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The Transforming Impact of PropTech in Driving Sustainability in the Real Estate Industry

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Abstract

The real estate industry is undergoing a transformative shift driven by the integration of property technology (PropTech), including artificial intelligence, big data analytics, and Virtual Reality. This study aimed to analyse the role of PropTech in reshaping the real estate industry and its potential to pave the way for a sustainable future within the industry**.** The sample for the study comprises residential real estate developers, architects, and property managers in the state of Uttarakhand, who are using advanced technologies to manage their real estate business activities. The study analyses the role of the adoption of PropTech, including artificial intelligence, big data analytics and virtual reality, in the real estate industry in enhancing efficiency, transparency, prediction of customer demands, customisation and utilization of resources of businesses operating in the real estate industry, ultimately leading to sustainability within the real estate industry. The study concludes that the adoption of advanced technologies is transforming the real estate landscape by providing multiple benefits, such as predicting markets, valuing properties, personalizing searches, and empowering developers with customer insights. These benefits facilitate data-driven decision-making and create a more responsive industry that would pave the way for real estate professionals and policymakers to navigate the evolving real estate industry on a sustainable basis.

Keywords: Real Estate Industry, PrepTech, Artificial Intelligence, Big Data Analytics, Virtual Reality, Sustainability

1. INTRODUCTION

In recent years, the business environment has globally witnessed a rapid acceleration in technological innovation that is impacting almost every sector (Allioui & Mourdi, 2023). This rapid technological advancement has also made a profound transformation in the real estate industry (Musarat, Irfan, Alaloul, Maqsoom, & Ghufran, 2023). The real estate industry, traditionally known for its brick-and-mortar approach, is undergoing a significant transformation driven by modern and advanced technology (Saiz, 2020). Real estate developers, engineers, and architects are using cutting-edge technologies, popularly known as PropTech in the real estate sector, to revolutionise the way properties are bought, sold, and managed. This tech-driven evolution brings in a bundle of benefits that can enhance the business outcomes in real estate industry. The integration of advanced technologies in real estate businesses can analyse vast amounts of datasets to identify market trends, predict future demand, and inform strategic investment decisions. These advantages, in turn, empower data-driven decision-making, leading to a more responsive and adaptable industry. This technological advancement can give real estate professionals and policymakers the tools they need to adapt to changes in a sustainable way. The integration of PropTech can enable the real estate industry to become more efficient, transparent, and data-driven, ultimately achieving greater sustainability (Naeem, Rana, & Nasir, 2023)**.**

1.1. Harnessing Advanced Technologies for Sustainable Real Estate Business

The real estate industry is experiencing significant changes due to the growing importance of sustainability and the potential of advanced technologies. In today's fast-paced technological environment, real estate businesses are expected to adopt innovations like AI, big data analytics, virtual reality, Internet of Things, blockchain, etc. to improve their performance, stay competitive, and ensure long-term success. The real estate businesses that are failed to embrace these technologies could lead to becoming outdated, while utilizing them may provide them with sustained growth and prosperity.

The shift towards sustainability combined with cutting-edge technologies is crucial for the future of real estate enterprises. Traditional methods of real estate development are no longer adequate to address environmental challenges, changing consumer preferences, and evolving regulations. With the help of integration PropTech, real estate businesses can unlock numerous benefits that enable them to thrive sustainably while meeting modern market demands.

Real estate businesses are expected to embrace these technologies to remain competitive in today's dynamic marketplace. Real estate entities integrating PropTech can gain a strategic advantage by offering innovative solutions, reducing environmental impact, and delivering superior value to stakeholders. Practices that focus on sustainability attract customers, investors, and regulators. They help in building lasting connections and create chances for new growth.

In Uttarakhand, a region known for its ecological diversity and natural beauty, adopting sustainable real estate practices is particularly important. Real estate businesses in Uttarakhand can align development activities with environmental conservation efforts by leveraging advanced technologies. This would help in contributing to the preservation of the region's ecological heritage while meeting the evolving needs of residents and visitors. The convergence of sustainability and advanced technologies presents a transformative opportunity for the real estate industry. Businesses can achieve operational excellence, optimize resource utilization, and deliver lasting value by utilizing cutting-edge technologies.

The present study focuses on analysing the transformative impact of property technology (PropTech) on the Uttarakhand's real estate sector and its potential role in facilitating a sustainable future within the industry. The research examines the role of the integration of PropTech within the real estate sector in improving operational efficiency, transparency, prediction of customer demands, customization, and responsible resource use, ultimately leading to sustainability within the real estate industry.

