Journal of Informatics Education and Research
ISSN: 1526-4726
Vol 4 Issue 2 (2024)

Artificial Intelligence (AI) Revolution in Real Estate and Real Estate Investment Trust (Reits): A Comprehensive Analysis (1989–2023)

Siddhant Walia[1*], Subhabaha Pal[1], Sankersan Sarkar[2] and Birajit Mohanty[1]

*Corresponding author: siddhant.walia@jaipur.manipal.edu

1 Manipal University Jaipur, Jaipur, Rajasthan, India

2 School of Business & Economics, Adamas University, Kolkata, India

Abstract

This research paper provides a thorough examination of the convergence of artificial intelligence (AI) with the real estate industry, specifically focused on the timeframe spanning from 1989 to 2023. The study aims to investigate five fundamental research inquiries in order to examine the development, patterns, and theme clusters within this constantly evolving domain. The research utilizes bibliometric and cluster analysis techniques, with Scopus serving as a key database. Data analysis is conducted using VOSviewer and biblioshiny. The results demonstrate a substantial yearly increase of 8.29% in publications relevant to AI, indicating a steady and continuous rise in research activities. The study highlights the current and significant emphasis on AI in the real estate sector, as seen by an average paper age of 5.79 years and an average citation rate of 14.82. The inclusion of prominent journals, such as "Expert Systems with Applications" and the "Journal of Property Investment and Finance," signifies the integration of multiple disciplines. A phrase frequency analysis reveals the significance of terms such as "artificial intelligence," "decision support systems," and "neural networks," underscoring their vital roles in decision-making and forecasting. The research is organized into three primary themes: the incorporation of AI into the process of real estate valuation, progress in machine learning techniques for optimization, and the application of AI to improve predictive modeling. The thematic clusters examine various viewpoints and cutting-edge approaches within the wider framework of AI and the real estate industry. The report continues by delineating six prospective areas for future research, encompassing AI-fueled predictive analytics, property management operations, sustainable smart buildings, real estate transactions, AI-driven consumer experiences, and ethical considerations. Overall, this research offers useful insights into the bibliometric characteristics, research patterns, and prospective areas for future investigation at the interface of AI and the real estate sector. The collaborative and interdisciplinary nature of this emerging sector demonstrates the significant influence of AI on influencing the future of the property industry and real estate investment trusts (REITs).

Keywords: real estate, REIT, artificial Intelligence, bibliometric analysis, cluster analysis, property

1. Introduction

The substantial influence of artificial intelligence (AI) on several sectors has proven revolutionary, fundamentally altering traditional paradigms across industries. AI has become a crucial factor in the property industry, including related domains such as real estate investment trusts (REITs), by bringing about remarkable improvements in efficiency, accuracy, and creativity. The impact of technology can be seen in a wide range of applications, such as using predictive analytics to improve property appraisals and using machine learning algorithms to streamline property management procedures. This has led to a significant transformation in real estate practices. The use of AI not only improves operational efficiencies but also has a significant impact on decision-making processes, investment strategies, and the whole structure of the real estate market. The real estate market has experienced heightened interest in AI applications due to the introduction of AI portals, such as ChatGPT, which have showcased significant breakthroughs. These AI interfaces, designed to be easy for users to interact with, demonstrate the capabilities of natural language processing and machine learning algorithms. They enable more interactive and intelligent interactions between humans and machines. The availability of these sophisticated AI capabilities has made involvement with the technology more accessible, drawing interest from professionals, researchers, and fans alike. This has led to a significant increase in interest, indicating a wider movement towards making AI more accessible and practical in other disciplines. As a result, the collaboration between AI and the property industry is entering a new phase marked by increased interest, exploration, and the expectation of significant advancements, thus broadening the scope of AI's influence on the real estate field. To effectively plan future research in AI within the real estate and REIT sector, it is crucial to fully understand the current knowledge in this field. This research aims to address this requirement by analyzing previous studies that have investigated the convergence of AI with the real estate and REIT sector. The study seeks to investigate five distinct research issues, each intended to shed light on various aspects of the current literature and establish a basis for future investigations in this dynamic and growing field. The five research questions that the current seeks to address are:

RQ1: How has research on AI in property sector evolved, and what contributed to notable changes in publication activity?

RQ2: Which journals lead in publishing AI and property sector research, and how does this reflect interdisciplinary collaboration?

RQ3: What terms are frequently used in AI and real estate research, and how do they highlight key areas of focus?

RQ4: What are the main themes and research topics that have been explored in the literature on AI in the property sector?
RQ5: What are the gaps and opportunities for future research in the field of AI in real estate sector and related domain of REIT?

