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Gyan Management is an open-access International Bi-annual refereed Journal published by Gian Jyoti Institute of Management and Technology, Mohali since the year 2007. It is dedicated to enhancing teaching and learning in the field of Management & Commerce, Information Technology, and business strategies. The focus of the journal is on collating applied research and reflections relevant to various discipline practices and disseminating knowledge. It establishes an effective communication channel between decision and policymakers in business and academicians, to recognize the implementation of effective systems in the business world.

Gyan Management is published in January and July every year. The journal accepts theoretical and applied research work for publication. It publishes original, research-based papers, articles, cases & book reviews on topics of current concern in all areas of management & technology affecting the business environment.

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Gyan Management serves as a vital communication channel between academia and industry, facilitating dialogue between decision-makers, policy influencers, and scholars. The journal publishes original research papers, case studies, articles, and book reviews addressing contemporary issues and emerging trends within these disciplines. By focusing on applied research and practical insights, it supports the implementation of effective systems and strategies in the business world, promoting informed decision-making and enhancing educational outcomes in the management and technology sectors.

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From Mechanization to Sustainability: A Bibliometric Exploration of Industrialization Research Trends and Conceptual Frameworks

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Abstract

Given that there is no bibliometric study exhibiting dynamics of industrialization research, the present study conducts its comprehensive bibliometric analysis and maps its conceptual structure on the basis of 1,377 journal documents published between 2000 and 2025 and sourced from the Scopus database. The study's findings reveal a sharp increase in scholarly contributions on industrialization over the past two decades, with the United States and Spain leading in terms of both volume and impact. At the level of authorship, prominent authors, namely Merigo JM, Porter AL and Kostoff RN, emerge as central figures, collectively shaping a large portion of the field. Journals, namely *Technological Forecasting and Social Change and Research Policy*, provide the maximum and most frequent publication outlets. Six main subject clusters, including innovation, industrial policy, sustainability, Industry 4.0, economic changes and market competition, structure the conceptual frameworks of the industrialization research, showing its development from conventional mechanization to sophisticated automation and finally to the new paradigm of sustainable industrialization. The study emphasizes that future research should critically assess policy effectiveness, technological transitions and sustainability strategies to build resilient, innovative and green industrial ecosystems across diverse economies.

Keywords

Industrialization, industrial policy, industrial sector, innovation and sustainability

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Introduction

Industrialization is a key driver of economic growth and national development, fostering increased productivity, job creation and technological advancements (Ahluwalia, 2002). It represents a transformative shift from agrarian economies to large-scale manufacturing, mechanization and urbanization, significantly shaping societies worldwide. This transformative shift began with the Industrial Revolution in the late 18th century and has led to exponential growth in production processes, construction, transportation, employment and technological advancements (Athukorala & Jayasuriya, 2000). The Industrial Revolution played an important part in constructing modern economies, as indicated by the transformation of countries such as the United States, Germany, Japan and China becoming economic powerhouses through persistent industrial expansion (Butlin, 1986; Franck & Galor, 2021). These modern economies introduced economic reforms which led to rapid industrialization, soaring GDP growth, lower poverty and improved production (Dutta, 2005; Klein, 1996). China introduced these reforms after the Second World War, beginning with agricultural changes in 1978, leading to rapid industrialization. South Korea's rapid industrialization, driven by a shift from import substitution to export-led growth, boosted GDP by 7.5% annually, expanded manufacturing exports and reduced inequality through government welfare programmes (Kniivilä, 2007; Noland & Pack, 2003). On the other hand, Japan's industrialization was driven by small-scale firms, electrification and a blend of modern and traditional technologies (Minami, 1984). Singapore's swift GDP expansion, propelled by foreign direct investment, reliance on exports and educational programmes, has elevated it to one of the world's wealthiest nations despite its scarce natural resources (Krugman, 1994; Vu, 2011). While the government of India brought agricultural reforms and introduced industrial policies to strengthen industries. This has led to employment generation, reduction in income inequality and poverty reduction. After 1991, foreign investment was also welcomed, which significantly resulted in a decrease in trade tariffs. All such efforts played a vital role in industry development, and large-scale industries have always benefited from the backing of smaller industries (Kumari, 2015).

Building on this basis, industrialization has continued to change around the world in different phases, reflecting changes in economic models, environmental consciousness and technology. Often referred to as Industry 1.0, the first stage concentrated on steam and water-powered machinery. Following this was Industry 2.0, which was characterized by assembly lines and mass production made possible by electricity. Industry 3.0 emerged in the middle of the 20th century, revolutionizing scalability and efficiency through automation, electronics and information technology. Industry 4.0, which integrates cyber-physical systems, the Internet of Things (IoT), artificial intelligence and data analytics, is bringing forth smart manufacturing (Duan et al., 2024). As nations adapt to these shifts, the focus shifts from merely raising productivity to moral business practices that balance economic advancement with social and environmental well-being. This pattern demonstrates how industrialization is no longer only a strategy for achieving

economic domination but is now necessary to achieve long-term sustainable development on a global scale (Zhou et al., 2022).

Historically, industrialization has changed over time through waves that were marked by electricity, steam power, digital technology and, more recently, automation and artificial intelligence. These waves have together redefined paradigms for global development. There are a large number of studies explaining this journey of industrialization worldwide, and a wide range of topics have been the subject of industrialization research, including the impact of industrialization on economic growth, its contribution to international trade, the effects of unbridled industrial growth on environmental damage and its effects on governance and public policy. Furthermore, the study of industrialization has gained new dimensions of interest with the advent of the Sustainable Development Goals (SDGs), especially Goal 9: 'Industry, Innovation and Infrastructure', which places a greater emphasis on inclusive and sustainable industrial growth (Govindan et al., 2020).

With the extensive body of research on industrialization, this field of study is still widely scattered among areas like development studies, economics, technology, policy and environmental studies. Because of this fragmentation, it is challenging to track the development of ideas, the dominant themes in the subject, the institutions and locations influencing the industrialization discourses, and the areas where knowledge gaps still exist. Further, the absence of a cohesive knowledge map makes it more difficult to understand the conceptual framework of the subject. Although there are many narrative reviews and topic studies, they frequently concentrate on just one key area or the other. Thus, the entire spectrum of industrialization research has not yet been properly mapped. Moreover, no other bibliometric study had simultaneously examined industrialization across the three dimensions of mechanization, sustainability and Industry 4.0. In this view, there is a dire need for a bibliometric analysis to systematically assemble and depict the vast and scattered corpus of industrialization literature and its conceptual structure. In this context, this article conducts a bibliometric analysis of scholarly literature on industrialization and identifies the most productive and influential authors and countries, highlights the key journals publishing in this area over time and maps the conceptual structure of industrialization research. This research is significant for academicians, researchers and policymakers as it does not merely catalogue the existing literature but critically assesses how research on industrialization has developed, how it is interconnected and where it may be heading. The research is highly relevant in the face of global challenges such as climate change, geopolitical shifts and digital transformation, which the industrialization is facing both in the Global North and Global South.

This article is structured into five broad sections. The first section introduces the research problem and outlines the need, significance and relevance of the study. The second section describes methodological and data-related issues. The results and discussion on bibliometric analysis are presented in the third section in detail, and the fourth section details the future research in the field of industrialization. Lastly, the fifth section concludes the findings of the study and draws policy implications.

Methodology and Data

In the present study, a bibliometric analysis of industrialization research has been executed on studies published between 2000 and 2025. Scopus provides access to leading journal articles, references and publication details required for bibliometric studies. Thus, Scopus was used as the primary source in this study for data collection because the majority of the sources in Scopus and Web of Science are similar. This article analyses the trends and patterns of industrialization research by employing various bibliometric analytical tools. The comprehensive science mapping analysis has been applied to documents extracted from the Scopus database. Using the seminal papers/documents extracted from the Scopus database, this article conducts performance analysis and applies 'keyword co-occurrence analysis' and 'thematic-evolution analysis' to map the domain's intellectual and conceptual structure. The study utilizes the Bibliometrix package in Studio and Biblioshiny (Aria & Cuccurullo, 2017) for these analyses. Furthermore, VOSviewer (Van Eck & Waltman, 2010) has been employed to create visualization networks. The software tools used in this study are well-acknowledged and often utilized by scholars performing bibliometric analyses.

Process of Data Extraction Pertaining to Industrialization Research

For extracting data for bibliometric analysis on industrialization research, the following search queries were entered in the Scopus database: TITLE-ABS-KEY ('economic reforms' OR 'industrial policy' OR 'industrial sector'). This search yielded 50,447 publications and 1,377 documents, including 1,365 research papers and 12 conference papers were finalized for analysis. The selection procedure, including the inclusion and exclusion criteria for research studies, has been depicted in Figure 1. The publication outcomes were exported in text format, including detailed citation information, bibliographic details, abstracts and keywords, to facilitate further analysis.

Results and Discussion

General Information of the Corpus of Industrialization Research (2000–2025)

The summary statistics of the bibliometric metadata of 1,377 documents, including articles (n = 1,365) and conference papers (n = 12) published between 2000 and 2025, are presented in Table 1. These articles were sourced from 520 different sources, with 1,365 articles produced by these sources, with an average citation count of 37.12. The collaboration of researchers in the industrialization domain was demonstrated by the utilization of 43,935 references and 2,243 keywords across publications produced by 2,079 authors. There were 2,079 authors producing research outcomes; of these, there were 121 single authors, and the number of co-authors per document was 2.96.

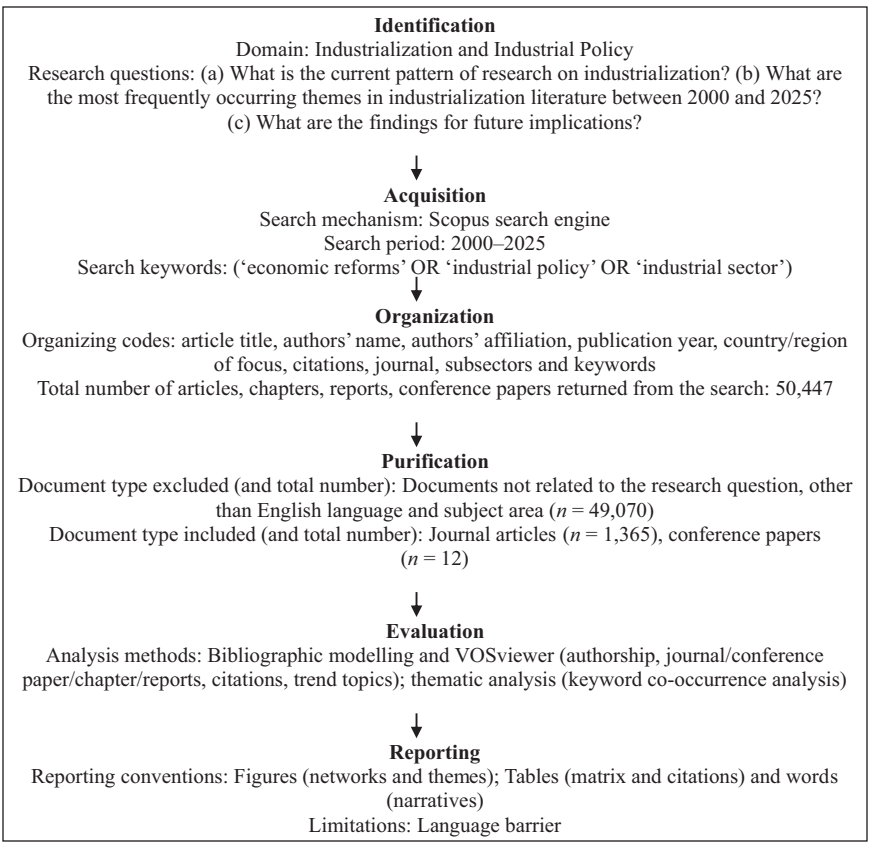

Table 1. Characteristics of the Corpus of Industrialization Research (2000–2025).

Timespan	2000–2025
Total published documents	50,447
Sources	365
Documents finalized for analysis	1,377
Research papers/articles	1,365
Conference papers	12
Average citations per document	37.12
References	43,935
Authors' keywords	2,243
Authors	2,079
Single-authored documents' authors	121
Co-author per doc	2.96

Source: Generated by the authors using the Scopus database.

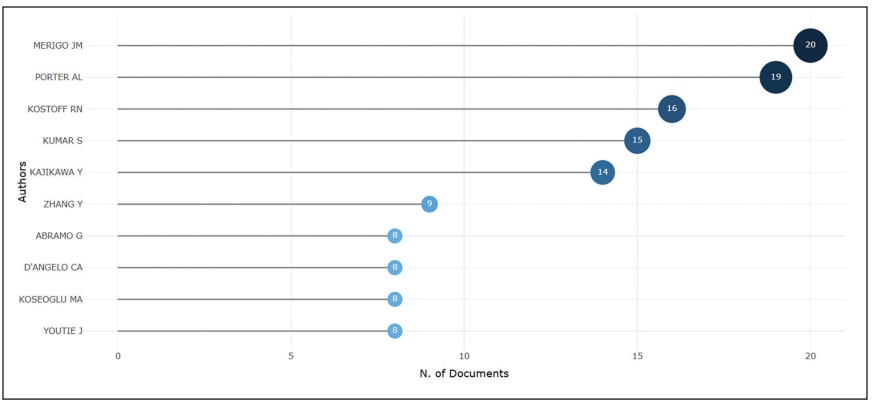

Figure 1. Prolific Authors in Research on Industrialization (2000–2025).

Source: Generated by the authors using the Scopus database.

Prominent Authors in Research on Industrialization and Their Impact (2000–2025)

Figure 1 represents the information of authors working on industrialization research during 2000–2025. The fractionalized articles column provides a more accurate measure of each author's individual impact by accounting for shared authorship. Merigo JM stood out as the top contributor with 20 articles and a fractionalized article count of 5.42, indicating a strong presence even when co-authorship was considered. Merigo JM was followed by Porter AL with 19 articles (fractionalized count 5.84) and Kostoff RN with 16 articles, who actually had the highest fractionalized score of 7.77, meaning he often contributed more substantially to each article he co-authored. Kumar S, Kajikawa Y and Zhang Y, among others, were other notable contributors. Overall, Table 2 and its accompanying explanation establish Merigo JM, Porter AL, Kostoff RN, Kumar S and Kajikawa Y as the top five prominent authors in industrialization research.

Relevant Sources for Industrialization Research (2000–2025)

The leading journals contributing to industrialization research, ranked by articles, are presented in Table 3 and Figure 2. The most productive journals in the domain of industrialization research were *Technological Forecasting and Social Change* ($n = 97$), followed by *Research Policy* ($n = 83$), *Technology Analysis and Strategic Management* ($n = 31$), *Journal of Business Research* ($n = 28$), *Science and Public Policy* ($n = 25$) and *Technovation* ($n = 19$).

This table presents the top 10 journals that have published the highest number of research articles on the topics of and related to industrialization. It includes five key columns: the journal name (Sources), the number of articles published (Articles), articles fractionalized, the journal's quality rating as per the Australian Business Deans Council (ABDC) and the SC Imago Journal Rank (SJR), which

Table 2. Prominent Authors in Industrialization Research (2000–2025).

Authors	Articles	Articles Fractionalized
Merigo JM	20	5.42
Porter AL	19	5.84
Kostoff RN	16	7.77
Kumar S	15	4.28
Kajikawa Y	14	4.62
Zhang Y	9	2.05
Abramo G	8	2.58
D'Angelo CA	8	2.58
Koseoglu MA	8	3.07
Youtie J	8	2.48
Total (Top 10)	125	100.00

Source: Generated by the authors using the Scopus database.

Table 3. Most Prolific Journals in Research on Industrialization (2000–2025).

Rank	Sources	Articles	Articles Fractionalized	ABDC	SJR
1	*Technological Forecasting and Social Change*	97	29.85	A	Q1
2	*Research Policy*	83	25.54	A*	Q1
3	*Technology Analysis and Strategic Management*	31	9.54	B	Q2
4	*Journal of Business Research*	28	8.62	A	Q1
5	*Science and Public Policy*	25	7.69	C	Q2
6	*Technovation*	19	5.85	A	Q1
7	*Journal of Technology Transfer*	12	3.69	B	Q1
8	*International Journal of Contemporary Hospitality Management*	10	3.08	A	Q1
9	*International Journal of Innovation and Technology Management*	10	3.08	C	Q3
10	*R&D Management*	10	3.08	A	Q1
	Total (Top 10)	325	100.00	–	–

Source: Generated by the authors using the Scopus database.

Note: ABDC: Australian Business Deans Council; SJR 203: SC Imago Journal Rank.

shows the journal's scientific influence. The journal *Technological Forecasting and Social Change* ranked first with 97 articles (maximum fractionalized count 29.85) and held a high-quality ranking of A in ABDC and Q1 in SJR, indicating it

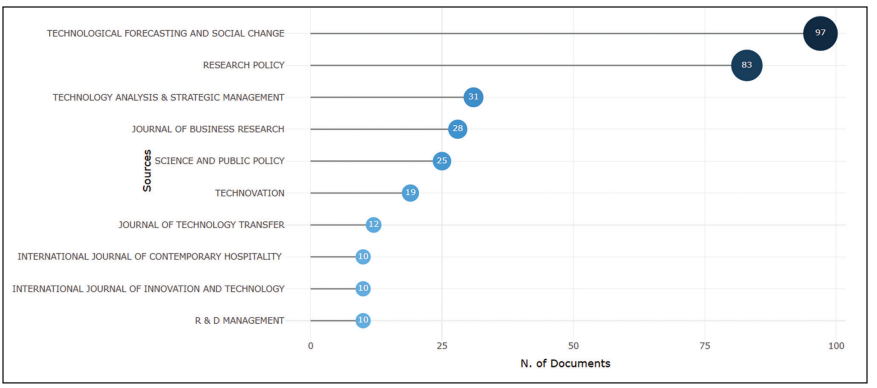

Figure 2. Most Prolific Journals in Research on Industrialization (2000–2025).

Source: Generated by the authors using the Scopus database.

was both prolific and influential in providing research output on industrialization research. *Research Policy* followed with 83 articles (fractionalized count 25.54) and had the highest ABDC rating of A*. Most of the top journals in the list have Q1 SJR rankings, showing they were among the most prestigious in their fields. While some journals like *Science and Public Policy* and *International Journal of Innovation and Technology Management* had lower ABDC ratings (C) or SJR ranks (Q2 or Q3), they still contributed significantly to industrialization research. Overall, Table 3 and its accompanying explanation establish *Technological Forecasting and Social Change* and *Research Policy* as the prominent and impactful journals contributing more than 50% of the research output of the top ten journals on industrialization research.

Most Cited Countries in Industrialization Research (2000–2025)

Table 4 presents a comparative overview of the top ten countries contributing to scholarly research based on total citations and average citations per article. In the context of the most cited countries, the United States, followed by Spain and the United Kingdom, had the highest number of scholarly publications (Table 4). The United States led industrialization research worldwide, with 8,896 total citations and an average of 60.90 citations per article, accounting for 36.7% of the total citations among the top ten countries. Spain and the United Kingdom followed, contributing 11.73% and 8.84% respectively, while maintaining strong average citation rates, indicating consistent research impact. The Netherlands stood out with one of the highest average citations per article at 68.10, despite having slightly fewer total citations than the United Kingdom and Spain. China showed a strong presence in terms of volume (1,939 citations) but had a comparatively lower average of 23.10 citations per article, suggesting high research output but moderate impact per paper. Notably, Slovenia, despite having fewer total citations, demonstrated exceptional research quality with the highest average citations per article (157.10), reflecting the influence of a smaller but highly impactful body of work.

Overall, these data in Table 4 establish the United States, Spain, the United Kingdom, the Netherlands and China as the top-five countries leading industrialization research. This finding highlights the dominance of developed nations in research visibility and impact, while also emphasizing the notable efficiency of countries like Slovenia in producing high-impact scholarly contributions (Figure 3).

Table 4. Most Cited Countries in Industrialization Research (2000–2025).

S. No.	Country	Total Citations	Average Citations per Article	Percentage of Citations in Top Ten Countries
1	USA	8,896	60.90	36.7
2	Spain	2,843	39.50	11.73
3	UK	2,143	45.60	8.84
4	Netherlands	2,110	68.10	8.71
5	China	1,939	23.10	8.00
6	Italy	1,566	32.00	6.46
7	Germany	1,449	34.50	5.98
8	Japan	1,104	46.00	4.55
9	Slovenia	1,100	157.10	4.54
10	Brazil	1,074	16.50	4.43

Source: Generated by the authors using the Scopus database.

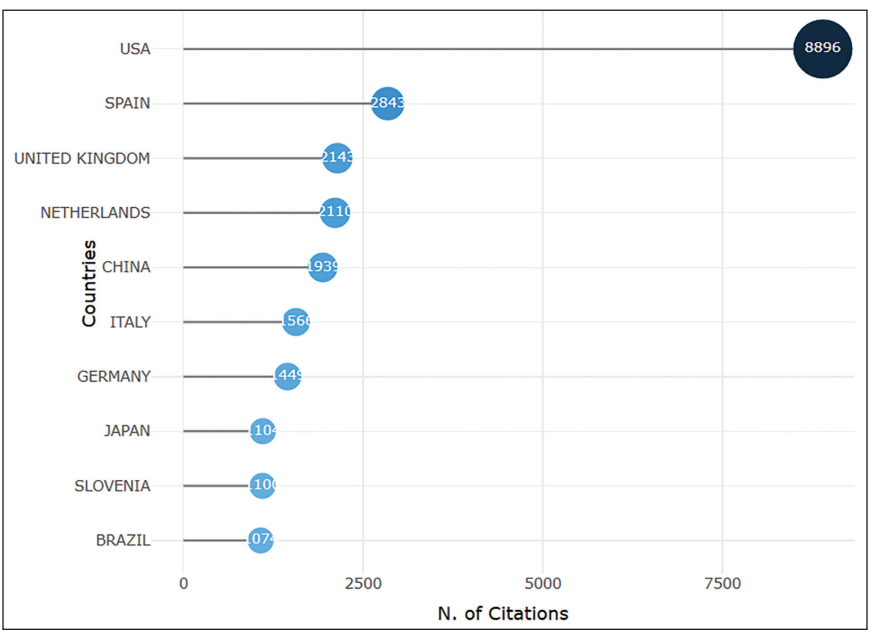

Figure 3. Most Cited Countries in Research on Industrialization (2000–2025).

