

Emerging Technologies in Real Estate

Matthew N. O. Sadiku¹, Paul A. Adekunle², Janet O. Sadiku³

¹Roy G. Perry College of Engineering, Prairie View A&M University, Prairie View, TX, USA

²International Institute of Professional Security, Lagos, Nigeria

³Juliana King University, Houston, TX, USA

ABSTRACT

Real estate has traditionally been characterized by physical assets, localized expertise, lengthy transactions, and fragmented information. Emerging technologies are transforming real estate from a traditionally relationship-driven and document-intensive industry into one increasingly shaped by data, automation, and interconnected digital systems. Artificial intelligence, big-data analytics, building information modeling, virtual and augmented reality, smart-building systems, blockchain, drones, and digital transaction platforms are creating a more efficient and responsive property market. They are not only improving operational efficiency but also redefining how properties are built, bought, sold, and managed. Their greatest value lies not in replacing real estate professionals, but in giving developers, investors, agents, property managers, buyers, and tenants better information and more effective tools. When adopted responsibly, these technologies can reduce costs, improve decision-making, strengthen sustainability, expand market access, and enhance the experience of property users. This paper investigates the transformative impact of emerging technologies on the property and real estate sector.

KEYWORDS: *technology, emerging technologies, real estate, realtor, property.*

INTRODUCTION

The global real estate industry, traditionally valued at over \$300 trillion in assets, is undergoing one of its most significant transformations in history, driven by rapid technological innovation. Real estate has traditionally been viewed as a conservative industry built around physical assets, personal relationships, and lengthy transactions. Today, however, emerging technologies are changing how property is designed, financed, marketed, sold, leased, and managed. Emerging technologies are turning properties into data-producing systems and enabling decisions to be made across an asset's entire lifecycle. They are changing real estate from a collection of periodic transactions into a continuously observed and increasingly intelligent system. AI improves analysis; IoT makes building conditions visible; BIM and digital twins connect information across the asset lifecycle; blockchain may strengthen traceability; immersive tools improve communication; and robotics extends digital control into physical work. Their combined effect could produce more efficient,

sustainable, responsive, and transparent property markets [1].

Real estate technologies are transforming how investors, developers, and property managers operate. From AI-powered analytics to blockchain-secured transactions, innovation is no longer optional. Real estate startups and companies are utilizing emerging technologies, influencing various industry facets. Companies that adopt the right tools can increase efficiency, reduce risk, and deliver better tenant experiences. However, with so many emerging solutions available, separating real value from industry noise is critical [2].

WHAT ARE EMERGING TECHNOLOGIES?

Technology may be regarded as a collection of systems designed to perform some function. It can help alleviate some of the challenges facing business today. Emerging technology is a term generally used to describe new technology. The term often refers to technologies currently developing or expected to be

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available within the next five to ten years. Any imminent, but not fully realized, technological innovations will have some impact on the status quo.

Emerging technologies are shaping our societies. They continue to affect the way we live, work, and interact with one another. Emerging technology (ET) lacks a consensus on what classifies them as “emergent.” It is a relative term because one may see a technology as emerging and others may not see it the same way. It is a term that is often used to describe a new technology. A technology is still emerging if it is not yet a “must-have” [3]. An emerging technology is the one that holds the promise of creating a new economic engine and is trans-industrial. ET is used in different areas such as media, healthcare, business, science, education, or defense.

The characteristics of emerging technologies include the following [4]:

- *Novelty*: Emerging technologies are typically new or novel, meaning they have yet to be widely adopted or used. They often represent a significant departure from existing technologies or processes.
- *Potential for Disruption*: Emerging technologies have the potential to disrupt existing markets, industries, or ways of doing things. They may also displace existing businesses or industries.
- *Uncertainty*: Because emerging technologies are still in the early stages of development, there is often a high uncertainty surrounding their future potential and impact. It can be challenging to predict how they will evolve.
- *Rapid Change*: Emerging technologies often evolve rapidly, with new developments and innovations emerging frequently. It can make keeping up with the latest trends and advancements challenging.
- *Interdisciplinary*: Emerging technologies often involve multiple disciplines or fields of study, such as computer science, engineering, and biology. They may require collaboration across different fields and industries to develop their potential fully.

