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A Literature Review on Application of Artificial Intelligence on the Example of Real Estate Business

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Abstract

Artificial intelligence (AI) is a central focus in contemporary scientific and social discourse, generating both optimistic prospects for humanity and concerns about its potential risks, particularly in relation to the labor force. However, the ongoing discussions often lack specificity regarding the fundamental areas influenced or anticipated to be influenced by AI.

This research aims to identify the scientific focal points within the realm of AI research and analyze the perspectives of researchers. In particular, the life cycle of the real estate should also be taken into account so that a clear application of AI in the real estate industry can be identified.

The primary areas of focus identified are Valuation, Property Development, Data, Property Search and Property Management.

The research methodology involves an extensive literature review, compiling and evaluating numerous researchers' opinions. Utilizing the Scopus and Web of Science databases, relevant literature and authors were meticulously examined, employing a systematic approach that resulted in recorded tables. In a systematic analysis of topics, each subject was examined in detail and results were derived based on their frequency. The prevailing theme in current literature revolves around the evaluation of whether to assess the present value or future value. This seems to offer the greatest benefit combined with the best feasibility. The study findings indicate that the potential benefits of artificial intelligence (AI) are significant. However, the current utilization of AI is sporadic. Despite this, substantial efforts are underway in numerous areas to actively implement and integrate AI technologies.

Keywords: Artificial Intelligence, Real Estate Business, Property Life Cycle, Big Data.

1. Introduction

Artificial intelligence (AI) harbors the transformative potential to fundamentally alter business paradigms, extending its influence across a wide range of sectors within the private sector,

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including in the real estate industry. Cajias (2021, p.15-16) argues that AI is a disruptive force that serves as a game changer in the real estate business. Seagraves (2023) calls AI a transformative force across many industries.

The start of the AI revolution primarily manifested in the manufacturing sector, known as Industry 4.0, with major players being multinational manufacturers. Only recently AI has extended its reach to various industries, accompanied by advancements like big data, predictive analytics, machine learning / deep learning, artificial neural networks, genetic algorithms, cloud computing, internet of things (IoT) and many others. In the field of real estate management, scholars have recently coined the term "Real Estate 4.0" (Starr/Saginor/Worzala, 2021, p.157).

According to Conway, real estate companies have not been at the forefront of adopting AI, suggesting that the industry has yet to fully harness the potential of this technology. This hesitancy in embracing AI and related technologies is attributed to factors such as inertia, cultural resistance, a deficiency in accountability, reluctance to share information, and various other elements. C (Conway, 2018, p.30). Starr/Saginor/Worzala (2021, p.157-160) note a historical sluggishness in the real estate sector's adoption of innovations, but acknowledge a shift with the advent of AI. Seagraves (2023) emphasizes that the real estate industry "stands out as one experiencing some of the most remarkable innovations, fuelled by AI. Liu (2022, p.5) affirms the substantial impact AI has already made on the real estate industry.

The AI revolution in the real estate is facilitated by new tech firms (Property / Real Estate Tech / PropTech), which have emerged in recent years and are progressively challenging the established positions of traditional real estate companies (Starr/Saginor/Worzala, 2021, p.157-158). Conway (2018, p.29) highlights the significant prominence of this topic in recent years within the real estate industry.

The objective of this paper is to conduct a literature review to identify the relevance of AI within the context of the real estate industry. The current research gap is that there is no comprehensive elaboration on the scientific status of property life cycles. Only the individual areas have been extensively researched, which means that the connection and interaction between the individual AI-supported functions can be lost. Accordingly, the accuracy and structure of previous work has been increased (Zupic and Čater, 2015, p. 31).

To fulfill the objective of providing a comprehensive overview of the latest developments in the application of artificial intelligence (AI) in the field of commercial real estate, this paper employs a desk research methodology through a search to identify relevant scientific online literature.