Source: Generated by the authors using the Scopus database

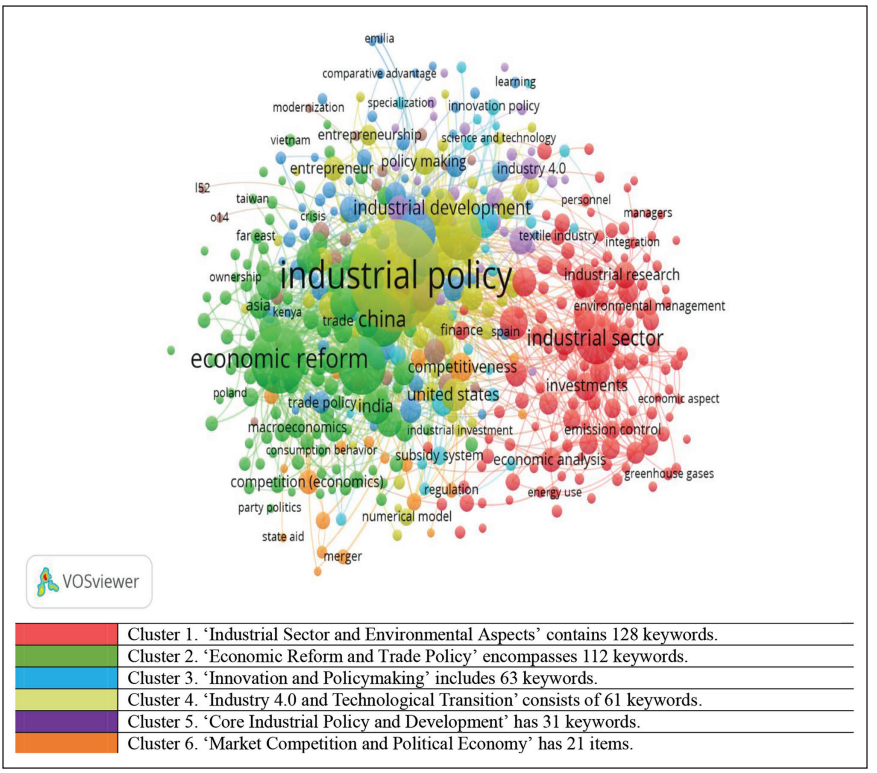

Figure 4. A Screenshot of the Bibliometric Map Created Based on Keywords Co-occurrence Analysis.

Source: VOSviewer.

Keyword Co-occurrence Analysis of Industrialization Research (2000–2025)

Under keyword co-occurrence analysis, words that share conceptual or contextual similarities are aligned and grouped into clusters, each representing a distinct thematic area of study. This process enables researchers to visualize the intellectual structure of a field, revealing how different topics are interconnected and how research focus has evolved over time. To carry out the keyword co-occurrence analysis, we set a minimum inclusion criterion of eight occurrences for each specified keyword. As a result, 167 keywords satisfied the threshold criterion from 2,243 author keywords. Figure 4 illustrates the keyword co-occurrence map. The result map delineates six groups of keywords: Cluster 1 (red) contains 128 keywords, Cluster 2 (green) encompasses 112 keywords, Cluster 3 (blue) includes 63 keywords, Cluster 4 (yellow) consists of 61 keywords, Cluster 5 (purple) has 31 keywords and Cluster 6 (orange) has 21 items. These research clusters illustrate the conceptual structure of the industrialization research domain.

Cluster 1: Industrial Sector and Environmental Aspects

This cluster represents one of the key thematic areas that have emerged from past studies in the field, focusing on the industrial sector's internal structure and its environmental implications. The presence of core keywords such as industrial sector, investments, industrial research, environmental management, emission control and greenhouse gases reflects how scholarly attention increasingly focuses on the industrial sector's internal structure and its environmental implications, representing a crucial and evolving theme in contemporary industrialization discourse. In view of escalating global climate pledges and environmental, social and governance indicators, the increased focus on energy use, resource efficiency and economic elements demonstrates a dual concern for ecological responsibility and operational productivity. This cluster also highlights the ways in which industrial systems are evolving to align with the principles of green growth, circular economy and low-carbon development. According to Dai et al. (2023) and Li et al. (2022), businesses adapt to global competition and regulatory constraints, and technological innovation is being incorporated more and more to lower emissions and provide cleaner products. These studies highlight the critical role that investments in sustainable infrastructure and green financing play important role in promoting ecologically conscious industrialization and generating long-term economic and ecological benefits.

Furthermore, environmental issues are now being incorporated into broader policy frameworks, which can be seen in the form of the strong links between this cluster and the core industrial policy cluster (yellow). Industrial strategies now seek to secure long-term ecological viability rather than just expansion and productivity. The links with the economic reform cluster (green) further underscore the necessity of regulatory instruments, fiscal incentives and institutional changes in minimizing the negative externalities of industrial development. Given all things considered, this cluster signifies a move towards sustainable industrial transformation, where social responsibility, environmental preservation and economic goals are pursued together.

Cluster 2: Economic Reform and Trade Policy

This cluster represents the macroeconomic and structural underpinnings of industrialization processes, emphasizing how national-level reforms and trade strategies have shaped the trajectory of industrial development. Core keywords such as economic reform, trade policy, macroeconomics, China, India, Asia and ownership indicate a strong research focus on the transformative impact of liberalization, privatization and globalization, especially in the context of emerging economies. These reforms have redefined the role of the state in the economy, with greater emphasis on market mechanisms, foreign direct investment (FDI) and global value chain integration. The inclusion of regional references such as China, India and the Far East reflects how reform-driven industrialization models have differed across national contexts, influenced by local institutional structures and political economies. In particular, China's strategic use of export-oriented industrialization, combined with controlled market reforms and India's gradual liberalization post-1991, provides contrasting yet instructive pathways of

reform-led industrial growth. Similarly, Soong et al. (2025) highlighted that the prominence of keywords such as economic reform and trade policy reflects growing attention to the restructuring and expansion of trade policy reform agendas. Their comprehensive bibliometric analysis of research on the Association of South East Asian Nations (ASEAN) and the Regional Comprehensive Economic Partnership (RCEP) further uncovered emerging trends and key areas of focus in regional economic integration and policy development.

Furthermore, associations with terms like crisis suggest that economic reforms are both proactive tools for development and responses to economic shocks that push nations to reassess their industrial policies, such as global recessions, trade disruptions or financial crises. This cluster's strong ties to the industrial policy core (yellow cluster) demonstrate how strategic government interventions, such as targeted investments, industrial zoning and subsidies, are frequently woven into macroeconomic reforms in order to guide industrial competitiveness. This cluster is also closely linked to the competition and political economy cluster (orange), pointing to how reforms influence market structure, regulatory frameworks and institutional competitiveness. Debates around state aid, antitrust policy and regulatory governance often arise in tandem with liberalization policies, underscoring the political dimensions of economic restructuring. Overall, this cluster captures the systemic transitions and policy realignments that underpin industrial growth in both developed and developing economies, situating trade and reform as key levers in the global industrial order.

Cluster 3: Innovation and Policymaking

This cluster centres on the design and evolution of innovation-oriented policy frameworks, capturing the growing recognition that knowledge, technology and entrepreneurship are the critical drivers of modern industrial growth. A thematic focus on the institutional and cognitive aspects of industrial change is illustrated by key terms like learning, science and technology, entrepreneurship, innovation policy, policymaking and entrepreneurship. In contrast to traditional industrial policy, which usually emphasizes physical capital and infrastructure, this cluster indicates a shift towards intangible assets like human capital, research capacity and technology readiness. The strong correlation between learning and entrepreneurship highlights how crucial individual agency, adaptive governance and institutional learning are to the development of innovation ecosystems. To foster an innovative culture, policymaking involves not just adopting legislation but also industry co-creation, feedback-driven experimentation and capacity building. These developments have also been described by De Carvalho Pedro et al. (2021). This study emphasized that start-ups, SMEs, incubators and technology transfer all work together to promote bottom-up industrial dynamism. Their research highlighted the complex interrelationship between innovation and public policies, emphasizing the vital roles that entrepreneurship, state participation and the growth of innovation ecosystems play in promoting inclusive and sustainable innovation.

This cluster forms key linkages with the industrial development theme (yellow cluster), indicating that innovation policy is now viewed as a crucial component

of national policies for boosting competitiveness and accomplishing sustained industrial upgrading. Additionally, it is intimately related to the themes of Industry 4.0 and technical advancement (purple cluster), showing how advanced manufacturing, automation and digital transformation are being incorporated into policy agendas. The increasing complexity of industrial systems and the demand for multi-level governance strategies that balance societal, technological and economic objectives are reflected in the synergy among these clusters.

Importantly, this cluster serves as a conceptual and structural bridge between traditional state-led industrial policy and emerging innovation-led development models. It captures the transition from static, sector-specific interventions to dynamic, system-level policies that promote resilience, agility and knowledge diffusion. The cluster's orientation implies that policy design must be anticipatory, grounded in foresight and informed by ongoing scientific and technological change. This aligns with global trends that emphasize mission-oriented innovation, inclusive growth and the pursuit of long-term competitiveness through innovation-led strategies.

Cluster 4: Industry 4.0 and Technological Transition

Despite being smaller, this cluster represents a rapidly growing and strategically significant theme in industrial research: the digital transformation of manufacturing and production systems, often conceptualized under the umbrella of Industry 4.0. Key terms such as Industry 4.0, innovation policy and science and technology signal the profound shifts being driven by the integration of advanced digital technologies including artificial intelligence (AI), robotics, IoT, cyber-physical systems and big data analytics into industrial operations. The focus of this cluster is the shift from conventional, labour-intensive manufacturing models to intelligent, automated and data-driven systems that promise an increase in supply chain integration, productivity, customization and responsiveness.

The spread of these technologies is not just a technical issue; rather, it requires necessary enabling factors such as supportive legislative and administrative frameworks, a trained workforce and digital infrastructure. The findings of Calabrese et al. (2025) also contend that coordinated innovation policies are crucial in enabling SMEs to adopt Industry 4.0 technologies and thereby accelerate industrial upgrading and sustainable growth. These findings are consistent with this cluster's relationship to the innovation and policymaking cluster (blue), which emphasizes the need for enabling conditions like digital infrastructure, a trained workforce and a supportive regulatory and policy environment. This relationship between innovation policy and policymaking highlights the increasing demand for progressive governance frameworks that can anticipate and control technological disruption, encourage the use of technology by SMEs and close digital disparities across industries and regions.

This cluster's connections with the industrial and environmental sector cluster (red) suggest that Industry 4.0 technologies function both as instruments for environmental sustainability and as enablers of economic growth. Industry 4.0 technologies serve as instruments for environmental sustainability and economic enablers. The circular economy and more environmentally friendly production

techniques can be facilitated by real-time monitoring and smart manufacturing, which can significantly reduce greenhouse gas emissions, waste creation and resource consumption. According to empirical data, integrating intelligent manufacturing systems with industrial robots significantly lowers energy consumption and carbon emissions (Lv et al., 2022). The establishment of industrial sharing economy frameworks in smart manufacturing has also been demonstrated to help achieve SDGs by removing major obstacles to resource efficiency (Govindan et al., 2020). These results collectively position Industry 4.0 as a key force behind the next phase of sustainable industrial development, at the intersection of technology modernization and environmental responsibility.

Overall, this cluster encapsulates Industry 4.0's transformative potential as a complete paradigm shift in the way industries are organized, managed and linked to larger economic and environmental systems, rather than just as a collection of technology. The expanding topic of digital transformation in industry is encapsulated by this cluster, which is centred on concepts like Industry 4.0, innovation policy and science and technology. It illustrates how technological advancements are altering traditional industrial paradigms by emphasizing the application of AI, automation and smart manufacturing systems. The significant overlap with the innovation policy and policymaking cluster (blue) reflects the need for regulatory frameworks that facilitate digital industrialization. Industry 4.0 is also being examined as a potential enabler of resource-efficient and sustainable manufacturing, as indicated by its connections to the industrial and environmental sector cluster (red).

Cluster 5: Core Industrial Policy and Development

Positioned at the heart of the co-occurrence map, this cluster emerges as the largest and most densely connected group, reflecting a major thematic focus identified through the analysis. This cluster represents the intellectual and strategic core of industrialization research, dominated by foundational terms such as industrial policy, industrial development, competitiveness, subsidy system and regulation. Furthermore, this cluster encapsulates the broad institutional, economic and governance dimensions of how states guide and structure industrial growth. It reflects the enduring relevance of strategic state intervention, even in an increasingly globalized and innovation-driven industrial landscape. The presence of China as a prominent keyword underscores the country's pivotal role in shaping the global discourse on industrial policy. China's success in leveraging targeted subsidies, state-owned enterprises, strategic planning and technology upgrading policies serves as a widely studied model for developmental industrial strategy, influencing both academic inquiry and policy emulation in other emerging economies.

This cluster forms conceptual and empirical linkages with nearly every other thematic cluster, highlighting the centrality of industrial policy as the organizing framework for multiple dimensions of industrial transformation. It connects with the economic reform and trade cluster (green) through themes like financial restructuring, export orientation, FDI policy and liberalization strategies, demonstrating how industrial policy often evolves in tandem with broader macroeconomic shifts. Its ties to the environmental and industrial sector cluster (red), which

illustrates the integration of sustainability goals into industrial planning, such as green subsidies, emissions standards and eco-industrial parks, reflecting the rise of eco-industrial policy as a subdomain. Linkages with the innovation and policy-making cluster (blue) underscore how contemporary industrial strategies are increasingly innovation-led, embedding R&D incentives, human capital development and institutional learning within policy frameworks.

Additionally, its connections to the Industry 4.0 and technological transition cluster (purple) indicate that digitalization and advanced manufacturing technologies are now central to industrial policy agendas, influencing national priorities on infrastructure, upskilling and digital sovereignty. This cluster also reflects the dynamic and multi-level nature of industrial policy—encompassing not just national governments but also regional authorities, international institutions and private sector partnerships. Ferraz et al. (2021) and Nugroho et al. (2025) likewise provide empirical evidence showing that the incorporation of terms such as subsidy systems and regulatory frameworks reflects the wide array of policy instruments available to governments. These range from fiscal incentives and public procurement to standards-setting and industrial zoning. Such mechanisms are employed not only to address market failures but also to actively shape markets, nurture strategic sectors and advance broader national development objectives. The cluster represents a paradigm transition from passive to proactive industrial strategy, which is significant. In the face of market liberalism and globalization, industrial policy is experiencing a renaissance, this time framed in terms of technological leadership, inclusive growth, resilience and strategic autonomy. Its central location in the network affirms its role as the anchor theme that not only integrates but also influences the trajectory of other research themes in the industrialization discourse.

Cluster 6: Market Competition and Political Economy

This smaller yet analytically vital cluster delves into the structural and political dimensions of market competition, capturing how political institutions, ideological orientations and regulatory interventions shape industrial outcomes. Centred around keywords such as competition (economics), party politics, merger and state aid, this cluster situates industrialization within the broader framework of political economy, where state interests, power dynamics and market logics intersect. Consequently, this cluster illustrates that industrial governance is not a neutral or purely economic process but one deeply embedded in political objectives and power structures. Furthermore, its connection with the green economic reform cluster indicates that policy transformations like deregulation, privatization and liberalization evolve in complex, non-linear ways, shaped as much by political agendas as by economic imperatives. In this regard, empirical evidence from the Indian pharmaceutical sector shows that mergers and acquisitions significantly enhanced firms' export competitiveness, altering market behaviour and concentration patterns (Mishra & Jaiswal, 2017). Similarly, data from the Indian banking industry show that bank mergers can increase concentration and decrease market competitiveness, highlighting the necessity for regulatory agencies to keep an eye on and balance the effects of these consolidations (Arizo & Khan, 2024). These

results demonstrate that rigorous regulatory examination is essential in sectors where strategic consolidation or global competition may occur. Keywords such as party politics and state assistance reveal how political incentives and ideological orientations shape decisions regarding industrial support, subsidy allocation and the enforcement of competition regulations—thereby underscoring the politicized nature of industrial policy. The inclusion of terms like state assistance and protectionist measures points to the often-contentious debates surrounding political negotiations among corporate lobbies, civil society and state actors. This cluster, therefore, highlights that industrial governance is far from neutral, as political objectives frequently override purely economic considerations. Moreover, its connection with the green economic reform cluster indicates that policy transitions such as deregulation, privatization and liberalization tend to follow complex, non-linear trajectories influenced by political dynamics rather than purely technocratic motives. They have a strong hold on political conversations and frequently start discussions about institutional legitimacy, market justice and inequality. These links imply that market restructuring, which is influenced by shifting alliances, regulatory philosophies and vested interests, is as much a political as an economic process.

Furthermore, the links with the core industrial policy cluster (yellow) show how national decisions on strategic sector selection, investment priority and regulatory design are influenced by competitive dynamics that feed into broader policy frameworks. For instance, choices about granting state subsidies or permitting a merger are strongly related to more general issues of technological independence, economic sovereignty and industrial competitiveness. Therefore, this cluster is essential to comprehending the governance architecture and institutional environment of industrial development. It highlights the ways in which politics, power and policy interact to affect how industrial markets operate. The subjects included in this cluster are becoming more and more pertinent for both academics and policymakers in an era characterized by geopolitical competitiveness, reshoring trends and resurgent state activism. Ultimately, it serves as a reminder that industrial development is a highly institutionalized and political process, in addition to being an economic one.

Based on the above discussion on six clusters and their interconnections, it is concluded that the industrial policy cluster (yellow cluster), which serves as a conceptual anchor, is at the centre of this interconnected thematic network. From this hub, the innovation-policy cluster (blue) provides strategic and intellectual inputs, the economic reform cluster (green) provides macroeconomic foundations, the technology cluster (purple) symbolizes future directions through Industry 4.0, while the environmental cluster (red) addresses sustainability issues. Additionally, regulatory and ideological factors are explained by the political economy cluster (orange). In a nutshell, the combined perspective emerging from the six clusters of industrialization literature offers a comprehensive understanding of industrialization as a historical process as well as a contemporary development approach influenced by economics, technology, politics and the environment, assigning centrality to industrial policy.

This visualization, which shows the relationships between frequently used keywords in the literature, was made using VOSviewer. While larger nodes imply higher keyword usage frequency, wider connecting lines suggest stronger co-occurrence relationships between phrases. Different colours are used to represent clusters of related themes: The green cluster represents economic reform and trade policy, the red cluster represents the industrial sector and research/investment, the blue/purple clusters represent entrepreneurship, innovation policy and industry, and the yellow cluster represents industrial policy and development. 4.0. This figure illustrates the main themes and relationships within the discipline, demonstrating how discussions on industrial policy touch on issues such as technical innovation, competitiveness, economic changes and environmental concerns.

Most Trending Topics in Industrialization Research (2000–2025)

A thorough summary of the historical development of study topics in the field of industrialization can be found in the trend topics figure produced by Biblioshiny. Figure 5, which shows keywords across a timeline from 2000 to 2025, illustrates the dynamic changes in academic focus on industrialization research. Blue bubbles represent the years of peak usage and relative frequency, while horizontal blue lines on the X-axis show the length of time each phrase has been used in the literature. Each term on the Y-axis is mapped against its period of relevance on the X-axis.

The chart illustrates a number of significant trends in the development of research priorities. In recent years, particularly after 2015, there has been a noticeable surge in interest around themes such as sustainability, entrepreneurship, management, innovation, technology and science. Numerous studies have been conducted on the theme of environmental effects of industrialization and adoption of technology in the industrial sector (Jee & Srivastav, 2024). These topics reflect

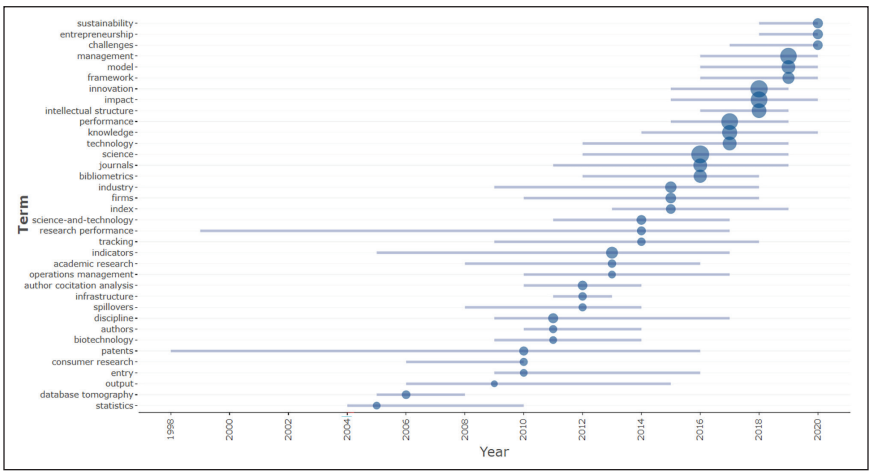

Figure 5. Most Trending Topics in Research on Industrialization.

Source: Generated by the authors using the Scopus database.

a growing academic concern with sustainable industrial growth, innovation-driven policy and the role of knowledge and scientific advancement in industrial development. This indicates a paradigm shift towards science-based, sustainable and technologically enabled models of industrialization, an orientation aligned with contemporary concerns such as Industry 4.0 and climate-conscious economic planning. Meanwhile, topics such as bibliometrics, industry, index and research performance show a long-standing and consistent presence in the literature, underscoring a persistent scholarly interest in assessing industrial productivity and evaluating the impact of industrial policies. Furthermore, earlier research from the 2000s placed greater emphasis on classical industrial themes, such as infrastructure, spillovers, firms, output, operations management and entry barriers, revealing a more traditional focus on industrial growth, firm-level behaviour and physical capital formation during that period.

Overall, this trend analysis underscores a significant transformation in the thematic orientation of industrialization research from foundational economic and infrastructure-related concerns to a modern, innovation-led and sustainability-driven agenda. Such insights are vital for identifying emerging research frontiers and guiding future investigations within the field of industrial policy and development.

Directions for Future Research

This study proposes that future research on industrial trends could place greater emphasis on exploring policy effectiveness across different economies to understand how industries adapt and sustain resilience during economic shocks and crises. It is important to examine how the ongoing digital revolution and the emergence of green start-ups are transforming entrepreneurship, particularly in the context of small and medium enterprises (SMEs). Additionally, studies could focus on assessing the lifecycle sustainability of new materials, integrating green finance and promoting competitiveness driven by environmental sustainability goals to support a circular economy. Another critical direction is investigating the role of AI integration, innovation ecosystems and technological transitions in traditional industries, as well as understanding how innovation diffuses into SMEs and rural economies. Finally, future work could expand the geographic scope of industrial research by conducting comparative cross-country studies and including underrepresented regions such as Africa and Southeast Asia to provide broader and more inclusive insights.