2. REVIEW OF LITERATURE

The integration of property technology (PropTech) within the real estate sector has drawn significant attention in recent years, especially in the context of enhancing sustainability and operational efficiency. The following literature review provides a comprehensive overview of relevant research studies, highlighting the transformative impact of PropTech on real estate as well as its role in driving sustainability within the real estate industry.

2.1. Transformative Role of PropTech in the Real Estate Industry

The rapid advancements in technology of Industry 4.0 are able to transform the real estate industry into real estate 4.0, significantly enhancing the efficiency of real estate businesses (Starr, Saginor, and Worzala, 2020). Braesemann and Baum (2020) reveal that PropTech is transforming real estate into a data-driven market, highlighting the importance of data analytics technologies and the need

for users and owners to recognize the business value of their generated data. Göppinger, Luque, and Marcato (2024) conclude that adopting market information technology in the short-term rental market significantly increases revenue through reduced daily prices and higher occupancy rates, particularly benefiting high-end properties.The digital technologies like Blockchain and Property Passports are able enhance efficiency by analyzing transaction processes and proposing innovative solutions (Saull, Baum, and Braesemann, 2020). Naeem, Rana, and Nasir (2023) explore that digital real estate, through decision support systems and advanced technologies, has the potential to revolutionize future urban planning and real estate development. DeLisle, Never, and Grissom (2020) reveals that integration of big data helps in addressing societal needs and improving decision-making processes within the real estate industry. The use of predictive analytics in property management can forecast maintenance needs and optimize resource allocation that further lead to reduction in operational costs and improvement in value of properties (Huang et al., 2020). Xu et al. (2020) analyse that the adoption of digital twins, which are virtual models of physical objects, can enhance planning, design, and operational efficiency through real-time data integration and analysis. Saiz (2020) explores how digital and IT technologies, including online brokerage, space commoditization, and fintech, are transforming commercial real estate markets, emphasizing the economic viability and impact of these innovations on traditional players. Tan and Miller (2023) found that digitalization of building operations enhances sustainability through real-time monitoring and automation, yet PropTech startups face challenges in integrating technology stacks, aligning with business processes, and engaging owners and occupants, despite their critical role in accelerating digitalization and sustainability in real estate (Unissu, 2020).

2.2. Conceptual Framework

The above literature review highlights the multifaceted impact of PropTech on the real estate sector. The integration of AI, big data analytics, VR, blockchain, IoT, smart building technologies, and digital twins has the ability to enhance operational efficiency and transparency. Further, it paves the way for a sustainable and customer-centric real estate industry. Considering the above literature review, following conceptual model is developed considering the objectives of the present study:

