded universities. Between 2019 and 2025, the field experienced consistent growth, averaging 6 publications per year. The publication trend has undergone a structural shift, particularly in the post-pandemic years. There has been a noticeable surge in studies, reflecting scholars' growing interest in examining the digital transition from traditional to online and hybrid modes of learning in higher education settings. New dominant themes have emerged, such as blended learning, student digital experience, MOOCs and learning management systems.

During this era, the number of open-access documents was 23, compared to 35 closed-access documents. This study reviewed a total of 58 documents. Over the years 2010–2025, open access publishing has experienced continuous growth, demonstrating that research is becoming increasingly accessible. Among these publications, 17 appeared in gold open-access journals, 9 were made available through the green route, while 4 adopted a mix of both approaches.

Despite the high Article Processing Charges levied on authors to publish in OA journals, which funding agencies in several countries, such as India, are unwilling to cover, the number of documents published in closed-access journals has declined over the last five years (2020–2025). The reason for this is rising journal subscription costs and government directives mandating that researchers publish and deposit their work in OA repositories. This has led to a significant increase in the number of open-access journals and unrestricted repositories in India over the past decade (Nazim et al., 2023).



Author's own computation

Figure 3. Publication trend of Application of Kano in HEI

6.2 Most influential authors, institutes, countries, documents, and journals

The most impactful authors who have contributed to this subject area are listed in decreasing order of their citation count (Table 2). The authors with the highest citation impact are Gandolfo Dominici and Federica Palumbo, with 136 citations on their co-authored papers. The most productive author is Thorsten Gruber, with 3 documents published in this niche domain. A notable observation about the authorship distribution is that even though the number of publications per author is relatively low, citations are heavily clustered around a few key authors. This confirms that research in this field of study is still emerging and has not yet reached maturity.

Among top-performing countries, Italy ranked first with an impactful citation count of 207 (Table 2). The most productive countries are tied between China and the United States, each with 9 publications, followed by India with 8 publications in the field. The two most impactful organisations, Sapienza University of Rome and the University of Palermo, were both located in Italy, with citation counts of 136 each. There is a visible disproportionality between citation impact and research productivity across countries. While the US, China, and India dominate the field in terms of publication volume,

Italy outpaces them in citation impact. This pattern signifies a shift from geographically concentrated research to globally dispersed research output. The decentralisation of scholarly enquiry shows that the utilisation of the Kano model has successfully permeated a broad spectrum of academic environments.

Among the most influential journals, Business Horizons has the highest citation impact of 126, followed by Journal of Academic Librarianship with a citation count of 111 on the discussed theme (Table 3). The pattern displayed across the list of journals indicates the prevalence of robust cross-disciplinary research in this field. The distribution of publications across domains such as Marketing, Higher Education, Management, and Information Science suggests that the deployment of the Kano model in higher education is not confined to a single field but is dynamically adapted across multiple disciplines.

The most influential article published on the theme is "How to build an e-learning product: factors for student/customer satisfaction" (Dominici & Palumbo, 2013), with a total citation count of 126 (Table 4). The study was aimed at understanding the requirements of university-level students in e-learning courses to help educational institutions build e-learning programmes that meet student expectations. Based on a survey of undergraduate students at the

University of Palermo in Italy, the expectations and perceived satisfaction of students regarding e-learning courses have been derived. The analysis concludes that an uncomplicated, easy-to-use platform is a must-have; its absence can lead to high user dissatisfaction. In contrast to that, personal direct tutorship and prompt release of a certificate of course completion do not have much impact on satisfaction.

There are an impressive number of papers on e-learning initiatives in higher education institutions, and the top 2 most influential documents on the list revolve around this theme. This indicates a noticeable shift in research attention towards digital learning environments, driven by the sector's ongoing transition from traditional to hybrid pedagogical modes. Another significant publication topping the chart is a paper titled "Evaluation of a Digital Library by Means of Quality Function Deployment (QFD) and the Kano Model" (Garibay et al., 2010) with a citation count of 95. This study was conducted among users of the University of Guadalajara's

digital library in Mexico. The primary aim of the study was to gain insight into what satisfies recipients of library services by listening to stakeholders' voices. This would help to frame a structure that would optimise the transition from traditional academic layouts to digital formats in libraries. A combination of Kano, SERVQUAL and QFD has been adopted to gather and analyse the data. The study concluded that paying heed to the voice of the key stakeholders and implementing crucial changes based on their feedback would boost satisfaction and elevate service standards.

Both these studies underscore the essential role of digital learning ecosystems, particularly the influence of e-learning interfaces and virtual libraries in the higher education sector. This highlights the fundamental alignment of the Kano model with digital-centric service quality. Furthermore, the triangulation of SERVQUAL-Kano-QFD highlights Kano's seamless integration with other service quality measurement frameworks.

Table 2. Most influential authors, organisations and countries

TC	Author	TP	TC	Organisation	TP	TC	Country	TP
136	Dominici, Gandolfo	2	136	Sapienza University of Rome, Italy	2	136	Italy	2
136	Palumbo, Federica	2	136	University of Palermo, Italy	2	96	Mexico	2
95	Garibay, Cecilia	1	95	University of Guadalajara, Mexico	1	94	United Kingdom	3
95	Gutiérrez, Humberto	1	94	The University of Manchester, United Kingdom	3	85	China	9
95	Figuroa, Arturo	1	94	University of London, United Kingdom	3	82	India	8
94	Gruber, Thorsten	3	79	University of Applied Sciences of Zurich, Switzerland	2	80	South Korea	5
94	Reppel, Alexander	3	40	Gyeongsang National University, South Korea	1	79	Switzerland	2
79	Voss, Roediger	2	40	Pukyong National University, South Korea	1	68	Iran	5
45	Sahney, Sangeeta	2	39	Rzeszów University of Technology, Poland	1	51	United States	9
40	Suh, Yongyoon	1	39	Catholic University in Ruzomberok, Slovakia	1	39	Poland	1

Author's own computation

Notes: TC = Total Citations. TP = Total Publication

Table 3. Most influential journals on the application of Kano in HEI

Journal	TC	MKT/ MGT	HEI	TP	2010-2014	2015-2019	2020-2025
Business Horizons	126	X		1	1		
Journal of Academic Librarianship	111		X	3	1		2
TQM Journal	60	X		4	2		2
International Journal of Productivity and Quality Management	49	X		2		2	
Journal of Marketing for Higher Education	45	X	X	1	1		
Administrative Sciences Journal of Marketing Education	39	X		1			1
Technological Forecasting and Social Change	34	X		1	1		
Library Hi Tech	40	X		1			1
Studies in Educational Evaluation	26		X	1			1
	21		X	1			1

Author's own computation

Notes: TC = Total Citations. TP = Total Publication. MKT/MGT = X if a journal falls under the Marketing or Management domain. HEI = X if a journal falls under the Higher Education domain.

Table 4. Most influential articles on the application of Kano in HEI

Author(s)	Title of Document	TC
Dominici & Palumbo (2013)	How to build an E-learning product: Factors for student/customer satisfaction	126
Garibay et al. (2010)	Evaluation of a Digital Library by Means of Quality Function Deployment (QFD) and the Kano Model	95
Gruber et al. (2010)	Understanding the characteristics of effective professors: The student's perspective	45
Suh et al. (2019)	Analysing the satisfaction of university–industry cooperation efforts based on the Kano model: A Korean case	40
Madzik et al. (2019)	Application of the Kano Model for a better understanding of customer requirements in Higher Education—a pilot study	39
Gruber et al. (2012)	Investigating the Influence of Professor Characteristics on Student Satisfaction and Dissatisfaction: A Comparative Study	34
Apornak (2017)	Customer Satisfaction measurement using the SERVQUAL model, integration of the Kano and QFD approach in an Educational Institution	34
Meng et al. (2021)	An analysis of university students' health information service needs from the academic library in the post-COVID-19 age through the Kano model	26
Sahney (2011b)	Delighting customers of Management Education in India: A student perspective, Part I	25
Seo & Um (2019)	The asymmetric effect of fairness and quality dimensions on satisfaction and dissatisfaction: An application of the Kano model to the Interdisciplinary College Program Evaluation	21
Sahney (2011a)	Delighting customers of management education in India: A student perspective, Part II	20

Author's own computation

Note: TC = Total Citations

6.3 Thematic clusters developed through bibliographic coupling

By reviewing the title, abstract, and keywords, five thematic clusters could be clearly identified, consisting of 39 documents in total (Table 5). Cluster 1 included 10 documents on a common theme: virtual and e-learning. There has been growing interest in blended learning in the post-pandemic era; several researchers have shown interest in exploring strategies that advance digital learning. Cluster 2 incorporated 8 papers on Business/Management education. Most studies on this theme used management institutions and business schools as the primary backdrop for analysis, aiming to assess students' stewardship intentions. Cluster 3 consisted of 8 papers, which were based on Kano's interaction with other tools for measuring service quality. Kano's integration with supplementary techniques, including QFD and SERVQUAL, was the mutual factor between these papers, and hence, the theme was formulated based on the methodology applied to achieve the research objectives. Cluster 4 comprised 8 papers, which were based on library services in higher education institutions. The discussion has focused on improving the service quality of academic libraries in universities, and strategies to make library services user-centric have been recommended. The last cluster included 5 documents based on professor characteristics. These papers

highlight traits embodied by educators that are crucial for increasing student satisfaction. It also includes discerning the requirements and expectations of faculty members that lead to building up their sense of well-being, along with upgrading overall service quality.

