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Mohammed T. Nuseir, Ahmad Aljumah, Ghaleb A. El Refae

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Revolution of the marketing mix idea using AI tech to forecast strategic marketing decision management with moderating effect of environmental parameters in UAE real estate industry

Mohammed T. Nuseir*

College of Business,
Al Ain University, UAE
Email: drmnuseir@yahoo.com
*Corresponding author

Ahmad Aljumah

College of Communication and Media,
Al Ain University, UAE
Email: ahmad.aljumah@aau.ac.ae

Ghaleb A. El Refae

College of Business,
Al Ain University, UAE
Email: ghaleb.elrefae@aau.ac.ae

Abstract: The prime objective of the study is to examine the direct impact of machine learning, deep learning and big data on the marketing strategies of real estate firms in UAE. In addition to that, the study has also examined the moderating role of environmental factors in the relationship between the deep learning, machine learning, big data and marketing strategies of real estate firms in UAE. In the current research, the data from the total 300 marketing managers were collected using the non-probability convenient sampling technique from Dubai UAE. The study has employed quantitative research design and SEM-PLS was used for the analysis purpose. The results of the study emphasise leveraging AI within the marketing mix, as it predicts how the marketing decision-making should be done and gives data driven insights, which reshape traditional marketing framework.

Keywords: machine learning; marketing mix; deep learning; real estate UAE; strategic marketing decision management; big-data; environmental factor.

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Biographical notes: Mohammed T. Nuseir is a Professor in Marketing with a cross-cultural background; he joins the Al Ain University, UAE in the College of Business in 2017. He possesses academic and training experience at multinational academic institutes and corporations. He holds academic degrees from the USA and Canadian universities, along with experience in teaching UG and graduate courses in the field of marketing and Business. He has been supervising Masters and PhD students. Moreover, his work has been extended to research papers, where he published many papers in collaboration with some fellows in peer-reviewed international business journals, with a focus on topics that aim at leveraging technology in digital marketing, social media, and artificial intelligence in business.

Ahmad Aljumah is an Assistant Professor in Marketing. He joins the Al Ain University in 2019 in the College of Communication and Media. He possesses academic and training experience. He holds a PhD degree from the Malaysian University, along with experience in teaching courses in the field of marketing and business. Moreover, his work has been extended to research papers, where he published many papers in collaboration with some fellows in international journals, with a focus on topics that aim at leveraging technology in marketing and business in Asia and Middle East region.

Ghaleb A. El Refae is a Professor of Financial Economics and Accounting in the College of Business at Al Ain University, UAE. He has published in various journals, books and conferences proceedings. He served as a guest editor, and has recently become a chief-editor, and an editorial member of several economics, business and information technology journals. His research interests include university corporate governance, risk management, financial contract theory, theory of the firm, industrial organisation, business analytics, artificial intelligence, and drone technology in business environment.