Both scientific articles and books are used as sources, focusing also on an overall understanding of AI and big data relying on relevant literature even if it is unrelated specifically to the real estate field. Google Scholar is utilized for the initial search, employing the keywords "Artificial Intelligence" and "Big Data". To ensure the quality of sources, the publications selected belong exclusively to reputable science publishers such as Springer, Hanser or Duncker & Humblot. For the primary section of the paper, a refined search using the keywords "Artificial Intelligence" and "Real Estate" is conducted, specifically utilizing the Web of Science database to ensure rigor. This search yields 410 results, from which duplications and irrelevant outcomes are

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removed after an initial review of titles. The refined list comprises around 50 sources, and subsequent scrutiny of abstracts narrows down the selection to 13 papers and books, chosen as references based on their relevance and scholarly merit.

1.1 Artificial Intelligence

Conway (2018, p.18) defines AI as software capable of executing tasks that typically require human intelligence. However, this does not imply that AI mimics human thought processes; current AI systems primarily focus on proficiently performing specific tasks rather than replicating human thinking.

In the literature, a distinction is made between strong and weak AI. Weak AI refers to software designed for well-defined tasks, incapable of analyzing problems beyond their programming. All existing AI technology fall under the category of weak AI. Strong AI, on the other hand, would have the ability to analyze and solve unprogrammed problems that they were not specifically designed to solve. The fundamental distinction between weak and strong AI lies in specialization versus generalization. A strong AI algorithm would possess the ability to perform tasks such as driving in public traffic, playing chess, or solving complex mathematical problems without specific programming for each activity. It would operate autonomously, exhibiting characteristics like self-consciousness, creativity, empathy, and moral judgment. Currently, strong AI does not exist, and its emergence in the foreseeable future is uncertain. Wilhelmi (2020, p.118) and Fischer (2020, p.79) suggest that the development of strong AI is unlikely in the near term. Conway (2018, p.18) emphasizes that achieving a general-purpose AI in the real estate sector remains a distant goal.

1.2 Artificial Intelligence and Big Data

AI heavily relies on data as its input, often dealing with large amounts of data (Conway, 2018, p.17). Big data models can encompass hundreds of thousands of variables (Kumar et al., 2019, p.299). The term Big Data encompasses both the extensive volume of data and the powerful tools employed for electronic data analysis. The sheer size and heterogeneity of big data make them incompatible with conventional database systems, a characteristic often referred to as No-SQL in the literature (Freiknecht, 2014, p.9).

Within the literature, three fundamental characteristics of big data, commonly known as the three V's, are frequently emphasized (Conway, 2018, p.17):

- Volume: large (unstructured) amounts of data in electronic form.
- Velocity: data can be generated, transmitted, and processed, often at high speeds.
- Variety: encompasses the heterogeneity of data, originating from a diverse array of data types and sources. (Fasel/Meier, 2016, p.3).

In terms of volume, big data typically starts at the terabyte range. Velocity emphasizes the necessity for data processing in (almost) real time. A critical requirement for big data applications is the capacity to rapidly assess data, irrespective of its formatting. A noteworthy

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example of variety is easily visible in social media content which incorporates diverse data types such as text, pictures, videos, links, in various formats (Fasel/Meier, 2016, p.6).

Recent expansions to the definition of big data include two additional characteristics: veracity and value (Conway, 2018, p.17). In a business context, input data should be useful in the sense that it can help enhancing the company's overall value (Mäder/Franke, 2015, p.357).

1.3 Applications of AI in the Real Estate Business

In the scholarly literature, numerous cases for AI in real estate are discussed, with property valuation emerging as a particularly prominent topic (Al-Qawasmi, 2022; Deaconu/Buiga/Tothazan, 2022; Starr/Saginor/Worzala, 2021). Proper valuation, situated within the real estate domain, is inherently data-driven, and the proliferation of the internet has provided vast amounts of data on real estate markets and transactions, making it an ideal field for AI applications. Moreover, valuation involves mathematical modeling, an area where AI can leverage its specific strengths (Naz et al., 2022, p.157). It is unsurprising, therefore, that the application of AI in valuation, with its capacity to process extensive datasets, holds significant promise.

The AI valuation literature predominantly delves into technological aspects, introducing and comparing various mathematical models along their comparative strengths and weaknesses. These methods and models are observed to undergo rapid evolution (Zhou et al., 2018). Starr/Saginor/Worzala (2021, p.157-158) assert that the future of valuation in real estate is likely to be automated, suggesting that this is an area where AI may eventually replace human involvement.