Conclusion

This study conducts a bibliometric analysis of scholarly literature on industrialization and maps the conceptual structure of industrialization research on the basis of 1,377 scholarly documents sourced from the Scopus database. The findings of bibliometric analysis reveal a sharp increase in scholarly contributions on industrialization over the past two decades, with the United States and Spain

leading in terms of both volume and impact. The United States dominates with nearly 9,000 citations, accounting for more than a third of all citations among the top ten contributing countries. Overall, the geographic distribution of contributions not only highlights the dominance of advanced economies but also signals a growing role for emerging economies like China and India in shaping the future contours of industrialization discourse. At the level of authorship, prominent scholars such as Merigo JM, Porter AL and Kostoff RN emerge as central figures, collectively shaping a large portion of the field. The mapping of sources further demonstrates that the field is anchored in high-quality journals at the intersection of technology, management and policy. Journals such as *Technological Forecasting and Social Change* and *Research Policy* not only provide the most frequent publication outlets but also maintain high academic prestige, indicating that industrialization research is increasingly situated within forward-looking, interdisciplinary conversations. Keyword co-occurrence analysis has provided the richest insights by distilling the field into six interconnected thematic clusters. In summary, this bibliometric exploration concludes that the conceptual structure of industrialization research has expanded from mechanization-focused studies to a wide-ranging discourse emphasizing sustainability, digital transformation and strategic policymaking. In a nutshell, this study highlights the prolific authors, influential journals and dominant countries in shaping this trajectory of industrialization research and outlines six thematic clusters that collectively define the conceptual landscape of the field. The results point towards a future where industrialization research and practice will be inseparably tied to questions of green growth, innovation ecosystems and equitable global integration.

This study clusters industrialization research into six main clusters spanning from sustainability, innovation, Industry 4.0, industrial policy and economic reforms, which has significant academic value. This research provides useful inputs for academia for incorporating in the curriculum of industrial economics and its allied subjects. In this way, the work motivates academicians to expand on conceptual understanding of industrial policies further, leading to high-impact publications. Thus, this research can pave the path for further theoretical advancements in industrialization by moving the scholarly discourse from mechanization to innovation-led, sustainability-driven and policy-integrated industrial policies. It also guides entrepreneurs to develop a combined perspective on industrialization, identifying the role of AI, sustainable technologies, innovations, environmental sustainability and governance systems. The policymakers can draw useful directions from this research to articulate holistic industrial policies to provide effective state support to the industrialization process in the economy. This study emphasizes that future research must focus on critically evaluating policy outcomes, managing technological transitions and advancing sustainability strategies to build resilient, innovative and sustainable industrial ecosystems across different economies.

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Article

The Interplay Between Digital Transformation and Corporate Governance Practices: A Systematic Literature Review

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Abstract

Corporate governance has undergone a significant transformation with the advent of digital transformation. However, existing literature on this relationship remains conceptually dispersed and lacks coherence. To address this gap, the present study seeks to assess the interplay between digital transformation and corporate governance by systematically analyzing and summarizing 40 research articles extracted from the Scopus and Web of Science databases. The review follows PRISMA methodology using predefined keywords, inclusion–exclusion criteria, and a transparent multiple screening procedure to provide a systematic and well-organized review of the existing literature. The research findings highlight that digital transformation may enhance decision-making, encourage innovations, and foster sustainability. Nevertheless, it calls attention to a strong regulatory structure to mitigate the associated risk of digital transformation implementation. Additionally, the study reinforces the argument that the corporate governance framework must evolve to account for the transformative impact of digital technologies. The present review extends prior academic understanding of digital transformation and corporate governance and proposes domains for future studies. Further, this comprehensive review offers meaningful insights to boards, policymakers, and regulators on the relationship between digital transformation and facets of corporate governance.

Keywords

Digital transformation, corporate governance, strategic decision-making, boardroom decision

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Introduction

Corporate governance (CG) focuses on enhancing firm's value through a structured framework and a strong monitoring system (Cuervo, 2002). It is critical to achieve sustainable business growth and stakeholder confidence. CG mechanisms strengthen decision-making, enhance transparency and accountability, and mitigate agency costs (Almubarak & Aljughaiman, 2024). As outlined in the Cadbury Report (1992), CG provides a mechanism for directing and controlling companies. The board of directors (BODs) is responsible for monitoring the governance in companies, while the shareholders hold the authority to appoint directors and auditors, and ensure that an effective governance framework is established. The corporate board is the key CG mechanism. It contributes more expertise and wisdom to the enterprise, enabling uncertainty management and resource accessibility (Hillman et al., 2009). However, the evolution of digital tools has redefined conventional CG practices, entailing funding for financial innovations, reforming governance structures, and reshaping boardroom strategies.

Digitalization replaced the short-term focus of business with long-term sustainable growth. Technology offers a more advanced accountability system for ensuring a transparent, accurate, and real-time flow of information to stakeholders (Varoglu et al., 2021). Investing more in digital transformation (DT) will enhance data storage and make data sharing easier, which will further boost business communication and information. This reduces information asymmetry by dismantling the earlier "information silos" and speeding up internal information flow within the companies (Li et al., 2024). Data-driven insights help boards of directors and CEOs in strategic decision-making. Technology-enabled tools, including artificial intelligence (AI), big data, cloud computing, and blockchain, facilitate continuous monitoring, fraud detection, and compliance management. Yet, technology also brings risks of cybersecurity, moral dilemmas, and legal challenges. Organizations are required to create a strong digital governance structure to maintain a balance between innovation and responsible monitoring.

Digital technologies enable the improvement of CG mechanisms and monitoring practices through strengthening decision-making, implementing IT governance frameworks, and fostering sustainable strategies. Although the research on this relationship has expanded in recent years, the evidence remains fragmented over several theoretical and empirical strands. Hence, a comprehensive review is necessary to embrace diverse insights and broaden knowledge in this emerging discipline. This study seeks to comprehend the understanding of the relationship between DT and corporate governance mechanisms by synthesizing existing evidence and outlining how DT influences key CG dimensions. Accordingly, this study addresses the following research question: How are DT and CG practices interconnected? This systematic literature review adheres to the PRISMA methodology for identifying, screening, and analyzing research articles. The findings will provide valuable insights to researchers, policymakers, and business executives.

Literature Review

The relationship between DT and CG has garnered considerable scholarly attention. Literature reflects how technologically driven improvements disrupt not only business operations but also organizational oversight and compliance systems. Additionally, effective governance mechanisms enable organizations to leverage digital tools for a strategic edge.

Corporate Digital Transformation

DT raised total factor productivity and reinforced governance mechanisms, including internal control and technical cooperation, serving as mediators between DT and productivity. This beneficial effect has been more apparent in non-high-tech corporations, where digitalization significantly strengthens governance and operations, notably when there is diversified executive education and stronger environmental, social, and governance (ESG) performance (Li et al., 2022, 2024).

To optimally leverage DT, firms must establish and evolve dynamic capabilities. Wang et al. (2024) demonstrated that DT augmented green innovation varied across stages, with adaptive and innovative capabilities and leadership commitment fostering outcomes. Yu et al. (2022) revealed that the interaction of strategic focus and operational performance has been mediated by the corporation's DT capabilities, which include sensing, organizing, and restructuring. DT capabilities have been crucial for innovation and a competitive edge.

Corporate Governance Practices

Resilient governance practices have been playing a crucial role in guiding performance trajectories. Ria (2023) and Danilov (2024) uncovered that CG has been the primary and immediate driver of performance. The independent board, the size of the board, the effectiveness of the audit committee, and higher board activity exerted a substantial and favorable influence on organizational performance and capital structure. However, gender diversity has yielded mixed outcomes. Additionally, Guluma (2021) demonstrated that performance is enhanced by both internal and external CG approaches, such as the degree of product market competition and concentration of ownership.

Danilov (2024) and Guluma (2021) highlighted that profitability has been adversely affected by CG flaws such as CEO duality and overly large boards, underscoring the vitality of well-organized CG mechanisms for facilitating robust monitoring and elevated corporate results.

Broadly, DT and CG have been reinforcing firm-level outcomes.

Interplay of Digital Transformation and Corporate Governance

DT has been redesigning CG through restructuring board roles, competencies, and organizational structure. According to Oliveira et al. (2022), DT has notably influenced board strategic plans, oversight, information-gathering process, and

sustainability goals, which have strengthened board capabilities concerning the resource-dependence view. Companies in France, Spain, and Italy have been revamping their governance models by establishing new committees, responsibilities, and reporting practices that have been emphasized on sustainability and digitalization (Capurro et al., 2023).

The successful implementation of DT has required contemporary CG, including a board with high digital proficiency and proactive technological governance. Enterprises with a digitally competent board have realized significantly superior market performance (Ekaterina, 2025).

In aggregate, companies have been adopting digitally focused governance approaches; however, the efficacy of these transformations varies owing to the absence of standardized frameworks and well-defined digital competencies. In parallel, a well-established CG could speed up structured and value-creating DT.

Despite expanding academic interest in DT and CG, the literature on the relationship between DT and CG has remained dispersed, providing scarce insights into how CG facilitates technology adoption or how DT reshapes governance mechanisms. Consequently, there is a need for a comprehensive study that provides an integrated view of the DT–CG relationship.

Methodology

Searching Articles and Selecting Databases

To ensure an extensive overview, the study conducted a systematic literature review. The literature on DT and CG has been found using the Scopus and Web of Science databases. Table 1 represents the search query executed in the databases. This search consists of articles published from 2014 to 2025. The articles available on the databases as of September 16, 2025, were taken into consideration. A 10-year span from 2014 to 2025 was selected to emphasize contemporary research assessing the interplay of DT and CG, taking into account current practices, trends, and empirical insights into their dynamic interrelationship. The initial search yielded a total of 444 articles.

Selecting Criteria

The identified papers were confined to certain inclusion–exclusion criteria to ensure relevance and rigor. First, database filters were applied to include only English-language open-access articles published between 2014 and 2025. Additionally, the articles were limited to Business Management and Accounting; Economics, econometrics, finance, and the social science area for a credible body of evidence, reducing the initial articles to 115. Further, two duplicate articles were removed. Afterward, the title and abstract were screened to select relevant articles in the context of the DT and CG relationship. Finally, full-text reading of articles has been done to retain exclusively those studies that met the inclusion criteria, ensuring robust and insightful analysis. Finally, 40 articles were retained

Table 1. Search Query Employed for Systematic Literature Review.

Database	Search Strings	No. of Articles
Scopus	TITLE-ABS-KEY ("corporate governance" AND "strategic decision*" OR "boardroom decision*" OR "corporate strategy" OR "governance model*" OR "AI governance" OR "technology governance" OR "board of directors" OR "executive decision-making") AND ("digital transformation" OR "artificial intelligence" OR "blockchain" OR "big data" OR "automation" OR "cloud computing" OR "machine learning" OR "digitization" OR "artificial intelligence in governance")	411
Web of Science	((ALL=("corporate governance")) AND ALL = ("strategic decision*" OR "boardroom decision*" OR "corporate strategy" OR "governance model*" OR "AI governance" OR "technology governance" OR "board of directors" OR "executive decision-making")) AND ALL = ("digital transformation" OR "artificial intelligence" OR "blockchain" OR "big data" OR "automation" OR "cloud computing" OR "machine learning" OR "digitization" OR "artificial intelligence in governance")	33
Total articles		444

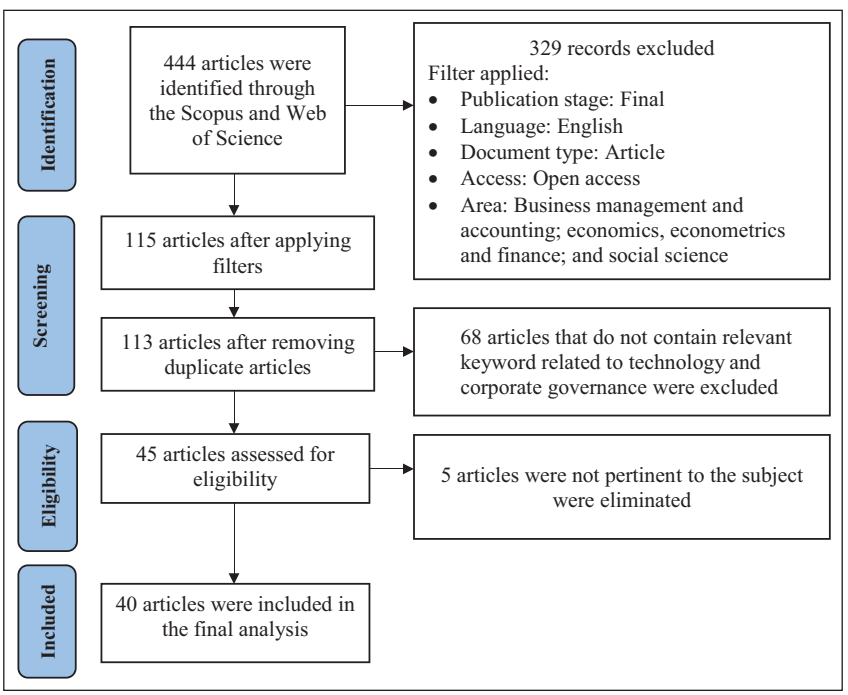

Figure 1. Phases of Systematic Review.

in the sample and systematically classified into themes. Figure 1 represents the selection criteria for the articles.

Findings and Discussions

Journal-wise publications

Table 2 represents the distribution of publications across journals, with *Sustainability* standing out with the highest number, accounting for 12 publications. Following the *Journal of Governance and Regulation* and the *Journal of Business Research,* with two publications each. The remaining journals had a count of one. This suggests that research on DT and CG is widely dispersed across different journals. The diversity of journals spanning business, management, finance, technology, and social science indicates an interdisciplinary interest in the subject.

Table 2. Journal-wise Publications.

Journal Name	No. of Publications
Administrative Sciences	1
Cambridge Journal of Regions, Economy and Society	1
Cogent Business and Management	1
Corporate Governance-An International Review	1
Corporate Governance and Sustainability Review	1
European Journal of Information Systems	1
European Business Organization Law Review	1
Global Knowledge, Memory and Communication	1
Information Technology and Tourism	1
International Food and Agribusiness Management Review	1
Journal of Applied Business Research	1
Journal of Business Research	2
Journal of Corporate Finance Research	1
Journal of Ecohumanism	1
Journal of Governance and Regulation	2
Journal of Management	1
Journal of Management and Governance	1
Journal of Manufacturing Technology Management	1
Journal of Risk and Financial Management	1
Organizacija	1
Revista de Cercetare si Interventie Sociala	1
Revista de Gestao	1
Risk Governance and Control: Financial Markets and Institutions	1
SAGE Open	1
Sustainability (Switzerland)	12
Technological Forecasting and Social Change	1
WSEAS Transactions on Business and Economics	1

Year-wise Publications

Figure 2 shows the year-wise publications, indicating a significant growth in research output over time, particularly after 2020. The count of publications remained low in the early years, with only one publication in 2014, two publications in 2015, and one publication in 2019. However, there was a sharp rise in 2020 with five publications, followed by some fluctuations in 2021 and 2022. The upward trend continued strongly in 2023 and peaked in 2024 with nine publications, followed by eight publications up to September 2025. The trend suggests growing academic interest in DT and CG.

Thematic Analysis

The study classifies the literature into the following three themes.

Digital-led Governance and Boardroom Decision-making

CG practices have been changing in exceptional ways. The utilization of big data and associated technologies have modified all facets of CG. Businesses could utilize the potent benefits of technology, which has notably improved the quantity and quality of data. This has further impacted efficient resource optimization, minimized operational costs, and raised management efficacy (Lin & Aman, 2025). The London Stock Exchange (LSE) was compelled to demutualize due to heightened competition and technological development. Aligning with agency theory, the LSE has reinforced its financial position after demutualization by reforming its board structure, minimizing the participation of exchange members, and adding more independent directors with varying corporate backgrounds. To support novel strategic objectives, the LSE has restructured its management and implemented pay-for-performance. The results demonstrated that demutualization has upgraded efficiency by integrating with governance and compensation strategies reforms (Angulo et al., 2014).

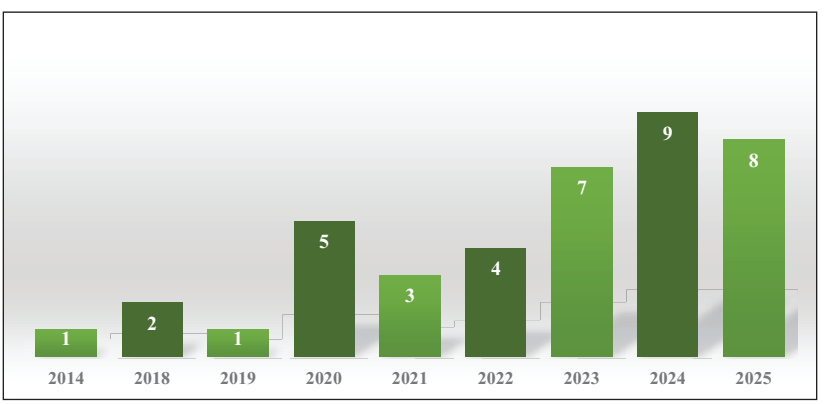

Figure 2. Year-wise Publications.

Technology-enabled management systems have resulted in intelligent decision-making, management process automation, and real-time data, strengthened core competencies, enlarged market share, and boosted customer trust (Lin & Aman, 2025). Kalkan (2024) examined how AI transforms CG, decision-making, and data transparency. The study demonstrated that AI has enhanced CG by improving decision-making efficacy, risk management, and stakeholder involvement. DT has positively impacted the implementation and efficacy of internal control. Moreover, this association has been more noticeable in corporations with comparatively strong levels of market competition (Wang et al., 2023). Accounting information system (AIS) and non-financial information have been key drivers of effective decision-making and non-financial performance. Additionally, AIS quality contributed to non-financial performance through a sequential mediation pathway involving the combined roles of non-financial information quality and decision-making (Thuy, 2025).

However, literature also disclosed that board members and management have often interpreted and employed big data analytics (BDA) in distinct ways, which could exacerbate information asymmetries and agency problems. BDA use has embodied a dichotomy, whereby managers might exploit it to bias reporting, yet board members could still leverage it for enhanced decision-making (Karamatzanis et al., 2025). Merendino et al. (2018) employed a theoretical lens of the knowledge-based view and cognitive and dynamic capabilities to evaluate the manner and extent by which big data (BD) has affected boardroom decision-making. Findings demonstrated that BODs have confronted a gap in cognitive capabilities to cope with BD and have undergone cognitive biases and overload. Additionally, they have encountered challenges to board cohesion with BD utilization, which may influence decision-making. BD has prompted the BODs to incorporate new working practices beyond conventional boundaries and to leverage third-party capabilities for BD management.

Highly effective BODs have proactively participated in sustainable strategy formation. They have been leveraging their diverse and industry-specific expertise to promote innovation and sustainable value creation (Grove et al., 2021). Diversity in board experience has a notable impact on corporate green technological innovation. The board's absorptive capacity has amplified this effect. Further, the position of directors within inter-board networks, assessed through network centrality, has enhanced the relationship between board diversity experience and innovation, as well as explicitly influenced innovation (Zhao et al., 2025). In an era of rapid technological advancement, investors in the stock market have given a premium for signals related to the CEO's commitment to technological innovations. Governance functions have mediated the relationship between the CEO's inclination toward technology and investors' assessments of enterprise worth (Filatotchev et al., 2023). Karayalcin (2025) revealed that personal competencies, academic training, and leadership approach have greater influence on innovation than do familial relationships in Turkish family businesses. Family CEOs have exhibited an emphasis on legacy integration and sustainability, while the non-family CEOs have aspired to a long-term strategic approach. However, they have been indistinguishable in their perceived outcome on innovations in products,

acknowledging the strategic value of structured innovation processes and risk-seeking propensity. Substantial family engagement has enhanced the favorable impact of family CEO on innovation. Further, female CEOs allocate more resources to innovation. Nevertheless, education has remained crucial for establishing innovation strategies.

The literature revealed that DT has influenced the BODs. The four key facets have been (a) obtaining, analyzing, and disseminating information, (b) board stewardship, (c) strategic planning goals, and (d) blue-sky strategizing (Oliveira et al., 2022). Yan and Yu (2023) investigated how board informal hierarchy influenced digitalization in Chinese corporates from 2012 to 2019, concerning relational contract theory. The study revealed that digitalization and board informal hierarchy have been positively associated. The chairman, in a superior position, has strengthened this relationship. Further, the informal hierarchy has promoted digitalization through enhanced efficacy of BODs' decisions, reduced managerial myopia, and promoted data sharing. Board size and fintech services have a significant negative relationship, while the independent BODs have enhanced performance through innovation development (Almubarak & Aljughaiman, 2024). Extended board tenure, expanded board networks, and greater gender diversity have enhanced the association between organizational slack and innovation, while larger board size and higher independent BODs have reduced it (Heubeck & Meckl, 2024). Board independence has been favorably related to corporate environmental performance. Utilization of digital technology has a favorable impact on environmental performance in companies with a significant proportion of independent directors. Increased deployment of digital technology alone has not enhanced the corporation's environmental performance (Napoli, 2023).

Mu et al. (2023) investigated the impact of technology-based firms on performance-based compensation scheme selection from the viewpoint of information asymmetry. The results discovered that performance commitments have been more likely to be achieved with equity, annual, and two-way compensation. Equity compensation and annual incentives have been substantially favorable to accomplishing the target company's performance obligations. The two-way compensation model has demonstrated a stronger incentive effect on promises. Tech-based corporations should apply equity and annual incentive methods to minimize information asymmetry problems by guaranteeing completion levels. Compensation strategies through enhanced corporate performance have influenced commitment fulfillment. The extent of this influence varied with CG practices and debt payback demands. Additionally, disclosing pay-for-performance has provided a decision-making foundation for commitment agreements.