Emerging technologies are worth investigating. They are responsible for developing new products or devices. As emerging technologies continue to evolve, engineering is poised for a transformative future. Emerging technologies have driven innovation and progress in today's rapidly evolving digital landscape. The collective impact of emerging technologies such as artificial intelligence, machine learning, big data, and the Internet of things is

undeniably transformative. Some emerging technologies are shown in Figure 1 [5].

EMERGING TECHNOLOGIES IN REAL ESTATE

A review of smart-city technologies shows that AI, IoT, GIS, BIM, digital twins, immersive technologies, drones, and robotics can contribute across site analysis, planning, development, construction, marketing, and operations. Emerging technologies in real estate include the following [1,6,7]:

1. *Artificial Intelligence*: Artificial intelligence is among the most influential emerging technologies in real estate because the sector generates large volumes of structured and unstructured data. It can automate routine work such as classifying documents, answering common inquiries, identifying suitable listings, and organizing leads. Machine-learning models can analyze large datasets involving transactions, rents, demographics, mobility, building performance, and market conditions. In practice, such systems can support automated valuation, site selection, demand forecasting, mortgage underwriting, lease analysis, customer service, fraud detection, and maintenance planning. Generative AI can also summarize contracts, prepare marketing materials, answer tenant questions, and make unstructured documents easier to search.
2. *Robotics*: Robotics and digitally controlled fabrication can automate repetitive or hazardous work, while additive and modular construction methods can reduce waste and move more production into controlled environments.
3. *Drones*: Before making a purchase or investment, individuals scrutinize properties meticulously to ensure they meet their utility and aesthetic preferences. The advent of drone technology in the real estate sector has revolutionized this process, offering aerial perspectives for a comprehensive view. Drones are unmanned aerial vehicles used in real estate for high-quality aerial photography, land surveys, site progress monitoring, and data collection that feeds mapping and GIS tools. Drones, geographic information systems, and remote sensing expand the industry's ability to observe properties and places. Drones can capture aerial marketing images, inspect roofs and façades, document construction progress, perform topographic surveys, assess damage after extreme events, and reach locations that would otherwise expose workers to risk.
4. *Internet of Things*: We are living in a digital age where convenience and quick access to

information is a top priority. The use of various types of IoT devices and sensors facilitates this. The Internet of things (IoT) consists of networks of connected sensors and devices embedded in buildings that monitor energy use, occupancy, security, and environmental conditions. It connects physical equipment and sensors to digital networks. Sensors and IoT devices can monitor occupancy, temperature, air quality, lighting, water use, equipment performance, and security. When connected to building-management software, these devices allow systems to respond to actual conditions rather than operating continuously according to fixed schedules. The resulting data allows building-management systems to adjust lighting, heating, ventilation, and air conditioning according to actual demand rather than fixed schedules.