2. Research Methodology

In this research paper, we have followed a systematic approach to analyze this topic using bibliometric and cluster analysis. To gather relevant information, we chose the Scopus database for its comprehensive coverage of scientific disciplines, including business and real estate. We then used Microsoft Excel, VOSviewer, and biblioshiny (Aria & Cuccurullo, 2017) for data analysis, visualizing trends and identifying key contributors and themes. Our search strategy focused on retrieving journal papers published in English. Through bibliographic coupling, we formed clusters to highlight three research themes. Finally, we proposed future research directions based on the analysis. The visualizations we created helped present the findings in an easily understandable manner, providing valuable insights into the world of commercial real estate investment research.

2.1. Visualization and bibliometric tools

The collected data underwent analysis using Microsoft Excel, VOSviewer, and biblioshiny, involving cleaning, graph management, and chart creation in Microsoft Excel. VOSviewer and biblioshiny, recognized tools for bibliometric mapping and network visualization, were employed to visualize textual data. These widely acknowledged software solutions enable researchers to identify research themes through keyword clusters. The study utilized in bibliographic coupling in VOSviewer. Bibliographic coupling assessed thematic connections among papers with shared cited references, offering insights into the current state of knowledge and guiding future research. Additionally, biblioshiny, a web-based interface for bibliometric analysis, was employed to scrutinize the top publication trend, top journals and frequently used terms in the chosen research area.

2.2. Search strategy

The research used a specific search string to retrieve relevant articles that focus on the intersection of “Artificial Intelligence”, “Property”, “Real estate” and “REIT”. By incorporating these different terms, the search aims to capture a comprehensive range of articles that explore the relationship between property sector, REIT, and AI. Initially, 405 documents were identified covering the time from 1986 to 2023. The language was further restricted to English and to ensure the analysis focused on high-quality sources, only articles were included, reducing the number to 136. This extracted database was then analysed using biblioshiny and VOSviewer. Finally, 29 papers chosen from bibliometric analysis as part of three cluster were manually reviewed for finding future scope of research and establishing current research trajectory in this area.

2.3. Summary Information

The data extracted from biblioshiny, using the bibiliometrix R package for Scopus data on AI, property, and REITs, offers a comprehensive overview with a specific emphasis on publications that meet certain inclusion criteria. The dataset covers the time period from 1989 to 2023 and encompasses data from 108 diverse sources, including journals and books. This compilation amounts to a total of 136 documents. The yearly growth rate of 8.29% signifies a consistent and substantial increase in research over a period of time. The average age of the paper, which is 5.79 years, indicates a recent emphasis on AI, property, and REITs. On average, each document is cited 14.82 times, indicating the research's relevance and influence in the scientific community. The dataset contains 5909 references, demonstrating the extensive integration of information. Keywords Plus (ID) and Author’s Keywords (DE) provide more information regarding the content of the document. Keywords Plus (ID) denotes terms recognized by Scopus to augment the detectability of publications, offering an extensive array of descriptors that beyond author-assigned keywords. The Author’s Keywords (DE) are selected by the authors themselves to encapsulate the main ideas of their work. These components enhance a more intricate comprehension of the fundamental issues and ideas examined in the English-language literature on AI, property, and REITs. The participation of 421 writers, with 24 generating documents as sole authors, highlights the cooperative aspect of research in this field. Typically, each document has an average of 3.33 co-authors, and 20.59% of these co-authors are from different countries. This highlights the importance of worldwide collaboration in the AI, property, and REITs research community. The dataset consists mostly of 136 articles, indicating the high occurrence of this document type in scholarly production.

In summary, Table 1 offers a detailed overview of the bibliometric attributes of the study field, providing vital information on the expansion, cooperation, and substance of works pertaining to AI, property, and REITs that satisfy certain inclusion criteria.

Table 1: Summary of Information of SCOPUS data

Description	**Results**	
Main information about data	Timespan	1989 to 2023
	Sources (journals, books, etc)	108
	Documents	136
	Annual GROWTH Rate %	8.29
	Document average age	5.79
	Average citations per doc	14.82
	References	5909
Document contents	Keywords Plus (ID)	850
	Author's Keywords (DE)	510
Authors	Authors	421
	Authors of single-authored docs	24
Authors collaboration	Single-authored docs	26
	Co-Authors per Doc	3.33
	International co-authorships %	20.59
Document types	Article	136

2.4. Annual research publication rate

The annual research publication rate, as depicted in table 1, illustrates a remarkable evolution in the field of AI within the property sector over the years. In the early years, from 1989 to the late 1990s, there was minimal to no publication activity. However, starting in the late 1990s and early 2000s, there is a noticeable increase, with occasional spikes in the number of articles. The momentum picks up notably around 2008, with a surge in publications that continues into the following years.