Figueroa-Domecq et al. (2020) measured the impact of enterprise technology on women's leadership in the tourism industry and the implications of gender diversity promotion initiatives in the BODs and management teams. The results revealed that an enterprise's technological level has been positively associated with less involvement of women on the board and in management. Gender diversity initiatives promote women's representation on the board. Gender diversity requirements on the board have not been minimized, even if AI makes decisions as a board member. Gender quotas have been desired regardless of whether AI has

been hired as a director, has been expected to analyze data for decision-making, or has been exclusively utilized to choose directors. Therefore, even though AI would undoubtedly intervene in decision-making, the possibility of biased assessments from AI should not preclude debates about board gender diversity (Eroğlu & Karatepe Kaya, 2022).

IT Governance and Performance Outcomes

Information technology governance (ITG) has become more interdisciplinary, drawing on considerable contributions from other academic specializations such as engineering, computer science, and management. The most credible models reflected crucial theoretical frameworks. ITG research has principally addressed new technologies such as cloud computing and the Internet of Things (Falchi de Magalhães et al., 2021). Tambo and Filtenborg (2019) examined the implications and possibilities of a practically developed ITG framework for the field of technology administration in the IT sector. The study's findings demonstrated that the ITG framework has offered utility and greater knowledge about the service distribution structure if the value stream approach has been adopted. IT procedures have been more operational and comparable to CG and generic technology management structures.

Chauke and Ngoepe (2024) investigated how multiple ITG aspects have been integrated at the South African Professional Council to establish a framework. The findings revealed that inadequate data management has delayed decision-making, and effective risk management has depended on accountability frameworks. Although organizational knowledge management principles were established, a governance gap resulted from the lack of authorized records management policy. Despite the council following the law's reporting requirements, insufficient control caused problems with outsourced services. The study proposed that implementing a standardized IT framework has led to data integrity, simplified governance practices, and enhanced organizational efficacy. Lowry et al. (2025) disaggregated ITG into two elements encompassing ITG mechanisms and ITG principles, positing that effective ITG requires embracing principles with strong executive and board-level support. The authors highlighted that the relationship between ITG mechanisms and strategic alignment has been fully explained by Commitment to COBIT Principles (CCP). Moreover, assistance from leadership for IT has reinforced CCP and directly augmented strategic alignment.

ITG has been essential for sustainability and corporate performance, although insufficient knowledge about its structure and contributing factors. The inadequate senior management and IT leaders have created the vulnerability of ITG. The prevailing ITG models have been too basic to consider the industry, size, and maturity variations. This remains valid for SMEs whose ITG adoption and growth have been considerably less, contrasting with large-scale organizations. ITG must be modified to facilitate corporate DT (Levstek et al., 2018).

DT has profoundly impacted governance practices, especially in businesses with dual equity structures, by improving data transparency, effective decision-making, and business oversight. Digitalization has enhanced strategic cost

management, streamlined value chains, and provided access to real-time data, which has minimized operating costs and boosted financial performance (Shaohan et al., 2024). Liu and Jung (2024) utilized resource-based view theory to investigate the inherent mechanism of DT on firm performance in Korea and China, with the ESG mechanism playing a mediator. The evidence pointed out that DT has been positively associated with ESG management and firm performance in both countries. Additionally, ESG management and non-financial performance have a positive relationship in Korea and China. However, only Korea showed a positive association between ESG management and financial performance. Further, the ESG mechanism has a positive mediating impact on the association of DT and firm performance.

Capurro et al. (2023) examined the impact of integrated DT into the governance framework on enterprise communication in the Italian, French, and Spanish fashion and food industries. The results have shown favorable integration of new company positions focused on sustainability and digitalization process management. Nonetheless, these responsibilities have diverse effects on CG frameworks and various means of communication with the outside world. Another research reported that online social networking has a considerable governance impact, specifically in non-state-owned enterprises and assisted corporates in minimizing the detrimental impact of investment opportunities and media reporting on investment efficacy. Online social networks, in addition to disseminating information, have connected a broader range of stakeholders. It has successfully made up for media reports' shortcomings as a CG tool.

AI adoption has played a key role in good governance (Nasr et al., 2024). The adopted AI system has determined its legal accountability for repercussions stemming from its utilization in CG (Yang et al., 2020). The deployment of AI has a substantially favorable impact on the efficacy of CG, reinforcing risk management frameworks and strengthening stakeholder involvement. Through automated monitoring functions, AI has facilitated corporates' adherence to regulations more efficiently and mitigated human error in reporting. Notwithstanding this, corporates have faced ongoing challenges comprising algorithmic bias, concerns over data privacy, and the requirement for a regulatory framework to align with AI advancements (Shaban & Omoush, 2025). Governance, assurance, and risk management have been pivotal for shaping business strategies and investment decisions. Professionals have been encouraged to leverage emerging technologies, while organizations have been urged to foster innovation and incorporate entrepreneurial orientation in navigating the shift from the fourth to the fifth Industrial Revolution (Nene, 2024).

Risk Management and Sustainability in the Digital Era

DT has enhanced environmental performance by boosting CG practices and green innovation. This outcome has been more apparent in state-owned, large and highly polluted business entities (Xu et al., 2022). Nazzaroi et al. (2022) examined how CG and collective smart innovations contributed to wine cooperatives' environmental and sustainable transformation. The study analyzed the case of La Guardiense. The findings suggested that innovations assisted by governance

models have developed economic value. Collective smart innovations have influenced external socially driven economies, including environmental preservation and regional growth, and internal economies such as higher turnover and lower expenses.

The growth of the digital economy has enhanced corporate social responsibility (CSR) activities through boosted online media attention, strengthened agency efficiency, and enabled corporate DT. The local digital economy has influenced varying facets of CSR differently. State-owned firms, secondary industry corporations, large-scale businesses, and non-digital enterprises have encountered greater effects than others (Hu & Liu, 2023).

Ying and Jin (2024) investigated the implications of environmental management system certification (EMSC) and government environmental protection subsidies (EPSs) in market-incentive environmental regulations (ER) on green innovation (GI). Furthermore, the influence of CG and ecological disclosures on the ER–GI relationship of Chinese-listed companies from 2012 to 2021. The findings uncovered that EMSC and EPSs have favorably impacted GI. CG and environmental disclosures have a moderating effect on this relationship. GI has significantly enhanced ESG ratings, and GI combined with ESG has enhanced financial performance. ESG has a mediating impact on fostering GI and economic performance. Further, political affiliation and regional-level innovation have adversely moderated the green innovation-financial performance relationship (Zheng et al., 2022).

However, critical challenges, including algorithmic prejudice, data privacy, and regulatory concerns, need to be addressed (Kalkan, 2024). Grove et al. (2020) explored the key threats, challenges, and opportunities of AI in governance mechanisms. AI has been improving governance practices; however, significant threats include substituting AI for human activities, effective AI management, controlling human–AI relationships, and challenging digital dashboards and quantum computing.

The literature has highlighted critical threats that have impacted CG, including deep shift risk, global economic uncertainties, digital risk, data security risk, diversified consumer expectations, and reputational risk. CG has to comprehend and control these technical threats to strengthen the governance framework and successfully retain competitive advantage. Further, boards of directors need to take proactive measures to deal with technological change to gain investor trust. It has been essential to minimize interruptions from AI or variations in employee behavior for long-term success (Grove et al., 2020).

Keyword Analysis

Figure 3 represents the co-occurrence network that demonstrates three clusters created from the keywords defined by the authors. The red cluster of co-occurring keywords reflects emerging research domains encompassing DT, BODs, decision-making, and monitoring. Also, agency theory and resource dependency theory appear as keywords in this cluster. The green cluster highlights key areas explored in recent studies, including information technology, IT governance and

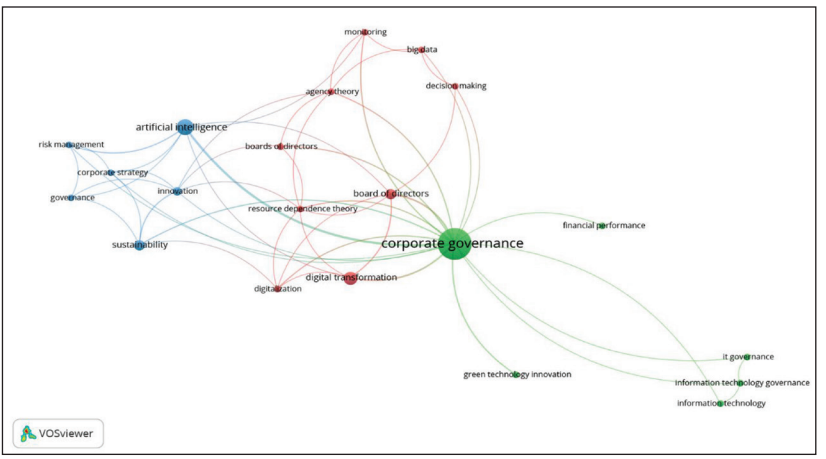

Figure 3. Co-occurrence Network of Author-defined Keywords.

Source: Authors' representation using VOSviewer.

financial performance, accounting for integration of IT governance and performance outcomes. The blue cluster, composed of AI, innovation, risk management, and sustainability keywords, reveals prominent trends in the literature.

Findings

The reviewed articles are analyzed and outlined thematically in this section, underscoring the interplay between DT and CG.

As documented by the analyzed scholarly literature, DT is a strategic asset for streamlining processes and curtailing spending. It further equips managers with efficient decision-making (Kalkan, 2024; Lin & Aman, 2025). However, this is particularly noteworthy in markets characterized by intense competition (Kalkan, 2024). Digital tools such as AIS and BD upgrade decision quality (Karamatzanis et al., 2025; Thuy, 2025). Nonetheless, optimal deployment is occasionally obstructed by board cohesiveness and limited board capabilities, aligning with the knowledge-based view and cognitive and dynamic capabilities theory (Merendino et al., 2018). A comparative analysis uncovers that experienced, competent and professionally trained boards proactively facilitate innovation; conversely, family boards or those with informal hierarchy assist DT in a less organized way (Grove et al., 2021; Karayalcin, 2025; Yan & Yu, 2023; Zhao et al., 2025). Independent BODs show enhanced environmental performance and firm outcomes through innovation (Heubeck & Meckl, 2024). There is contrasting evidence regarding gender diversity on the board. From one standpoint, lower female participation has been correlated with higher DT level, while another documented that the significance of gender diversity has been independent of AI usage (Eroğlu & Karatepe Kaya, 2022; Figueroa-Domecq et al., 2020). From an analytical

perspective, this evidence implies that the influence of DT on GC relies on the composition, structure, and capabilities of the board.

Within the IT governance and performance outcomes theme, the analyzed literature demonstrated ITG as a key pillar of good CG. ITG extends the framework, process, and expertise essential for consistent and credible service execution and operational oversight (Falchi de Magalhães et al., 2021; Tambo & Filtenborg, 2019). Literature highlights that even when organizations comply with legislative reporting requirements, insufficient internal control contributes to vulnerabilities, underscoring the critical need for standardized ITG frameworks to uphold data integrity and optimize efficiency (Chauke & Ngoepe, 2024). Additionally, analysis indicates that ITG mechanisms aligned with ITG principles, backed by top executives, elevate corporate outcomes and sustainability (Lowry et al., 2025). With the resource-based theoretical lens, research finds that DT capabilities advance ESG performance (Liu & Jung, 2024). Furthermore, AI and online social media have a positive impact on good CG (Capurro et al., 2023; Nasr et al., 2024; Shaban & Omoush, 2025).

Literature indicates that DT improves ESG practices through strengthening CG and fostering GI, notably among state-owned, large, and highly polluted enterprises (Xu et al., 2022). CG-supported innovation and digital economy elevate CSR activities, which further enhance economic value (Hu & Liu, 2023; Nazzaroi et al., 2022). Moreover, EMSC and EPSs boost GI (Ying & Jin, 2024). Nevertheless, despite the potential of AI to reinforce CG, organizations have to deal with growing digital risk. Digitalization presents cybersecurity threats, moral conundrums, and implementation difficulties (Grove et al., 2020; Kalkan, 2024). A critical cross-literature insight is that regulating technology-induced organizational risks through strong digital governance is vital for enduring sustainability benefits. Organizations must require a technology-enabled strategy balanced with human oversight and moral governance procedures.

Future Research Directions

Subsequent work could supplement the literature on DT and CG. There remains an avenue to examine board-level deployment of BDA across geographical and industrial contexts, and investigate how board members leverage these technologies (Karamatzanis et al., 2025). Another dimension requiring scholarly attention concerns whether the direct effect of the CEO's digital technology orientation and the moderating effects of board characteristics also exist in smaller and younger firms, as well as in the business units of large publicly traded corporations. Additionally, identification of broader CG characteristics that might alter the focal association between the CEO's digital technology orientation and stock market value would provide meaningful insights (Filatotchev et al., 2023).

A subsequent line of research could examine the influence of slack on output measures of innovation (e.g., patent count, new product development) and how this relationship is affected by board characteristics. Furthermore, the results are

reproducible in more stakeholder-oriented CG systems, such as the German two-tiered board, as well as between more and less dynamic industries (Heubeck & Meckl, 2024). A further area for inquiry involves how board experience diversity shapes environmental innovation, notably via knowledge dissemination and multidisciplinary collaboration. Multi-context analysis and accounting for factors including firm size, industry, and competition could enhance understanding (Zhao et al., 2025). Subsequent research ought to investigate how family ties and socioeconomic wealth drive innovation within distinct cultural and institutional systems. Long-term assessment is required to observe top management succession influence on innovation (Karayalcin, 2025).

Another crucial issue is examining how DT affects internal control systems and the resulting economic effects (Wang et al., 2023). To ensure that corporate remuneration schemes are aligned with sustainability goals, prospective studies should also look at the implications of the digital age on equity incentive schemes and M&A models (Mu et al., 2023).

Future studies on DT, CG, and ER should fill the significant gaps by extending research contexts, including longitudinal analysis, and combined financial and non-financial measures. Existing literature has focused on large and listed firms; future work should concentrate on small and medium-sized enterprises (SMEs) that confront difficulties because of their low resources and unstructured decision-making. Examining the impact of external support, including government policies and financial assistance, on SMEs' digital adoption could be insightful. Furthermore, there is a need for more research to understand the role of independent directors in decision-making, corporate performance, and board hierarchy (Yan & Yu, 2023). Additionally, cross-national comparative studies are required to assess the impact of organizational culture and economic disparities on the results of DT. Studies should also examine the time-lag effects of DT on enterprise performance and innovation (Liu & Jung, 2024).

Another key research area is the relationship between DT and ER in determining corporate sustainability and CSR. Prospective studies are recommended to investigate how ER can be applied to different nations and regulatory settings (Ying & Jin, 2024). The changing interplay between innovation, governance frameworks, and digitalization should also be the subject of future research. Extending the studies to non-listed enterprises and diverse industries will provide more generalizable conclusions (Capurro et al., 2023). Bridging these knowledge gaps will offer a foundational support for comprehending how CG mechanisms, ER, and DT collectively influence corporate outcomes.

Conclusion

This systematic literature review examined the interaction of DT and CG over the past decade (2014–2025). The analysis uncovered that DT has a significant impact on company strategies, governance frameworks, and decision-making, while a resilient governance framework fosters strategic and well-implemented DT. Technology-driven flexibility must be included in future CG mechanisms while

maintaining governance's resilience, ethics, and inclusivity. DT provides unmatched opportunities for CG efficacy, but how well enterprises handle its risks, obstacles, and ethical considerations will determine its success. Organizations may create sustainable governance frameworks that complement the changing digital economy by cultivating a digital responsible culture. This review demonstrates a thorough grasp of the existing literature on DT–CG interplay and its academic and practical significance.

Implications

There are significant ramifications for scholars, policymakers, and business executives. Employing a digital governance structure is essential for corporate leaders to preserve regulatory compliance and competitiveness. The BODs must ensure risk management and build digital capabilities.

Policymakers can outline a strategic framework and guidelines that drive transparency and board-level oversight, upholding public accountability. Also, there is a need to update governance legislation to ensure that emerging technologies adhere to legal, ethical, and ESG norms.

Researchers might further investigate effective AI-driven board decision-making, the role of technological ethics in governance, and the long-term effects of blockchain on transparency. Additionally, exploring the DT–CG relationship across multiple sectors and contexts, and using longitudinal and mixed-method designs, can generate more nuanced understandings.

Limitations

This study contributes to the understanding of DT in CG. Despite insightful findings, this study has certain limitations. It relies only on articles indexed in Scopus and Web of Science, which may introduce biases or coverage gaps. The study primarily concentrates on published articles and overlooks real-world situations and useful industry applications. Furthermore, digital technologies are developing so quickly that findings could become out of date. Inclusion of articles explicitly assessing DT–CG interaction potentially overlooked work concerning DT and CG exclusively but was relevant for comprehending the interaction. To improve the reliability of results, future research should include industry reports, expert interviews, and empirical case studies.

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Article

Exploring the Influence of Fintech on Mutual Fund Investments: A Systematic Review

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Abstract

Objectives: This study examines the influence of fintech innovations on investors' decision-making and behavior in mutual fund investments.
Methodology: The study reviews studies published between 2008 and 2024 across databases such as Scopus, Web of Science, and Google Scholar using a systematic literature review (SLR) approach.
Findings: Fintech solutions have been shown to significantly enhance investor convenience, accessibility, and engagement by lowering barriers to entry and facilitating real-time financial insights. Blockchain technology promotes trust and transaction security, while robo-advisors and artificial intelligence (AI)-based analytics offer tailored portfolio recommendations. However, even in digital environments with abundant data, behavioral biases such as herding and overconfidence still influence decision-making.
Implications: According to the research, adopting fintech into mutual fund ecosystems can boost investor confidence, encourage transparent investing practices, and improve financial inclusion. To promote sustainable fintech adoption, policymakers, and financial institutions aim to develop regulatory frameworks that ensure investor awareness, ethical AI use, and data protection.

Keywords

Fintech, Mutual Funds, Robo-Advisors, Blockchain, Big Data Analytics, Investor Behavior

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Introduction

Fintech developments have brought out a new era of communication between investors and financial markets, significantly changing the economic landscape in India. From the words "financial" and "technology," the term "fintech" refers to a range of digital tools and apps for financial services that facilitate easier, more convenient, and more decision-friendly transactions.

Fintech advances largely determine behavior, which in turn influences market dynamics. The innovation makes investments more accessible and transparent by removing obstacles, including information asymmetry, procedural complexity, and a lack of financial literacy. Furthermore, to develop individualized financial solutions, fintech platforms examine investor preferences and risk tolerance using artificial intelligence (AI) and big data analytics.

The digital revolution, driven by the convergence of financial services and rapidly advancing technologies, has had a big impact on how investors participate in mutual funds globally. Fintech technologies have changed investor behavior, increased accessibility, and improved efficiency, revolutionizing traditional investing procedures. The mutual fund sector in India exemplifies this shift, with assets under management (AUM) increasing from ₹27.05 trillion in 2019 to ₹68.08 trillion in 2024, primarily driven by systematic investment plans (SIPs) and digital adoption.

The study examines how fintech significantly shapes investor behavior in mutual funds. It investigates how technological advancements affect financial involvement, trust, and investment choices.

In the current financial landscape, it is essential to examine how fintech affects mutual fund investments as it reflects the ongoing shift in how investors access, assess, and manage financial assets in an increasingly digital market. By improving transparency, simplicity, and personalization, fintech innovations like robo-advisors, blockchain, AI-driven analytics, and mobile trading platforms have completely changed the way mutual funds are distributed. Fintech acts as a catalyst for financial inclusion, investor education, and operational efficiency in India, where mutual fund AUMs keep growing rapidly.

There are notable gaps in the current research on how fintech affects mutual fund investing. Most studies focus on financial technologies broadly rather than the specific dynamics related to mutual funds, and little research examines how investor behavior shifts with fintech adoption. Additionally, limited work has been done on how fintech interacts with traditional mutual fund distributors or influences different investor segments. These gaps emphasize the need for more comprehensive, long-term, and focused studies to understand how fintech is changing mutual fund investment methods.

Literature Review

Fintech has shifted investor preferences to direct plan investments, eschewing middlemen in favor of more efficiency and transparency. Investors make frequent,

well-informed decisions by utilizing goal-based recommendation tools, SIPs, and real-time data. Although behavioral biases still exist, trust and literacy are strengthened by digital transparency and personalized data.

Mutual Funds and Digital Platforms

Millennials and Gen Z are increasingly using digital platforms for investing in mutual funds. Kaur & Kaushik (2016) and Kaur (2018) revealed that while risk perception is less important, awareness has a significant impact on decisions. Dewi and Rahadi (2020) found that Indonesian millennials are influenced by design quality and trust. For Gen Z investors in India, Jha and Dangwal (2024) highlighted perceived risk, pricing value, and service trust as factors. Similar findings on platform usability and adoption behavior are also reported by Xie et al. (2021).

Behavioral and Technological Determinants

When it comes to fintech adoption, behavioral biases continue to play a significant role. Almansour et al. (2023) demonstrated how disposition effects, blue-chip bias, and herding influence investor attitudes and risk-taking. Bihari et al. (2023) identified regret aversion and overconfidence as two significant biases that were exacerbated by the handy features of fintech. Haritha and Uchil (2019) provided evidence that peer and media influences predominate in decision-making, which is consistent with behavioral finance theory (Badola et al., 2023). A systematic synthesis of behavioral biases affecting investment decisions further supports these findings (Badola et al., 2023).

Blockchain and Cryptocurrencies

Blockchain's immutability, transparency, and decentralization have sparked interest in its implementation, particularly for safeguarding and resolving issues in mutual fund operations. Albayati et al. (2020) highlight the importance of supportive policy frameworks for investor acceptability, emphasizing trust and regulatory clarity. Arias-Oliva et al. (2019) integrate technology acceptance model (TAM) with financial literacy and perceived risk, highlighting performance expectancy as a greater driver. Mazambani and Mutambara (2020) showed, using theory of planned behavior (TPB) in South Africa, that attitudes and perceived behavioral control have a more significant influence on bitcoin acceptance than subjective norms.

Robo-advisors

Robo-advisors provide affordable, algorithmic investment techniques, democratizing portfolio management (Belanche et al., 2019). Although robo-advisors improve access, they might not be able to eliminate abnormal behaviors as biases

such as overconfidence and loss aversion still exist in automated systems (Bhatia et al., 2022). Yeh et al. (2023) showed that facilitating conditions and performance expectations directly influence the behavioral intention.

Big Data and AI

Not only does dig data analytics improve portfolio optimization and forecast accuracy, but it also requires ethical frameworks, expertise, and organizational readiness (He et al., 2023; Lee & Lee, 2015). Although its use raises concerns about responsibility, privacy, and governance, AI is transforming risk management, investor profiling, and regulatory compliance in the mutual fund industry.