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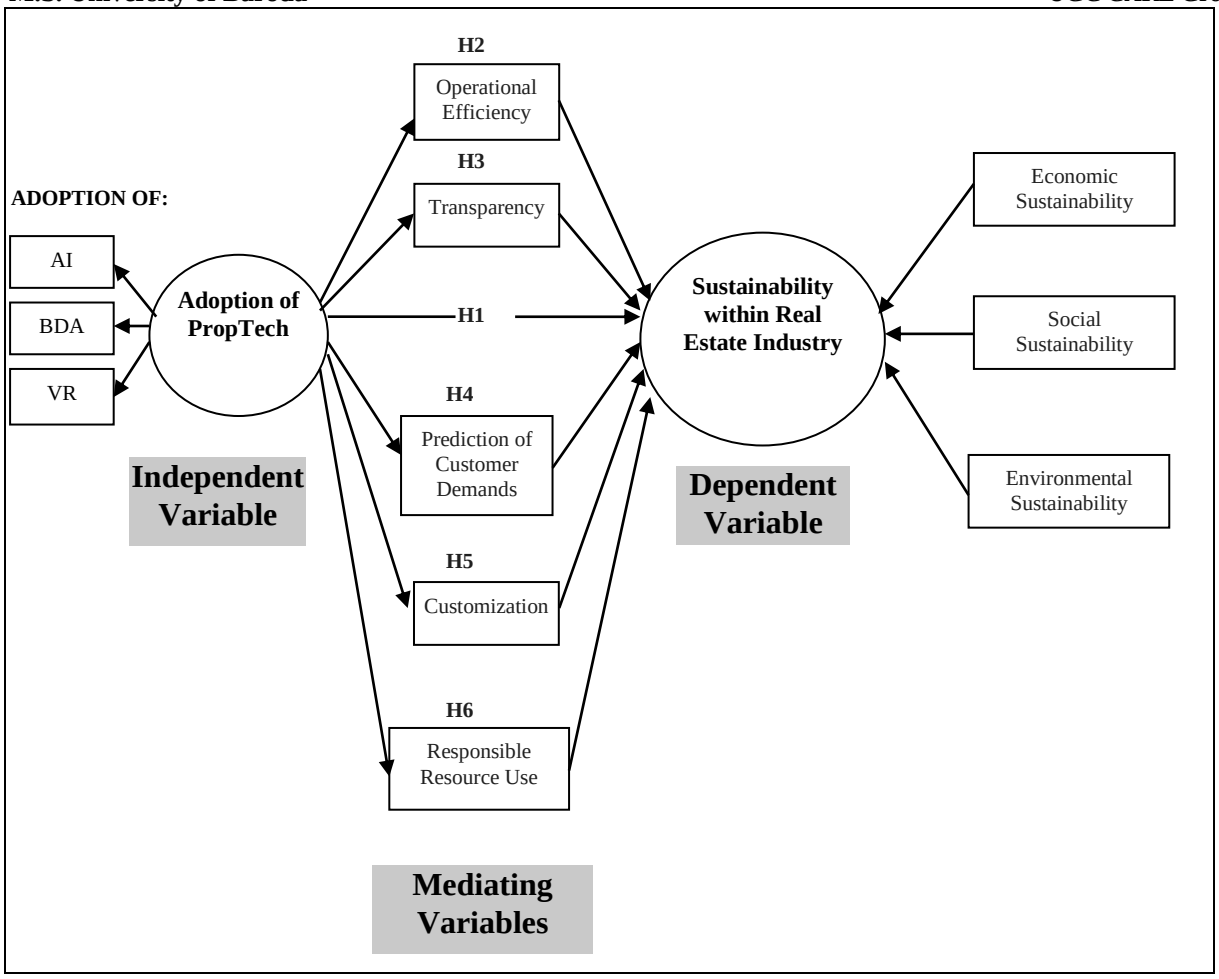

Figure 1: Conceptual Model of the Study:

2.3. Hypotheses of the Study

Based on the conceptual framework of the study, the following hypotheses were formulated and tested further using appropriate statistical tools:

H1: The adoption of PropTech significantly contributes to promoting sustainability within the real estate industry.

H2: Operational efficiency mediates the relationship between the adoption of PropTech and sustainability within the real estate industry

H3: Transparency mediates the relationship between the adoption of advanced technologies and sustainability within the real estate industry

H4: Prediction of customer demands mediates the relationship between the adoption of advanced technologies and sustainability within the real estate industry

H5: Customisation mediates the relationship between the adoption of advanced technologies and sustainability within the real estate industry

H6: Responsible resource use mediate the relationship between the adoption of advanced technologies and sustainability within the real estate industry

H7: Operational efficiency, Transparency, Prediction of customer demands, Customisation, and Responsible resource use collectively mediate the relationship between the adoption of advanced technologies and sustainability within the real estate industry.

3. RESEARCH METHODOLOGY

3.1. Sample and Data Collection

The present research utilises a mixed-methods approach, i.e., both quantitative and qualitative data collection techniques, to analyse the transformative impact of technology on the real estate sector. Quantitative data was collected through surveys conducted on residential real estate developers, architects, and property managers in the state of Uttarakhand. The respondents were selected from various areas of Uttarakhand that are having considerable number of residential societies to ensure they closely matched the overall population of the state. The surveys helped in gathering quantitative data using structured questionnaire that carried questions based on a 5-Point Likert Scale, where 1 = strongly disagree and 5 = strongly agree. The questionnaire comprised seven sets of scales regarding integration of advanced technologies, operational efficiency, transparency, prediction of customer demands, customisation, Responsible resource use, and sustainability. The questionnaires were distributed to the relevant respondents using Google Forms and some were also completed in-person. Qualitative data was obtained through in-depth interviews with a group of industry stakeholders. These interviews provided deeper insights into their experiences with technology integration and its effects on the real estate sector. Moreover, it helped in capturing qualitative data on the perceived benefits and challenges of adopting advanced technologies within the real estate industry. The study utilizes purposive sampling technique in order to select the respondents of the study by which only those residential real estate developers were selected who have adopted advanced technologies in building real estate properties. A total of 201 questionnaires were collected, out of which only 178 were found to be suitable and appropriate for the present study and hence used for the final data analysis. The data was analysed using Structural Equation Modeling (SEM) technique, which was run in SMART PLS SEM software version 4.