5. *Big Data:* Data-driven decision-making is becoming a defining characteristic of modern real estate. The availability of large datasets—ranging from market trends and consumer behavior to economic indicators—has enabled real estate companies to make more informed and strategic decisions. Big data is now being used across the entire value chain, from site selection and pricing to asset management and investment strategy. Big data analytics enables firms to sift through real estate market data to pinpoint ideal investment properties. This approach facilitates the matching of clients with properties that cater to their unique preferences, such as proximity to workplaces or schools. Big data analytics finds utility in building information modeling (BIM), where startups leverage collected data to craft 3D building models, a tool vital for property maintenance and construction endeavors.
6. *Immersive Technologies:* Touring multiple properties is still a standard practice for property investors to find their ideal match. But this is a tedious process with various limitations like time and location access. To tackle these limitations and improve buyer experience, the use of virtual reality (VR) and augmented reality (AR) technology has risen as a key property technology trend in the industry. Many real estate firms now offer virtual tours of their properties to prospective clients. Virtual and augmented reality are changing how people experience property before visiting or constructing it. Virtual reality (VR) can provide immersive tours of existing buildings or computer-generated experiences of developments that have not yet been completed. VR also supports architectural review and space planning. Augmented reality (AR) overlays digital information on a view of the physical world. It can be used for virtual staging, furniture placement, renovation visualization, navigation, or maintenance instructions. Figure 2 shows immersive technologies in real estate [8].
7. *Blockchain:* Most property transactions currently involve multiple third parties and extensive paper documentation, coupled with the hurdle of escalating property prices, deterring younger generations from investing. Blockchain technology is emerging as a solution in the property technology landscape, addressing these issues effectively. Blockchain is a distributed-ledger technology that can create shared, tamper-evident records among participants. In real estate, proposed applications include title histories, identity verification, shared due-diligence records, escrow processes, tokenized ownership, and smart contracts that execute agreed actions. Blockchain addresses trust among parties that maintain separate records. Distributed ledgers can create tamper-evident histories of transactions and documents, while smart contracts can automate specified actions when agreed conditions are met. Potential real-estate applications include ownership records, identity verification, escrow, rent payments, maintenance approvals, and the exchange of building information. Blockchain technology plays a vital role in fraud prevention by ensuring that every transaction is validated and traceable.
8. *Digital Twins:* A digital twin is live, data-connected virtual replica of a physical property or building, continuously updated by IoT sensors and used for maintenance prediction, energy optimization, and asset planning. Digital twins create dynamic virtual representations of physical assets. Unlike a static architectural model, a digital twin can incorporate live sensor data and operational records, allowing owners and managers to compare expected and actual performance. It can also be used to test “what-if” scenarios involving energy consumption, space use, renovations, emergency conditions, or equipment failure. A building twin may combine BIM, IoT sensors, maintenance records, spatial data, and analytical models. Managers can use it to observe present conditions, simulate alternative operating strategies, investigate faults, plan retrofits, test emergency scenarios, or predict the consequences of equipment failure.
9. *Building Information Modeling (BIM):* Emerging technologies are equally valuable during property

design and construction. BIM provides a related digital foundation during design and construction. It creates a detailed digital representation that connects information from architects, engineers, contractors, and owners. This shared model can help teams identify design conflicts before construction, coordinate schedules, estimate quantities, visualize alternatives, and reduce expensive rework. During design and construction, BIM helps identify clashes between systems, improve quantity estimation, document changes, and reduce coordination errors.

10. *Geographic Information Systems (GIS)*: These combine maps with demographic, environmental, infrastructure, mobility, zoning, and market data. Developers can use GIS for site selection, planners can examine land-use change, investors can analyze access and neighborhood characteristics, and insurers or lenders can evaluate exposure to floods, fires, heat, or other hazards. Satellite imagery and remote sensing can reveal urban expansion, vegetation conditions, surface temperature, construction activity, and disaster impacts across large areas.
11. *Building Management Systems (BMS)*: Daily home and workplace chores, including lighting adjustment and space management, are becoming automated through sensors and smart building management systems (BMS), enhancing convenience. BMS governs various functionalities such as energy management and heating, ventilation, and air conditioning (HVAC), adapting to the tenant's schedule to automate temperature adjustments. BMS plays a pivotal role in space management in commercial settings, analyzing foot traffic to identify active work areas, a critical feature in the post-pandemic era to avoid congestion and adhere to social distancing. Further, it leverages occupancy data to optimize energy distribution, thereby reducing electricity consumption.

Other emerging technologies include cloud computing and 3D printing.