Industry Trends and Growth

An overview of prior studies examining FinTech adoption, behavioral factors, and mutual fund investments is presented in Table 1. Empirical data support the global growth in mutual funds made possible by fintech. According to the International

Table 1. Overview of Studies.

Theme	Representative Studies	Key Findings/Determinants
Mutual funds and digital platforms	Kaur and Kaushik (2016), Dewi and Rahadi (2020), Jha and Dangwal (2024), Nicolescu and Tudorache (2020), Xie et al. (2021)	Awareness, trust, knowledge, demographic factors, and platform design quality strongly influence adoption; risk perception effects vary across studies.
Blockchain and cryptocurrencies	Albayati et al. (2020), Arias-Oliva et al. (2019), Chang et al. (2020), Du et al. (2019), Mazambani and Mutambara (2020)	Trust, regulatory support, perceived usefulness, and ease of use primarily drive adoption; subjective norms are less impactful; a favorable policy environment is crucial.
Robo-advisors	Belanche et al. (2019), Bhatia et al. (2022), Yeh et al. (2023)	Attitudes, mass media, facilitating conditions, and performance expectancy influence adoption; robo-advisory is less capable of mitigating behavioral biases.
Behavioral finance factors	Haritha and Uchil (2019), Almansour et al. (2023), Bihari et al. (2023)	Herding, regret aversion, overconfidence, and loss aversion significantly affect investor attitudes and risk perceptions; social and media interactions amplify biases.
Big data and AI	He et al. (2023), Werth et al. (2023)	Big data enhances strategic planning and operational efficiency; success depends on technical readiness and non-technical factors such as skills, trust, and regulation.

Investment Funds Association (n.d.), with consistent inflows, regulated open-end funds are predicted to reach $69.17 trillion by the first quarter of 2024. In FY24, SIP investments in India totaled about ₹2 lakh crore, demonstrating the growing integration of digital platforms. New trends indicate that digital onboarding, cybersecurity improvement, and mobile access are boosting investor participation and trust.

Research Methodology

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were followed in this study's systematic literature review (SLR) to ensure methodological rigor, transparency, and replicability.

Search Strategy

The three main databases, Scopus, Web of Science, and Google Scholar, were thoroughly researched. Industry reports from AMFI, IIFA, and EY fintech reports were additional sources.

The following keywords were combined in search strings: "FinTech," "mutual funds," "robo-advisors," "blockchain," "investor behavior," "AI in finance," "digital platforms," "technology adoption," and "investment decisions."

Works published between 2008 and 2024 were considered in the review.

Inclusion Criteria

Included studies were those that:

1. Looked at fintech tools for mutual funds and investing.
2. Highlighted digital platforms, technological adoption, and investment behavior.
3. Industry reports, conference papers, or peer-reviewed journal publications.
4. Published in the English language.

Exclusion Criteria

Excluded studies were those that:

1. Duplicates found in different databases.
2. Reports and articles not published in a peer-reviewed journal.
3. Publications that are not in English.

PRISMA Flow Summary

The study selection and screening process followed under PRISMA guidelines is illustrated in Figure 1.

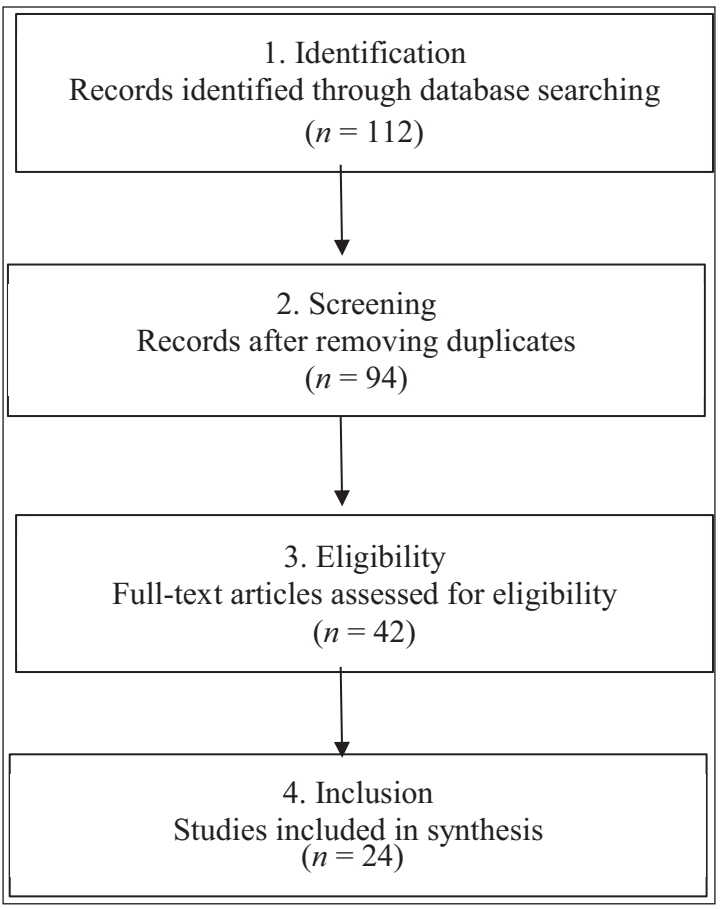


Figure 1. A PRISMA Flow Diagram.

- A total of 112 records were found using database searches (Scopus, Web of Science, and Google Scholar).
- 18 duplicates were removed, leaving 94 records for title and abstract screening.
- 52 records were excluded because they were outside the scope of fintech and mutual fund investments.
- 42 articles' full texts were evaluated for eligibility; 18 of these were eliminated because they did not fit the inclusion criteria (e.g., not mutual fund-focused, conceptual papers, or non-peer-reviewed).
- In the end, 24 studies were included in the systematic review.

Research Gap

The link between fintech adoption and mutual fund investor behavior is largely overlooked, especially in India. While many studies examine fintech and investing as a whole, there is limited insight into how technologies like blockchain, AI,

and robo-advisors affect behavioral biases and decision-making in mutual fund investments.

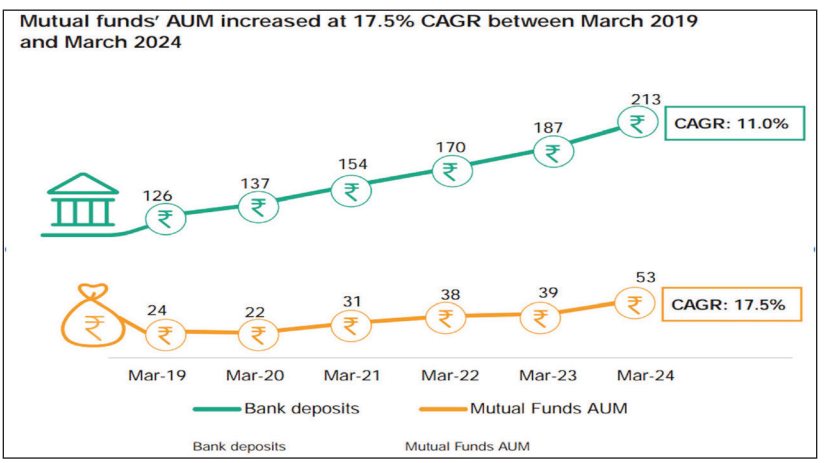
Objective

To examine how technology-driven platforms and fintech tools improve accessibility, streamline investing procedures, and affect investor behavior in mutual fund investments.

Mutual Fund Industry Growth: Empirical Trends

Growth in Mutual Fund AUM Surpassed Bank Deposits in the Last Five Years

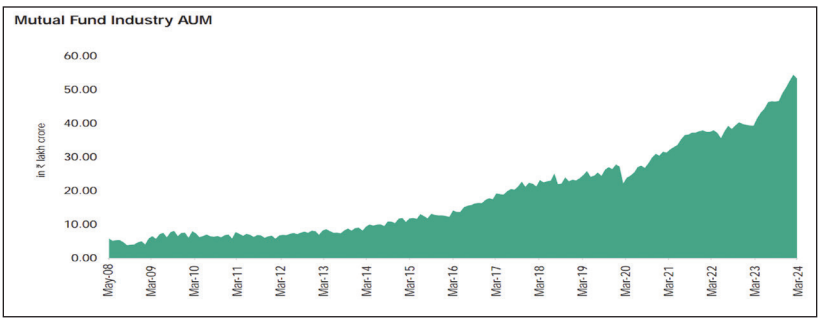
Indian mutual fund AUM grew at a compound annual growth rate (CAGR) of 17.5%, from ₹23.80 lakh crore in March 2019 to ₹53.40 lakh crore in March 2024. In the meantime, bank deposits grew at a CAGR of 11.0%, from ₹126.39 lakh crore in March 2019 to ₹212.53 lakh crore in March 2024. Investor preferences have shifted because low interest rates on fixed deposits have encouraged them to consider higher-return options such as mutual funds.



Source: Indian mutual fund industry; Association of Mutual Funds in India (AMFI, n.d.) website (www.amfiindia.com).

MF Industry's Assets Jump

The mutual fund industry has experienced remarkable growth, with AUM rising ninefold over the past 15 years, from ₹5.89 lakh crore in May 2008 to ₹53.40 lakh crore in March 2024. This significant growth reflects a shift in investor behavior and the increasing adoption of SIPs and digital platforms, underscoring the impact of fintech innovations on the mutual fund landscape. Some of the factors driving



Source: Indian mutual fund industry; AMFI(n.d.) website (www.amfiindia.com).

Table 2. Conceptual Framework That Maps Fintech Dimensions to Investor Behavior Variables Such as Trust, Risk Tolerance, and Behavioral Bias.

Fintech Dimension	Investor Behavior Variable	Conceptual Linkage
Robo-advisors	Trust	Provide algorithmic, transparent advice to build trust and reduce information disparity.
	Risk tolerance	Enable goal-based, customizable portfolios that adjust risk based on investor preferences.
	Behavioral bias	Reduce biases but can be influenced by overconfidence and algorithmic dependency.
Blockchain	Trust	Enhance transaction security, immutability, and transparency to increase investor trust.
	Risk perception	Lower fraud risk perception due to decentralized verification
	Behavioral bias	Reduce biases associated with mistrust, but have little impact on cognitive decision biases.
Big data and AI	Trust	Improve investor profiling to promote individualized interaction and trust.
	Risk tolerance	Improve predictive analytics to facilitate dynamic risk adjustment.
	Behavioral bias	Potentially mitigate bias by giving data-driven insights, but may lead to a dependence on data.
Digital platforms and mobile apps	Trust	Increase access and usability to drive greater participation and trust.
	Investment frequency	Easy access makes regular transactions and spontaneous investments more convenient.
	Behavioral bias	Gamification could amplify biases such as impulsive decision-making.

Note: This theoretical framework shows how different fintech innovations affect various aspects of investors' behavior, including risk tolerance, trust, and behavioral bias, and how they could assist or hinder mutual fund investment decisions.

Table 3. Linking the Discussion with Behavioral Finance or Technology Adoption Theories.

Theory	Key Constructs	Insights from Review	Supporting Studies
Technology acceptance model (TAM)	Perceived usefulness (PU), perceived ease of use (PEOU)	PU and PEOU significantly influence fintech adoption in digital mutual fund platforms.	Davis (1987) and other recent fintech adoption studies
Theory of planned behavior (TPB)	Attitude, subjective norms, perceived behavioral control (PBC)	Fintech use is more strongly predicted by attitude and PBC than by subjective standards.	Mazambani and Mutambara (2020)
Unified theory of acceptance and use of technology (UTAUT)	Performance expectancy, effort expectancy, social influence, facilitating conditions	The adoption of robo-advisors and mobile trading apps is strongly predicted by performance expectancy and supporting conditions.	Yeh et al. (2023)

Table 4. Influence of Fintech on Mutual Fund Investments.

FinTech Innovation	Impact on Investment Process	Investor Behavioral Effects
Robo-Advisors	Automated portfolio management, algorithmic advice	Increased accessibility, personalized advice, persistence of behavioral biases
Blockchain	Enhanced transparency, security, and transaction efficiency	Increased trust, reduced fraud perception
Big Data and AI Analytics	Data-driven asset allocation and risk profiling	More informed decisions, better risk management
Digital Platforms and Mobile Apps	Seamless onboarding, 24/7 access	Increased participation, growth of SIP adoption
Digital Payment Systems	Faster, cost-efficient transaction execution	Greater convenience and transaction frequency

expansion include increased retail involvement, greater digital use, financial knowledge, disposable incomes, and legislative reforms that encourage competition.

Discussion

The findings show that fintech significantly changes investor involvement, lowers barriers to entry, and improves transparency in mutual fund investing (Table 4). Despite advances in technology, long-standing psychological biases still influence investment behavior. The dualism implies that while technology enhances human judgment and psychological processes, it does not replace them. For fintech integration to be sustainable, inclusive technical design, policy evolution, and strategic investor education are essential.

Research such as that by Belanche et al. (2019) and Bhatia et al. (2022) demonstrates that while robo-advisors improve accessibility, biases such as loss aversion and overconfidence remain. Similarly, Albayati et al. (2020) and Mazambani and Mutambara (2020) show that blockchain adoption is more significantly influenced by regulatory clarity and trust than by technological expertise.

Comparing research shows that:

- Digital platforms increase convenience and financial literacy (Dewi & Rahadi, 2020; Jha & Dangwal, 2024).
- Behavioral biases persist in all situations (Almansour et al., 2023; Haritha and Uchil, 2019).
- Although AI and big data increase risk profiling accuracy, they also present legal issues (He et al., 2023).

Ethical and Regulatory Challenges

Despite the advantages of fintech, many issues still exist:

- Risks to cybersecurity and data privacy imposed by digital transactions
- An investor profile may be affected by algorithmic bias and unclear AI algorithms.
- Regulatory loopholes about blockchain platforms, robo-advisors, and international fintech companies
- Low knowledge of digital finance, particularly among the elderly and rural investors.

To ensure responsible and inclusive fintech adoption in mutual fund ecosystems, these challenges must be addressed.

The conceptual linkage between FinTech dimensions and investor behavior variables is summarized in Table 2. Theoretical foundations explaining technology adoption and investor behavior are summarized in Table 3.

Conclusion

FinTech innovations are changing the way people participate in mutual funds by increasing investor participation, accessibility, and convenience. Technologies include mobile trading apps, blockchain platforms, robo-advisors, and big data

analytics, enabling real-time data, customized recommendations, and faster transactions. However, investment behavior is still influenced by behavioral biases and regulatory constraints. To establish a transparent, safe, and inclusive investment framework, legislators, banks, and tech companies must work together. Future research should investigate how fintech impacts different investor types, ethical considerations, and the effectiveness of regulations. The influence of various FinTech innovations on the mutual fund investment process and investor behavior is presented in Table 4.

Limitations of the Study

1. It relies on secondary data and literature, which may not completely capture the changing nature of fintech advancements and investor behavior.
2. There is insufficient longitudinal and empirical data to determine the long-term effects of fintech on investor decision-making.
3. Behavioral finance theories may fail to explain new biases arising from fintech services.
4. Ethical and regulatory issues, such as data privacy and algorithmic bias, are understudied.

Future Implications

1. To fully understand the influence of fintech, use interdisciplinary techniques that integrate technology, policy, and behavioral finance.
2. To assess long-lasting behavioral changes, conduct empirical longitudinal research.
3. Investigate recently identified behavioral biases that are specifically linked to fintech tools.
4. Examine how various investor categories react to fintech advances in different ways.

Declaration of Conflicting Interests

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Article

Post Office Saving Schemes in India: An Empirical Analysis of Growth Trends

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Abstract

The Post Office Savings Bank engaged in financial services as a trust provider, promoting financial stability and savings culture. This study aims to analyse the growth and trends recorded by postal saving schemes from 2001–2002 to 2021–2022, focusing on receipts and outstandings across seven saving schemes. Additionally, the researcher attempted to compare these savings schemes using a paired *t*-test to determine the difference in receipts, and the growth of savings schemes was also checked using the compounded annual growth rate. The results highlighted that the Public Provident Fund (PPF) recorded maximum growth, with Kisan Vikas Patra reporting the lowest in the case of receipts. The highest outstandings were recorded by the Senior Citizen Savings Scheme (SCSS), whereas Kisan Vikas Patra (KVP) shows the least. A neutral trend has been recorded across all the savings schemes. The comparison reveals significant differences in the saving account (SB), followed recurring deposit (RD) Account. Results suggest the preference of investors for PPF and SCSS accounts, while savings accounts and RD are found popular due to stable performance. The policymakers should revisit the design of KVP to make it more appealing and performing.

Keywords:

Savings Scheme Analysis, Post Office Saving Account, Public Provident Fund, Outstandings and Receipts

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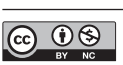

Introduction

The Indian economy is growing in a significant phase where mobilisation of financial resources has been conducted using various investment options. In the last two decades, the significant transformation of the financial landscape has highlighted the emerging and vital role of postal savings in fund mobility and capital formation. Although there are numerous vehicles available for the intended mobilisation of savings, there are still few options meeting the needs of lower-income groups. Savings, being an important aspect of living, should be made with caution. Postal Saving schemes intend to meet the requirements of investors with lower incomes. The Post Office Savings Bank (POSB) provides multiple options of small savings to meet individuals' convenience in availing cost-effective benefits, backed with government security (Sunder & Jacob, 2009). The bank engaged in providing seven savings schemes and three savings certificates to induce savings interest among its customers. Despite severe proliferation of digital banking, the savings of the post office continued to attract a large number of investors, especially in unreserved and rural areas. The postal network has recorded six-fold growth since independence, primarily focusing on rural areas (Ravindran & Venkatachalam, 2016). The rural people found savings in post offices attractive due to the guaranteed principal amount, along with attractive returns. Mathew (2020a, 2020b) reported more schemes, helping employees, quick services, strong network, safety and efficient returns as strengths of POSB in his research. Postal saving schemes have a positive influence over their investors, which acts as a great strength of the POSB (Usha & Miranda, 2020). A higher and regular return on these schemes helps the rural sections in better mobilisation of their funds. Even the performance of the India Post has gained a position in the market during the COVID-19 outbreak (Bhuvaneswari & Tamilarasi, 2020). The Indian postal department, since its establishment, has gone through different phases of growth. The study therefore aims to explore the potential of these savings in terms of growth, trends and popularity over the past two decades.

The different kinds of schemes attracted a larger amount, which ultimately helped the post offices to rehabilitate and enhance their profitability. Although the post offices are experiencing stiff competition from market forces, better returns and easy accessibility is somewhere helping the savings bank to meet these challenges. It, therefore, becomes imperative to analyse the growth and nature of schemes that are performing better and effectively.

Review of Related Literature

A review of the related literature helps to determine the framework of the study in relation to the research objectives and gaps identified. In this study, to analyse the trend of amount invested with saving schemes, growth recorded by saving schemes and to discover the schemes which gained maximum popularity among investors, the authors reviewed 48 related studies to offer useful insights related to the working of saving schemes.

For predicting the trend of small savings in India from 1950 to 1985, Shah and Parmod (1992) divided the savings growth into four phases: phase of low savings (1950–1968), the initial year of expansion (1968–1976), high savings phase (1977–1980) and stagnation phase (1980–1985). Prakash and Gurusamy (2018) tracked the growth of postal banking services from 2006 to 2016 and presented an upward trend of deposits with a yearly 94.6% increase, whereas amounts invested presented maximum growth in 2007–2008 with 8.57% in saving accounts. An analysis performed by Ashish and Singh (2018) presented the growth of deposits from 60.16 million in 2001 to 114.28 million in 2015. Total deposits recorded growth from 140,773.35 million in 2001 to 2,076,150.00 million in 2015. As per Tamarakar and Mani (2007), remarkable growth was recorded by savings in phase from 1984–1985 to 1995–1996, during which people highly invested in small saving schemes that came with tax rebate and were backed by state insurance, therefore marking it as a growth phase.

An empirical study of Salam and Kulsum (2002) revealed an upward household savings trend from 75.9% in 1980–1981 to 86% in 2007–2008. Deposit mobilisation in small savings, as per Kasilingam and Jayabal (2009) and Jain and Saluja (2016), generated greater revenue for the postal department because a greater amount of financial savings was being generated by postal savings (Mohan, 2008). Ramlal (1994) and Tendulkar and Umesh (2003) highly regarded small savings as the country's viable financial option for the general masses, especially for people residing in rural areas. In India, the rate of savings has been consistently recording higher amounts compared to other countries. People used to invest in precautionary savings and found small savings more lucrative. As per Sinha (2017), interest rates of saving schemes proved much appealing to the masses, which were revised quarterly. Latterly, reduced interest rates of such schemes reduced the savings for plans less than five years. Declining interest rates of small savings discouraged the middle class, and therefore these needed to be framed strategically if the government wanted to shift savings towards other avenues, as per studies of Bhatnagar (2017), Mehta (2013) and Samudra and Burghate (2012).

Similarly, Moorthy (2001) recommended an inflation-adjusted formula for setting interest rates on provident funds and small savings for effective running. However, the safety and security provided by postal savings still encouraged people to invest in postal savings, as noted by Jothilakshmi and Santhi (2019), Ghosh (2007), Priyadarshee et al. (2010) and Sahoo and Gomkale (2015). Growing demand for saving schemes also attracted investment from people receiving disbursement of MGNREGA, social security pension schemes, Indira Gandhi National Old Age Pension Scheme, Indira Gandhi Matritva Sahyog Yojana and conditional cash transfer (CCT); these, therefore, induced an upward saving trend according to Malakar (2013).

Performance of the postal service was not impressive from 2005 to 2010 as per the compounded growth rate technique applied by Dl and Ramesh (2013) and therefore they suggested a strategic partnership with other financial institutions.

In Sankaran (2017), a positive compounded growth rate was reported in all saving schemes except the monthly income scheme, national saving certificate and Kisan Vikas Patra (KVP) scheme. Saranya and Hamsalakshmi (2018) studied the recent trend in saving plans using the simple percentage method, weighted

arithmetic means, standard deviation and coefficient of variation, and the performance analysis of various schemes reflected 193.76% performance in the year 2007–2008. Eleven schemes of India Post proved useful to every investor. Mathew (2015) presented the growth of small savings through the savings bank from 99.88 million accounts in 1996 to 162.16 million accounts in 2005–2006. The saving schemes were performing well, and a positive growth rate was recorded for all schemes except KVP and National Savings Certificate, according to findings of Sankaran (2017) and Nagalakshmi (2015).