3.2. Questionnaire Development

The development of the questionnaire for this study involved several key steps to ensure its validity and effectiveness in gathering data on the transformative impact of technology in the real estate sector. In order to develop the questionnaire, consultations were held with relevant experts in real estate development, architecture, and property management. Insights gathered from these experts helped in framing and structuring the questionnaire to encompass key aspects of technology integration and its impact on the industry. A pilot study was conducted wherein a preliminary version of the questionnaire was administered to a small group of experts in the field. These experts provided valuable feedback on the clarity, relevance, and comprehensiveness of the questions. Based on their input, necessary adjustments were made to refine the questionnaire. The literature review also helped in identifying relevant constructs and dimensions to be included in the questionnaire. Subsequent to the pilot study, expert consultations, and literature review, the final version of the questionnaire was prepared. The questionnaire was structured to gather data on seven dimensions such as integration of advanced technologies, operational efficiency, transparency, prediction of customer demands, customization, responsible resource use, and sustainability using a 5-Point Likert Scale. The integration of advanced technologies was measured using three items, namely adoption of AI, big data and PropTech, whereas sustainability within the real estate sector was assessed using three sub-dimensions, namely economic, social and environmental sustainability.

4. DATA ANALYSIS AND RESULTS

The present study adopted the two-stage approach as recommended by Anderson and Gerbing (1988). The data was analysed applying Structural Equation Modeling (SEM) Technique using SmartPLS 4. Firstly, the measurement model was assessed to ensure the validity and reliability of each construct. Subsequently, the structural model was tested to analyse the hypothesized relationships between the variables, including independent, mediating as well as dependent variables.

4.1. Measurement Model Analysis (Testing the Reliability and Validity)

The measurement model was developed and evaluated for reliability and validity of constructs present in the study. Table 1 shows the values of Cronbach's Alpha, CR Alpha, AVE and factor loadings for each construct involved in the study. The results reveal that all loadings within each construct exceeded the recommended threshold of 0.60 (Chin, 1998). This indicates that all items

contributed effectively in estimating their underlying constructs. Further, reliability of research instrument was assessed using Cronbach's alpha and composite reliability (CR). As shown in Table 1, both Cronbach's alpha and CR values surpassed the threshold of 0.70 (as recommended by Wasko and Faraj, 2005), indicating strong internal consistency across all constructs. Convergent validity was assessed with the help of average variance extracted (AVE), which exceeded 0.50 (as shown in Table 1), hence establishing convergent validity. Discriminant validity was evaluated using the Fornell and Larcker (1981) criterion. According to Fornell and Larcker (1981), discriminant validity is established if the square root of AVE of each construct exceeds the inter-correlations between other constructs. The results reveal that the AVE values were greater than the squared correlations between each pair of constructs (italicized along the diagonal in Table 2), hence supporting the presence of discriminant validity (see Table 2).

Table 1: Reliability and convergent validity of the constructs

Scale	Cronbach's Alpha	CR Alpha	AVE	Scale item number and loadings					
				1	2	3	4	5	6
Adoption of PropTech	0.914	0.965	0.711	0.767	0.734	0.898	0.789	0.736	0.878
Operational efficiency	0.883	0.910	0.627	0.754	0.762	0.823	0.803	0.766	0.829
Transparency	0.876	0.906	0.616	0.821	0.736	0.776	0.760	0.832	-
Prediction of customer demands	0.821	0.874	0.582	0.824	0.739	0.765	0.743	0.769	0.854
Customisation	0.861	0.900	0.643	0.792	0.835	0.821	0.798	0.745	-
Responsible resource use	0.841	0.886	0.609	0.765	0.864	0.823	0.747	0.791	0.793
Economic sustainability	0.881	0.908	0.624	0.791	0.765	0.823	0.865	0.746	-
Social sustainability	0.885	0.916	0.685	0.798	0.765	0.791	0.893	0.821	-
Environmental sustainability	0.838	0.910	0.691	0.793	0.746	0.792	0.764	0.743	0.891