APPLICATIONS OF EMERGING TECHNOLOGIES IN REAL ESTATE

Common applications of emerging technologies in real estate include the following [1,6,7,9]:

- *Property Technology*: Real estate has traditionally been characterized by physical assets, localized markets, lengthy transactions, fragmented information, and extensive reliance on professional judgment. Although these features remain important, the industry is increasingly

shaped by property technology, commonly called PropTech. The term covers the digital systems used to design, construct, market, finance, transact, occupy, and manage property. A major academic review describes digital real estate as an ecosystem involving information and communication technologies, data-collection technologies, networking tools, and decision-support systems rather than a collection of isolated products. PropTech providers are responding with built-in compliance tooling, automated monitoring, real-time anomaly detection, and audit-ready reporting. Figure 2 is a representation of property and real estate [9].

- *Listing Photography*: Aerial shots contextualize a property within its surroundings (e.g., proximity to water, green space, road access, and neighborhood density) in a single image. Drone-enabled listings consistently generate higher engagement than ground-only photography.
- *Site Assessment*: Before acquisition, drones can survey terrain, drainage patterns, and boundary conditions faster and more cheaply than traditional methods. Combined with GIS data, they give developers a fuller picture before a single dollar changes hands.
- *Construction Monitoring*: Drones track site progress against plans in real time, catching deviations early. They reduce the need for in-person site visits and create a timestamped visual record of every project phase.
- *Virtual Assistant*: Canadian startup Gabbi.ai leverages AI to enable real estate agents to improve the customer journey for their clients. Gabbi is an AI assistant that responds to clients, nurtures leads, and keeps track of important communication. It follows up client texts, calls, and emails 24/7. Gabbi is also integrated with multiple listing services and book showings along with managing multiple tasks on its own. This approach eliminates tedious tasks, converts cold leads, and improves team collaboration for real estate agents.
- *Green and Sustainable Buildings*: Green and sustainable buildings are rapidly transitioning from niche developments to mainstream real estate assets. This shift is largely driven by regulatory mandates, rising energy costs, and increasing tenant demand for eco-friendly spaces. Buildings currently account for approximately 37–40% of global carbon emissions, prompting governments across over 70 countries to introduce net-zero targets and stricter building codes. As a

result, developers are integrating renewable energy systems, energy-efficient materials, and low-carbon construction practices into their projects. From an economic perspective, green buildings are proving to be highly attractive investments.

BENEFITS

Emerging technologies are creating winners and losers. Companies that invest in AI are becoming more efficient and profitable. Those that delay adoption might find it harder to compete when it comes to speed, cost, or quality of service. The advantages of emerging technology depend on responsible implementation. Other benefits of emerging technologies in real estate include the following [1]:

- *Automation:* Many property managers are turning to AI to help with tasks that previously required hours of manual work. Automation can reduce processing time and allow professionals to focus on negotiation, strategy, and complex judgment. Smart contract systems can automate parts of the transaction process, creating standard documents, ensuring compliance with local regulations, and tracking signatures. Automation in construction is reshaping the real estate industry, with technologies such as robotics, modular construction, and 3D printing reducing costs. Automation decreases administrative overhead and human labor, lowering property management's operational expenses.
- *Predictive Maintenance:* AI can monitor building systems to determine when HVAC units, plumbing, or electrical systems are likely to fail and schedule preventive maintenance before problems occur. This can also extend equipment life, while digital design tools can help teams evaluate material use and embodied carbon before construction. Technology does not replace insulation, efficient equipment, low-carbon materials, or sound urban planning, but it can make these measures more measurable, responsive, and financially manageable.
- *Personalization:* People can search for homes differently these days. Instead of sorting properties with simple parameters like price and bedroom count, buyers can tell an AI agent what they are looking for in a broader context. A buyer might say: "Find me a house with a home office, walking distance to coffee shops, in a quiet neighborhood with good schools." AI systems understand these nuanced requests and can find properties with specific features that traditional search filters would ignore.

- *Lease Management:* A typical real estate transaction can bring a mountain of paperwork, including purchase agreements, inspection reports, title documents, disclosures, and more. Smart lease systems track lease terms, send automatic renewal notices, flag violations, and even negotiate lease terms. AI automates rent payments by handling collections, sending reminders, and processing payments with little to no human intervention.