Among various saving schemes, the RD scheme gained more popularity due to its compulsory saving nature (Rajeswari, 2017). The KVP is another popular saving option that has attracted considerable funds from investors, especially in Coimbatore City (Karthikeyan, 2016). Postal deposits gained greater trust among working women in rural areas (Rameshkumar, 2018), whereas the PPF gained importance among government employees. A study on the performance of monthly saving schemes offered by banks and non-banking institutions reported that mutual fund schemes were more effective (Nandhini & Rathnamani, 2015). The recent launch of the Mahila Samman Saving Certificate bearing an interest rate of 7.5% started attracting a significant amount from women investors due to the benefits it offers (VA et al., 2023). Gavini and Athma (1999) found Indra Vikas Patra (IVP), Kisan Vikas Patra (KVP) and RD as popular schemes in urban and rural areas. Investors liked to invest more in the MIS, savings account, TD and RD as per the study by Ravindran and Venkatachalam (2016). In this way, different saving schemes of post offices attracted a greater amount in confronting the overall growth of small savings in India. People of Uthangarai taluk reported RD, post office savings account and monthly income scheme as the most popular schemes (Manimekalai & Ragunathan, 2021).

The above literature presented an overview of small savings in India and their performance. Existing studies lacked comprehensive comparisons among various postal schemes and were more focused on individual schemes. A more nuanced analysis of trends is also lacking to identify the factors responsible for the underperformance of schemes. The present study widens the scope by analysing the differences in saving schemes in the context of receipts of the last 21 years, along with the growth trend recorded by the saving schemes.

Research Objectives

1. To study the trend of receipts and outstandings of various savings schemes in India.
2. To analyse the growth recorded by receipts and outstanding balances of the savings schemes.
3. To conduct a comparative analysis among different savings schemes.

Research Methodology

This study presents an empirical analysis of various saving schemes, including Post Office Saving Account, Monthly Income Scheme Account, National Savings

RD Account, National Savings Time Deposit Account, Senior Citizen Savings Scheme, KVP and public provident fund (PPF).

This study used secondary data collected from the *Handbook* of RBI, that is, from 2001–2002 to 2021–2022, annual reports of India Post and other accessible sources, and analysed using tabulation in Microsoft Excel. Descriptive and statistical tools *t*-test, compounded annual growth rate (CAGR), trend analysis, line and bar charts were used to interpret the study.

Analysis and Interpretations

Saving schemes in the previous 21 years have undergone drastic changes. The present study empirically analyses the trend, growth and significant difference of the saving scheme. Time deposit account has not been considered for trend analysis due to the unavailability of sufficient data.

Trend of Receipts and Outstandings of Saving Schemes

This study intends to present the trend analysis of receipts and outstandings of each scheme with the help of tables and line charts from 2001–2002 to 2021–2022. The trend of receipts will help to understand the performance of each scheme and its role in generating funds from households for promoting capital formation in the Indian economy. Receipts for saving schemes mean the amount invested under different schemes by postal investors, and outstandings mean the balance left under different saving schemes, which constitute liabilities of the central government. Receipts and outstandings are expressed in crores, and the trend is presented in percentages by taking the previous year as the base year. The performance and trend analysis of postal schemes is presented using tables and line charts, as shown below.

With reference to Tables 1 and 2, in Figure 1, receipts and outstandings recorded under SB are presented from 2001–2002 to 2021–2022 to understand the trend of the same. It was examined that receipts of SB revealed a positive trend till 2016–2017, a major downfall was observed in 2017–2018 due to reduced interest rate, and afterwards receipts started moving upwards. The outstandings also rose from 2001–2002 to 2021–2022, recording an upward trend in outstandings. Maximum receipts and outstandings of ₹247,446 crores and ₹205,888 crores were recorded in 2016–2017 and 2020–2021, respectively.

With reference to Tables 1 and 2, in Figure 2 shows the trend of MIS schemes receipts and outstandings from 2001–2002 to 2021–2022. It was found that receipts with MIS have increased in the last 20 years, except in years, that is, 2007–2008, 2012–2013, and majorly in 2017–2018. This scheme has recorded a major outstanding balance, which is showing an upward trend in very recent years. Maximum receipts were received in 2010–2011 at ₹56,693 crore and the receipts received a major hit in 2017–2018, remaining 1,625 crores only. At the end of 2021–2022, MIS recorded the highest outstandings of ₹235,820 crores.

With reference to Tables 1 and 2, Figure 3 depicts the trend of receipts and outstanding balance with SCSS, and it was in this context that SCSS reported an

Table 1. Trend Analysis of Receipts with Post Office Saving Schemes.

Year	*SB*	*Trend*	*MIS*	*Trend*	*SCSS*	*Trend*	*RD*	*Trend*	*NSC VIII*	*Trend*	*KVP*	*Trend*	*PPF*	*Trend*
2001–2002	14,077	100	18,798	100	–	–	11,811	**100**	7,840	100	20,221	100	1,929	100
2002–2003	17,612	125	27,641	147	–	–	13,993	**118**	9,583	122	23,234	115	2,337	121
2003–2004	21,720	123	38,851	140	–	–	16,645	**119**	11,397	119	27,796	120	2,528	108
2004–2005	24,824	114	48,457	125	8,474	100	19,979	**120**	10,097	88	23,398	84	2,534	100
2005–2006	31,432	127	47,273	97	7,436	88	23,488	**117**	10,541	104	29,282	8	3,024	119
2006–2007	36,067	115	26,461	56	7,239	97	26,339	**112**	8,912	84	23,495	80	4,065	134
2007–2008	43,165	120	17,025	64	2,011	28	27,684	**97**	6,285	70	14,975	64	3,347	82
2008–2009	53,600	124	23,812	140	1,383	69	28,443	**102**	7,082	113	15,706	105	3,652	109
2009–2010	68,046	127	54,300	228	9,626	696	30,353	**92**	10,517	148	21,166	135	4,196	114
2010–2011	84,354	124	56,693	104	11,395	118	32,862	**108**	9,757	93	21,631	102	6,837	163
2011–2012	85,905	102	28,424	50	2,986	26	34,495	**105**	10,326	106	7,651	35	6,222	91
2012–2013	83,900	98	19,049	67	1,978	66	35,899	**11**	19,102	185	27	0	7,221	116
2013–2014	94,650	113	17,991	94	1,994	101	38,646	**107**	16,924	88	18	0	7,074	97
2014–2015	114,229	121	21.569	120	3,011	151	41,824	**108**	16,584	98	2,110	100	8,157	115
2015–2016	157,415	138	31,526	146	10,321	343	40,315	**96**	9,826	59	21,318	1,010	7,791	95
2016–2017	247,446	157	35,334	112	10,002	97	47,451	**117**	12,063	123	16,923	79	17,235	221
2017–2018	17,145	7	1,625	4	12,264	123	7,868	**16**	−65	0	24,588	145	6,623	38
2018–2019	31,037	181	10,967	675	13,990	114	10,081	**128**	11,318	−17,412	23,018	94	8,539	129
2019–2020	25,893	83	16,510	150	20,334	145	11,821	**117**	19,495	172	28,972	126	13,014	152
2020–2021	39,748	153	12,211	74	21,009	103	17,807	**151**	17,361	89	25,340	87	13,690	105
2021–2022	41,329	104	14,441	118	22,281	106	24,840	**139**	19,696	113	26,619	105	13,119	96

Source: *Handbook of Statistics on Indian Economy*, RBI.

Note: Bold values indicate significant differences among groups of schemes.

Table 2. Trend Analysis of Outstanding Balance with Post Office Saving Schemes.

Year	*SB*	*Trend*	*MIS*	*Trend*	*SCSS*	*Trend*	*RD*	*Trend*	*NSC VIII*	*Trend*	*KVP*	*Trend*	*PPF*	*Trend*
2001–2002	10,045	100	57,335	100	–	–	23,648	100	40,205	100	102,751	100	8,111	100
2002–2003	11,594	115	80,915	141	–	–	28,084	118	44,525	111	113,675	111	10,156	125
2003–2004	13,367	115	113,386	140	–	–	33,963	121	50,633	114	122,188	107	12,267	121
2004–2005	14,870	111	151,026	121	5,436	100	41,102	121	55,128	109	136,449	112	14,273	116
2005–2006	16,790	113	183,077	121	15,916	292	50,188	125	58,541	106	146,607	107	16,872	118
2006–2007	18,565	110	189,440	103	22,284	140	60,228	120	58,913	100	152,767	104	19,457	115
2007–2008	19,789	106	182,390	96	22,197	99	65,071	108	57,388	97	105,408	70	21,358	110
2008–2009	22,690	115	179,504	99	20,651	93	65,072	100	55,309	96	147,517	140	23,402	109
2009–2010	26,458	117	201,693	112	24,989	121	62,818	96	54,776	99	153,933	104	26,096	111
2010–2011	30,101	114	218,674	108	30,913	123	61,250	98	54,642	99	158,584	103	31,583	121
2011–2012	34,070	113	205,288	93	26,763	86	62,661	102	55,069	100	153,960	97	35,993	114
2012–2013	37,850	111	201,787	98	24,093	90	67,962	108	64,719	117	128,375	83	41,121	114
2013–2014	43,017	114	202,085	100	22,492	93	74,149	109	75,086	116	106,754	83	46,608	113
2014–2015	47,428	110	200,557	99	17,975	80	74,513	100	85,608	97	2,671	100	52,748	113
2015–2016	61,567	130	193,808	96	22,876	127	76,179	103	88,139	103	29,118	1,090	57,603	109
2016–2017	92,064	149	180,066	92	29,453	129	84,453	111	87,239	99	46,023	158	63,361	110
2017–2018	109,210	119	181,691	100	41,718	142	92,320	109	87,174	100	70,612	153	69,985	110
2018–2019	140,247	128	192,658	106	55,708	133	102,401	90	98,492	113	93,630	132	78,524	112
2019–2020	166,140	118	209,168	108	76,042	136	114,222	111	117,987	120	122,602	131	91,538	116
2020–2021	205,888	123	221,379	105	97,051	127	132,029	115	135,348	115	147,942	121	105,228	115
2021–2022	247,216	120	235,820	11	119,333	123	156,869	119	155,043	114	174,560	118	118,347	112

Source: *Handbook of Statistics on Indian Economy*, RBI.

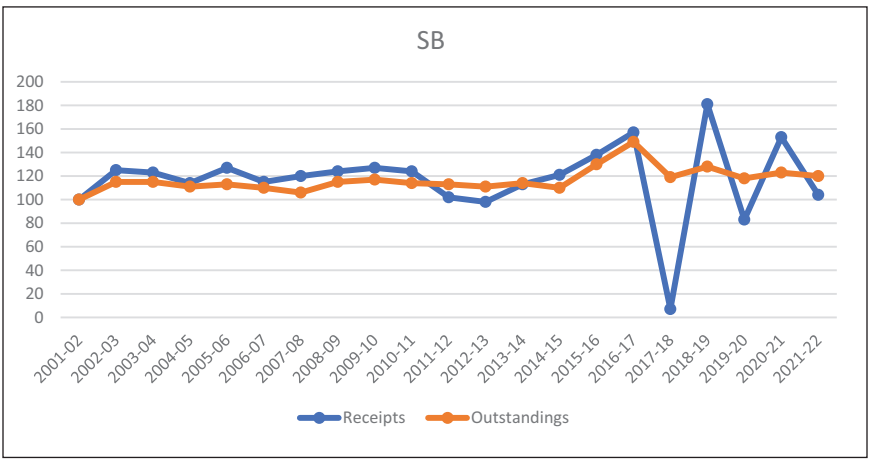

Figure 1. Receipts and Outstandings under Post Office Saving Account (SB).

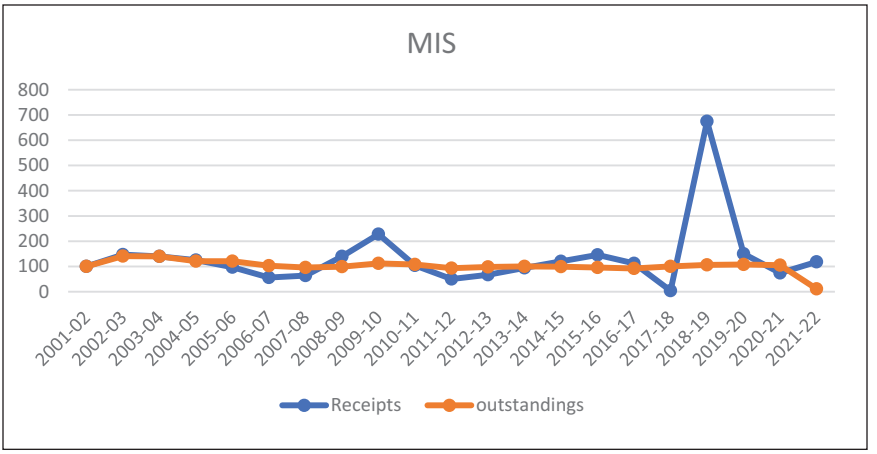

Figure 2. Receipts and Outstandings under National Monthly Income Statement.

upward trend in receipts with little variation, and the same performance has been recorded in outstandings, which shows significant investment towards this savings scheme by senior citizens. SCSS was initiated in 2005 and, so far, has recorded ₹167,734.00 crores as receipts and ₹675,890 crores as outstandings. Overall, an upward trend was recorded in receipts and outstandings with SCSS.

With reference to Tables 1 and 2, Figure 4 shows the trend of receipts and outstandings under the RD account. An upward trend is shown in receipts except in 2017–2018, when a major downfall was recorded from 47,451 to 7,868 crore. An outstanding balance rose to ₹1,531,832 crore within the tenure of 21 years, as this account has a five-year maturity period. An upward trend was recorded by this in two phases, that is, before 2017–2018 and after it.

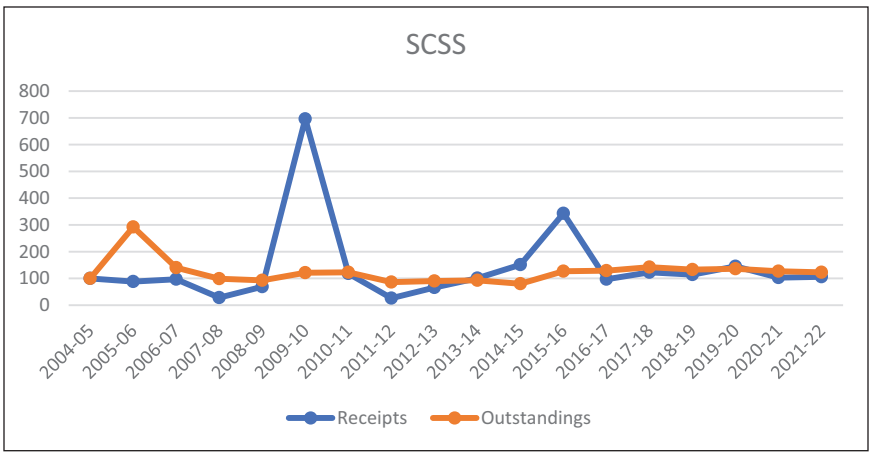

Figure 3. Receipts and Outstandings under the Senior Citizen Saving Scheme.

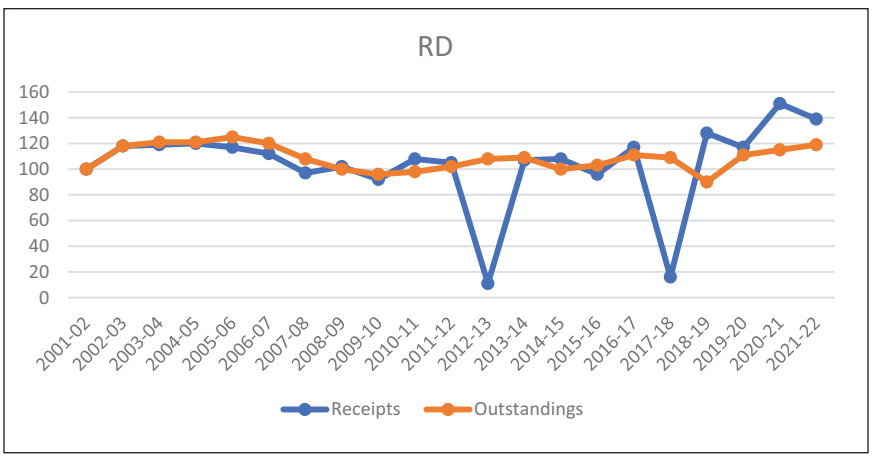

Figure 4. Receipts and Outstandings under the RD Account.

With reference to Tables 1 and 2, Figure 5 shows receipts and outstandings recorded under the scheme NSC to analyse its trend. The figure shows that receipts with NSC VIII depict steady growth with little variation. In recent years, the receipts have been increasing with this scheme. On the other hand, the outstanding balance has also risen over the time span of 21 years. So far, this scheme has recorded 1,583,114 crores outstanding balance and 246,264 crores in receipts.

With reference to Tables 1 and 2, Figure 6 analysed the trend of KVP from 2001–2002 to 2021–2022. The figure shows that receipts and outstandings declined over the years, and therefore a downward trend is reflected in the previous 21 years. KVP was discontinued in 2011 and relaunched in 2014. Therefore,

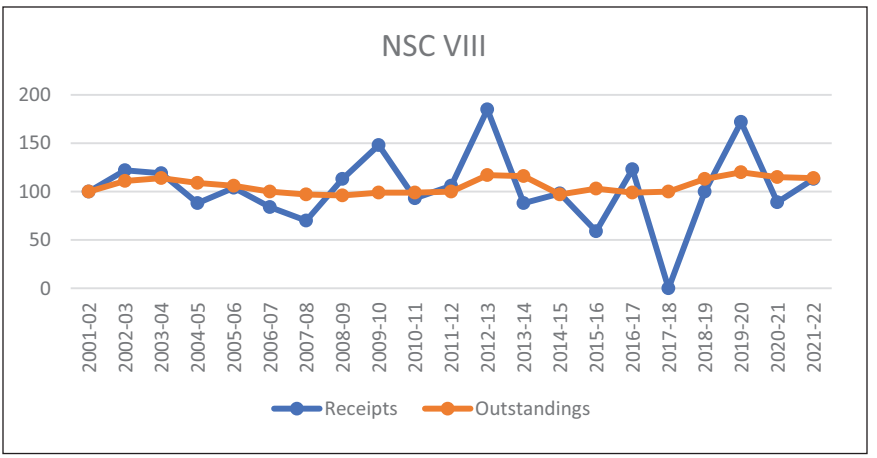

Figure 5. Receipts and Outstandings under National Saving Certificate VIII.

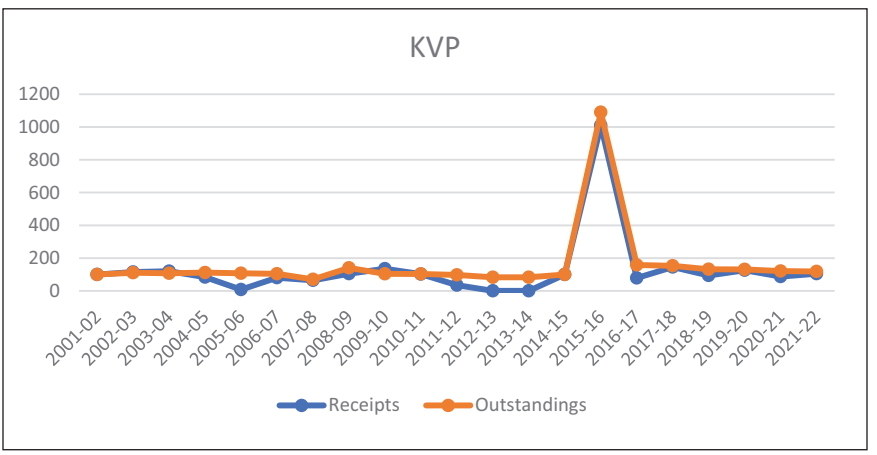

Figure 6. Receipts and Outstandings under KVP.

no receipts were recorded in 2011, and the trend has gone upwards after 2014 with little variation.

With reference to Tables 1 and 2, Figure 7 presents the trend of receipts and outstandings from 2001–2002 to 2021–2022. The PPF scheme has flourished from 2001–2002 to 2021–2022 with a steady rate and has recorded a positive growth rate. On the other hand, an outstanding balance also increased in the previous 20 years. This scheme has recorded the highest growth and received an amount of 143,134 crores as receipts and 944,631 crores as outstanding balance. Overall, PPF recorded an upward trend in receipts and outstandings.

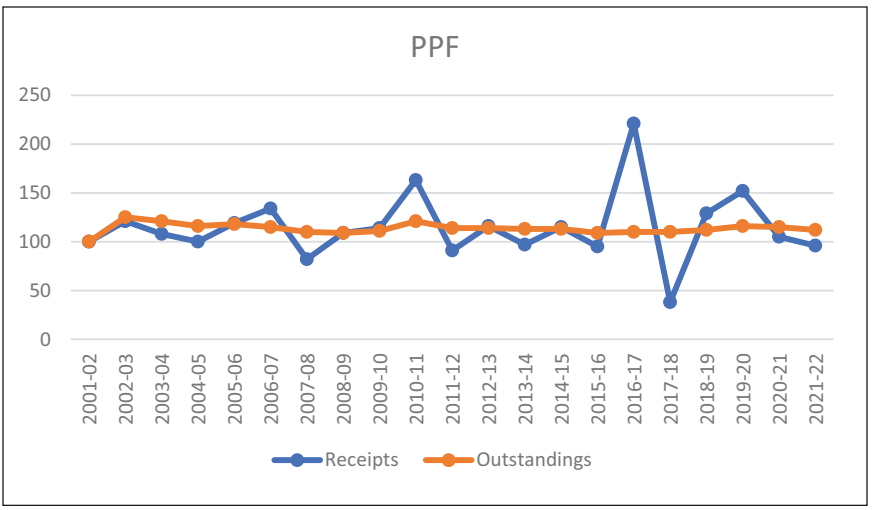

Figure 7. Receipts and Outstandings under PPF Account.

Table 3. CAGR of Saving Schemes.