Taken together, these thematic clusters demonstrate the expansion of Kano-centric research across a wide spectrum of higher education functions. Strong emphasis has been laid on service enhancement in digital learning environments in the recent past. Several authors have also focused on methodological integration by applying the Kano framework with other methodologies like SERVQUAL, HESQUAL, QFD and IPA. While the identification of distinct clusters point towards thematic diversification, the minimal intersection between the clusters suggests a highly fragmented field of study. Moreover, the data reveal a notable lack of convergence across different stakeholder perspectives. The existing literature is heavily skewed towards the student perspective, with a marginal focus on academic staff, and a more pronounced neglect of recruiters, policy makers and institutional leadership. This suggests that the research in this field is still at its nascent stage, with substantial potential for more cohesive research that integrates the views of diverse stakeholder groups.

Table 5. Thematic clusters of research on Application of Kano in HEI using bibliographic coupling

Theme	Author(s)	Title	TC
E-learning	Dominici & Palumbo (2013)	How to Build an E-learning Product: Factors for Student/Customer Satisfaction	126
	González-Yebra et al. (2019)	Co-design of a 3D virtual campus for synchronous distance teaching based on student satisfaction: Experience at the University of Almería (Spain)	17
	Fujs et al. (2022)	Improving the efficiency of remote conference tool use for distance learning in higher education: A Kano -based approach	15
	Esmaeili Givi et al. (2023)	Quality assessment of E-learning website using asymmetric impact–performance analysis and Kano’s customer satisfaction model: a case study based on WebQual 4.0	10
	Rezaie et al. (2012)	Applying the KANO model for users' satisfaction assessment in e-learning systems: A case study in Iranian virtual higher educational systems	9
	Um et al. (2021)	The Ramifications of COVID-19 in Education: Beyond the Extension of the Kano Model and Unipolar View of Satisfaction and Dissatisfaction in the Field of Blended Learning	9

Management Education	Sahney (2011a)	Delighting Customers of Management Education in India: A Student Perspective, Part I	25
	Grunwald et al. (2024)	Application of the Kano model for insights into business students' sustainability transformation expectations from higher educational institutions: A cross-country study	7
	Tontini & Walter (2011)	Background to the perceived quality of a Business Course: A Non-linear Approach	4
	Bhola & Nalawade (2013)	Factors influencing students' preference of Management institutes: A Kano model analysis	2
Integration of Kano and QFD	Garibay et al. (2010)	Evaluation of a Digital Library by Means of Quality Function Deployment (QFD) and the Kano Model	95
	Apornak (2017)	Customer satisfaction measurement using the SERVQUAL model, integration of the Kano and QFD approach in an educational institution	34
	Sahney (2011b)	Delighting Customers of Management Education in India: A Student Perspective, Part II	20
	Theresiawati et al. (2023)	Implementing quality function deployment using service quality and the Kano model to the quality of e-learning	12
	Terzakis et al. (2012)	Translating the service quality gaps into strategy formulation. An experimental case study of a Greek Academic Department	5
	Hamzah et al. (2018)	Quality evaluation on private higher education institutions in Pekanbaru, Indonesia (Integrating Kano Model and Quality Function Deployment)	3
Library Services	Garibay et al. (2010)	Evaluation of a Digital Library by Means of Quality Function Deployment (QFD) and the Kano Model	95
	Meng et al. (2021)	An analysis of university students' health information service needs from the academic library in the post-COVID-19 age through the Kano model	26
	Li et al. (2020)	Making the Digital Turn: Identifying the User Requirements of Digital Scholarship Services in University Libraries	16
	Dominici et al. (2015)	The Drivers of Customer Satisfaction for Academic Library Services: Managerial Hints from an Empirical Study on Two Italian University Libraries using the Kano model	10
	Chen et al. (2022)	Service Quality of and User Satisfaction with Non-State-Owned Academic Libraries in China: Integrating the Fuzzy Delphi Method with the Kano Approach	5
	Datta & Chaudhuri (2022)	Application of the Kano Model in evaluating the indoor environment qualities of university libraries	4
Professor Traits	Gruber et al. (2010)	Understanding the Characteristics of Effective Professors: The Student's Perspective	45
	Gruber et al. (2012)	Investigating the Influence of Professor Characteristics on Student Satisfaction and Dissatisfaction: A Comparative Study	34
	Gruber et al. (2011)	Service Recovery in Higher Education: Does National Culture Play a Role?	15
	Cudney et al. (2023)	Using the voice of the student to identify perceptions of teaching effectiveness attributes: a pilot study	3

Author's own computation

Note: TC = Total Citations

6.4 Thematic trends of author keywords developed through co-occurrence analysis

A co-occurrence analysis, taking only author keywords into account, has been conducted for three different year ranges, based on which a thematic trend has been derived.

6.4.1 Between 2010-2014: The main keywords highlighted during this era were customary terms related to the central theme, namely 'Kano', 'service quality', and 'customer satisfaction' (Fig. 4). Over this period, researchers produced 15 publications that delved into evaluating service quality in higher education and explored approaches to strengthening stakeholder satisfaction. Management colleges and B-schools have been the focal point of researchers during this timeline (Sahney, 2011a, 2011b; Tontini & Walter, 2011; Bhola & Nalawade, 2013). 'Professor characteristics' has also appeared among the popular keywords, indicating that several papers pivot on the capabilities of faculty members in higher education (Gruber et al., 2010; Gruber et al., 2011; Gruber et al., 2012). Another recurring keyword was 'SERVQUAL', a framework used by several authors, alongside the Kano Model, to evaluate the gap between stakeholder preferences and the experiences they have with the services they receive (Kuo et al., 2011; Sahney, 2011a; Terzakis et al., 2012).

6.4.2 Between 2015-2019: This phase witnessed only 10 documents published over a period of five years. One of the Top-featured keywords during this period was 'quality function deployment' (Fig. 5), as several authors have incorporated the integration of Kano with QFD and other methods of evaluating service quality as part of the research methodology (Apornak, 2017; Hurriyati et al., 2018). Among the few studies published during this era, most were

conducted on public or state-funded universities (Dominici et al., 2015; Shahin & Janatyan, 2015; González-Yebra et al., 2019), except for one specific study (Hamzah et al., 2018), which focused on assessing service quality in Private universities. This highlights the dearth of scholarly research in the private higher education sector, where the market is extremely competitive and service quality is expected to meet premium global standards.

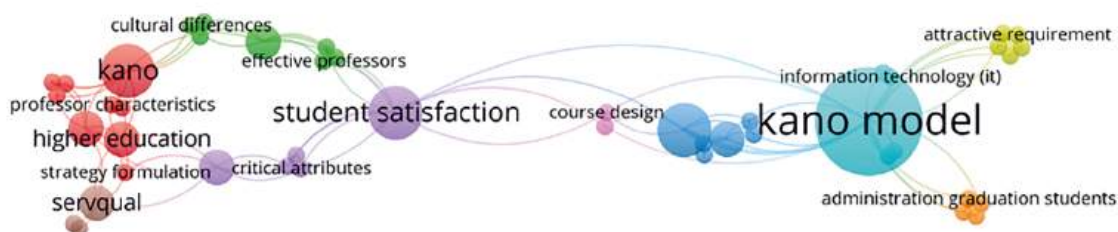
The node size depicts keyword frequency, link thickness indicates co-occurrence strength, and colours denote thematic clusters.

Author's own computation using VOSviewer version 1.6.20

The node size depicts keyword frequency, link thickness indicates co-occurrence strength, and colours denote thematic clusters.