Another use case for AI in real estate is real estate development (Al-Qawasmi, 2022, p.231). In the literature, the term “smart real estate projects / development” can be found for development projects using AI (Liu, 2022). While there is a noteworthy body of literature on AI in property development, it appears somewhat less extensive compared to AI in real estate valuation. This discrepancy might stem from the nature of development being less data and model-driven than valuation, making AI use cases less evident. Nevertheless, Liu (2022, p.1) asserts that “research results on the application of artificial intelligence and big data to real estate development are relatively rich.

According to Seagraves (2023), a significant application of AI in the real estate sector is property search and recommendation, leveraging AI's capacity to analyze vast and heterogeneous datasets. Big data analytics for location identification appears highly promising, potentially outperforming traditional methods (Kumar et al., 2019). This application is closely associated with the domain of customer services, where AI, particularly in the form of chatbots, can play a crucial role (Seagraves, 2023).

Similar to areas like valuation and property search, property management is experiencing an increasing generation of extensive data, including video and audio data from cameras and microphones or sensor data. Consequently, the entire field of property management presents a broad spectrum of promising use cases for AI applications (Naz et al., 2022). According to Seagraves (2023), AI in property management can contribute to improving both effectiveness

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and efficiency, improving services for tenants, reducing costs and contributing to sustainability. Safety and security of residents represent another domain where AI can bring substantial enhancements.

An additional valuable application of AI in real estate lies in supporting management and employees in administrative tasks. Administration in the real estate industry involves activities such as contract review, due diligence, and compliance management. AI in paperwork not only alleviates the workload for management and employees but also reduces the risk of human error (Seagraves, 2023).

1.4 Property Life Cycle and AI application

First, a piece of land is being acquired at a specified price (valuation) and the property is being developed (property development).

Upon completion and readiness for the market, the apartments or commercial spaces are listed for potential occupants. At this stage, property search and customer / broker services become crucial operations. Once tenants are secured, the real estate firm provides property management services. Finally, the overarching function of administering the real estate firm itself comes into play, an essential aspect throughout the entire property life cycle. The phases can be simply called the project development phase, the use phase and the exploitation phase (Schellenberger, 2020). The following figure provides a summary of the aforementioned processes.

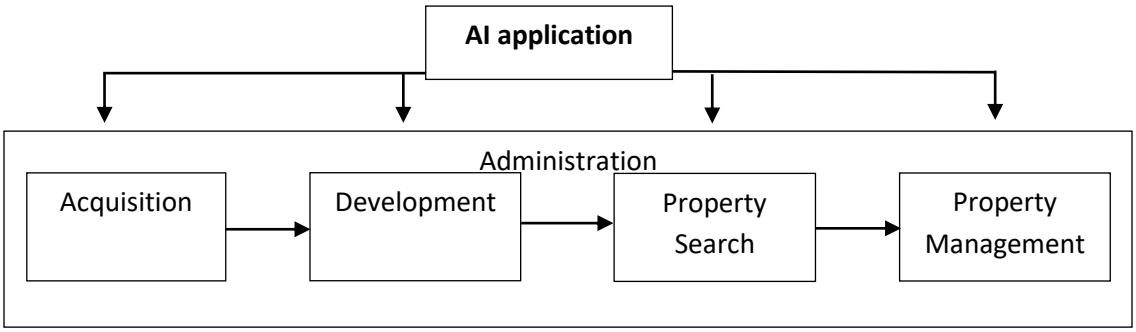

Figure 1 Property Life Cycle and AI application

Source: Authors' own research.

2. Method

This study investigates opinions on artificial intelligence within the existing literature. The initial step involves a thorough examination of relevant literature, followed by a refinement and focus on essential scientific works. To maintain the high quality of this study, a strict criterion was applied, restricting the use of literature exclusively to listings in the Web of Science or Scopus databases. Evaluation of both databases is imperative to ensure comprehensiveness, as Web of Science offers a deeper index, while Scopus provides a broader coverage.

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Therefore, the methodology used follows the process of compiling, sorting and evaluating existing literature (Paul et. al. 2021, p. 2). Casino also uses a similar approach (Casino et al., 2019, p. 58), where literature can be found, selected and evaluated, followed by an analysis phase. The following table shows the compilation of identified literature and its sorting according to relevance. Thereafter, an assessment of the literature in the subject areas was carried out.