Saving Scheme	Receipts (CAGR in %)	Outstandings (CAGR in %)
Post Office Saving Account	6	17
Monthly Income Statement	−1	7
Senior Citizen Saving Scheme	6	20
Recurring Deposit Account	4	10
Time Deposit Account	4	−5
National Saving Certificate VIII	5	7
Kisan Vikas Patra	−17	−22
Public Provident Fund	10	14

Compounded Annual Growth Rate of Saving Schemes

Growth of postal saving schemes in the last 21 years, that is, from 2001–2002 to 2021–2022, has been investigated using the compounded annual growth rate: $CAGR = (EV / BV)^{1/N} - 1$, where EV is the ending value, BV is the beginning value, and N means the number of years.

Table 3 exhibits the growth rate of different saving schemes in the context of their receipts and outstandings in the previous 21 years. The table shows that all saving schemes are attracting funds positively every year except MIS and KVP. The potential reasons for negative MIS are declining interest rates and its suitability for the salaried class. Underperformance of KVP has been recorded since the scheme was discontinued in 2011 and relaunched in 2014, leading to the sale of KVPs from 2012 to 2018. Post Office SB, SCSS, RD and TD are growing at

6% and 4% CAGR. National Saving Certificate VIII recorded a 5% CAGR. The maximum growth rate is recorded by PPF at 10%. Meanwhile, an adverse growth rate of outstandings with saving schemes shows clearance of balances by the postal department. The given performance of schemes highlights the consideration of policymakers with respect to interest rate revisions, withdrawal rules, targeting marketing and maturity periods.

Analysing Differences in Receipts Among Saving Schemes Using the t-test

This study aimed to understand the difference in saving schemes with respect to their receipts. To verify the difference between the mean scores of each saving scheme and with other seven saving schemes, a paired *t*-test was run for each scheme. A total of 56 tests were performed to examine the difference between the mean scores of schemes by means of receipts.

In Table 4, a paired *t*-test was run on eight saving schemes to investigate the difference in their receipts simultaneously to understand if the saving schemes varied from one another in terms of their receipts. An analysis of the *t*-test showed that out of 56 tests, 30 paired tests showed significant results, meaning that a total of 30 pairs of saving schemes showed differences in their mean scores, or schemes differed reciprocally in terms of their receipts. Twenty-six paired tests, conversely, reflected insignificant differences among receipts of saving schemes, meaning that such schemes differ very little in terms of receipts. Each scheme was paired with the remaining seven schemes to present the difference effectively.

From Table 4, on considering pairs of significant differences or pairs with a *p* value less than .05, it was found that receipts of SB were significantly different from the other six schemes; in the case of the RD scheme, receipts vary from the other five schemes. PPF, MIS and NSC VIII showed differences in their receipts from the four schemes, respectively. SCSS and KVP revealed significant differences in their receipts from three schemes, whereas TD presented the least difference in mean score from the SB account only. The *p* value of significant results was highlighted in Table 4.

On the basis of counts of maximum significant results for schemes, the post office SB and the RD are the second most popular saving schemes of the POSB for 21 years.

Discussions

The findings of the study underscore that post office saving schemes have gone through tremendous growth from 2001–2002 to 2016–2017, which presented the great reliance on these schemes and their relevance in the Indian economy. The study furthermore observed that receipts got majorly hit in the year 2017–2018 because of the linkage of POSB and India Post Payments Banks, which also influence the spread of banking facilities (Minj et al., 2021). It might also be due to a shift towards other institutions or an increase in online payments. KVP was

Table 4. Results of the Paired *t*-test.

Schemes	Mean Difference	Std Error	Sign.
SB MIS	36,411.23810	12,054.05867	.007
SCSS	55,517.14286	12,411.80347	.000
RD	37,664.28571	10,222.79419	.001
TD	49,465.90476	11,167.57071	.000
NSC VIII	51,854.90476	12,140.16154	.000
KVP	55,449.47619	13,292.42785	.000
PPF	56,688.57143	11,806.94013	.000
MIS SB	−36,411.23810	12,054.05867	.007
SCSS	19,105.90476	3,841.59768	.000
RD	1,253.04762	3,426.55464	.718
TD	13,054.66667	6,195.75171	.048
NSC VIII	15,443.66667	3,541.29037	.000
KVP	19,038.23810	2,499.77845	.000
PPF	20,277.33333	3,663.69306	.000
SCSS SB	−55,517.14286	12,411.80347	.000
MIS	−19,105.90476	3,841.59768	.000
RD	−17,852.85714	3,227.48191	.000
TD	−6,051.23810	3,282.29413	.080
NSC VIII	−3,662.23810	1550.27253	.028
KVP	−67.66667	4,423.93390	.988
PPF	1,171.42857	1102.34137	.301
RD SB	−37,664.28571	10,222.79419	.001
MIS	−1,253.04762	3,426.55464	.718
SCSS	17,852.85714	3,227.48191	.000
TD	11,801.61905	4,664.49795	.020
NSC VIII	14,190.61905	2,464.74803	.000
KVP	17,785.19048	4024.05651	.000
PPF	19,024.28571	2,441.00319	.000
TD SB	−49,465.90476	11,167.57071	.000
MIS	−13,054.66667	6,195.75171	.048
SCSS	6,051.23810	3,282.29413	.080
RD	−11,801.61905	4,664.49795	.020
NSC VIII	2,389.00000	3,886.52548	.546
KVP	5,983.57143	6,999.01175	.403
PPF	7,222.66667	3,418.09588	.047

(Table 4 continued)

(Table 4 continued)

Schemes	Mean Difference	Std Error	Sign.
NSC VIII SB	−51,854.90476	12,140.16154	.000
MIS	−15,443.66667	3,541.29037	.000
SCSS	3,662.23810	1550.27253	.028
RD	−14,190.61905	2,464.74803	.000
TD	−2,389.00000	3,886.52548	.546
KVP	3,594.57143	3,855.31487	.362
PPF	4,833.66667	963.18640	.000
KVP SB	−55,449.47619	13,292.42785	.000
MIS	−19,038.23810	2,499.77845	.000
SCSS	67.66667	4,423.93390	.988
RD	−17,785.19048	4024.05651	.000
TD	−5,983.57143	6,999.01175	.403
NSC VIII	−3,594.57143	3,855.31487	.362
PPF	1,239.09524	4,094.55211	.765
PPF SB	−56,688.57143	11,806.94013	.000
MIS	−20,277.33333	3,663.69306	.000
SCSS	−1,171.42857	1102.34137	.301
RD	−19,024.28571	2,441.00319	.000
TD	−7,222.66667	3,418.09588	.047
NSC VIII	−4,833.66667	963.18640	.000
KVP	−1,239.09524	4,094.55211	.765

Source: Authors' computation using SPSS.

Note: The mean difference is significant at the 0.05 level.

discontinued in between due to less response from the public. The underperformance of KVP in receipts and outstandings raises concerns, as observed in earlier studies (Deb & Paul, 2015). PPF emerged as the top performer in generating receipts, while SCSS outperforms in outstandings, aligning results with studies highlighting their performance (Pungalia et al., 2017; Ray & Shantnu, 2020). There is a need for further investigation into the underlying factors responsible for the neutral trend of savings schemes, as noted by Sinha (2017). The significant differences for the saving account followed by the RD account necessitate attention, particularly in view of studies highlighting the importance of flexibility and liquidity in saving plans (Shetti & Krithika, 2025). Therefore, the government can work on these aspects of schemes to improve investor appeal. Implementing technology-aided banking features and advertising through campaigns could help to increase the interest of more investors. Better interest rates and more withdrawal intervals could induce flexibility.

Conclusion

The postal saving schemes have witnessed significant growth between 2001–2002 and 2021–2022. The present study aimed to analyse the trend in receipts and outstanding balance of these savings schemes, finding an upward trend with minimal variations in terms of receipts and outstandings, except for KVP, for which the policymakers can consider revamping the schemes in terms of revised interest rates, withdrawal rules and maturity period.

The PPF, showing the highest compounded growth rate, followed by SCSS, should be continuously supported by the policymakers through provided benefits and targeted marketing. Saving account and RD are recognised as popular schemes as per the results of the test, which also warrant adjustments relating to fees, interest rates for continuously meeting the needs of investors. A step towards investor education helps individuals to better meet investors' requirements. Policymakers could also design targeted interventions such as improving liquidity options for schemes like MIS and savings accounts or improving returns for recurring deposits.

Declaration of Conflicting Interests

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Article

Unveiling Youth Intentions Towards Sustainable Clothing: An Extended Theory of Planned Behaviour Approach

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Abstract

In today's era of fashion, the young population have the tendency to adopt fashionable clothing. Nevertheless, the ever-increasing popularity of sustainability in every walk of contemporary life instils a sense of sustainability when a consumer thinks of fashionable clothes. Therefore, this exploratory study takes a comprehensive approach to unveil the factors affecting people's behaviour towards sustainable clothes, recognising that human behaviour is dynamic. An offline purposive sampling survey was carried out to collect data from 282 respondents, and data were analysed with the PLS-SEM software. The findings show that determinants like attitude, guilt, willingness to pay, and hedonic value have a crucial role to play in creating sustainable clothing purchase intention among youth in India. Our study is the first to add additional variables to the extended theory of planned behaviour and integrate these variables into a unifying framework for examining their effects on purchase intention for sustainable clothing. Moreover, the study used advanced features like the IPMA of PLS-SEM software to recognise the important factors that aid practitioners in better decision-making.

Keywords

Environmental consciousness, hedonic value, IPMA, purchase behaviour and sustainability

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Introduction

The clothing sector globally contributes substantially to environmental degradation (Apaolaza et al., 2023). Around 10% of the contribution to global carbon emissions is attributed to the ever-increasing consumption of limited natural resources in the manufacturing phase (Cocquyt et al., 2020). The excessive and conspicuous consumption of clothing is characterised by trendy style with affordable pricing and low-quality clothes, resulting in the unnecessary disposal of usable clothing in landfills (Birtwistle & Moore, 2007). This excessive acquisition of clothes and their disposal is sometimes referred to as 'fast fashion', and the youth population occupies the major portion (Lundblad & Davies, 2016). Excessive growth in the fashion industry has caused an alarming problem of overconsumption of clothing with little attention accorded to what the cloth is made up of, how long the customer uses it, and where that cloth will end up (Bly et al., 2015). The basis of this trend in consumption is prompt stock turnover, causing an increased number of textiles that ultimately find their final stay in landfills, which could be recycled or reused (Colucci & Vecchi, 2021; Remy et al., 2016). Sustainable clothing has the potential to provide a solution to these issues (Jacobs et al., 2018). Therefore, many clothes manufacturing players are striving hard to push themselves into manufacturing more sustainable clothing that includes eco-friendly production processes, which, among others, comprise using organic dye or reusable materials to manufacture long-lasting clothes (Jacobs et al., 2018; Sadiq et al., 2021). In recent years, marketers and academicians started paying attention to sustainable clothing owing to widespread awareness about environment among consumers, their beliefs, and growing inclination towards eco-friendly commodities (Elf et al., 2022; Saha et al., 2022) because sustainable product features like (reusable materials) have proven to leave a good effect on the intention to purchase fashionable commodities (Grazzini et al., 2021). In emerging economies like India, the annual consumer expenditure is projected to grow much faster, from around $1.5 trillion today to $6 trillion by 2030. In recent years, because of global warming concerns, consumers have shown interest in purchasing green products and living an eco-friendly lifestyle; however, green product purchases have not increased significantly.

This study strives to address gaps in current literature by investigating the role of various factors that shape consumers' purchasing intentions regarding sustainable clothing, thereby contributing to a clearer understanding of consumer decision-making in this critical area. Analysing these factors in an integrated model will help provide an integrative framework that identifies the factor(s) with a strong influence on the intention to buy sustainable clothes. The study evaluates a model using a group of university students as its sample. The theoretical framework addresses the impact of several variables that shape purchasing intentions and, consequently, encourage the buying of sustainable clothing. Accordingly, this research investigates the key drivers behind sustainable clothing choices. Insights from the findings can assist clothing manufacturers and other stakeholders in recognising factors that support the adoption of sustainable fashion among younger generations. The contents of the article are structured as follows: the next

section presents the theoretical foundation of the predictors of sustainable clothing purchasing intention, followed by the methodology, and then a discussion of the results is provided.

Theoretical Background and Literature Review

Theory of Planned Behaviour (TPB)

The TPB posits that the inclination of a person to do a specific action influences that individual's actual conduct. It suggests that whether someone actually does something depends a lot on how likely they are to do it, and that likelihood is governed by three key things: their attitude towards the behaviour, how much control they feel they have over it, and the social pressures they experience. Researchers have been using this theory to look at all sorts of decisions, from why consumers purchase certain products to how they act in environmentally friendly ways (Bamberg & Möser, 2007; Trumbo & O'Keefe, 2005), to the choices they make about clothing and other ethical products (Elliott et al., 2003). When we talk about perceived behavioural control, we are really talking about how easy or hard someone thinks it will be to do something (Ajzen, 1991; Sheppard et al., 1988). This idea is closely linked to self-confidence or self-efficacy (Ajzen & Fishbein, 1969). Attitude is about whether someone expects good or bad results from a behaviour, whereas subjective norms are all about how much people around them think they should (or should not) do it. Researchers believe that our sense of control comes from all the different beliefs we have about what might help or stop us from taking action. Prior studies have explored how this sense of control affects whether people choose environmentally friendly products (Wiederhold & Martinez, 2018). Today, young consumers are aware of the damage being done to the environment, and they are often conscious about what they buy to make a positive difference. According to the TPB, our attitudes are shaped by two main things: what we think will happen if we act a certain way, and whether we see those outcomes as good or bad. Jung et al. (2020) and Kang et al. (2013) advocate that attitude determines a person's behaviour. Thus, consumers who like sustainable products are more inclined to purchase them (Punyatoya, 2015). Similarly, consumers who hold a favourable attitude towards sustainable clothes will have a higher intention to purchase them.

Subjective norms determine the extent of societal pressure to behave in a specific way. These are the individual perceptions of behaviour that are primarily affected by the judgement of near and dear ones (e.g., family, spouse, friends and societies). These norms are primarily formed on the basis of one's perception of the expectations of significant others (Manaktola & Jauhari, 2007), and TPB posits that subjective norms are correlated to the intention to adopt pro-environmental behaviour and sustainable clothing.

In the sustainable clothing arena, TPB is being used extensively in research to unveil the critical variables that influence consumers' intention to buy sustainable clothing. Over the period of time, there have been some well-articulated studies on sustainable clothing (Kim & Oh, 2020; Rausch & Kopplin, 2021). The extant

literature reports that most of the studies on sustainable clothing generally studied topics like sustainable fashion, supply chains and sustainable business models, but a limited study has investigated the consumer behaviour perspective on sustainable fashion (Busalim et al., 2022). Furthermore, of those that have studied the issue from the lens of consumer, most of them have primarily emphasised investigating the influence of factors linked to the eco-friendliness awareness of consumers, while a limited studies have addressed the intention to purchase and consumption (Han et al., 2017; Mcneill & Moore, 2015; Park & Lin, 2020). Moreover, prior studies have failed to give conclusive findings on the relationship between consumers' environmental awareness and their intention to adopt sustainable clothing (Busalim et al., 2022; Diddi et al., 2019; ElHaffar et al., 2020; Rausch & Kopplin, 2021) and reported that buying fashionable clothes is a complex process, as clothing choices are often emotionally tied to personal expression and the desire for social approval, rather than simply serving rational needs (Niinimäki, 2010; Preuit & Yan, 2016). Thus, existing studies highlight the effectiveness of the TPB, revealing that perceived behavioural control, individual attitudes and subjective norms significantly shape intentions to buy sustainable products.

Thus, it is hypothesised that:

H_1. Consumers' purchase intention towards sustainable clothing is significantly influenced by perceived behavioural control.
H_2. Attitude significantly influences consumers' purchase intention towards sustainable clothing.
H_3. Subjective norms significantly influence consumers' intentions to purchase sustainable clothing.

Extended Version of TPB

Over time, researchers and practitioners have introduced additional factors to the original dimensions of the TPB and proposed numerous theoretical models in the research domain of environmentally friendly behaviour to improve the explanatory power of TPB (Gangakhedkar et al., 2023). This is consistent with the recommendation of Ajzen (1991) that more factors can be incorporated into the original framework of TPB, provided such additional variables help in improving the explanatory power of TPB. Therefore, previous researchers have incorporated dimensions such as trust propensity and perceived risk. This study adds environmental knowledge (EK), environmental consciousness (EC), guilt (GU), willingness to pay (WP) and hedonic value (HV) to the original TPB framework.

Environmental Knowledge.

EK has become a scholarly topic lately, not only for researchers but also for people working in the field. When people are aware of environmental issues, they are more likely to pay attention to their choices and think about how those choices affect the world around them (Bamberg & Möser, 2007). In contrast, those who are unaware of the environment are often the ones whose actions do the most

harm (Connell & Kozar, 2014). Therefore, understanding environmental problems matters—it helps individuals make more informed decisions on how to use resources and how to avoid damaging the planet (Liu et al., 2020).

In modern days, a substantial portion of clothing is made from petrochemicals, which create a lot of waste and harm the environment. As people learn more about the negative impact of synthetic materials like nylon and polyester, many are turning to eco-friendly fabrics. Now, options like hemp, bamboo and linen are becoming more popular in the fashion industry, replacing traditional materials like cotton and polyester. Studies, such as Liu et al. (2020), have demonstrated that increased EC significantly influences consumers' propensity to select sustainable products. Thus, it is hypothesised that:

H_4. EK positively and significantly affects the consumers' purchase intention towards sustainable clothing.

Environmental Consciousness (EC).

EC transcends the notion of environmental awareness, incorporating a more expansive and cohesive viewpoint. This study considers it a principal variable within the research framework. EC pertains to the psychological factors that affect a person's likelihood of engaging in pro-environmental behaviour (Schlegelmilch et al., 1996). This kind of awareness helps people think about things and makes them more responsible (Florka, 2002). EC, as a multifaceted construct, profoundly impacts purchasing intentions (Krause, 1993). Some latest studies report that young Indian shoppers are becoming more aware of environmental damage and are changing the way they shop (Mishal et al., 2017). Hence, our next hypothesis is:

H_5. EC has a positive and significant effect on the consumers' purchase intention towards sustainable clothing.

Guilt (GU).

Guilt is an unpleasant, sad feeling of not 'being right' with someone who has been hurt, which makes a person bow their head and avoid looking at them (Izard, 1997). It is the emotion consumers feel while acquiring the product (Goldsmith et al., 2012; Ramanathan & Williams, 2007), including the acquisition of trivial items (Mishra & Mishra, 2011) or engaging in impulsive buying (Miao, 2011). Lindenmeier et al. (2017) conducted a study that revealed a direct and positive correlation between guilt and purchase intention. Consequently, the preceding argument supports the formulation of the hypothesis given below.

H_6. Guilt has a positive and significant effect on consumers' purchasing intention towards sustainable clothing.

Willingness to Pay.

WP is defined as the maximum amount of money a consumer is ready to spend for a product. The financial aspect is the most important determinant for purchase

decisions, as rational consumers are price-conscious. A study by Kumar et al. (2021) revealed that Indian youth are ready to spend more on sustainable clothing owing to a sense of EC among them. The existing literature (e.g., Nassivera et al., 2017) reports that although consumers are aware but they show a negative intention to make additional efforts in terms of monetary expenditure, as sustainable clothes are being sold at unreasonably high prices. Whereas Belk (1975) found that the consumer's monetary situation hinders the consumer from paying more for sustainable clothing. Therefore, we suggest the following hypothesis.

H_7. WP has a significant and positive effect on the consumers' purchasing intention towards sustainable clothing.

Hedonic Value.

HV is a comprehensive term that covers more than mere experience alone and is defined as the value a consumer receives, which is measured in terms of the subjective feeling of fun and pleasure (Babin et al., 1994). Therefore, we have treated HV as one of the determinants in the extended framework. Human beings tend to search for happiness and the avoidance of displeasure. Today's generation of consumers, being environmentally conscious, shows more interest in buying sustainable clothes. Thus, it is proposed that HV has a positive effect on intention to buy sustainable clothes.

H_8. HV positively and significantly affects consumers' purchase intention towards sustainable clothing.

Purchase Intention (PI) and Purchasing Behaviour (PB).

PI denotes a person's pronounced inclination or readiness to acquire a specific product in the future (Bagozzi, 1981). Consumers' inclination to choose eco-friendly products is primarily shaped by their attitudes (Yadav & Pathak, 2016) and their level of EC (Kumar et al., 2017). Intention refers to a person's readiness to act, while behaviour represents the actual manifestation of that intention (Ajzen & Fishbein, 1969; Bagozzi, 1981; Hassan, 2018; Yadav & Pathak, 2016). Prior research (e.g., Morren & Grinstein, 2016) suggests that the likelihood of intentions translating into actual behaviour is generally higher in developed markets. Nonetheless, the literature remains indeterminate owing to the effect of different socio-cultural contexts. Consumers are more likely to go for eco-friendly products when they develop good feelings about them (Cheah & Phau, 2011). Consequently, individuals who genuinely desire to purchase eco-friendly apparel are more inclined to do so. Recent studies on sustainable consumption have begun to study the mediating role of PI in the link between TPB variables and consumer behaviour. Therefore, we propose the following hypotheses:

H_9. PI significantly influences the consumers' PB towards sustainable clothing.
H_{9a}. PI mediates the relationship between perceived behavioural control and purchase behaviour towards sustainable clothing.

H_{9b}. PI has a mediating effect on the relationship between attitude and purchase behaviour towards sustainable clothing.
H_{9c}. PI has a mediating role in the relationship between subjective norms and purchase behaviour towards sustainable clothing.
H_{9d}. PI positively mediates the relationship between EK and purchase behaviour towards sustainable clothing.
H_{9e}. PI plays a mediating role in the relationship between EC and purchase behaviour towards sustainable clothing.
H_{9f}. PI mediates the relationship between guilt and purchase behaviour towards sustainable clothing.
H_{9g}. PI mediates the relationship between WP and purchase behaviour towards sustainable clothing.
H_{9h}. PI mediates the relationship between HV and purchase behaviour towards sustainable clothing.

Additionally, previous literature has highlighted the gap in studying the PI and purchase behaviour in the sustainable clothing area, clearly implying that more research on both domains is needed as human behaviour evolves. Hence, the present study emphasises investigating the variables that have an effect on a person's intention to opt for sustainable clothing. Relevant existing studies reported the impact of attitude, past buying behaviour, financial risk and peer influence in a sustainable clothing context (Aldilax et al., 2020; Shukla, 2019). However, there seems to be a lack of research that studies the role of EK, EC, guilt, WP and HV in the PI of sustainable clothing in the Indian context (Kuswati et al., 2021; Liu et al., 2020). Therefore, our study added these variables to the extended TPB and incorporated them into the theoretical framework as presented in Figure 1.