In recent years, particularly from 2016 onward, there is a substantial acceleration in research output focusing on the intersection of AI and the property sector. The year 2022 stands out with a significant increase, and the trend continues into 2023, reaching the highest publication rate in the provided data. This surge in research publications indicates a growing and sustained interest in the application of AI in the property sector, with a particular emphasis on the years 2018–2020, and 2022. The increasing numbers suggest an emerging and intensified focus on leveraging AI technologies within the property sector during this period (Figure 1).

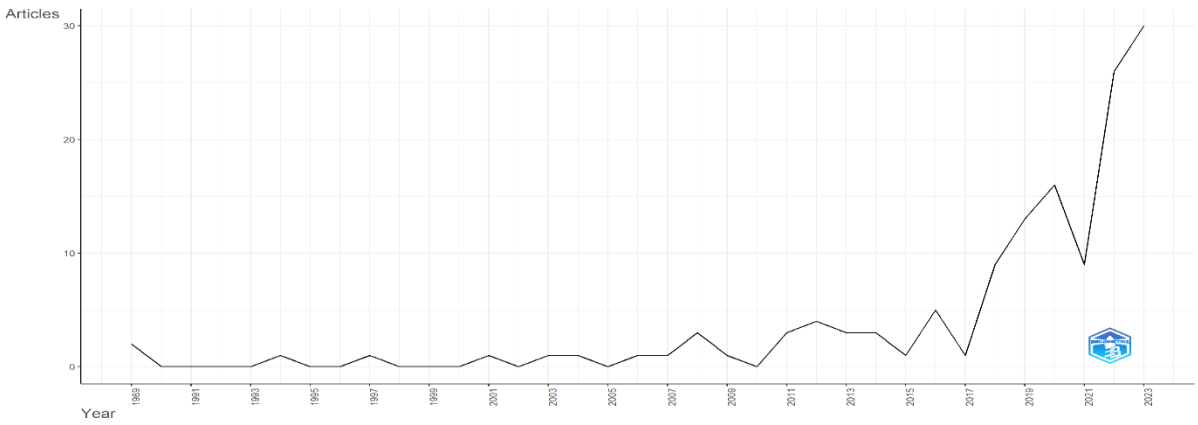

Figure 1: Annual scientific production

2.5. Top publishing journals

The Scopus data reveal the top 10 journals that significantly contribute to the dissemination of research related to AI in the field of Property and REITs. "Expert Systems with Applications" and the "Journal of Property Investment and Finance" emerge as the leading journals, each publishing seven articles. "Electronics (Switzerland)" follows closely with four articles, while the "Journal of Housing and the Built Environment" and "Sustainability (Switzerland)" both contribute three articles. These journals, spanning a variety of disciplines, act as key platforms for researchers exploring the intersection of AI, property, and REITs. This information is relevant as it provides valuable insights for scholars, practitioners, and policymakers seeking to stay abreast of the latest developments and trends in this dynamic field. Identifying the most prolific journals facilitates efficient literature reviews and enables stakeholders to target their efforts for accessing and contributing to the most impactful research in the AI and property-related domain (Figure 2).