CHALLENGES

Emerging technologies offer real estate substantial opportunities, but they also expose weaknesses in the industry's data, governance, skills, and institutional arrangements. The most important challenges are interconnected: poor data can produce biased AI; fragmented responsibility can weaken cybersecurity; uncertain regulation can deter investment; and digital exclusion can convert efficiency into unfairness. Other challenges of emerging technologies in real estate include the following [1,10]:

- *Cost:* One of the most immediate barriers is the cost and complexity of implementation. Installing sensors, upgrading network infrastructure, creating digital twins, migrating records, purchasing software, and training employees all require substantial investment. These costs are especially difficult to justify when returns are indirect, delayed, or difficult to measure. Energy is one of the most significant controllable costs in many properties, and occupancy-aware controls can reduce waste while maintaining comfort.
- *Privacy Concerns:* The expansion of connected systems also creates serious privacy and cybersecurity risks. Smart buildings may collect information about occupants' movements, access patterns, energy use, environmental preferences, and use of shared spaces.
- *Data Quality:* Data quality is a foundational concern. Incomplete transaction records, inconsistent building information, outdated maps, or unrepresentative training data can produce misleading analyses. AI models can also reproduce historical patterns of exclusion or create proxy discrimination in housing, lending, tenant screening, and marketing. Because real estate decisions affect access to shelter, wealth, mobility, and opportunity, errors may have serious social consequences.
- *Cybersecurity:* Cybersecurity is equally important because connected buildings are both digital systems and physical environments. A compromised device may expose personal data,

interrupt access controls, disable building services, or provide an entry point into a wider corporate network. Responsibility is often dispersed among owners, property managers, technology vendors, contractors, and cloud providers, making it difficult to determine who must secure, update, and monitor each component.

- **Accountability:** Artificial intelligence introduces the challenge of bias, opacity, and accountability. The US Government Accountability Office has found that property technologies used in tenant screening, advertising, rent setting, and facial recognition can create risks involving opacity, inaccurate information, privacy, and discriminatory outcomes. Consequently, AI should augment rather than replace accountable human decision-making.
- **Integration:** Real-estate firms often operate legacy systems, inconsistent data, and portfolios containing equipment from many vendors. Integration problems can therefore turn a potentially useful innovation into another isolated platform, increasing complexity instead of reducing it. Research on real estate digital transformation identifies precisely such integration difficulties as a persistent obstacle to adoption.
- **Interoperability:** Interoperability poses another obstacle: a building may contain equipment, databases, and software from many generations and vendors. Without open standards and careful integration, owners may face fragmented systems, duplicated data, and vendor lock-in. Many property firms operate with a patchwork of legacy databases, spreadsheets, building-management systems, customer platforms, and third-party applications. Emerging technologies often depend on combining data from these different sources, yet the data may be incomplete, inconsistent, outdated, or stored in incompatible formats.
- **Organizational Culture:** A further challenge concerns people and organizational culture. Real estate depends heavily on local knowledge, negotiation, trust, and professional networks. Employees may resist systems that appear to threaten established roles or make their performance more visible. Others may accept automated outputs too readily because they assume that computational results are objective. Both reactions are problematic. Resistance can prevent organizations from realizing legitimate benefits, whereas overconfidence can weaken critical judgment.

- **Digital Divide:** Technology can deepen market inequality and digital exclusion. Not all real estate firms have equal access to AI technology. Larger companies with big IT and tech budgets can afford custom AI solutions and dedicated data teams. Smaller firms might struggle to implement even the most basic tools. This creates competitive advantages for tech-savvy real estate companies and disadvantages for those that are slower to adopt.