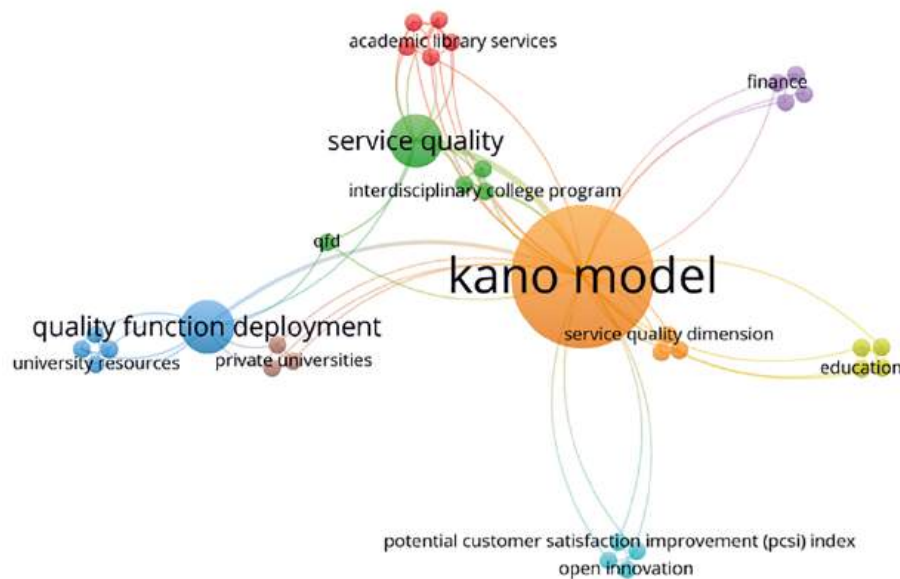
Author's own computation using VOSviewer version 1.6.20

6.4.3 Between 2020 and 2025: A total of 33 documents were published on this subject during the pandemic and post-pandemic period. This was a substantial leap from the previous period, where many fewer documents were published. During this phase, the spotlight was evidently on 'hybrid learning', 'blended learning', and 'e-learning' (Fig. 6). The post-pandemic years have witnessed an outpouring of publications on the usage of digital platforms to conduct remote classes and their impact on stakeholder satisfaction (Um et al., 2021; Fujs et al., 2022; Pop et al., 2022; Theresiawati et al., 2023). 'Library service quality' and 'webqual' are two other keywords that have occurred in several manuscripts. A fair share of attention is devoted to research on the quality of academic libraries and digital libraries, and on the availability of e-resources for their users (Li et al., 2020; Meng et al., 2021; Datta & Chaudhuri, 2022). The quality of service in the higher education sphere



The node size depicts keyword frequency, link thickness indicates co-occurrence strength, and colours denote thematic clusters. Author's own computation using VOSviewer version 1.6.20

Figure 4. Co-occurrence of author keywords between 2010 and 2014.



The node size depicts keyword frequency, link thickness indicates co-occurrence strength, and colours denote thematic clusters. Author's own computation using VOSviewer version 1.6.20

Figure 5. Co-occurrence of author keywords between 2015 and 2019

depends on the availability of top-grade infrastructure and amenities, among which a well-stocked library ranks high on the list of prerequisites. Hence, multiple authors (Li et al., 2020; Chen et al., 2022) have focused on research that facilitates a smooth transition from traditional to digital libraries. Additionally, a few notable studies have specifically focused on assessing the quality of university websites (Esmaeili Givi et al., 2023). Another emerging keyword that has appeared during this timeline is 'cross-country study', in which service quality in higher education institutions located in different countries has been compared (Grunwald et al., 2024a, 2024b; Grunwald et al., 2025a, 2025b, 2025c).

6.4.4 Comparative analysis across time periods

Contrasting these three timeframes shows a clear thematic shift in how the Kano model has been applied in the higher education landscape. The earlier studies, conducted between 2010 and 2014, sought to define service quality in a classroom setting. This phase was defined by a primary interest in professor characteristics, student engagement and course design. The primary backdrop for the analysis was mostly management or engineering institutes. This phase was followed by a subsequent period of relative inactivity (2015-2019). Though the momentum of research slowed,

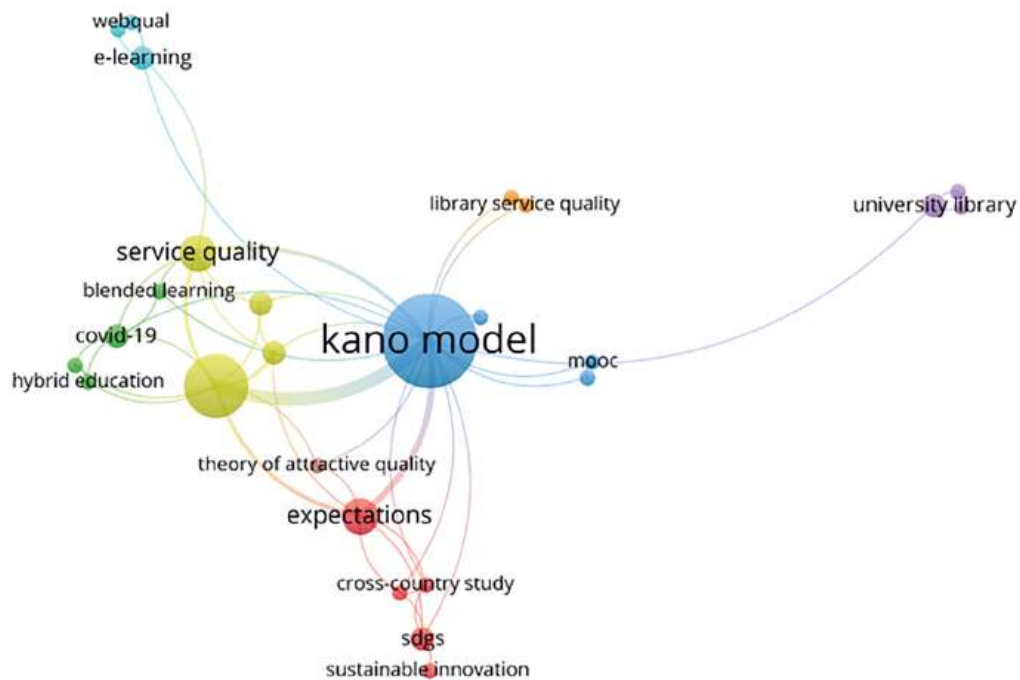
the technical depth sharpened through the methodological integration of techniques such as Kano, QFD, IPA, and other quality measurement frameworks. In the most recent era (2020-2025), the attention has pivoted sharply towards digital learning ecosystems. This transformative shift, gravitating towards e-learning and hybrid educational settings, was a strategic response to challenges posed by the global COVID-19 pandemic. However, the digital transition was not just a temporary adaptive measure but a permanent structural shift, with the current research trajectory firmly centred on this new reality.

7. Critical Gaps in Existing Research and Recommendations for Future Research

While the work presented is an exhaustive review of existing studies on the deployment of the Kano Model in the higher education landscape, there are several facets of this theme that remain underexplored. Crucial gaps have been identified below that warrant further research in this domain.

7.1 Methodological Extension

The current study has explored only the Scopus and Web of Science databases; future studies can conduct similar research using data from other databases, such as ProQuest,



The node size depicts keyword frequency, link thickness is indicative of co-occurrence strength, and colours denote thematic clusters. Author's own computation using VOSviewer version 1.6.20

Figure 6. Co-occurrence of author keywords between 2020 and 2025

EBSCO, and JSTOR, to provide exhaustive coverage of the literature (Bramer et al., 2017). Information from other databases can be merged to furnish a more comprehensive and holistic picture (Ewald, 2022). Google Scholar can also be considered for emerging exploratory research and grey literature that has not been indexed on curated databases like Scopus or Web of Science (Martín-Martín et al., 2018).

Barely any prior studies employ a longitudinal approach (Buffon et al., 2024). Every prior study has been cross-sectional, ignoring changes in Kano attributes over time (Tontini & Walter, 2011; Madzik et al., 2019; Dash et al., 2022). An intriguing fact about Kano attributes is that they tend to vary over time, so that an attractive feature can become a basic feature as stakeholders' priorities and preferences change (Löfgren, 2011). Hence, studies capturing the dynamic nature of Kano attributes would help to update service quality requirements in HEI (Gonela & Khoja, 2023). Moreover, post the COVID-19 pandemic, an inevitable shift has been witnessed from traditional classroom learning to blended learning (Um et al. 2021; Fujis

et al., 2022; Pop et al., 2022; Theresiawati et al., 2023). Longitudinal studies comparing the pre-pandemic, pandemic, and post-pandemic eras would explore how stakeholder needs have evolved over time. Additionally, transnational comparative studies are also a highly neglected area of research (Buffon et al., 2024). Although limited studies have focused on exploring variation in stakeholder satisfaction across different cultures and academic settings (Grunwald et al., 2024a, 2024b; Grunwald et al., 2025a, 2025b, 2025c), further research in this area can be undertaken to better understand the dynamics of Kano attributes.

On the methodological forefront, a mixed-methods research design combining the Kano questionnaire for quantitative analysis and in-depth interviews with stakeholders for qualitative analysis can provide an in-depth understanding of stakeholder perspectives and motivations (Tetteh, 2017). Earlier studies have integrated Kano with other frameworks such as QFD and SERVQUAL (Apornak, 2017; Sahney, 2011a; Hamza et al., 2018; Theresiawati et al., 2023). Future

researchers can also combine Kano with other quantitative approaches like Structural Equation Modelling (SEM), Partial Least Squares (PLS-SEM), Importance-Performance Analysis (IPA) or fuzzy knowledge integration with the Kano framework.

7.2 Contextual Extension

Past studies have neglected the perspectives of key stakeholders in higher education. Sahney (2011b) stated that her study cannot be considered exhaustive because it did not incorporate the viewpoints of all key stakeholders in the higher education system. Most previous studies have only considered the student perspective (Voss et al., 2007; Violante & Vezzetti, 2015; Meng et al., 2021). There should be an attempt to analyse satisfaction from the viewpoint of all concerned stakeholders, which encompasses the perspective of students, their parents, faculty members, non-teaching staff, administrative staff, alumni, recruiters and policymakers (Tetteh, 2017).