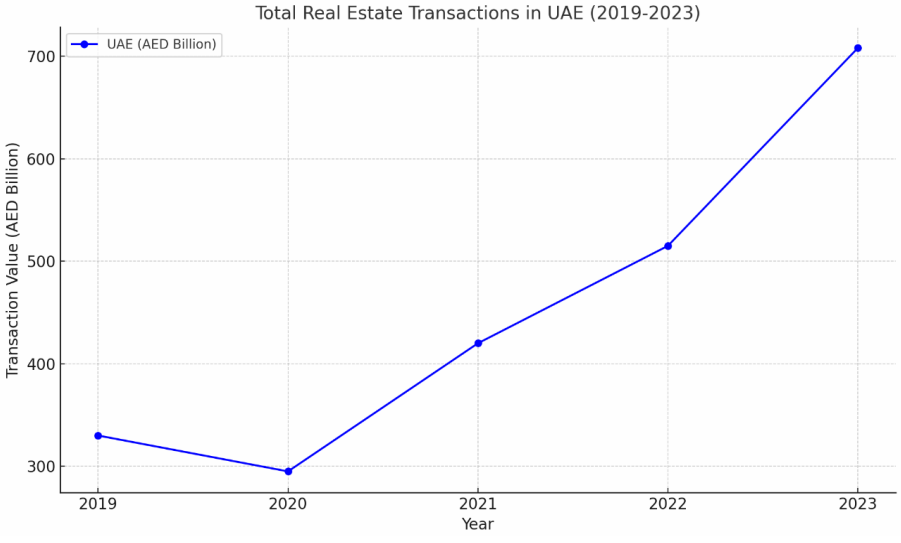
1 Introduction

UAE real estate sector is a key driver of economic diversification and key contributor to the non-oil economy (Antwi-Boateng and Al Jaberi, 2022). In 2023, Dubai had over 122,000 real estate transactions made, and luxury realty saw huge demand thanks to increasing interest from ultra-high-net worth individuals (UHNWIs). However, mega projects such as Saadiyat Grove and Reem Hills were what attracted the domestic and international buyers in Abu Dhabi too. Foreign investment has been fuelled by the government's Golden Visa program, which offers long-term residence to property investors. Expo 2020's legacy has also led to investment in eco-friendly developments to align with global sustainability goals, while plans for COP28 in the UAE have also spearheaded investment into environmentally friendly initiatives. The hospitality and retail real estate are also doing well: mixed-use developments grew 20% from one year ago. At the same time, the technology adoption in the world of property management – the use of block chain for secure transactions, AI-powered smart home solutions – demonstrates the innovation in this industry. Despite this, bullish outlook continues with expatriate flow, the UAE's commitment to infrastructural development that will see valuations lift in key areas.

The real estate transaction values, total across Dubai and Abu Dhabi (the UAE), have been presented in Figure 1 from 2019 to 2023. It shows a gradual growth trajectory in the

period from AED 330 billion in 2019 and climbs to AED 708 billion in 2023. Global slowdown caused by the COVID-19 pandemic in 2020 manifests in its slight dip, but the sector recovered strongly after 2021. Foreign investment, government incentives and rising demand for luxury and sustainable developments helps the UAE maintain its status as a top real estate hub.

Figure 1 Total real estate transactions in UAE (2019–2023) (see online version for colours)



The rapid expansion of the Middle East's real estate industry is a function of technology, as there are growing problems that have to be tackled in a scalable manner, while technology is making everything simpler and more available. To address the needs and issues faced in the UAE real estate industry, it has technologically creative solutions to improve the experience of the operations of property related operations (Issac, 2024). In the current economic climate, technological aid for the real estate industry's strategic decision-making tends to be irregular and capricious (Amankwah-Amoah et al., 2021; Al Shawabkeh et al., 2021). Lambourne (2022) shows that most properties in the UAE are being put on portals. Through these portals, many prospects can be reached and properties with street view technology which best suits the location requirements of prospective tenants and buyers can be found. Just like technology helps property holders and tenants with neat property listings, property holders are given the badge to let the tenants know whether the listing is registered and running at that point in the time. The real estate industry heavily embraces technology to improve business for all parties involved, including tenants, property owners, and consultants. The house-hunting process is also performed virtually, allowing them to view a property's street view and take a virtual tour using identical 2D and 3D floor plans. Future developments will also include live property visualisation to provide tenants with a bird's-eye viewpoint in actual time. There is much support for property consultants, where technology alters the experience of owners and tenants. Cutting-edge technology methods used in the real estate market provide agents and brokers of property with items relevant to the sector. Real estate agents can negotiate more effectively using technology and artificial intelligence (AI) to gain a deeper understanding of their client's wants and expectations. Additionally, it

simplifies the process of lead management for managers, which helps close professional agreements. A comprehensive method to meet the demands of property finders and brokers is provided by solutions of property technology combined with AI techniques, such as big data, machine learning (ML), and deep learning (DL).