Table 2: Discriminant validity of the constructs (Fornell and Larcker Criterion)

	APT	OE	TR	PCD	CUS	ORUR	ES	SS	ENVS
APT	***0.785***								
OE	0.476	***0.791***							
TR	0.656	0.487	***0.764***						
PCD	0.434	0.421	0.267	***0.805***					
CUS	0.359	0.368	0.641	0.431	***0.782***				
ORUR	0.386	0.315	0.632	0.681	0.524	***0.792***			
ES	0.218	0.201	0.272	0.214	0.263	0.498	***0.819***		
SS	0.662	0.698	0.367	0.345	0.326	0.217	0.562	***0.732***	
ENVS	0.515	0.312	0.486	0.324	0.102	0.112	0.321	0.341	***0.747***

Note: Italics refer to square root of AVE

4.2. Structural Model Analysis

Subsequent to assessing the measurement model, the structural model was tested to analyse the relationship between adoption of PropTech and sustainability within the real estate industry. Initially, we evaluated the extent to which the independent and mediating variables account for variance in the dependent variable. In this regard, we assessed how the adoption of PropTech, operational efficiency, transparency, prediction of customer demands, customization, and responsible resource utilization explain the variability in sustainability within the real estate industry. The results reveal that these factors collectively accounted for 49.1% of the variance in sustainability, which is considered moderate (Chin et al., 2008).

To determine if the relationship between APT and sustainability was influenced by operational efficiency, transparency, prediction of customer demands, customization, and optimum and responsible resource use, we conducted a bootstrapping procedure with 5,000 samples (Hair et al., 2017). The study examined seven variables: APT as the predictor variable, operational efficiency, transparency, prediction of customer demands, customization, and responsible resource use as mediating variables, and sustainability as the outcome variable. We first tested direct effects by assessing whether APT predicts sustainability and whether APT predicts the mediating variables. Subsequently, we tested indirect effects to investigate whether operational efficiency, transparency, prediction of customer demands, customization, and responsible resource use mediate the relationship between APT and sustainability within the real estate sector.

The results supported the formulated hypotheses of the study (H1-H7), as shown in table 3. The results reveal that integrating advanced technologies positively and significantly predicted sustainability ($\beta = 0.812$, $t = 4.431$, $p < 0.001$), indicating that advanced technology integration fosters sustainability within the real estate sector. APT also positively and significantly predicted

all five mediating variables: operational efficiency (β = 0.174, t = 3.395, p < 0.001), transparency (β = 0.181, t = 3.349, p < 0.001), prediction of customer demands (β = 0.178, t = 3.643, p < 0.001), customization (β = 0.723, t = 4.124, p < 0.001), and responsible resource use (β = 0.213, t = 4.173, p < 0.001), suggesting that adopting PropTech provides multiple benefits to real estate businesses by improving these aspects.

Furthermore, the direct effects of the mediating variables on sustainability were significant. There were positive relations for all five mediating variables on sustainability, indicating that improvements in operational efficiency (β = 0.214, t = 4.182, p < 0.001), transparency (β = 0.162, t = 3.789, p < 0.001), prediction of customer demands (β = 0.114, t = 3.389, p < 0.001), customization (β = 0.240, t = 3.358, p < 0.001), and responsible resource use (β = 0.167, t = 3.386, p < 0.001) contribute to sustainability within the real estate industry.

Lastly, the mediation analysis was performed. The results showed that with the inclusion of five parallel mediators, the direct effect of APT on sustainability was found insignificant (β = 0.113, t = 1.741, p < 0.082), whereas the indirect effects of APT on sustainability through operational efficiency, transparency, prediction of customer demands, customization, and responsible resource use were significant (table 3). The results confirmed that these parallel mediators fully mediate the influence of APT on sustainability, supporting the hypotheses (H2, H3, H4, H5, and H6) of the study. The seventh hypothesis of the study was tested, and it was found that there is a significant and positive parallel mediating effect of operational efficiency, transparency, prediction of customer demands, customisation, and responsible resource use on the relationship between the adoption of PropTech and sustainability within the real estate industry (β = 0.644, t = 17.031, p < 0.001).