Another significant gap stems from the fact that many previous studies have singled out an institute or university without emphasising whether it belongs to the private or public education sector. This emphasis is necessary, as it is not feasible to compare institutes across state and private universities on several levels, such as infrastructure, capital, regulatory differences, and profit motive (Venkateswarlu et al., 2020). Moreover, the growth of the global economy has led to the mushrooming of numerous private institutions in the past decades (Ministry of Education, 2024). This necessitates a call for research that focuses only on private universities, which play a pivotal role in painting the educational landscape. Even if comparative studies between private and public universities are conducted, they should focus on highlighting variations in funding, resource allocation, profit motive, and administrative structure, emphasising on how these differences shape satisfaction determinants. This would uncover which aspects of satisfaction are generalisable and which are context-specific.

As previously highlighted, past studies have orbited Management, Engineering and Business programmes in HEI (Tontini & Walter, 2011; Bhola & Nalawade, 2013), leaving several disciplines underrepresented. Future studies can focus on distinguishable fields such as Medicine, Natural Sciences, and Humanities. Another highly neglected subset of this domain is the exploration of the quality of doctoral programmes and the satisfaction of stakeholders involved in pursuing a doctoral degree

(Barrios-Ipenza et al., 2024). Additionally, Kano-based studies can also be conducted in the domain of primary and secondary education, which forms the base for higher education. This would help understand how foundational requirements and experiences shape expectations at advanced levels.

Furthermore, researchers should also explore the overall stakeholder experience rather than examining only the customary factors that impact satisfaction in the higher education context, like teaching effectiveness, campus resources and placements. Rather, attention can be diverted to offbeat unconventional factors like emotional experiences, micro-amenities, empowerment and autonomy, and work-life balance, which also provide insight into the complete experience of the stakeholder. Very often, researchers tend to overlook these recently emerging aspects that exert an increasing influence on stakeholder gratification (Mikulic & Prebežac, 2011). In recent times, stakeholders are evolving into eco-conscious individuals. Sustainable and environmentally conscious efforts introduced on the campus tend to bear a positive impression on environmentally responsible stakeholders. Studying the progression and impact of such climate-friendly attributes would help to redefine stakeholder expectations within the higher education context (Grunwald et al., 2024a).

In a post-pandemic world, future research can also be directed towards the integration of artificial intelligence in academia (Kong et al., 2026). Personalised learning through AI tutors, virtual classrooms and AI automated grading and assessments are upcoming features that are expected to replace traditional pedagogical modes of teaching and learning. The influence of these attributes on higher education participants is another underexplored area of research (Spivakovsky et al., 2025).

7.3 Practical Research

Very few existing studies have focused on the practical aspects of the Kano framework, namely how the outcomes of implementing these attributes are measured (Qiu, 2022). Does prioritising one-dimensional or attractive features have a positive impact on stakeholder loyalty and retention? Does it boost the image of the institution in the eyes of the parents or leverage its visibility before recruiters? Is there any productive influence on the ranks and grades assigned to institutions by quality assessment boards? These are some unanswered research questions with insufficient empirical evidence.

Recruiters are another very significant yet understudied contributor in the higher education spectrum. They have a symbiotic relationship with university students. Subsequent studies can aim to integrate curricular frameworks with industry needs and expectations so that both groups can mutually benefit from such research (Zeidan & Bishnoi, 2020).

Additionally, comparative studies across multiple stakeholder segments are another area where research is required (Kultanan et al., 2006). Students, faculty and recruiters all have divergent and overlapping requirements; bridging these gaps would strengthen collaboration between academia and industry.

7.4 Meta-analytical Gaps

A systematic review may be conducted to determine which service attributes are most widely identified and reported globally across studies. A meta-analysis measuring the strength and consistency of Kano attributes using correlation or regression coefficients would help synthesise findings from previous empirical studies.

Furthermore, research unearthing contextual moderators like demographics, location, private vs public universities and stakeholder-specific moderators would examine how satisfaction drivers vary across different stakeholder groups and time periods. Likewise, performing systematic reviews to identify research clusters and highlight underrepresented research fields would warrant further interest and investigation in this domain (Widodo et al., 2025).

To sum up, forthcoming research in the higher education sphere should be empirically grounded with a pragmatic orientation. Focus on underrepresented stakeholder groups, cross-country comparisons or simply a practical approach revealing institutional outcomes are the recommended directions to pursue. By broadening the methodology scope, emerging research can advance both conceptual foundations and real-world applications of service effectiveness in the higher education sphere.

8. Conclusion and Implications

8.1 Managerial and Policy Implications

This study provides a range of practical implications for policymakers and institutional administrative bodies in higher education, particularly within the context of emerging economies like India.

From a managerial perspective, efforts should extend beyond developing basic and performance attributes to increased attention on latent and attractive attributes. The technology-driven shift in the post-pandemic era to increased research on hybrid learning experiences indicates that efforts should be directed towards consistent investment in digital infrastructure and AI-enabled pedagogical systems. This would help to build reputation and differentiate institutions from their competitors in a saturated higher education market.

Existing studies have overlooked the perspectives of secondary stakeholders like recruiters, members of faculty and administrative staff. This warrants the need for administrative bodies within higher education institutions to implement changes through a holistic, stakeholder-inclusive approach. Feedback mechanisms should be designed to capture a comprehensive range of stakeholder perspectives, rather than relying solely on a student-centric view.

From a policy perspective, there is a need for funding bodies and regulators to incentivise cross-country studies, longitudinal work and methodologically diverse research in this domain. Hybrid approaches integrating Kano with other frameworks (HESQUAL, QFD or IPA) would provide a more nuanced understanding of service quality in the higher education field. Moreover, policymakers and regulatory bodies should encourage HEIs to incorporate broader institutional dimensions such as emotional experiences, sustainability, governance, and well-being into their evaluation and accreditation processes.

These strategic directions would enable HEIs to make more informed, inclusive, and forward-looking decisions, resulting in stronger alignment between higher education outcomes and stakeholder expectations in India.

8.2 Conclusion

The field of quality management in higher education has become a prominent focus of contemporary research. Scholarly inquiry on the use of the Kano model to appraise service quality in HEI remains fragmented, but has gained increasing momentum in the post-pandemic period. Appraising service quality has to do with examining the satisfaction of stakeholders in the higher education realm. Who counts as a stakeholder in higher education has been widely discussed in previous studies. According to Voss et al. (2007), a stakeholder is anyone who benefits from an institution's services. In this sense, students are the main stakeholders, while their employers play a secondary role

(Madzik et al., 2019; Dhawan, 2022). Most former studies have kept students as their central focus while analysing stakeholder satisfaction. The requirements and perceptions of secondary stakeholders of higher education institutions have been largely neglected.

Thus, there is a need for more comprehensive, multi-stakeholder research, particularly in private higher education institutions, where there is intensified competition and heterogeneous stakeholder expectations. Such efforts will contribute to improving service quality, strengthening stakeholder satisfaction, and enhancing institutional effectiveness in the evolving higher education landscape.

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Driving Regional Growth through Strategic Allocation of Public Expenditures in Meghalaya

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A b s t r a c t

The present study explores how public resource allocation can strategically support regional economic growth in Meghalaya, aiming to achieve a state Gross Domestic Product (GDP) of \$10 billion by 2028. The public resources, i.e. capital expenditures, expenditure on agriculture and allied sectors, rural development, industries and minerals and social services, and the role of entrepreneurship growth with national GDP as a mediating factor and the inflation as a moderating factor were examined for any direct and indirect effect on state GDP using Structural Equation Modelling (SEM). To assess how changes in the growth rate of public expenditure influence tactical outcomes, a scenario analysis was conducted. The interaction among public policies, entrepreneurship, and human development plays a vital role in regional sustainable development. In a region rich in natural resources and cultural legacies, like Meghalaya state, understanding the magnitude of public expenditure to influence entrepreneurship and overall sustainability is vital for effective and efficient policy-making. Hence, an attempt was made to address these challenges by analysing time-series data from FY 2005-06 to FY 2022-23. The study finds that while public expenditure in the Industry & Mining sector significantly drives regional growth, its narrow allocation limits overall impact. With national economic trends playing a significant role through Industries & Mining development expenditures, the path toward Meghalaya's \$10 billion Gross State Domestic Product (GSDP) target by 2028 requires a more diversified and stable fiscal approach.

Keywords: *Regional economic growth, Strategy, Public expenditure, GSDP, public resource allocation*

1. Introduction

Public expenditure has long been recognised as a critical instrument for stimulating economic growth, particularly in developing economies where structural bottlenecks and regional disparities persist. Recent empirical study employed advanced econometric techniques, such as Hansen's panel threshold regression, to capture the nonlinear dynamics between government expenditure and growth outcomes (Sharma et al., 2024) and highlighted that the impact of expenditure is not uniform across regions in India; where North-Eastern region (NER) exhibits highest threshold (81.9%) compared to Northern regions (60.5%) and Western regions (50.7%). This is consistent with broader evidence that regions with weaker private sector participation and limited industrial bases depend more heavily on public expenditure to drive economic activity (Maitra & Hossain, 2025). This implies that Meghalaya state, being part of the NER and constraining industrial growth (IBEF, 2025), can absorb more expenditure productively as its baseline development needs are greater and have room for productive public expenditure. The policy implications are significant and align with recent debates on the optimal composition of public expenditure, where numerous studies emphasise the need to strategise and prioritise developmental over non-developmental expenditure to maximise economic growth (Sharma et al., 2024; Maitra & Hossain, 2025; Khan, 2023).