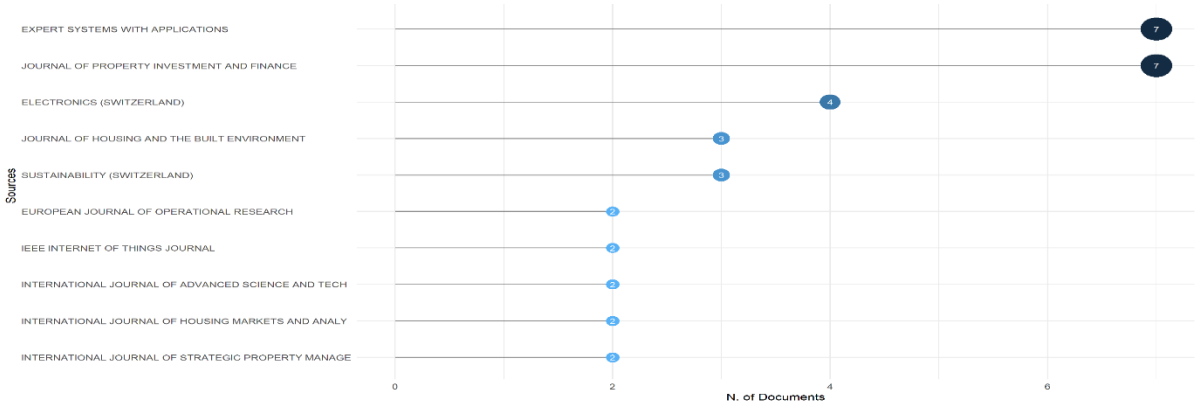

Figure 2: Most relevant sources

2.6. Most frequently used terms

The table presents the frequency of specific terms within the exported data related to AI and real estate. Notably, "AI" occurs most frequently with 59 mentions, underscoring its prominence in the discourse. Other key terms include "decision support systems" with 21 occurrences, "decision making" with 15, and "neural networks" with 12. Additionally, both "real estate" and "real-estates" are mentioned 12 times collectively, emphasizing the relevance of these terms in the context of AI applications. "Learning systems" and "machine learning" each occur 10 times, showcasing the significant focus on AI-driven learning methodologies. The terms "costs" and "forecasting" are also notable, with nine and eight occurrences, respectively. This table provides a valuable snapshot of the prevalent themes and keywords within the dataset, offering insights into the key areas of research emphasis in the intersection of AI and real estate (Figure 3).

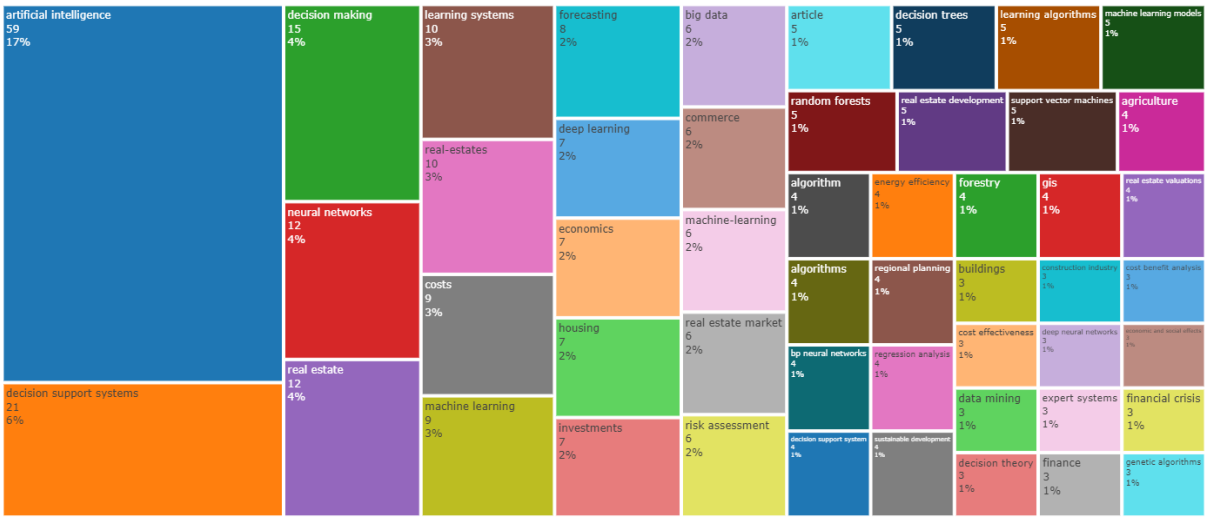

Figure 3: Frequency of specific terms

2.7. Bibliographic coupling and cluster analysis

Bibliographic coupling is a method used to analyze the references cited in various articles. It is different from co-citation analysis, where two articles are cited together in a third article. In this study, bibliographic coupling was conducted using a tool called VoSviewer. The goal was to form clusters of studies that share a common theme based on the references they have in common. From a total of 136 articles, 29 articles were selected, which had minimum 20 total link strength. These 29 articles were divided into three clusters based on their selection and citation patterns. The clusters are discussed in detail in next section, highlighting the main objectives of the studies conducted in each cluster (Figure 4).