Table 3: Hypotheses Results:

Relationship	**Direct effect**	**SE**	**t**	**p**	**Hypothesis**
H1: IAT->SUST	0.812	0.031	4.431	0.000	Supported
Relationship	**Indirect effect**	**SE**	**t**	**p**	**Hypothesis**
H2: IAT->OE->SUST	0.214	0.071	3.349	0.000	Supported
H3: IAT->TR->SUST	0.129	0.038	3.576	0.000	Supported
H4: IAT->PCD->SUST	0.125	0.023	3.362	0.000	Supported
H5: IAT->CUS->SUST	0.084	0.033	2.982	0.003	Supported
H6: IAT->RRU->SUST	0.092	0.031	3.269	0.001	Supported
H7: IAT->OE->TR->PCD- >CUS->RRU->SUST	0.644	0.042	17.031	0.000	Supported

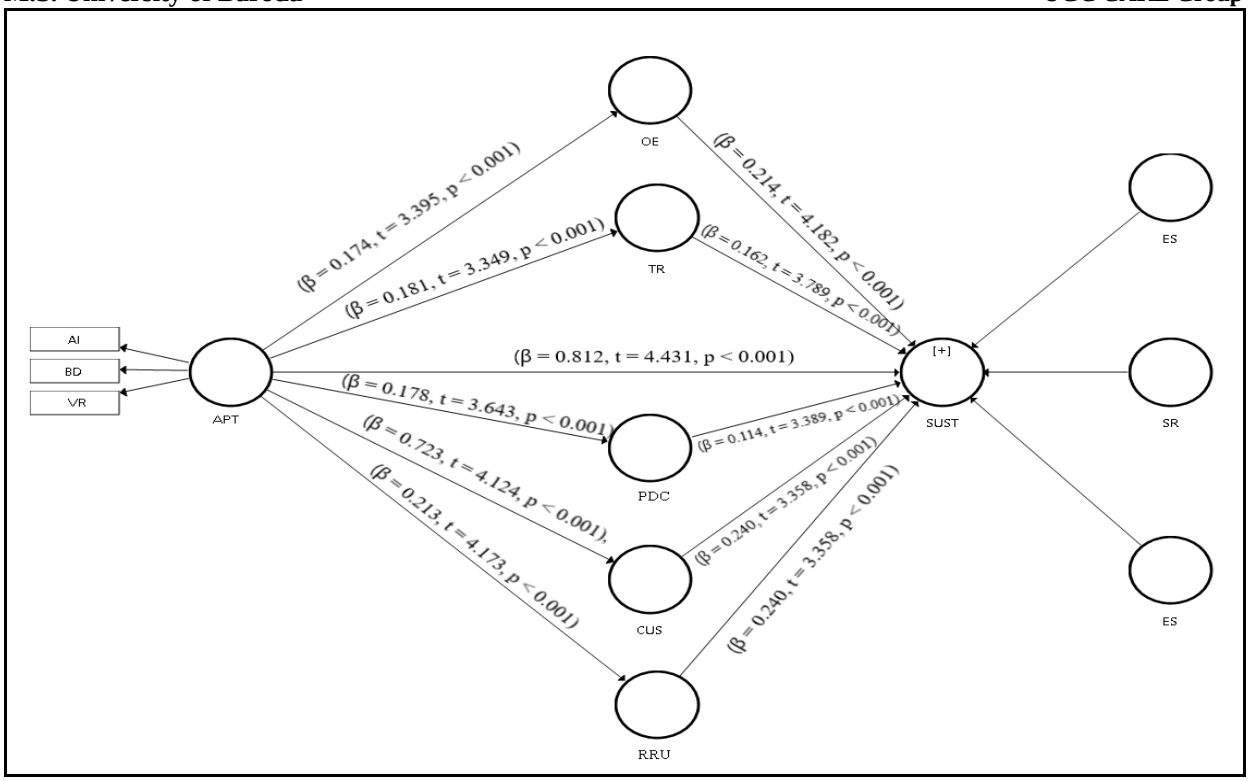

Figure 2: Structural Model

5. DISCUSSION

The results of the present study reveal a significant positive relationship between the integration of PropTech (including AI, big data analytics and virtual reality) and sustainability within the real estate industry. The study analyses that the integration of these technologies has a transformative impact on the real estate industry, leading to improvements across multiple dimensions, including improvement in operational efficiency, transparency, prediction of customer demands, customization, and responsible resource use. These improvements further lead to sustainability within the real estate businesses, which is measured in terms of economic, social as well as environmental sustainability.