During the Scopus evaluation, a search for "AI" yielded 364 hits. However, a satisfactory number of relevant literature sources could not be identified from the identified sources. Consequently, focus was placed on Web of Science. The search in Web of Science database, specifically in the "AI, Robotics, and Automatic Control" category produced 133 hits, From this result, a more extensive list of around 50 relevant sources was compiled. A detailed examination of these sources allowed for further refinement, resulting in a shortlist of 14 sources. The following authors and their main opinions were thus extracted from the two databases.

Table 1. Application of artificial intelligence in the stages of property live cycle (selected analyzed sources)

	Valuation Now/Future	Property Development	Property Search	Property Management	Data	Other Aspects
Bodenbender et al., 2019					X	
Cajias, 2021	X					
Conway, 2018			X			
Deaconu, 2022	X					
Huh et al., 2020						X
Kang et al., 2020	X					
Kumar et al., 2019		X				
Liu, 2022			X		X	
Lorenzo et al., 2022	X	X				
Schellenberger, 2020		X				
Seagraves, 2023				X	X	
Starr et al., 2021		X				
Tekouabou, 2023	X					
Zhou et al., 2018						X

Source: Authors' own research.

After clearing up Huh and Zhou who focus on rarer topics like contracts and taxes, a clear trend is still not evident. The frequency weighted order is as follows: Valuation, Property

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Development, Data, Property Search and Property Management. Administration is explained below for completeness, as the authors also addressed it as a peripheral topic.

The literature mentioned must then be critically assessed in order to prevent or counteract potential and possible distortions (Massaro et al., 2016, p 784). Bodenbender discusses the benefits and advantages of using AI in the area of data collection, but there is a lack of a uniform data standard. Likewise, the data stock is only usable for the AI if the data stock is continually updated. In the discussion, Cajias essentially compares location as a proven factor and AI as an aid to evaluating investments. However, it should not be overlooked that the essential building stock has no or insufficient documentation to enable the AI to make this decision.

Due to the heterogeneity of the real estate portfolio, a relatively accurate assessment can only be guaranteed by examining the condition and substance of the building on site. Conway presents the possibilities of AI in the real estate industry in great detail, but the inertia and resistance are not sufficiently considered. Especially when looking for owner-occupied properties, the decision and compromise often lies with two individuals. At Deaconu, it should be positively mentioned that the AI-supported prediction is close to the actual sales prices, but the AI does not lead to more precise results than previous valuation methods, so the use of AI in this clearly defined area does not bring added value. Huh essentially deals with blockchain transactions in real estate transactions and downstream AI support. Blockchain can reduce the costs of transactions and possibly also increase security. However, the current system of real estate transactions is already very secure. Kang comes to an even harsher conclusion than Deaconu. Kang has determined that the AI assessment produces less accurate results than the GA model. Kumar has focused on assessment in the context of landmarks and attractions. What is missing however, is the larger application framework and verification that an AI-supported assessment can also take place without anchor points.

Liu examines the Chinese market taking AI into account, but this investigation leads to distortions because market conditions have fundamentally changed from 2020 onwards. Only after there is sufficient data available again can the AI make reliable assumptions. Lorenzo's conclusion can only be verified in the future, as the model examined can only be evaluated once the real estate liquidations have been processed. Schellenberger does not sufficiently address the fact that it is possible that AI developments are carried out that do not meet the actual needs of the users. The economic aspect is also neglected: the additional costs must be seen in relation to the benefits.

Seagraves paints a positive picture of AI in real estate. Seagraves recognizes the issue of data protection, but the risk is broader, as data integrity can also be compromised. Therefore, data protection and security measures should be subject to a similar pace of development as AI development. Starr also neglects the human factor; the assumption is made here that debt restructuring or further training is possible for the jobs that will be lost. This assumption cannot be followed unconditionally, as AI is also finding its way into other areas. Following this approach, it must be assumed that there must be significant layoffs of personnel, as simply shifting the number of personnel deployed does not lead to an increase in productivity. AI implies that natural intelligence should and can be subsumed. The socio-political aspect is

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missing here. Tekouabou only examined articles written in English and listed in Scopus. The extensive articles from Web of Science and especially from the Asian region were not used. Zhou is subject to the same issue as Cajias, in principle an evaluation of the properties is conceivable and possible, but the generalized evaluation may lead to inaccurate results about the building structure and condition of the property.