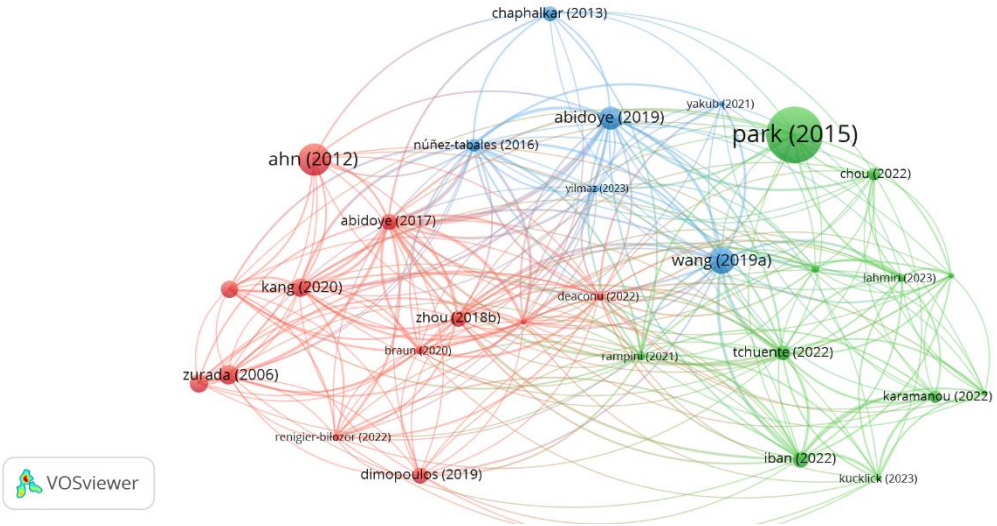

Figure 4: Bibliographic coupling

2.7.1. Cluster 1: Integration of artificial intelligence in real estate valuation and appraisal

This cluster of papers extensively explores the widespread integration of AI in various facets of the real estate industry, particularly focusing on property valuation. The overarching objective of each publication within this cluster is to enhance the accuracy, efficiency, and overall effectiveness of real estate appraisal operations. Emphasizing the improvement of decision-making abilities, forecasting techniques, and an in-depth understanding of market dynamics in the property sector, these papers collectively contribute to the advancement of AI applications in real estate and associate sector like REITs. Abidoye and Chan (2017) investigate the readiness of Nigerian valuers to adopt AI methods in property valuation, emphasizing the necessity for cooperation between local professional groups and international entities. Subsequent papers build on this foundation, introducing innovative methodologies and strategies. For instance, Ahn, Byun, Oh, and Kim (2012) introduces GA-Ridge, addressing the ongoing discourse between AI and multiple linear regression in real estate appraisal forecasting, specifically focusing on the identification of relevant predictor variables. In their 2020 study, Braun, Hausler, and Schäfers extends its focus by employing an artificial neural network to extract market sentiment from real estate news stories, establishing a crucial connection between sentiment analysis and changes in direct property market liquidity in the USA. This study unveils the enduring impact of emotion on liquidity, influencing investment choices. Furthermore, The investigation by Deaconu, Buiga, and Tothăzan (2022) did a comparative examination of Artificial Neural Networking (ANN) and Generalized Linear Model (GLM) in forecasting apartment selling values in Cluj-Napoca, Romania, confirming the superior predictive ability of ANN. Subsequent papers in the cluster offer diverse viewpoints and approaches, addressing various topics such as bridging the gap between academic research and practical implementation of machine learning models in mass appraisals (Dimopoulos & Bakas, 2019), creating predictive models for real estate auction prices using regression, artificial neural networks, and genetic algorithms (Kang et al., 2020), suggesting an adaptive random forest algorithm to mitigate biases in traditional valuation methods (Laskin & Gadasina, 2022), investigating the use of case-based reasoning as a computer-assisted valuation tool (O'Roarty et al., 1997), and introducing AI, machine learning, and computer vision to evaluate real estate attributes based on investor emotions (Renigier-Biłozor et al., 2022). Starr et al. (2021) explores the implementation of Industry 4.0 technologies, including IoT, cloud computing, and AI, in the commercial real estate sector, introducing the concept of Real Estate 4.0. Additionally, Zhou et al. (2018) examines the application of artificial neural networks in the real estate industry, emphasizing the need for further study to enhance their effectiveness, particularly in mass assessment in China's real estate sector. Finally, Zurada et al. (2006) addresses challenges in accurately assessing property values, presenting alternative approaches such as fuzzy logic and

memory-based reasoning, emphasizing the importance of feature reduction. Overall, this cluster represents a diverse array of ideas and approaches that contribute significantly to the ongoing discourse on incorporating AI into real estate appraisal.