FUTURE OF EMERGING TECHNOLOGIES IN REAL ESTATE

The future of real estate technology will not be defined by isolated gadgets or speculative disruption. Instead, the future is likely to involve greater convergence among emerging technologies. AI will analyze streams from IoT sensors; digital twins will integrate BIM and spatial data; AR interfaces will allow people to interact with building information; and cloud platforms will connect owners, occupants, contractors, regulators, and investors. The future of emerging technologies in real estate is a complex process of structural integration, requiring significant capital investment, workforce reskilling, and the modernization of legacy data systems. Ultimately, the real estate firms that succeed in the coming decade will be those that view these technologies not as isolated point solutions, but as an integrated ecosystem necessary to navigate an increasingly dynamic, resource-constrained, and data-driven world [1].

CONCLUSION

Emerging technologies are creating a real estate sector that is more informed, efficient, sustainable, transparent, and user-centered. They are transforming real estate at every stage, from land analysis and design to marketing, transactions, occupancy, and long-term management. They can improve transparency and trust. These innovations can lower costs and improve experiences for nearly every participant in the market. Used responsibly, emerging technologies will not diminish the importance of real estate professionals; they will enable those professionals to deliver better buildings, better services, and better decisions. The most successful organizations will not necessarily be those that adopt the greatest number of new tools. They will be those that select technologies according to genuine user and asset needs, establish trustworthy data foundations, integrate systems across the property lifecycle, and preserve meaningful human responsibility. More information about emerging technologies in real estate can be found in the books in [11-13] and the

following related journal: *Journal on Emerging Technologies*.

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Figure 1 Some emerging technologies [5].

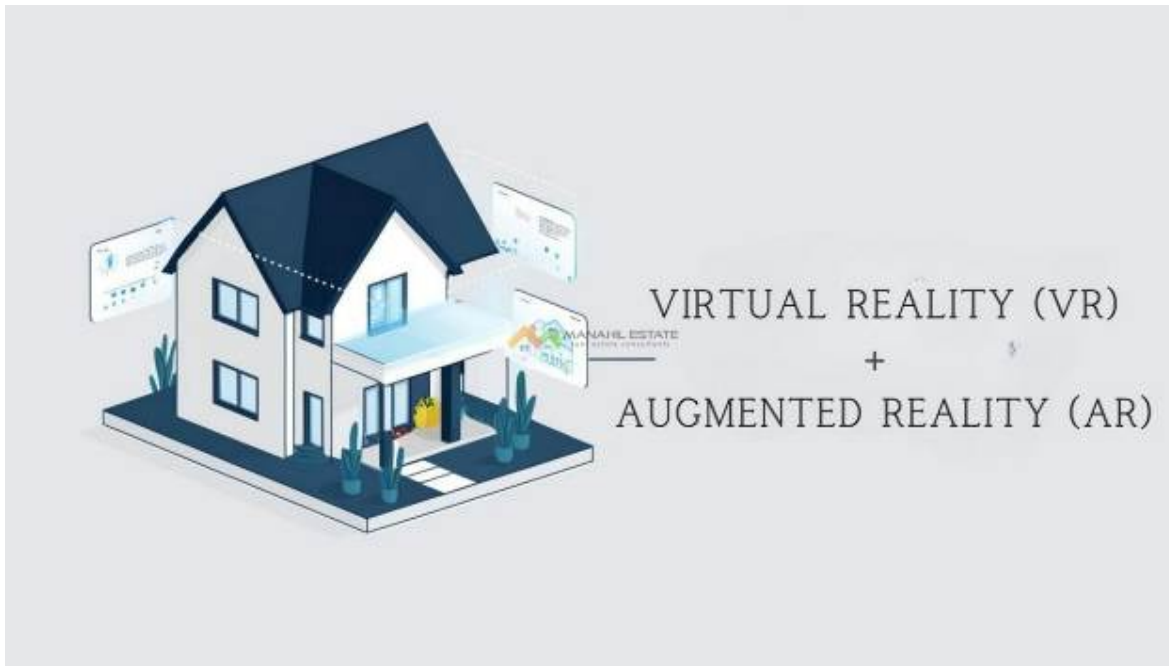


Figure 2 Immersive technologies in real estate [8].



Figure 3 A representation of property and real estate [10].