- Operational Efficiency: The study demonstrates that the incorporation of AI, big data, and virtual reality into real estate business activities enhances operational efficiency. This is evidenced by streamlined processes, reduced administrative burdens, and optimized resource allocation, resulting in cost savings and improved productivity for industry stakeholders.
- Transparency: The analysis indicates that advanced technologies contribute to greater transparency within the real estate sector. Through enhanced data collection, analysis, and reporting capabilities, stakeholders are better equipped to access and interpret information

related to property transactions, market trends, and regulatory compliance, bringing trust and confidence in the industry.

- Prediction of Customer Demands: The findings of the research highlight a positive correlation between technology adoption prediction of customer demands and preferences in the real estate sector. The real estate industry players are able to meet the evolving needs and expectations of clients, thereby enhancing overall satisfaction levels by utilising AI-driven tools for personalized property recommendations, facilitating seamless communication and transaction processes through digital platforms, and providing enhanced customer service experiences,.
- Customization: The study reveals that advanced technologies enable greater customization in real estate offerings and services. Through data-driven insights and predictive analytics, stakeholders can tailor their products and solutions to meet the unique preferences and requirements of individual clients, leading to higher levels of engagement and loyalty.
- Optimum and Responsible Resource Optimization: AI and big data analytics enable responsible utilization of resources in real estate development and management. By optimizing energy use, reducing waste, and implementing sustainable practices, companies can minimize environmental impact while maximizing efficiency and cost-effectiveness.

The improvements driven by these technologies ultimately contribute to sustainability within real estate businesses, encompassing economic, social, and environmental dimensions:

- Economic Sustainability: Enhanced operational efficiency and resource optimization lead to cost savings and improved financial performance. Sustainable practices attract investors and support long-term economic growth and stability within the real estate industry.
- Social Sustainability: Real estate businesses cultivate positive relationships with communities and stakeholders by prioritizing customer demands and offering customized solutions. This includes providing affordable and inclusive housing options, promoting public health and safety, and supporting local employment and development initiatives.
- Environmental Sustainability: The responsible use of resources and implementation of sustainable practices reduce the environmental footprint of real estate activities. This includes minimizing carbon emissions, conserving natural resources, and promoting eco-friendly building designs and technologies.

The study analysed that the integration of advanced technologies like AI, big data analytics, and virtual reality brings about significant improvements in operational efficiency, transparency,

prediction of customer demands, customization, and resource utilization within the real estate industry. These improvements further result in driving sustainability across economic, social, and environmental dimensions, reinforcing the importance of technology-driven innovation in advancing sustainable practices within real estate businesses.

5.1. Sustainable Advantages of Advanced Technologies in the Real Estate Sector

The following are the various sustainable benefits that are availed of by the use of advanced and modern technologies within the real estate sector:

Optimizing Design and Construction	AI can analyze vast datasets to generate energy-efficient building designs. It can also optimize material usage, minimizing waste and environmental impact
Smart Building Management	PropTech platforms can integrate with building systems to monitor energy and water consumption in real-time. This allows for proactive adjustments and significant reductions in resource usage.
Informed Material Selection	AI-powered tools can analyze the environmental footprint of various building materials, enabling developers to choose sustainable options with low embodied carbon.
Predictive Maintenance	AI can analyze sensor data to predict potential equipment failures in buildings. This allows for proactive maintenance, minimizing energy waste and extending equipment lifespans.
Occupant Engagement	Smart building technologies can provide residents or tenants with real-time feedback on their resource consumption. This transparency empowers them to adopt more sustainable practices.
Facility Management	PropTech platforms can help with streamlining maintenance schedules and resource allocation for existing buildings.
Real Estate Transactions	AI-powered property valuation tools can incorporate sustainability features, influencing buyers and developers to prioritize eco-friendly buildings.

6. FINDINGS, CONCLUSION AND SUGGESTIONS:

6.1. Findings

Previously, the real estate industry relied heavily on resource-intensive methods and materials, leading to concerns about environmental impact. Construction processes generated significant waste, and buildings often contributed heavily to energy consumption. However, technology is offering solutions to these challenges.

The present research analyses that the adoption of modern technologies in real estate brings dual advantages. Firstly, it extends the lifespan of constructed buildings and reduces construction costs. Secondly, it benefits users by providing sustainable buildings equipped with modern amenities such as proper ventilation systems, solar panels, modern interiors, and advanced devices. These improvements contribute to enhancing building durability and promoting the health and well-being of occupants.