Meghalaya state is a vibrant region with economic challenges yet opportunities endowed by abundant natural resources, cultural diversity and regional topography advantages (Yashpal et al., 2024; Government of Meghalaya, 2026). Meghalaya stands as the second fastest growing State in India after Tamil Nadu, recording an impressive 9.66% real GSDP growth in the financial year 2024-25 (Governor of Meghalaya, 2026). However, the region suffers socio-economic impediments such as limited industrial development (IBEF, 2025), dependence on primary sectors and suffer infrastructural gaps (Panda & Umdor, 2008). Nevertheless there remain ample opportunities with abundant agricultural base (Das, 2024), rich mineral resources and entrepreneurial spirit that create avenues with effective and efficient policies and investment. Hence with ambitious goals of attaining state GDP of \$10 billion by 2028, it is imperative to validate the causal pathways of regional economic growth. Public expenditure not only creates the infrastructural development and support industries but reinforces entrepreneurship (Pandey et al., 2024; Roundy, 2019 and Volery, 2000), improves rural

livelihoods (Deswal et al., 2023) and strengthens human development and thereby significantly modulates the pathway of growth and sustainability (Javed and Husain, 2024; Maryantika and Wijaya, 2022).

Given the strategic importance of public expenditure in regional economic development, a systematic empirical investigation was required to assess its impact on regional growth. Overall, the findings indicated that public expenditure plays a critical role in shaping regional economic growth in Meghalaya. Among the expenditure components, Industries & Minerals is the only factor with a significant and direct contribution to regional growth. At the same time, national economic growth also shows a significant mediating effect through capital expenditure, agricultural and allied activities, and rural development. Furthermore, inflation significantly moderates the relationship between IM and regional economic growth, weakening its impact during the study period from 2005-06 to 2022-23. These results highlight the importance of strategic public expenditure and macroeconomic stability in promoting balanced regional economic development in Meghalaya.

Uniqueness in socio-economic features, Meghalaya state offers compelling validation (MoFPI report, 2025) for exploring the region-based regional dynamics of entrepreneurship and economic development, considering public expenditure patterns. Encouragement of entrepreneurial activities and promotion of overall economic growth as the outcome of effective and efficient allocation of public resources, this tactical allocation of public resources can be helpful by understanding these dynamics. Hence, the exploration of these complex interactions among the public expenditure, entrepreneurship and economic development contributes to the body of knowledge and provides policy-oriented findings in the context of Meghalaya state.

2. Review of Related Literature

The literature on the critical interactions among entrepreneurship, public expenditure, economic growth, inflation, and the mediating role of economic growth has been reviewed thematically.

2.1 Public Expenditure as a Driver for Entrepreneurship

The relationship between public expenditure and entrepreneurial activity has been widely debated in the literature. There are mixed views among studies on the role of entrepreneurship in public expenditure. Cowling and

Bygrave (2006) and Koellinger and Minniti (2009) argue that public expenditure encourages entrepreneurship. Olds (2013 and 2014), Reddy et al. (2023), and Pandey et al. (2024) examined the composition of public expenditure and found that targeted public expenditure positively correlates with entrepreneurial development and firm performance. On the other hand, Kirzner (1997), Freytag and Thurik (2007), Engberg et al. (2019), and Solomon et al. (2021) depict an inverse relationship. Solomon et al. (2020) noted that there is considerable controversy over the extent to which public expenditure influences entrepreneurship, as policy researchers often hold opposing views on the effectiveness of government involvement in stimulating entrepreneurial activity. Several empirical studies argue that public expenditure can play a catalytic role by fostering a supportive economic environment, thereby promoting entrepreneurship as a key engine of economic growth (Roundy, 2019; Volery, 2000). These studies emphasise the importance of understanding how public policies and fiscal instruments can effectively fuel entrepreneurial ecosystems. In contrast, another group of studies questions the necessity of extensive government intervention. Sandstorm et al. (2019) presented different perspectives, raising an important debate about the economic role of government involvement versus market forces in stimulating entrepreneurial activity. These inconsistencies suggest that the effectiveness of public resource allocation may vary across regions and depend on the alignment of spending priorities with local entrepreneurial needs. This ongoing debate highlights the need for further empirical investigation into the mechanisms through which public expenditure influences entrepreneurial dynamics and broader economic development. Accordingly, the present study seeks to examine whether public spending significantly influences entrepreneurship and whether such allocations are effectively aligned with the regional requirements for entrepreneurial growth and performance.

2.2 Heterogeneous Effects of Entrepreneurship on Economic Growth

The connection between entrepreneurship and economic growth has been widely examined in the literature, with empirical findings indicating both temporal variations and cross-country differences in its impact. Abdinour and Adeniji (2023) examined how entrepreneurial activity influences economic growth, incorporating Global Entrepreneurship Monitor (GEM) data from 2001 to 2021 across 23 countries, computing the ARDL model, and found that entrepreneurial activity has no immediate impact on

economic growth; however, its effects materialise progressively over time. Furthermore, Hartog et al. (2010) conducted a widespread study across 21 OECD countries between 1981 and 2006, to understand how entrepreneurship affects economic growth and identified a strong interaction and long-term impact, which was later corroborated by the findings of Begum et al. (2022) to have a strong impact on overall economic growth by up-to 30.4%. Whereas Doran et al. (2018) examined the contribution of entrepreneurial activity (EA) across high-income and middle/low-income countries using an unbalanced panel of 55 countries over the period 2004-2011, with 14 indicators, PCA, and regression analysis. They observed that EA stimulated economic growth in high-income countries but had a negative effect in middle- and low-income countries. However, the interaction between entrepreneurship and economic growth in emerging countries was found to be inversely related (Zaki & Rashid, 2016). These inconsistencies create ambiguity regarding the nature and direction of this relationship, underscoring the need for context-specific analysis. Accordingly, the present study aims to examine whether entrepreneurship significantly contributes to economic growth in the study region and to determine the extent to which its impact aligns with patterns observed across different economic contexts.

2.3 Public expenditure and Economic growth interaction: to showcase the influence of Public expenditure on economic performances

Preceding studies have shown mixed consensus and conflicting findings about the interactions between public expenditure and the economic growth such as Carr (1986); Ram (1986); Kormendi and Meguire (1986); Ghura (1995); Ghali (1998); Sjoberg (2003); Dandan (2011) and Nurlina (2015) disclosed their findings that public expenditure has positive and significant relationship on economic growth. Whereas, Landau (1983); Barro (1991); Guseh (1997); Knoop (1999); Folster and Henrekson (1999, 2001); Pevcin (2004); Berg (2007) and Loto (2011) demonstrated an inverse relationship, and few studies, such as Karagiani (2009); Hearth (2009) and Facchini (2011) highlight the presence of a nonlinear relationship. Apart from these inconsistencies, Javed and Husain (2024) also identify other aspects of improving quality of life and encouraging productivity, and they unveil public expenditure as a catalyst for sustainable development. However, if public funds are mismanaged or spent excessively, they can lead to debt, budget deficits, and inflation (Mose, 2024). Therefore,

the impact of public expenditure on economic growth depends on careful planning and prudent resource allocation (Ahmad et al., 2024), suggesting that the impact is context-dependent and influenced by factors such as expenditure composition, fiscal discipline, and institutional effectiveness.

2.4 Inflation as a moderating variable: how inflationary pressures affect economic stability and growth trajectories

Attari and Javed (2013) investigate the relationship among the rate of inflation, economic growth and government expenditure in Pakistan using the econometrics tools such as ADF, ARDL, Johansen cointegration test and Granger causality test and found that there is a long-term relationship between rate of inflation, economic growth and government expenditure, which means the government expenditures yield positive externalities and linkages. In the short run, inflation rates do not affect economic growth, but government expenditures do. The causality test at the 10% significance level showed unidirectional causality from inflation to economic growth.

Ahmad et al. (2024) examine the fiscal policy determinants of economic development in Pakistan, using the exchange rate and inflation as moderators. Regression analysis using annual data spanning 2000 to 2023 was used as a the method of estimation. The results showed that government expenditure has a significant negative relationship, while tax revenue increases economic development. Exchange rates and inflation rates play a moderating role in shaping the relationship between economic development, which is not in line with Maulid et al. (2022), who showed that inflation has a negative effect on economic growth and tax revenue in Indonesia during the study period of 1973 to 2019. Bakari (2024) established that inflation can be significantly controlled when exchange rates are managed effectively and efficiently, a factor for maintaining economic stability, a favourable trade environment, and FDI attraction to promote sustainable economic growth.