2.7.2. Cluster 2: Advancements in machine learning and artificial intelligence for real estate optimization

The cluster of these papers focuses on applying machine learning (ML) and AI in real estate, specifically in property evaluation and price prediction. Each article explores how modern computational approaches enhance accuracy, efficacy, and transparency in real estate assessment operations. Abidoye and Chan (2018) addresses discrepancies in a visitor-influenced real estate market, using algorithms like k-nearest neighbors, random forest, and support vector machines for forecasting. Baur, Rosenfelder, & Lutz (2023) analyzes various ML models for real estate value forecasting, emphasizing the integration of textual data from property descriptions. Chou, Fleshman, & Truong (2022) introduces a hybrid model combining artificial neural networks, particle swarm optimization, and bagging for property price prediction, outperforming individual models. Iban (2022) emphasizes transparency in large-scale real estate evaluations through eXplainable AI (XAI) methodologies. In their study, Karamanou et al. (2022) utilizes connected Open Government Data (OGD) and ML (XGBoost and XAI) to improve forecast accuracy and reveal influencing factors. Research conducted by Kucklick and Müller (2023) addresses multi-view deep learning challenges, introducing the Grad-Ram technique for improved interpretability. Study by Lahmiri, Bekiros, and Avdoulas (2023) compares ensemble regression trees, support vector regression, and Gaussian process regression for housing price forecasting, with boosting ensemble regression trees proving most successful. In their investigation Park and Bae (2015) develops a model using C4.5, RIPPER, Naïve Bayesian, and AdaBoost, highlighting RIPPER's superior accuracy in housing price estimation. Rampini and Re Cecconi (2022) employs ElasticNet, XGBoost, and Artificial Neural Network for housing value prediction, confirming the efficacy of artificial neural networks. Sandeep Kumar et al. (2019) introduces a machine learning framework for real estate investment decisions, comparing decision trees, PCA, and K-means clustering, and assessing the efficacy of neural networks. Tchuente and Nyawa (2022) conducted research evaluates real estate price estimation in France using seven ML algorithms, emphasizing the importance of geographic characteristics and geocoding methodologies. Overall, these papers demonstrate a strategic shift toward advanced computational methods, particularly ML and AI, as essential tools for enhancing precision, transparency, and effectiveness in real estate valuation and price prediction. They contribute vital insights into the ongoing evolution of real estate and REIT operations through cutting-edge technical paradigms.

2.7.3. Cluster 3: Harnessing artificial intelligence and machine learning for enhanced real estate predictive modelling

In this cluster, researchers actively explore novel techniques utilizing AI and Machine Learning (ML) models to address significant challenges in the real estate industry, focusing on the development of prediction models for property values. This research area is highly relevant to stakeholders, including investors, property owners, and legislators. Analysing key findings from each publication unveils the intricate features of this research endeavour. Abidoye et al. (2019) through their study aim to predict the Property Price Index (PPI) using AI techniques, specifically Artificial Neural Networks (ANN) and Support Vector Machines (SVM), offering insights into the factors influencing property values in Hong Kong. It serves as a valuable resource for policy and strategy formulation in real estate investments. Chaphalkar and Sandbhor (2013) delves into AI techniques for property valuation, investigating their accuracy in predicting returns and risks associated with real estate investments. Emphasizing Artificial Neural Networks (ANN) and fuzzy logic, this study contributes practical insights for investors and property owners. In their study, Núñez-Tabales et al. (2016) employs AI, particularly ANN, to explore Commercial Property Valuation in Cordova, Spain, demonstrating the capability of ANN models in handling non-linearities and reducing valuation errors. Wang and Li (2019) provides a comprehensive analysis of the evolution of mass appraisal models, revealing a trend towards hybrid models, geographic information systems (GIS), and AI-based models, shaping the future of mass appraisal. Yakub et al. (2021) through their research introduces an Integrated Approach for Price Prediction, presenting the ANFIS-AN model that outperforms ANN in accuracy metrics, promising improved accuracy of price forecast algorithms for the real estate market. Finally, Yilmaz and Mert (2023) in their study presents the Adaptive-Neuro-Fuzzy-Inference-System Grading Model (ANFISGM) for evaluating the quality of residential properties, proving its accuracy and utility compared to conventional methods. Collectively, these papers contribute to the academic focus on applying AI and ML techniques to enhance predictive models and valuation procedures in the real estate industry, fostering a more informed and technologically advanced environment for real estate professionals.

3. Future direction of research: AI in property sector

The incorporation of AI in the real estate industry offers a wide range of opportunities for future investigation, covering six crucial domains that have substantial potential for creativity and progress. AI-powered predictive analytics has the potential to transform market forecasting by enabling real estate and REIT developers and investors to make well-informed decisions through the analysis of historical data, market patterns, and economic indicators. The rapid development of AI can be boon for REIT sector of developing countries such as India, where REITs have been only recently introduced (Walia