3. Discussion

3.1 Application of AI to valuation of real estate property

According to Al-Qawasmi (2022, p.231), the application of AI to valuation encompasses real estate property valuation, land valuation, mass appraisal or taxation, and rental value assessment. Technologies involved in AI-based real estate valuation include machine learning, neural networks, regression models, k-nearest neighbors, and support vector machines, among others (Baldominos et al., 2018 and Tekouabou, 2023). Deaconu/Buiga/Tothazan (2022, p.102.103) assert that Artificial Neural Networking produces more accurate outcomes than Regression Models. The primary objectives of applying AI in real estate valuation are efficiency and the elimination of inaccuracies as well as of subjective estimates inherent in human valuations (Al-Qawasmi, 2022, p.231). Improving valuation accuracy is crucial as it enhances transparency and fairness in the real estate market. Furthermore, accurate mass appraisal fosters taxpayers` trust in the taxation system and the government (Zhou et al., 2018). The methodical approach can increase the recognition and trustworthiness of pricing (Tekouabou, 2023).

Conway is somewhat cautious in assessing the capabilities of current AIs in the context of real estate valuation. According to this author, AI is not yet capable of accurately predicting real estate values without hands-on machine learning methods. The results of automated valuations so far have been rather controversial. There is no general AI that can be universally fed with data from any market and deliver accurate values without any additional adaptations. As of 2018, only a relatively small minority of real estate firms appear to have implemented AI-based automated valuation (Conway, 2018, p.18; p.30).

Many real estate transactions occur through auctions, making the prediction of auction prices a valuable skill for real estate investors. In this highly data and model-driven area, AI can leverage its strengths. Kang et al. (2020) develop a variety of AI-based models for predicting real estate auction prices, with Genetic Algorithms delivering the most effective outcomes.

Another area, where the ability of AI to determine accurate property values is in reverse mortgages. These contracts involve property owners borrowing money against the future liquidation value of their property. In this context, predicting the future value of the property is crucial, requiring estimates of the future development of the real estate market. Di Lorenzo/Piscopo/Sibillo (2020) present a predictive analytics model based on neural networks capable of projecting current real estate market data and providing a dynamic pricing algorithm for future price developments.

Cajias (2021, p.16) highlights an interesting aspect of automated business processes, particularly in the valuation of real estate. Assuming that AIs can perform the job as effectively as brokers or other professionals, clients may become increasingly independent from professionals in the

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market. This example suggests that, from the perspective of real estate professionals, AI has the potential to replace many of their jobs.

3.2 Application of AI in Property Development

In the field of property development, AI can aid real estate firms in gaining a better understanding of market demand (Liu, 2022, p.5). Locating the appropriate site for a real estate project can be an intricate challenge involving numerous input variables and parameters, such as investors preferences, local and regional demand structures, governmental and legal regulations etc. AI and big data solutions serve as ideal tools to address such highly complex problems. Kumar et al. (2019, p.303-312) have developed a machine learning model that empowers real estate investors to identify the optimal location for their project based on the investors' specific preferences.

AI can enhance the development process by using Building information modeling (BIM), a category of software initially employed by architects and construction firms. BIM software creates digital or virtual twins of physical architecture, whether yet to be built, in the process of being built, or already used. These digital twins assist developers in gaining a deeper understanding of the entire development process across all stages. Following the development stage, digital twins can be used to facilitate the property management (Starr/Saginor/Worzala, 2021, p.162).

3.3 Application of AI and Data Governance

Big data applications are contingent on the quality of the underlying information. If algorithms are fed incorrect or insufficient data, the resulting outcomes can become unusable. In computer science, the expression "garbage in garbage out" is widely acknowledged. There is a risk that users may blindly trust algorithms and accept results based on inaccurate or inadequate data, potentially compromising decision quality. This risk is particularly relevant for inexperienced users. Moreover, dealing with large volumes of information may lead to confusion rather than utility, negatively impacting decision-making processes. Information overload can be detrimental, and information theorists posit that while data quantity increases, the amount of reliable, objectively true data remains relatively constant or does not increase to the same extent. This implies that as the data volume grows, the proportion of data garbage (noise) also increases disproportionately, making it increasingly challenging to filter out useful information. Bodenbender/Kurzrock/Müller (2019, p.170-172) suggest that AI can help create information ecologies in the real estate industry where data is reliable, secure, up-to-date, and easily accessible. Interestingly, new information technologies provide a solution to problems that they have initially created. Augmented Analytics, utilizing machine learning, automates data preparation and insight discovery, empowering decision-makers with additional information and insights to make better decisions (Conway, 2018, P.18).