Research Methodology

Sample and Data Collection

The primary data were collected from respondents using a closed-ended questionnaire through the purposive sampling method. Each respondent was contacted in person and assured that their answers to questions would remain confidential. Out of the total 288 respondents who initially agreed to participate, usable responses from 282 respondents were retained after excluding six outliers identified through box-plot analysis (see Table 1). To ensure the validity of the survey instrument, a pilot survey was first done with 54 students, and the questionnaire was finalised after due consultation with two academic experts. Items of the latent variables were adapted from the existing literature, and the respondents were requested to mark their responses on a 5-point Likert scale ranging from 1 to 5, with 5 representing 'strongly agree' and 1 'strongly disagree'.

The extant literature suggests a minimum of ten times the maximum number of paths that lead to the endogenous latent variable as a sufficient sample size for PLS-SEM analysis (Hair et al., 2017). However, to ensure robust results, researchers are generally advised to follow more sound and scientific recommendations,

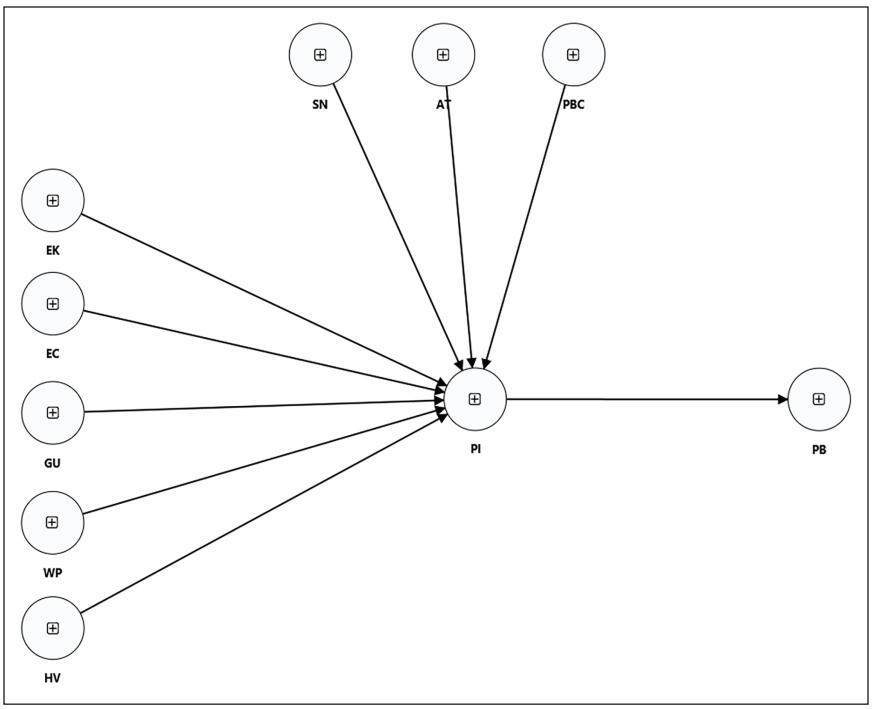

Figure 1. Theoretical Framework.

for example, software like G*Power (Hair et al., 2018), as it considers statistical power and effect sizes into account. A bare minimum sample size of 262 (Figure 2) was suggested as appropriate for the given parameters by G* Power Software (Faul et al., 2009) and data from 288 respondents, which is more than the bare minimum.

Data Analysis

Data were analysed using partial least squares structural equation modelling (PLS-SEM). Previous literature recommends using PLS-SEM since it is appropriate for exploratory research and does not require the assumption of normal distribution of data (Hair et al., 2019). As a data analysis technique, PLS-SEM works well on different sample sizes and is not restrictive in its assumptions (Hair et al., 2011). Therefore, Smart PLS 4 software version 4.1.0.1 (latest) was used.

Results

Common Method Bias

The study, being cross-sectional, is susceptible to common method bias (CMB), which arises from the measurement method rather than the structural relationships within the model. An assessment for CMB was conducted before model

Table 1. Demographic Profile of Respondents.

Demographic Variable	Category	*N* = 282	Percentage
Gender	Male	109	38.7
	Female	173	62.3
Age	20–25	100	35.5
	26–30	161	57.1
	31–35	21	7.4
	36 and above	00	00
Monthly family income	Below 40,000	56	19.9
	41,000–90,000	103	36.5
	91,000–150,000	85	30.1
	Above 150,000	38	13.5
Monthly spending	Below 5,000	197	69.9
	6,000–10,000	75	26.6
	11,000–20,000	10	3.5
	Above 20,000	00	00
Priority in shopping	Quality	186	66
	Cost	58	20.5
	Fashion trend	38	13.5
Frequency of purchase	Festival	23	8.15
	Occasionally	105	37.23
	All around the year	154	54.6

evaluation to address this potential bias. To identify any signs of CMB within the dataset, a complete examination using the full-collinearity approach was done. This approach involves testing the inner VIF values of all constructs vis-a-vis a random dependent variable, with a value exceeding 3.3 indicating the presence of CMB (Kock & Lynn, 2012). All inner VIFs of constructs were less than 3.3, confirming that the data set is free of CMB (Kock, 2015).

Measurement Model Analysis

The measurement model analysis involves evaluating item-level reliability, internal consistency reliability, convergent validity, and discriminant validity (Hair & Alamer 2022). If the outer loadings of an item are higher than 0.708, item-level reliability is confirmed (Hair et al., 2019). Two items related to perceived behavioural controls and one item related to EC had loadings below 0.5 in our study, so we left them out (Hair et al., 2014). We kept items with outer loadings between 0.5 and 0.708, though, because their construct-level AVE was above 0.50 (Hair et al., 2014). Also, as Table 2 shows, five-factor loadings are above 0.6, and the rest are well above 0.708, which means that indicator reliability is confirmed. We used both conservative and liberal measures of Cronbach's α and composite reliability

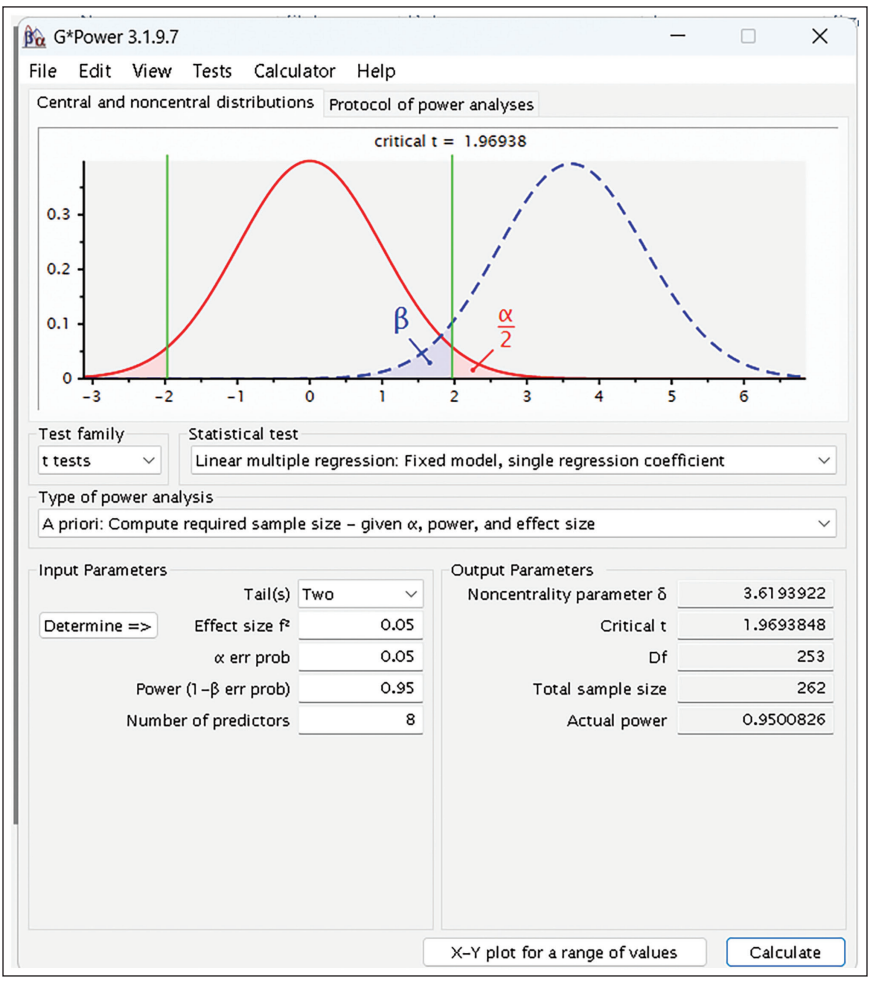

Figure 2. Calculation of Minimum Sample Size.

to check how reliable the constructs were. All latent variables exhibit reliability within the range of 0.70 to 0.95, thereby affirming overall reliability (Dijkstra & Henseler, 2015).

For checking convergent validity, the average variance extracted (AVE) is calculated. This shows how much a latent construct explains item variance and supports its validity. The model's ten constructs all have an AVE greater than 0.5, which confirms that they are all internally convergent and valid. Discriminant validity measures how different each construct in a model is from the others. The heterotrait–monotrait (HTMT) ratio is widely employed in existing literature to check the discriminant validity (Henseler et al., 2015). Our data underwent scrutiny for checking the discriminant validity, with values below 0.85 observed for all constructs in our model, thus affirming discriminant validity (refer to Table 3).

Table 2. Reliability and Validity.

Construct	Outer Loadings	Cronbach's α	Composite Reliability (rho_a)	Composite Reliability (rho_c)	AVE
AT1	0.677	0.84	0.861	0.886	0.61
AT2	0.763				
AT3	0.819				
AT4	0.832				
AT5	0.803				
EC1	0.666				
EC3	0.755	0.846	0.852	0.89	0.62
EC4	0.851				
EC5	0.842				
EC6	0.807				
EK1	0.745				
EK2	0.766				
EK3	0.668	0.86	0.863	0.893	0.545
EK4	0.788				
EK5	0.809				
EK6	0.665				
EK7	0.715				
GU1	0.8				
GU2	0.825				
GU3	0.867	0.895	0.906	0.922	0.703
GU4	0.87				
GU5	0.826				
HV1	0.671	0.839	0.888	0.888	0.668
HV2	0.832				
HV3	0.894				
HV4	0.854				
PB1	0.665				
PB2	0.73				
PB3	0.768				
PB4	0.755	0.869	0.897	0.897	0.556
PB5	0.724				
PB6	0.816				
PB7	0.752				
PBC2	0.673				
PBC3	0.794	0.704	0.734	0.816	0.529

(Table 2 continued)

(Table 2 continued)

Construct	Outer Loadings	Cronbach's α	Composite Reliability (rho_a)	Composite Reliability (rho_c)	AVE
PBC4	0.793				
PBC5	0.634				
PI1	0.767				
PI2	0.717				
PI3	0.846	0.916	0.92	0.932	0.631
PI4	0.758				
PI5	0.792				
PI6	0.766				
PI7	0.865				
PI8	0.834				
SN1	0.787				
SN2	0.782				
SN3	0.799	0.917	0.993	0.929	0.653
SN4	0.755				
SN5	0.883				
SN6	0.764				
SN7	0.877				
WP1	0.811				
WP2	0.867	0.91	0.919	0.933	0.735
WP3	0.856				
WP4	0.893				
WP5	0.857				

Table 3. HTMT Criterion.

	AT	EC	EK	GU	HV	PB	PBC	PI	SN	WP
AT										
EC	0.525									
EK	0.536	0.283								
GU	0.373	0.569	0.385							
HV	0.15	0.202	0.223	0.262						
PB	0.382	0.455	0.333	0.567	0.189					
PBC	0.515	0.576	0.356	0.535	0.102	0.384				
PI	0.657	0.44	0.532	0.574	0.298	0.422	0.415			
SN	0.317	0.435	0.192	0.286	0.226	0.254	0.526	0.207		
WP	0.4	0.487	0.326	0.599	0.154	0.475	0.466	0.509	0.312	

Structural Model Assessment

The first step in assessing the structural model is checking for inner VIF values to detect multicollinearity problems. In the study, VIF values fall below 3, thus ruling out the problem of multicollinearity (Hair et al., 2019). Next, assessing the structural model involves examining the R^2, which indicates the explanatory capacity of a model, and f^2, which indicates the effect size of exogenous variables on endogenous ones (Cohen, 1988), as detailed in Table 4. The R^2 value (Table 4) stands at 0.168, revealing that the exogenous variables cause 16% of the dependent variable's variance. After that, the f^2 values were used to find out how big the effect of each exogenous variable was. The f^2 values for attitude and PI had a big effect on both PI and purchase behaviour, with values of 0.201. However, other constructs have little to no effect on PI. The hypotheses are assessed by conducting bootstrapping functions with 10,000 subsamples at a 5% significance level. Table 4 shows the results of the structural model. It shows that all of the direct relationships are important, except for the ones from environmental consciousness (EC) to PI, purchase behaviour control (PBC) to PI, and subjective norms (SI) to PI. Consequently, hypotheses H_1, H_3, H_4, H_5, H_7 and H_9 are accepted, but H_2, H_6 and H_8 are not. After that, we used mediation analysis to see if there was a mediation effect. For these to be significant, two conditions had to be met: the total effect of the relationship between the exogenous and endogenous variables had to be significant. The subsequent step is to figure out how important the indirect effect between independent and dependent constructs is through the mediating variable. When these two criteria are met, the mediating variable has a full mediating effect between the independent variable and the dependent variable. If the direct effect of an outside variable on an inside variable is strong when the mediator is there, the mediator is said to have a partial mediating effect (Hayes, 2009; Khan et al., 2022). Table 4 shows how PI affects the relationship between exogenous variables (PBC, AT, SN, EK, EC, GU, WP and HV) and endogenous variables (PB). The insignificant effects are PBC, SN and EC. Because of this, the mediation relationships suggested in H_{9b}, H_{9d}, H_{9f}, H_{9g} and H_{9h} are confirmed, but the other mediation hypotheses do not have enough evidence to support them. In addition, Q^2 values are used to check the model's ability to make predictions on data. Q^2 shows the predictive exactness of the model, and the values must be above 0 for any endogenous construct to establish the out-of-sample predictive exactness of the model (Hair et al., 2019), so the values of 0.2 and 0.5 (as shown in Table 4), that is, 20% and 50%, confirm the out of the sample predictive power of the model. Moreover, the overall model has a good model fit with an SRMR value less than 0.10.

Importance–Performance Analysis (IPMA).

To strengthen and enhance the interpretation of path coefficients, Smart PLS has introduced a novel feature known as IPMA (Ringle & Sarstedt, 2016). IPMA shows the relative significance of all constructs in the model, gauged by their aggregate effects, juxtaposed with overall performance as indicated by their average variable scores (Ringle & Sarstedt, 2016). The primary purpose of IPMA is to

Table 4. Structural Model Results.

Hypothesis	Path	Coefficient	T statistics	*p* Values	Inference	f^2	R^2	Q^2	SRMR
H_1	PBC -> PI	0.02	0.351	.726	Not supported	0.001			
H_2	AT -> PI	0.388	7.145	.000	Supported	0.201			
H_3	SN -> PI	−0.064	1.382	.167	Not supported	0.007			
H_4	EK -> PI	0.144	2.82	.005	Supported	0.032			
H_5	EC -> PI	0.004	0.076	.939	Not supported	0			
H_6	GU -> PI	0.246	4.643	.000	Supported	0.073			
H_7	WP -> PI	0.145	2.716	.007	Supported	0.029			
H_8	HV -> PI	0.145	3.583	.000	Supported	0.04			
H_9	PI -> PB	0.409	7.778	.000	Supported	0.201			
H_{9a}	PBC -> PI -> PB	0.008	0.339	.735	Not supported				
H_{9b}	AT -> PI -> PB	0.159	5.356	.000	Supported				
H_{9c}	SN -> PI -> PB	−0.026	1.316	.188	Not supported				
H_{9d}	EK -> PI -> PB	0.059	2.626	.009	Supported				
H_{9e}	EC -> PI -> PB	0.002	0.074	.941	Not supported				
H_{9f}	GU -> PI -> PB	0.101	3.688	.000	Supported				
H_{9g}	WP -> PI -> PB	0.06	2.458	.014	Supported				
H_{9h}	HV -> PI -> PB	0.059	3.607	.000	Supported				
	PB						0.17	0.2	
	PI						0.53	0.5	
	Model fit SRMR								0.08

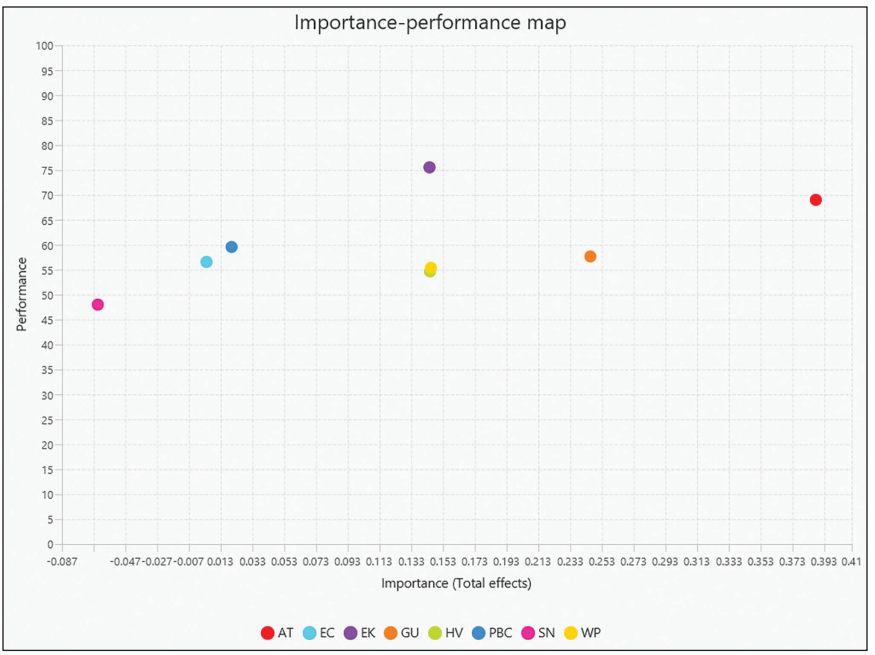

Figure 3. Importance–Performance Analysis Map.

show the constructs that have high importance yet exhibit low performance. In the IPMA Map (Figure 3), constructs positioned towards the right signify heightened importance. Policymakers and stakeholders of an entity should prioritise those constructs marked by high importance and low performance. While EK demonstrates the highest performance, its importance is relatively low. Therefore, practitioners are required to pay maximum attention to that construct. Practitioners should pay relatively less attention to constructs on the higher side than those on the right lower side (Ringle & Sarstedt, 2016). The construct of subjective norms should be accorded the least attention as it lies lowest in both importance and performance.

Discussion

Our findings reveal that variables such as attitude, guilt, WP and HV occupy a pivotal place in creating sustainable clothing PIs among consumers. The study reported that perceived behavioural control, subjective norms, and EC have no significant bearing on purchasing intention for sustainable clothing, which implies that consumers do not perceive subjective norms, EC and perceived behavioural control to be substantial for intention to purchase sustainable clothing. The findings also reveal that HV for sustainable clothing significantly and positively affected sustainable purchasing intention. Moreover, variables like purchasing intention and purchase behaviour have a positive and significant relationship,

signalling that modern youth positively translate their purchasing intention into purchase behaviour, and no intention–behaviour gap prevails. The study has attempted to bridge the significant gap in purchasing intention and PB for sustainable clothing by investigating the mediating effect of planned and extended planned behaviour variables. To the best of our understanding, this study is the first to incorporate the additional variables into the extended TPB and examine their total effect on PI in an integrated framework.

Conclusion

Our study adds fresh perspectives to the existing literature on sustainable clothing by expanding the TPB. It highlights the importance of understanding how younger consumers engage with sustainable fashion, a group that often drives trends and shapes market shifts. By applying a well-established theoretical framework known for explaining pro-environmental behaviours, such as the adoption of sustainable clothing, the research demonstrates that extending the traditional TPB model with additional variables can provide a richer and more nuanced understanding of consumer behaviour. Another important part is using mediation analysis, which makes it easier to present the results. Prior studies have reported that concentrating solely on direct relationships may neglect significant mediating effects, potentially resulting in incomplete conclusions (Nitzl et al., 2016). In this research, PI serves as a mediator connecting different elements of the TPB with actual sustainable clothing PB. Additionally, our research employed advanced techniques, including IPMA, a method infrequently utilised in PLS-SEM studies (Zahari & Esa, 2018). The IPMA assists professionals and marketers in determining the most significant and effective factors for practical implementation. The results show that marketers and policymakers need to focus on the variables that have the biggest effect on outcomes. Marketers should especially think about making campaigns that raise awareness on environmental issues that make youth realise the importance of conserving the environment. The analysis shows that EK should be given more importance because it is very important, but is not being used as much as it should be. Finally, marketers of sustainable clothing need to remember that modern youth not only prefer eco-friendly products; they also care about fashion and style.

Limitations and Future Research Agendas

It is important to acknowledge the limitations of any study, even though this study offers some insightful knowledge on youth intention to purchase sustainable clothing. These limitations offer avenues for potential study to build upon and improve the results. First, our study is confined to exploring the factors that affect PI and behaviour by youth towards sustainable clothing; the study overlooks other intervening variables that may affect this dynamic. Therefore, further studies should broaden the scope by analysing the effect of other intervening factors that may affect this relationship. Next, the current study has taken youth as

respondents, and future studies can do a comparative analysis of various sections of society to bring out more insightful results. Moreover, this study has concentrated on the clothing industry in India; similar studies could be done in other sectors and economies, like sustainable energy in developed countries, which may feature diverse consumer profiles, thereby improving the generalisability of the findings. Future studies can expand upon the existing constructs by incorporating additional variables into the TPB. Lastly, the present study's cross-sectional design provides a moment in time, making it hard to assess how the relationship among various determinants of PI and actual purchase behaviour changes over the period of time. Therefore, to address this problem, a longitudinal approach may be undertaken in the future. The above-mentioned limitations of the current study point to constructive directions for future studies. In spite of its limitations, the study contributes significantly to the body of research on how people buy clothes in a way that is good for the environment.

Declaration of Conflicting Interests

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