Advances in technology and data analytics allied with the UAE real estate sector have witnessed a remarkable transformation (El Khatib et al., 2023). Its evolution sits in line with worldwide trends but is moulded by the UAE's unique priority on innovation, sustainability and wealth diversification (Jamali et al., 2024). More and more, strategic marketing decision-making requires the integration of ML, DL, and big data analytics (BDA). With its dynamic and competitive UAE real estate market, those tools need to be precise and intelligent tools to predict market trends, understand the preferences of the customers, and optimise operational efficiency (AlBahsh and Hosseinian-Far, 2021). At a time when decisions carry high stakes and change happens swiftly, the ability to parse large data sets and extract strategic insights can make a big differentiator in the marketplace. They are not just secondary technologies but are fundamental to addressing issues that define the Emirates' property market such as fluctuating demand, international competition, and the requirements of regulatory compliance.

Together, ML and DL have transformed the process in which data is processed and utilised within the real estate space (Starr et al., 2021; Awawdeh et al., 2022). Since it does this from historical transaction data, ML can also be used to build predictive models to forecast future property trends and detect anomalies or risks or opportunities. Moreover, the information that DL can extract from unstructured data like images and videos, or customer reviews, provides for deeper insights into buyer preferences and the market dynamics (Starr et al., 2021; Wang et al., 2021; Aljumah, 2022). These technologies are important in the UAE, where real estate transactions involve widely varying types of buyers and investors, including wealthy individuals and expatriates, to create personalised marketing strategy. See, for example, how DL can optimise digital marketing campaigns based on customer interaction patterns, or ML can determine how marketing a luxury property will perform. This is where UAE real estate firms can take advantage of these capabilities and focus on niche markets to achieve better customer satisfaction and meet what is becoming the expectation of the consumer.

The UAE real estate sector experience due to environmental factors is no less significant in shaping strategic marketing decision management (AlBahsh and Hosseinian-Far, 2021; Aljumah et al., 2022). Market's progress is determined by many variables such as government policy, economic indicators and the sustainable development goals at the global level. The real estate sector is geared for growth thanks to the UAE Government, which has initiated many reforms like the Golden Visa program and the Expo 2020 legacy projects. Meanwhile, these initiatives drained in foreign investors and provided local investors the confidence in the market. Yet these environmental changes give rise to various complications that need sophisticated analytics for effective management. BDA allow big data of the external factors to be integrated in strategic framework for making strategic decision taking into consideration opportunities and risks. For example, oil price fluctuations or new construction regulations can evolve to exploit the situation better, adjusting marketing campaigns or investments plans so that the firms remain viable and flexible in a highly competitive market.

By harnessing the synergy between ML, DL, BDA and environmental factors, we provide a transformational way of strategic marketing decision making in UAE real estate

sector (Soomro et al., 2024). This integrated framework gives a firm the power to develop data-driven, agile and customer centric strategies with relevance in the increasingly digital economy. These technologies allow organisations to get a holistic view of the market, learn how to uncover them and solve them in a proactive way. Additionally, this framework also supports the UAE's Vision 2030 vision of sustainable and smart urbanity. The adoption of these advanced technologies in the UAE aims to not only boost the operational efficiency of the sector, but also to aid in the long-term growth, and sustainability of the sector as the UAE scouts for international leadership in innovation, and real estate which are two areas critical to its economic growth.

Previous studies complemented by this work inputs are made in providing an integrated framework incorporating ML and DL, BDA and environmental factors for the strategic marketing decision management in the real estate sector. The research bridges the gap between theoretical advancement in intelligent technologies and their practical application in an important high stakes, dynamic market, in the UAE real estate market industry. By focusing on one of the fastest growing and most competitive industries, this research provides actionable insights into how technological innovations can improve decision-making processes and allow firms to grow sustainably and with a competitive advantage.

This study also provides one key contribution: its practical focus on the way to ML and DL to predict market trends, to exploit consumer preferences, and to improve marketing strategies. Previous studies used these technologies in other industries but this research focuses on how they can be applied to real estate in UAE. To give you one example, the study shows how ML and DL models can be used for processing large-scale transactional data analyse the behaviour of buyers and draw property trends. Given the importance of precise, data informed strategies for success for firms operating in highly diverse and globalised customer markets, this contribution is particularly relevant.