et al., 2023). This study topic could concentrate on improving algorithms to increase precision and offer more sophisticated forecasts, ultimately enhancing investing methods. Furthermore, the implementation of AI in property management operations is a highly promising field. Potential future investigations may focus on the creation of sophisticated systems that can effectively manage everyday responsibilities, such as lease administration, maintenance planning, and tenant correspondence. The objective is to optimize operations, minimize expenses, and improve overall efficacy for property managers and owners. Furthermore, the intersection of AI technology and sustainable smart buildings is an emerging area of study. Subsequent studies may prioritize the advancement of AI systems that maximize energy efficiency, oversee building functionality, and improve ecological sustainability. This may entail developing sophisticated algorithms to control heating, ventilation, and air conditioning (HVAC) systems, along with conducting predictive maintenance to minimize energy inefficiency. Furthermore, the utilization of AI in real estate transactions presents a promising field for investigation. Subsequent investigations may prioritize the enhancement of automated valuation models (AVMs) using AI, with the aim of augmenting precision in property assessment and mitigating dangers linked to appraisal differences. In addition, the development of AI systems for contract review and due diligence processes has the potential to accelerate transaction timeframes and minimize the risk of errors. Additionally, investigating the advancement of AI-powered customer experiences in the real estate industry is an essential area of study for future research. This may entail the creation of virtual assistants, chatbots, or AI-driven customer care platforms that improve communication and interaction at every stage of the real estate process. Research could investigate methods to individualize interactions, predict client requirements, and deliver a smoother experience for purchasers, vendors, and lessees. Finally, the moral considerations about AI in real estate industry necessitate focused study endeavors. Potential future research endeavors may focus on examining concerns pertaining to data privacy, algorithmic bias, and the societal ramifications of AI-powered decision-making in the real estate sector. Exploring this field of study is essential for building ethical principles and frameworks that guarantee responsible and fair implementation of AI in the enterprise.

4. Conclusion

This paper offers a thorough investigation into the development and advancement of AI research in the property industry from 1989 to 2023. The analysis examines five important research questions and reveals a notable yearly growth rate of 8.29% in publications related to AI and property. This indicates a consistent rise in research activity. The mean age of articles, which is 5.79 years, highlights the recent focus on AI in the field of real estate. Additionally, with an average of 14.82 citations per document, the research demonstrates the significance and impact of AI in the scientific community. The inclusion of prominent journals such as "Expert Systems with Applications" and the "Journal of Property Investment and Finance" not only demonstrates the vitality of research platforms, but also implies the existence of interdisciplinary cooperation among different fields of study. The term frequency analysis highlights the prevalence of "artificial intelligence", "decision support systems", and "neural networks" in the real estate field, underscoring their significance in decision-making, learning systems, and forecasting. Thematic clusters, such as the incorporation of AI in real estate valuation, progress in machine learning for optimization, and utilization of AI for improved predictive modeling, provide valuable perspectives on the primary themes and research subjects. In addition, the study highlights six potential areas for further research in AI and the property industry. These areas include predictive analytics, property management operations, sustainable smart buildings, real estate transactions, AI-driven customer experiences, and ethical considerations. In summary, these findings enhance our comprehension of bibliometric characteristics, research patterns, and possible avenues in the fields of AI and real estate. This information benefits present stakeholders and establishes a significant basis for future research in this fast progressing domain. The collaborative nature of interdisciplinary efforts and the focus on pioneering AI applications highlight the profound impact that AI can have on influencing the future of the property industry and associated domains of REIT.

References

1. Abidoye, R. B., & Chan, A. P. (2017). Valuers' receptiveness to the application of artificial intelligence in property valuation. *Pacific Rim Property Research Journal*, *23*(2), 175–193.
2. Abidoye, R. B., Chan, A. P., Abidoye, F. A., & Oshodi, O. S. (2019). Predicting property price index using artificial intelligence techniques: Evidence from Hong Kong. *International journal of housing markets and Analysis*, *12*(6), 1072–1092.
3. Ahn, J. J., Byun, H. W., Oh, K. J., & Kim, T. Y. (2012). Using ridge regression with genetic algorithm to enhance real estate appraisal forecasting. *Expert Systems with Applications*, *39*(9), 8369–8379.
4. Aria, M., & Cuccurullo, C. (2017). bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of informetrics*, *11*(4), 959–975.
5. Baur, K., Rosenfelder, M., & Lutz, B. (2023). Automated real estate valuation with machine learning models using property descriptions. *Expert Systems with Applications*, *213*, 119147.