The rise of data-driven applications in real estate is heavily tied to the unresolved issue of data governance. In the future, it will be imperative to develop legal and contractual frameworks and standards. These measures are essential to ensure that, for instance, personal data collected in

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smart homes is utilized, shared, owned, and transferred in a fair, responsible, and secure manner (Starr/Saginor/Worzala, 2021, p.161).

3.4 Application of AI in Property Search

Software algorithms present distinctive opportunities for personalizing the property search process, enhancing both its effectiveness and efficiency. AI has the capability to take into account individual preferences of buyers or renters, encompassing factors such as location, property type and size, weather conditions, proximity to workplace, schools, shopping opportunities, budget restrictions, local safety scores, future development planes, and various other characteristics. These personal preferences are then systematically cross-referenced with property attributes. Furthermore, AI algorithms can dynamically adapt based on user behavior, continually refining the search process and optimizing outcome for the user (Seagraves, 2023).

In addition to accurate valuation, another noteworthy use case for AI in real estate valuation is the identification of underpriced opportunities. Baldominos et al. (2018) have developed a model grounded in diverse machine learning techniques and regression trees. This model demonstrates the capability to discern underpriced real estate offerings within extensive datasets.

Another compelling use case for AI in property involves the utilization of chatbots. AI-based chatbots have become increasingly prevalent in numerous customer-orientated industries. The rationale behind their deployment is evident: by (partially) substituting human employees with chatbots, businesses can either reduce pay roll costs or allocate human resources to more intricate, less repetitive tasks that contribute greater value to the organization. Additionally, chatbots being exempt from labor regulations, can operate continuously, offering customers the flexibility to interact with the company at any time. In this way, chatbots can enhance the business's opportunities (Seagraves, 2023). Moreover, chatbots find utility in various domains, such as facility management, enabling the provision of around-the-clock tenant services (Conway, 2018, p.43). Another noteworthy AI application with the potential to significantly enhance property search, is the integration of virtual reality (VR) and augmented reality (AR). These technologies empower users to view in detail objects in various location without the need for physical visits (Seagraves, 2023).

Furthermore, VR and AR have found application in real estate for exterior and interior design purposes. This allows users to visualize design options without the need for tangible alterations or even personal presence. Seagraves (2023) provides examples such as furniture placements and changes in wall color.

3.5 Application of AI in Property Management

Naz et al. ((2022) identifies several use cases for AI in property management, including the optimization of resource management, the implementation of customer-centric property management strategies, enhancements in sustainability practices, and the augmentation of safety and security measures for residents.

AIs integrated into facility management systems exhibit the capacity to optimize energy consumption in heating, ventilation, and air conditioning systems This optimization is achieved

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through considerations such as tenants' preferences, occupancy, and weather forecasts. Additionally, these AIs can streamline maintenance scheduling, security protocols and more. Utilizing predictive analytics tools, AI can strategically plan maintenance activities to mitigate the risk of expensive repairs (smart / predictive maintenance). This proactive approach involves addressing minor and cost-effective repairs promptly to prevent the occurrence of later, more substantial and costly issues. Respective input data stems from smart sensors continually monitoring infrastructure components (Seagraves, 2023).

As previously highlighted, data is of paramount importance for AI applications. Smart meters and various sensors systematically track data on water and energy consumption, as well as air quality. Concurrently, cameras and microphones are constantly monitoring the surroundings. Algorithms within AI systems are designed to respond to anomalies, such as deviations from typical patterns, by notifying property owners, managers, security personnel, or the police. (Cajias, 2021, p.16). Consequently, AI holds the potential to enhance the safety of individual homes or entire neighborhoods for residents.