2.5 Economic Growth as a Mediating Variable:

A growing body of empirical literature underscores the developmental role of public expenditure, particularly in social sectors. For instance, Bellettini and Berti Ceroni (2000) analyse a cross-country sample of 61 countries and panel data for 20 OECD countries; their empirical findings indicate that the growth-enhancing effects of public expenditure are significantly stronger in less developed countries than in more developed economies. Alam et al. (2010) also observe long-run dynamic relationships

between social expenditures and economic growth across 10 Asian countries for 1970–2005. Extending this evidence, Alper and Demiral (2016) and Cooray and Nam (2024) examine the relationship between public social spending, government effectiveness and economic growth using panel data covering 132 developed and developing countries during the 2008 to 2019 period and found that public expenditure of social security, education and health has a significant and positive impact on economic growth. At the sub-national level, Radzuan (2022) examine the relationship between state government fiscal and economic growth and the economic impact of the central government's contribution on state's budget allocation in Malaysia using a panel dataset that spans 13 Malaysian states and ten years, from 2008 to 2017, the findings indicated that public expenditure drives growth in state domestic products and further reveals that state public expenditure and central allocation to states significantly impact Malaysian state economic growth. More recently, Sharma et al. (2023) provide further insight from their studies on the relationship between public expenditure and human development, taking the economic growth as a mediating variable in the North-Eastern Region of India and showed that the economic growth has partially mediated the relationship between public expenditure and human development with respect to Meghalaya and Sikkim. In this context, the present study examines whether national economic growth (GDP) serves as a mediating mechanism between state government spending and regional economic growth. Accordingly, the study addresses the following research questions: (i) Does state government expenditure significantly influence regional economic growth? (ii) To what extent does national GDP mediate the relationship between state government spending and regional growth? and (iii) Does the inclusion of national economic growth alter the strength or direction of the expenditure–growth relationship?

2.6 Theoretical Framework

The relationship between sectoral development and economic growth has been extensively examined within the frameworks of structural transformation, industrialisation, and resource-based growth theories. In particular, the industrial sector has long been recognised as a central driver of economic expansion. According to Kaldor's growth laws, manufacturing and industrial activities serve as the primary engine of growth due to their ability to generate increasing returns to scale, enhance productivity, and stimulate technological progress (Kaldor, 1967). This theoretical

perspective provides a strong foundation for the inclusion of industries (IM) as an explanatory variable influencing regional economic growth.

The inclusion of mining within the IM introduces an additional dimension based on the resource-based growth theory. Natural resource endowments, particularly through mineral extraction, contribute to economic growth through capital accumulation, export earnings, and fiscal revenues (Sachs & Warner, 1995).

Furthermore, inflation (CPI) is widely recognised as a key macroeconomic factor influencing economic performance, particularly through its impact on investment efficiency and resource allocation. The perspectives on the inflation-growth relationship suggest that moderate levels of inflation may support economic activity, whereas higher levels can distort economic decisions and reduce growth potential (Fischer, 1993; Barro, 1995). In this regard, inflation is appropriately modelled as a moderating variable that influences the strength and direction of the relationship between sectoral development (IM) and economic growth (GSDP).

2.7 Research Gap

Although considerable research attention has been given to the interactions among entrepreneurship, public expenditure, economic growth, and inflation, and to their mediating roles, there is a noticeable gap and limited empirical research in the context of regional growth in Meghalaya state. In addition, the computation of the structural equation modelling (SEM) to investigate these interactions in Meghalaya state is relatively underexplored. Most importantly, the projection of the annual regional growth to attain the state GDP by 2028 reported another gap. The present study, therefore, attempted to bridge these gaps by computing SEM to provide robust statistical framework for direct and indirect effects and examining the mediating and moderating effect simultaneously and uncover significant drivers of regional economic growth in Meghalaya state by employing the dataset from 2005-06 to 2022-23 and to provide policy related findings using the projecting annual growth rates to attain the targeted \$10 billion state GDP.

3. Research Objectives

The primary objective of this study is to analyse the impact of public resource allocation on regional growth using SEM and scenario analysis. Specifically, we aim to:

1. To identify significant public expenditures affecting regional growth.
2. To examine the mediating role of national GDP and the moderating role of Inflation in the relationship between public expenditures and regional growth.
3. To evaluate the potential outcomes of different growth scenarios.

4. Research Methodology

4.1 Data Collection

The annual time series data and the figures are in lakhs and obtained from a secondary source, i.e. the Meghalaya Budget, Finance Department, Government of Meghalaya and for GDP and Inflation, the information was collected from Centre for Monitoring Indian Economy (CMIE) and data.gov.in, ranging from 2005-06 to 2022-23.

Public Expenditures: The data with respect to the Capital expenditure and expenditures in Economic services and the Social and Community services as reported in the Meghalaya budget.

Entrepreneurship: To enhance revenue, there is a strategic requirement to increase production and sales, which necessitates greater input acquisition, such as raw materials. This increase in operational activities invariably results in greater tax responsibilities, including, but not limited to sales/trades taxes, excise charges, and vehicle-related taxes, such as transportation levies on both products and passengers. This discernible upward trend in tax payments is a solid indicator of increased entrepreneurial activity, suggesting prospective profit increases and encouraging the growth of entrepreneurship. The aggregated outlays, which include sales/trade taxes, state excise taxes, vehicle taxes (transport), and taxes on goods and passengers, represent the state's dynamic engagement/activity of entrepreneurs. As Tax (VAT) data is widely used as a high-frequency proxy for firm-level economic activity, it directly reflects transactional sales and value addition (Bachas et al., 2025).

Gross State Domestic Product (GSDP): It represents the Economic Growth of the region.

Gross Domestic Product (GDP): The economic growth at the national level.

Inflation: the percentage of inflation rate; the missing values were determined using linear interpolation estimates.

5. Research Design

The study follows a longitudinal design, analysing data over 19 years (from 2005-06 to 2022-23). SEM is used to model the relationships between variables, and growth rates are projected to estimate future GSDP.

Structural Equation Modelling (SEM)

SEM is employed to identify significant variables influencing GSDP. The model includes latent constructs representing different public expenditure categories and their direct and indirect effects on GSDP.

1. Model Specification:

Direct Effect:

$$GSDP = \sigma + \beta_1 * GDP + \beta_2 * CPI + \beta_3 * IM + \beta_4 * IM * CPI + \epsilon$$

Indirect Effect:

$$GDP = \sigma_1 + \beta_5 * EA + \beta_6 * CapEx + \beta_7 * AAA + \beta_8 * RD + \beta_9 * IM + \beta_{10} * SS + \mu$$

Where,

GSDP (dependent variable) is a function of its predictors (EA, CapEx, AAA, RD, IM, & SS) and national GDP, along with CPI, and is considered to be mediated and moderated in an enquiry to derive its intricate relationship and consequential effects.

σ, σ_1	= intercept
$\beta_1, \beta_2, \dots, \beta_{10}$	= coefficients of the model's adjustment
ϵ, μ	= residuals (<i>error terms</i>)
EA	= Entrepreneurship growth measured by increased activities
CapEx	= Capital Expenditure
AAA	= Public expenditure in Agriculture and its Allied Activities
RD	= Public expenditure in Rural development
IM	= Public expenditure in Industries and Minerals, which also includes villages and small industries for textiles and cottage industries.
SS	= Public expenditure in Social and Community Services
GDP	= Economic growth measured by an increase in Gross Domestic Product and used as a mediator in the model.
CPI	= Inflation used as a moderator in the model

Scenario Analysis

Scenario analysis is conducted to project GSDP under different annual growth rates and strategic scenarios.

Baseline Scenario: Projected growth based on current trends and SEM coefficients. Here, the current trends of IM, national GDP and CPI are observed, and the required annual growth rate is determined to achieve the target GSDP in 7 years. Accordingly, the impact coefficients from SEM are used to proportionally allocate based on the required annual growth rate of GSDP; hence, depending on their ratios, the annual growth rates required to increase the allocation share of public expenditure in IM, national GDP, and the CPI are determined.

ANALYSIS: RESULTS & DISCUSSIONS

MODEL ESTIMATION

Dickey-Fuller Test:

To check for the stationary properties of the data, the Dickey-Fuller Test was computed, and the output is shown below:

It can be seen that the Test Statistics value of GSDP, GDP, IM and CPI are all higher than their corresponding 5% critical value. It means that the variables are stationary at level. Therefore, it can be concluded that the considered variables do not have a unit root as provided by the Dickey-Fuller Test.

Serial Correlation:

Since the study uses time-series data, testing for serial correlation is essential to ensure that the error terms are independent and that the estimated coefficients are unbiased and efficient.

To ensure the validity of the model, the Breusch–Godfrey serial correlation LM test was performed. The test results indicate that the null hypothesis of no serial correlation cannot be rejected, as the p-values are greater than 0.05. This confirms that the residuals are independent and that the model is free from autocorrelation issues.

Structural Equation Model

The SEM model in the present study used Maximum Likelihood estimation as a special technique to estimate the parameters in the model. All the observed variables are specified and standardised using STATA and was executed to test the significance of the direct and indirect effect of the Entrepreneurial Activity (EA) and Public expenditures in Infrastructure development (CapEx), Agricultural and its Allied Activities (AAA), Rural development (RD), Industries and Mining (IM) and Social and Community

Services on the regional development (GSDP) using the Economic growth (GDP) as mediator and Consumer Price Index (CPI) and moderator variables.

An initial variable screening was conducted using stepwise regression to identify the most statistically significant predictors of economic growth. Following this, multicollinearity diagnostics were performed to ensure the robustness of the selected variables. The results indicated that GDP, IM and CPI emerged as the key determinants influencing GSDP (GS). Furthermore, the multicollinearity

assessment, as presented below, reveals that all Variance Inflation Factor (VIF) values are below the conventional threshold of 5. This suggests the absence of severe multicollinearity among the explanatory variables, thereby confirming the suitability of the model for further structural analysis.