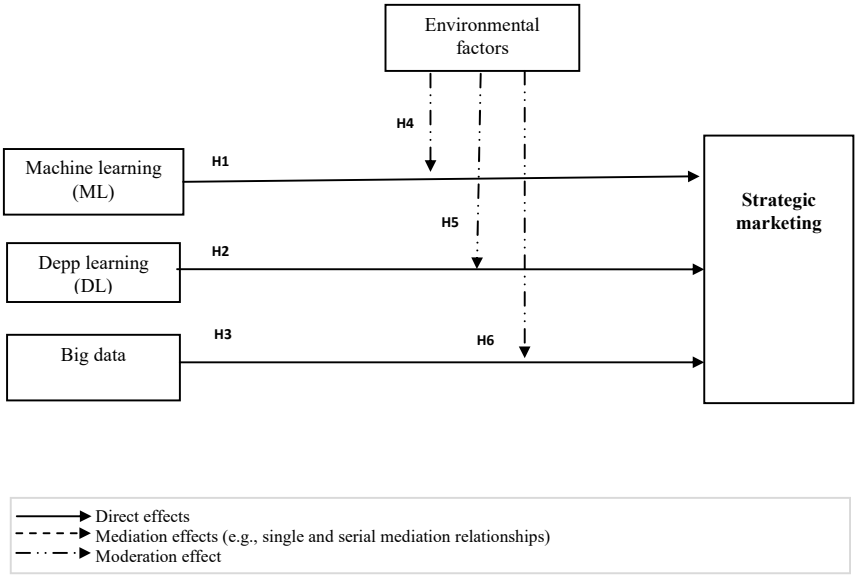
Integration of environmental factors into strategic decision-making is another critical aspect of this study. This research addresses the effect of variables, of government policies, economic shifts and sustainability initiatives on the challenges and opportunities of UAE real estate market. As this contribution demonstrates, it should also be viewed as an encouragement of combining technological insights with awareness of the broader macro economies to enable firms to navigate uncertainties and seize on emerging trends. This study is broad and realistic enough to include environmental factors making this highly applicable to real world situations in places with fast changing regulatory and economic landscapes.

Finally yet importantly, this study integrates its results with Vision 2030 of the UAE, as it is pledged to promote innovation, sustainability, and economic diversification. The proposed framework will not only contribute to operational excellence for real estate firms, but also supports the overall aim of positioning the UAE as a world leading real estate innovation. This research sets benchmark for future studies as well as offers a roadmap for industry stakeholders on how to successfully adopt new technology into the UAE market by addressing the unique challenges and opportunities of the UAE market. Beyond the academic importance, the study provides practical value to policymakers, real estate developers, and marketing professionals who would want to succeed in the 'digitised' world.

2 Conceptual framework

The study has proposed the conceptual framework as the starting point for academic investigation as to how advanced technologies (ML, DL, and Big Data) integrate into strategic marketing, how environmental factors function to moderate this relationship. The framework investigates direct effects of these technologies on marketing strategy and mediation effects (single and serial mediation relationships). It enables in depth exploration of the relationship between innovation and efficiency driven by technological advancements in marketing. In addition, factors inherent in a contextual dimension of environment are the moderation, to consider external factors that have an impact on the efficacy of these technologies. This framework, when combined, offers a solid foundation for studying the dynamic linkages among advanced technologies, environmental factors, and strategic marketing outcomes for empirical studies that ultimately advance theory and inform practice.