6. Braun, J., Hausler, J., & Schäfers, W. (2020). Artificial intelligence, news sentiment, and property market liquidity. *Journal of Property Investment & Finance*, *38*(4), 309–325.
7. Chaphalkar, N. B., & Sandbhor, S. (2013). Use of artificial intelligence in real property valuation. *International Journal of Engineering and Technology*, *5*(3), 2334–2337.
8. Chou, J. S., Fleshman, D. B., & Truong, D. N. (2022). Comparison of machine learning models to provide preliminary forecasts of real estate prices. *Journal of Housing and the Built Environment*, *37*(4), 2079–2114.
9. Deaconu, A., Buiga, A., & Tothăzan, H. (2022). Real estate valuation models performance in price prediction. *International Journal of Strategic Property Management*, *26*(2), 86–105.
10. Dimopoulos, T., & Bakas, N. (2019). Sensitivity analysis of machine learning models for the mass appraisal of real estate. Case study of residential units in Nicosia, Cyprus. *Remote Sensing*, *11*(24), 3047.
11. Iban, M. C. (2022). An explainable model for the mass appraisal of residences: The application of tree-based machine learning algorithms and interpretation of value determinants. *Habitat International*, *128*, 102660.
12. Kang, J., Lee, H. J., Jeong, S. H., Lee, H. S., & Oh, K. J. (2020). Developing a forecasting model for real estate auction prices using artificial intelligence. *Sustainability*, *12*(7), 2899.
13. Karamanou, A., Kalampokis, E., & Tarabanis, K. (2022). Linked open government data to predict and explain house prices: the case of Scottish statistics portal. *Big Data Research*, *30*, 100355.
14. Kucklick, J. P., & Müller, O. (2023). Tackling the accuracy-interpretability trade-off: Interpretable deep learning models for satellite image-based real estate appraisal. *ACM Transactions on Management Information Systems*, *14*(1), 1–24.
15. Lahmiri, S., Bekiros, S., & Avdoulas, C. (2023). A comparative assessment of machine learning methods for predicting housing prices using Bayesian optimization. *Decision Analytics Journal*, *6*, 100166.
16. Laskin, M. B., & Gadasina, L. V. (2022). Peculiarities of applying methods based on decision trees in the problems of real estate valuation. *Бизнес-информатика*, *16*(4 (eng)), 7–18.
17. Núñez-Tabales, J. M., Rey-Carmona, F. J., & Caridad y Ocerin, J. M. C. (2016). Commercial properties prices appraisal: Alternative approach based on neural networks. *Journal of Artificial Intelligence*, *14*(1), 53–70.
18. O'Roarty, B., Patterson, D., McGreal, S., & Adair, A. (1997). A case-based reasoning approach to the selection of comparable evidence for retail rent determination. *Expert Systems with Applications*, *12*(4), 417–428.
19. Park, B., & Bae, J. K. (2015). Using machine learning algorithms for housing price prediction: The case of Fairfax County, Virginia housing data. *Expert Systems With Applications*, *42*(6), 2928–2934.
20. Rampini, L., & Re Cecconi, F. (2022). Artificial intelligence algorithms to predict Italian real estate market prices. *Journal of Property Investment & Finance*, *40*(6), 588–611.
21. Renigier-Biłozor, M., Janowski, A., Walacik, M., & Chmielewska, A. (2022). Human emotion recognition in the significance assessment of property attributes. *Journal of Housing and the Built Environment*, *37*(1), 23–56.
22. Sandeep Kumar, E., Talasila, V., Rishe, N., Suresh Kumar, T. V., & Iyengar, S. S. (2019). Location identification for real estate investment using data analytics. *International Journal of Data Science and Analytics*, *8*, 299–323.
23. Starr, C. W., Saginor, J., & Worzala, E. (2021). The rise of PropTech: Emerging industrial technologies and their impact on real estate. *Journal of Property Investment & Finance*, *39*(2), 157–169.
24. Tchuente, D., & Nyawa, S. (2022). Real estate price estimation in French cities using geocoding and machine learning. *Annals of Operations Research*, 1–38.
25. Walia, S., Sarkar, S., Mohanty, B., & Pal, S. (2023). Practice briefing analysis of the emergence and initial performance of REITs in India. *Journal of Property Investment & Finance*, *41*(2), 256–268.
26. Wang, D., & Li, V. J. (2019). Mass appraisal models of real estate in the 21st century: A systematic literature review. *Sustainability*, *11*(24), 7006.
27. Yakub, A. A., Ali, H. M., Achu, K., Jalil, R. A., & Salawu, A. O. (2021). An integrated approach based on artificial intelligence using ANFIS and ANN for multiple criteria real estate price prediction. *Planning Malaysia*, *19*.
28. Yilmaz, S., & Mert, Z. G. (2023). An adaptive-neuro-fuzzy-inference-system based grading model to estimate the value of the residential real estate considering the quality of property location within the neighborhood. *Journal of Housing and the Built Environment*, 1–23.
29. Zhou, G., Ji, Y., Chen, X., & Zhang, F. (2018). Artificial neural networks and the mass appraisal of real estate. *International Journal of Online Engineering*, *14*(3).
30. Zurada, J. M., Levitan, A. S., & Guan, J. (2006). Non-conventional approaches to property value assessment. *Journal of Applied Business Research (JABR)*, *22*(3).