Based on these findings, a Structural Equation Modelling (SEM) framework was subsequently employed to examine both the direct and indirect relationships among the variables in alignment with the study objectives.

Table 1. Dickey-Fuller Test for Unit Root

Variable	Test Statistics	5% Critical Value
GSDP	4.057	-1.950
GDP	5.174	-1.950
IM	-3.899	-3.000
CPI	-3.864	-3.000

Source: Compiled from STATA output

Table 2. Breusch-Godfrey LM test for serial correlation

Lags(p)	Chi2	df	Prob > chi2
1	1.738	1	0.1874
H0: no serial correlation			

Source: STATA Output

Table 3. Multicollinearity Tests

Variable	VIF	1/VIF
GDP_std	4.57	0.218985
CPI_std	4.54	0.220367
IM_std	3.23	0.309401
Mean VIF		4.11

Source: STATA output

Table 4. Structural Equation Model

Structural equation model			Number of obs	=	18	
Estimation method				=	ml	
Log likelihood				=	-38.535502	
	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
Structural						
IM_std < -						
Gdp_std	.8030347	.1404626	5.72	0.000	.5277332	1.078366
_cons	-1.17e-08	.1365051	-0.00	1.000	-.2675451	-.267545
GSDP_std <-						
IM_std	.1491744	.0462232	3.23	0.001	.0585787	.2397702
GDP_std	.8444953	.0549432	15.37	0.000	.7368087	.9521819
CPI_std	.0291339	.0547706	0.53	0.595	-.0782146	.1364824
_cons	-2.41e-09	.0249867	0.00	1.000	-.048973	.048973
var (e.IM_std)	.3354055	0.1118018			.1745164	.6446203
var (e.GSDP_std)	.011238	.003746			.0058473	.0215985
LR test of model vs. saturated: chi2(1)			=	2.48, Prob > chi2	=	0.1152

Source: STATA output

The structural equation model demonstrates a good fit to the data ($\chi^2(1) = 2.48, p > 0.05$). The results indicate that GDP has a significant positive effect on IM ($\beta = 0.803, p < 0.01$), which in turn positively influences GSDP ($\beta = 0.149, p < 0.01$).

The direct effect of GDP on GSDP remains strong and statistically significant ($\beta = 0.844, p < 0.01$), suggesting partial mediation (Sharma et al., 2023). The indirect effect of GDP on GSDP through IM is positive but relatively modest in magnitude. The control variable CPI was found to be statistically insignificant, indicating no substantial direct influence on GSDP within the model.

DIAGNOSTIC TEST

The model demonstrates a good overall fit to the data, as indicated by the non-significant chi-square statistic ($\chi^2(1) =$

2.48, $p > 0.05$), high CFI (0.985), and acceptable TLI (0.923). The SRMR value (0.034) further confirms a good fit. Although the RMSEA value is relatively high (0.287), this may be attributed to the low degrees of freedom ($df = 1$), which is known to inflate RMSEA values in small models. Therefore, the model is considered to have an acceptable fit.

Hence, the above SEM is found appropriate and provides a good fit to the data, supporting its coefficients of the significant variables such as IM and GDP, as CPI was insignificant to use for further analysis and hence the study provides a comprehensive year-by-year forecast and outlines the necessary annual increments for each contributing variables which is further aligned to the target of GSDP for \$10 billion or 80,000 (in crores) by 2028 (Laitphlang, 2023) i.e. 5 years from the present time period of the study.

Table 5. Overall Goodness of Fit

Fit statistic	Value	Description
Likelihood ratio chi2_ms(1)	2.481	model vs. saturated
p > chi2	0.115	
chi2_bs (5)	100.879	baseline vs. saturated
p > chi2	0.000	
Population error RMSEA	0.2879	Root mean squared error of approximation
90% CI, lower bound	0.000	
upper bound	0.759	
pclose	0.123	Probability RMSEA <= 0.05
Information criteria		
AIC	93.071	Akaike's information criterion
BIC	100.194	Bayesian information criterion
Baseline comparison		
CFI	0.985	Comparative fit index
TLI	0.923	Tucker-Lewis index
Size of residuals		
SRMR	0.034	Standardized root mean squared residual
CD	0.985	Coefficient of determination

Source: STATA output

Since the value of GSDP is 38785 (in crores), i.e. Rs 3.8 billion as on the financial year 2022-23.

The formula for the annual growth rate r is:

$$= \text{Current GSDP} \times (1+r)^n$$

Substituting the given values:

$$\begin{aligned} 80,000 &= 38,785 \times (1+r)^5 \\ (1+r)^5 &= 80,000 \div 38,785 \\ (1+r)^5 &= 2.063 \\ 1+r &= (2.063)^{1/5} \\ 1+r &= 1.156 \\ r &= 0.156 \end{aligned}$$

The required annual percentage increase in GSDP is approximately 15.6%.

Using the SEM coefficients, how much each variable should be increased to achieve the annual increase in GSDP has been determined using the following coefficients.

$$\beta_{IM} = 0.149$$

$$\beta_{GDP} = 0.964 (0.844 \text{ Direct} + 0.12 \text{ Indirect} [0.844 * 0.149])$$

Hence, the total coefficients are 1.113

Therefore, the annual growths of the significant variables are:

$$IM_{\text{annual}} = 0.149 \div 1.113 = 0.134; \gg 15.6\% \times 0.134 = 02.09\%$$

$$GDP_{\text{annual}} = 0.964 \div 1.113 = 0.866; \gg 15.6\% \times 0.866 = 13.51\%$$

Table 6. Annual Growth Trends of IM, GDP and GSDP

Year	IM	GDP	GSDP
2023	6883.14	1607144572	38785
<i>Annual Increase requirement</i> »	2.09%	13.51%	15.60%
2024	7027	1824269804	44835
2025	7174	2070728654	51830
2026	7324	2350484095	59915
2027	7477	2668034497	69262
2028	7633	3028485957	80067

Source: Author's computation

The estimated coefficients derived from the model were used to determine the relative contribution (weightage) of the explanatory variables IM and GDP. These contributions were subsequently aligned with the targeted growth trajectory of the dependent variable, expressed in terms of the required 5-year Compound Annual Growth Rate (CAGR). Accordingly, the proportional weightage of each variable was adjusted to reflect its role in achieving the specified growth benchmarks. Hence, the total required growth is decomposed as:

$$15.6\% = 02.09\% + 13.51$$

This decomposition provides a structurally consistent interpretation of how the exogenous construct (IM) and the mediating pathway (GDP) jointly contribute to achieving the target growth of the endogenous construct GSDP. Subsequently, these calibrated contributions serve as baseline inputs for the Monte Carlo-based sensitivity analysis.

To assess the robustness and responsiveness of the model, a sensitivity analysis was conducted using the Monte Carlo simulation technique.

Monte Carlo Simulation Design

To account for uncertainty in future values of explanatory variables, Monte Carlo simulation is employed (Metropolis

& Ulam, 1949) and 10,00 iterations between -10% and +10% was conducted under the following assumptions:

- ♦ Each variable varies independently within a $\pm 10\%$ range (normal distribution)
- ♦ One variable is shocked at a time (ceteris paribus condition)
- ♦ Output: simulated CAGR of GSDP

The scenario analysis employs a Monte Carlo simulation framework using STATA to assess the sensitivity of economic growth (GSDP) to variations in key explanatory variables. For each simulated observation, the resulting change in GSDP is computed using the estimated structural coefficients obtained from the SEM model, thereby capturing the marginal impact of each variable. The distribution of simulated GSDP outcomes is then summarised using descriptive statistics, including mean, standard deviation, minimum, and maximum values. Additionally, the proportion of target achievement is calculated as the ratio of mean growth to the maximum attainable growth under each scenario, providing a measure of performance stability under uncertainty.

Table 7. Scenario-Based Simulation Results

Scenario	Variable Shocked	Mean (CAGR %)	Std. Dev.	Min (%)	Max (%)	Target Achieved (%)
Baseline	None	15.600	0.000	15.600	15.600	100.00
S1	IM	15.5998	0.0182	15.5688	15.6312	99.80
S2	GDP	15.5911	0.6644	14.4595	16.7403	93.13

Source: STATA output

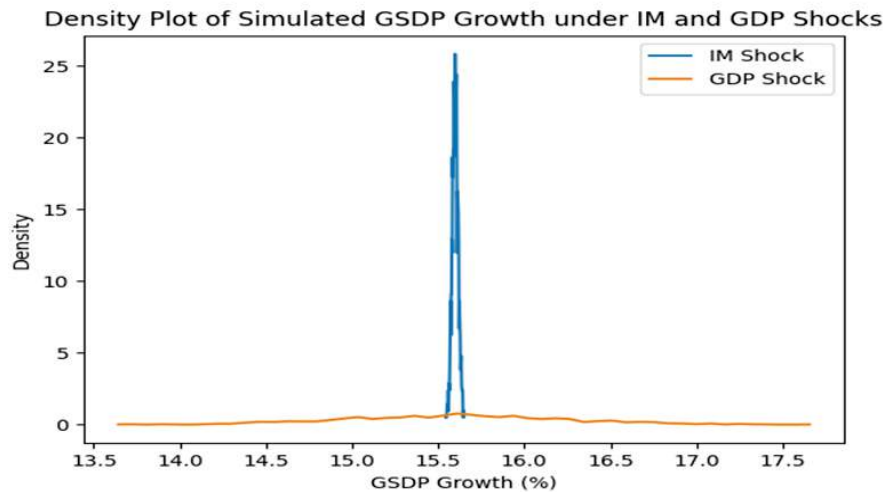


Figure 1. Density Plot of simulated GSDP under IM and GDP shocks

Note: Results are based on 1,000 Monte Carlo simulations with $\pm 10\%$ uniform shocks applied to each variable independently. Growth responses are computed using SEM-derived coefficients using STATA.