An area interconnected with property management, but transcending it, is smart homes. Initially driven by cost savings and sustainability goals, the emphasis has now shifted towards enhancing tenants' experiences and security, especially in light of COVID-19 pandemic (Starr/Saginor/Worzala, 2021, p.161). Similarly, Conway (2018, p.18) underscores that „smart houses “have the potential to augment tenants' convenience by learning from their preferences concerning lighting, temperature, and other features and adeptly applying this acquired knowledge.

3.6 Application of AI in Administration

Administrative tasks, often characterized by simplicity and repetition, have historically been managed by conventional software without AI capabilities. However, with the emergence of AI, software algorithms are now capable of handling increasingly intricate administrative functions. For instance, AI can now write or translate legal briefs. Natural language processing (NLP) stands out as a particularly valuable tool, enabling AI to comprehend the content of contracts and drafts effectively (Seagraves, 2023). NLP extends its utility to various areas, including the automatic extraction of data from internet sources for the distillation of real estate information. Additionally, Conway discusses the potential for (quasi) automated document generation within the framework of an appraisal platform (Conway, 2018, p.43-44). AI algorithms specialized in legal applications exhibit the capacity to identify potential legal risks within drafts, which could subsequently lead to heightened costs. In the domain of due diligence, AI can support the team in going through property records, title documents, environmental regulations and related matters (Seagraves, 2023). Moreover, the integration of AI and other technologies, such as blockchain, contributes to enhancing the security of real estate transactions (Huh/Kim, 2020).

In the context of administrative tasks, AI can enhance data accuracy. AI and big data analytics allow for the identification of errors, while predictive analytics enhances the precision of error predictions. Additionally, scholarly literature underscores the advantages of big data analytics for detecting fraud and other criminal activities. (Gulin/Hladika/Valenta, 2019, S.507).

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4. Conclusion

According to the literature, there appears to be a consensus that, in comparison to other sectors, the real estate industry has been relatively slow in adopting AI. However, scholars generally agree that AI possesses the potential to revolutionize the industry and is poised to do so in the future.

With the ascent of AI, the real estate industry may confront challenges similar to many other sectors: AI is likely to take over tasks currently handled by industry professionals, potentially leading to the displacement of human employees. It is noteworthy that the jobs threatened to be replaced by AI are not just simple, repetitive tasks, but increasingly extend to complex roles. Consequently, complexity alone may no longer guarantee job security. The only realm where AI might not be able to replace humans in the foreseeable future could be creativity. The outcome remains uncertain, as it is yet to be determined whether this evolution will result in significant job reductions in the real estate industry or if human employees will transition into new, more intricate, or even more creative roles that add further value to the business.

An additional consequence of the AI revolution in the real estate industry is the emergence and ascent of PropTech firms, which are progressively competing with traditional real estate entities. Consequently, jobs may shift from traditional brokers and other real estate firms towards new tech start-ups driving the AI transformation in real estate. From the point of view of real estate clients, it is of significance that AI harbors the potential to grant them substantially more independence from real estate professionals in areas such as property search or valuation. A positive consequence of the AI revolution could manifest in enhanced outcomes for real estate clients. AI has the potential to significantly improve the convenience and effectiveness of property searches by continually adapting to users' explicit and implicit preferences. Furthermore, in property valuation, AI's capacity to process very large amounts of data can refine price determinations to an extent beyond the reach of human evaluators, Moreover, AI valuation has the potential to mitigate subjectivity and biases in the valuation process. In the area of facility management, AI is poised to enhance the quality, speed, and cost-effectiveness of services provided to tenants, leading to improvements in safety and security in and around homes. The ongoing trend towards smart homes is anticipated to continue. In the more distant future, residences, much like automobiles and other tangible entities, are anticipated to achieve complete connectivity and integrate into the internet of things.

Additional research is needed to assess the evolution of application of AI in each area in more detail.

Due to the diversity and rapid change, future studies should again deal with the changes (Secinaro et al., 2022, p. 411), especially with the verification of the prediction models discussed, assessing whether these will deliver better results than the previous models. Without ongoing control and verification of the predictions, the accuracy and reliability of the AI models cannot be determined. Future research should therefore focus on verifying the statements of AI models and the exploitation phase, which has not been covered in this article.

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