The study found that big data analytics empower developers and architects to make informed decisions based on a vast amount of information. This data can include weather patterns, local building codes, energy consumption benchmarks, and the availability of sustainable materials. While utilizing and analyzing this data, professionals can design buildings that are optimized for energy efficiency and have a minimal environmental footprint. AI algorithms are further revolutionizing the design and construction phases of real estate projects. They can optimize building layouts for maximum natural light and ventilation, reducing reliance on artificial lighting and cooling systems. Furthermore, AI can analyze building materials and recommend sustainable alternatives with lower environmental impact. This not only benefits the environment but also leads to long-term cost savings through improved energy efficiency. The integration of Virtual Reality (VR) into the real estate business has the potential to revolutionize the industry by significantly enhancing the way properties are marketed, viewed, and sold. VR technology allows potential buyers to experience immersive, 3D virtual tours of properties from anywhere in the world, thereby eliminating the need for physical visits and saving time and resources for both buyers and realtors. This technology can showcase properties in their best light, providing detailed, interactive views that highlight features and layouts more effectively than traditional photos or videos. Furthermore, VR can assist in the planning and design phases of real estate projects, enabling architects and developers to visualize and modify spaces before construction begins. This can lead to more precise and efficient project management, reducing costs and errors. By offering an innovative and

engaging way to explore properties, VR can attract a broader audience, enhance customer satisfaction, and ultimately drive sales, making it a powerful tool in the competitive real estate market. The study identifies that the benefits of technology extend beyond the design and construction phases. Smart building technologies integrated with AI, big data and virtual reality can optimize energy consumption within a building. Sensors can monitor real-time usage patterns and automatically adjust lighting, heating, and cooling systems, significantly reducing energy waste. Moreover, AI-powered predictive maintenance can identify potential equipment failures before they happen, minimizing disruptions and extending the lifespan of building systems.

Furthermore, the present study realises that the impact of technology extends beyond enhancing efficiency. It empowers stakeholders in the real estate sector by enabling data-driven decision-making and promoting sustainable practices. Developers can attract environmentally conscious tenants and investors. Architects can design buildings that prioritize the well-being of occupants and the surrounding environment. Furthermore, property managers can leverage technology to ensure efficient operation and maintenance, minimizing the building's environmental impact.

6.2. Conclusion

The study concludes that the real estate developers can achieve longer-lasting structures that are more cost-effective to build by incorporating modern technologies. Furthermore, occupants can benefit from sustainable features like efficient ventilation systems, solar power utilization, contemporary interior designs, and smart devices integrated into the properties. These advancements not only enhance the longevity of buildings but also contribute to improving the health and hygiene of clients. Furthermore, the incorporation of modern technologies in real estate properties addresses the preferences of clients. When developing real estate projects, developers prioritize client preferences by considering factors like location and nearby amenities such as hospitals, schools, and retail shops.

6.3. Suggestions

The study suggests that real estate developers must understand the importance of meeting client preferences regarding the location of properties. They must ensure that properties are situated in areas with convenient access to essential services and amenities that clients value, such as healthcare facilities, educational institutions, and shopping centers. This client-focused approach enhances the appeal and usability of real estate properties, contributing to customer satisfaction and overall success in the market.

While technology presents a multitude of opportunities for building a sustainable future in real estate, there are challenges to consider. Integrating these technologies requires an upfront investment, and ensuring responsible data security and privacy remains paramount. Furthermore, upskilling the existing workforce will be crucial to adapt to a more technology-driven industry. However, by embracing these challenges and focusing on a collaborative approach, the real estate industry can leverage technology to create a more sustainable future for all.

6.4. Limitations and Future Scope of Study

The analysis of the present study as regard to PropTech adoption may not fully capture the extent to which different real estate owners integrate technology, potentially overlooking variations in their capabilities and how these impact sustainability outcomes. Hence, investigating emerging PropTech innovations beyond AI, big data analytics, and VR, such as blockchain and IoT, etc. could uncover their potential contributions to sustainability goals in real estate management. Given the rapid evolution of PropTech, the findings are also influenced by the technologies available and their adoption rates at the time of data collection, which could limit the long-term applicability of the study. In this regard, Longitudinal studies could track the evolving role of PropTech over time, examining its sustained effects on efficiency, transparency, and sustainability metrics within the sector. Future research can be conducted based on comparative studies across different regions or countries to assess how varying regulatory environments, market dynamics, and technological infrastructures influence PropTech adoption and its impact on sustainability in real estate.

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