Table 7 presents the results of the scenario-based simulation analysis. The baseline scenario reflects a constant growth rate of 15.6% with no variation. Under the infrastructure shock scenario (S1), the mean growth remains virtually unchanged at 15.60%, with minimal variability ($SD = 0.018$) and a narrow range, indicating limited sensitivity of growth to IM fluctuations. In contrast, the GDP shock scenario (S2) exhibits substantially higher dispersion ($SD = 0.664$), with growth ranging from 14.46% to 16.74%. The corresponding decline in target achievement to 93.13% highlights the significant influence of GDP on growth variability.

The density curve for IM is highly concentrated and sharply peaked around the mean (15.6%). The distribution exhibits very low dispersion, with values tightly clustered within a narrow band (15.57%–15.63%). This indicates that shocks to IM produce minimal deviation from the baseline growth path. The steep and narrow density curve suggests that infrastructure (IM) has a stable but weak influence on economic growth in the short run. Even under $\pm 10\%$ fluctuations, the growth trajectory remains largely unaffected, implying low sensitivity and high predictability. The density curve for GDP is much flatter and wider, indicating substantial dispersion. The distribution spans a

broad range (approximately 14.46%–16.74%), reflecting high variability in outcomes. The peak is lower compared to IM, indicating that outcomes are less concentrated around the mean. The wider and flatter density curve demonstrates that GDP shocks introduce significant uncertainty and volatility in growth outcomes. This reflects the dominant role of GDP as a driver of both upside potential and downside risk in the economy.

6. Implications of the Study

The findings of this study offer a nuanced perspective on the fiscal dynamics of Meghalaya, providing a roadmap for achieving the state's ambitious GSDP targets. The analysis reveals a complex interplay between sectoral expenditure, national economic synergy, and macroeconomic constraints.

6.1 Theoretical Implications

This study contributes to the literature on regional developmental economics by refining our understanding of how public expenditure interacts with regional growth in a resource-rich but structurally developing economy.

- a) **Refining Resource-Led Growth Theory:** The significant direct effect of Industry and Mining (IM) on GSDP reinforces the "resource-led growth" hypothesis. However, the statistical insignificance of other sectors suggests a sectoral decoupling, where public expenditure in traditional areas like agriculture or social services is not translating into immediate GSDP gains.

This adds to the theoretical discourse on the "Dutch Disease" or structural lopsidedness in sub-national economies.

- b) National-Regional Integration as a Mediator:** The study advances the theory of economic linkages by demonstrating that national growth does not merely "trickle down." Instead, it is mediated through specific regional channels—namely, Industries & Mining. This suggests that regional growth is functionally dependent on how well local infrastructure and primary sectors are aligned with the national economic trajectory.

6.2 Practical and Policy Implications

For policymakers in Meghalaya, the results provide a data-driven basis for fiscal restructuring and strategic planning.

- a) Diversification and Rebalancing:** While the IM sector is currently the engine of growth, the "statistically ineffective" nature of other sectors signals a need for a policy audit. To avoid structural imbalances, the government should move away from an over-reliance on mining and explore why expenditures in other sectors are failing to yield significant GSDP returns. This might involve improving the "quality" of expenditure rather than just the "quantity."
- b)** The strong linkage between GDP and GSDP implies that central economic policies create significant growth opportunities. However, the realisation of these opportunities depends on the ability of regional policies to align their development strategies with national growth trends. Your results suggest GDP shocks significantly influence growth variability, hence the policy must promote agro-based industries, tourism, and services, develop value chains in horticulture, bamboo, and handicrafts and overall strengthen the MSME ecosystems (MoFPI report, 2025; Yashpal et al., 2024; and Pandey et al., 2024). Meghalaya, being part of the Northeast region, holds strategic importance under India's Act East Policy, thereby the regional policy can plan for the development of cross-border trade corridors (Bangladesh, Myanmar, ASEAN), Promotion of export-oriented industries and strengthen logistics and border infrastructure and allows to convert geographic proximity into economic advantage, amplifying the impact of national GDP growth.

7. Conclusions

The present study examined the dynamics of economic growth in Northeast India by analysing the relationship between national-level GDP and state-level GSDP within a Structural Equation Modelling (SEM) framework. The findings reveal that GDP serves as the dominant driver of growth, exerting both direct and indirect effects (Sharma et al., 2023) on GSDP through infrastructure (IM). While the direct effect of GDP is strong and statistically significant, the indirect effect through Industries & Mining (IM) indicates the presence of partial mediation, highlighting the importance of transmission channels in the growth process. The scenario-based simulation further reinforces these findings by demonstrating that GDP shocks generate substantial variability in growth outcomes, whereas infrastructure shocks produce minimal deviations from the baseline. This indicates that GDP acts as a high-impact but volatile driver of growth, while Industries and Mining contribute to stability with relatively limited short-term influence. In the context of Meghalaya, these results suggest that economic growth is largely influenced by national macroeconomic conditions, but the extent to which these conditions translate into regional development depends on state-level policy responses, institutional capacity, and structural readiness. With national economic trends playing a significant role through IM expenditures, the path toward Meghalaya's \$10 billion GSDP target by 2028 requires a more diversified and stable fiscal approach.

8. Limitations of the Study

Despite its contributions, the study is subject to certain limitations. First, the SEM-derived coefficients are based on historical relationships and may not fully capture future structural changes in the economy. Second, the initial model produces amplified growth estimates due to its linear and additive structure, which does not incorporate real-world constraints such as diminishing returns, resource limitations, and policy inefficiencies. Although this issue was addressed through rescaling, the approach assumes proportional stability of relationships over time. Third, the analysis relies on deterministic growth assumptions for key variables, which may not adequately reflect macroeconomic uncertainties such as external shocks, policy changes, or fluctuations in inflation and national income. Fourth, while inflation is modelled as a moderating variable, its interaction effects may vary across different economic regimes, which are not explicitly captured in the present framework. Finally, the study focuses on aggregate

relationships and does not account for sectoral heterogeneity within public expenditure, which may influence growth outcomes differently.

Future Research Agenda

The limitations of the current model—specifically the impact of omitted variables and the inhibiting role of inflation—provide a clear direction for subsequent academic inquiry:

- ◆ **Exploration of Omitted Intercept Variables:** Initially, the public expenditures in 28 different sectors were considered for the present study, but due to high multicollinearity, the model could not be fitted, and the structural equation modelling was also not estimated. The study has not taken into consideration all the factors that could be affecting these variables.

Future studies should investigate non-fiscal determinants such as governance quality, digital infrastructure, and cross-border trade dynamics that may account for the current model's intercept variance.

- ◆ **Sectoral Synergies:** Research is needed to determine why sectors like Agriculture and Allied Activities (AAA) and Rural Development currently lack a direct significant impact on GSDP, exploring how "misallocated" funds can be redirected for higher ROI.
- ◆ **Dynamics in the Entrepreneurial Growth:** The dynamics of entrepreneurship in the economy may not be fully captured by the assessment of entrepreneurship growth and its effect on the GSDP, which is open to interpretation.
- ◆ **Inflationary Buffers:** Given that the Consumer Price Index (CPI) significantly inhibits the gains from the IM sector, further study into localised price stabilisation mechanisms is essential for protecting regional growth.
- ◆ **Long-term Sustainability:** Investigation into the transition from a resource-led (Mining) growth model to a service or knowledge-based economy to ensure structural balance and environmental resilience.

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Aims and Scope

The SCMS Journal of Indian Management is a quarterly, double-blind, peer reviewed journal that has been published since the year 2004. The journal's mission is to bring out the latest in management thought, academic research and corporate practice across all domains of business and management in a reader- friendly format. We welcome submissions that are innovative in ideation, conceptually sound, methodologically rigorous and contribute substantially to business and management literature. The journal targets an international audience that encompasses the entire business and management fraternity, in both industry and academia.

Our aim is to provide an avenue for the publication of the latest advancements in quality research output across all management functional areas while supporting our authors with constructive reviews and feedback from our expert reviewers throughout the publication process. We target the highest quality standards both in terms of timely delivery of research output as well as strict compliance to the principles laid out by the Committee on Publication Ethics (COPE). At no point do we charge any publication/ article processing fee. We are committed to publishing high-quality, open- access research to contribute to the expansion of scientific knowledge for the public good.

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