Figure 2 The proposed framework



With the emergence of machine, learning based AI systems integrated in strategic marketing processes (Huang and Rust, 2021) the ways of decision-making have gone a long way from the traditional ways, characterised by high reliance on human intuition, market research and historical data analysis. AI based on ML has a unique advantage that makes them perfect for processing huge amounts of data, predicting what consumers will do, as well as optimal marketing in real-time (Haleem et al., 2022; Nuseir et al., 2023). For example, predictive analytics, in fact, allows marketing to make remarkable accurate predictions on future trends and consumer demands (Seyedan and Mafakheri, 2020), with the actionable insights and recommendations for resource allocation, product positioning,

and campaign targeting, etc. Real-time data processing further adds to the agility of an organisation to react swiftly to market jostled, competitive activity and customer responses. To complement these capabilities, AI can personalise marketing efforts at never-before-seen scales. AI systems analyse each individual consumers preferences and craft highly targeted campaigns thus increasing customer satisfaction, loyalty and conversion rate (Iyelolu et al., 2024; Qasim et al., 2022), and to complement this, routine tasks like segmentation and tracking of performance are automated, freeing up marketers to deploy it towards strategic initiatives that enable innovation and long-term planning. It is amazing how little the marketing performance will benefit by, and how much the organisational success will depend on, all the efficiency and precision that AI brings.

While it presents these advantages, AI in marketing is not without its challenges, which are widespread. Ethical concerns around data privacy and algorithmic bias have arisen that would erode a consumer's trust if not addressed. To manage these risks, organisations must introduce some robust ethical guidelines and maintain a culture of transparency while enjoying the full capabilities of AI (Robinson, 2020; Nuseir, 2018). Additionally, AI's more technologically advanced analytical tools excel at synthesising complicated data and removing cognitive biases, resulting in much better quality of strategic marketing decision-making (Narne et al., 2024). It is a good way to ensure better alignment with organisational goals and make data driven decisions. In dynamic and competitive industries, early adaptors of AI technology in strategic marketing tend to gain a competitive edge through differentiation of offering and accomplishment of superior performance metrics (Rane et al., 2024; Nuseir and Qasim, 2021). In fact, the incorporation of AI into strategic marketing is not only a technological development, but also a major step forward in how an organisation will address its marketing goals. To raise effectiveness, responsiveness, personalisation and for ethical standards, AI is changing the face of strategic marketing at this age of data, creating endless possibilities of growth and innovation. Thus, the study has broached the following hypothesis

H1 Machine-learning-based AI systems affect decisions for strategic marketing in the UAE' real estate sector.

Initial integration of DL-based AI systems into strategic marketing decision-making has destroyed the supremacy of traditional tools of analysis, offering organisations a sea of transformative capabilities (Dwivedi et al., 2021a, 2021b; Johnson, 2019). A subset of AI, DL is amazing at analysing and processing complex, unstructured data like images, audio and language (Johnson, 2019; Alshehadeh et al., 2023). This allows marketers to discover complex patterns and correlations that would have been hidden through other forms of analytics (Ma and Sun, 2020). Organisation with these systems have possessed significantly elevated predictive analytics which can even forecast market trends and consumer behaviour in the most precise manner (Ahamed and Sridevi, 2025). Businesses can use DL models to optimise strategies for resource allocation, pricing, and product innovation while simultaneously fine-tuning campaigns to hit specific audience segments (Chandra et al., 2025). This amplifies organisational agility even further by allowing full interpretation of real-time data, allowing for rapid adaptation to ever-changing market conditions and quick response to competitor activities (Upadhyay et al., 2024). Furthermore, DL enables hyperactive personalisation by proactively analysing a wide variety of data points and writing highly custom marketing messages that encourage deeper consumer engagement and higher conversion rates (Mishra et al., 2024). Automating the mundane such as content generation and campaign monitoring frees up

the team to spend time on creative and strategically focused activities resulting in a stronger marketing efficiency and overall marketing innovation potential.

DL-based AI systems have creative advantages, but implementation of DL-based AI systems in strategic marketing is not as straightforward. Due to the reliance on extremely large datasets, there are ethical issues surrounding data privacy and security, which, if handled poorly, would undermine consumer trust and perceived brand integrity (Janiesch et al., 2021). Moreover, algorithmic bias should be reversed by thorough oversight so that fairness and inclusiveness is guaranteed in all things. For organisations that turn to DL, transparency must be prioritised and robust frameworks must be developed proactively to deal with these challenges. Despite these challenges, DL has made strategic marketing an application domain for early adopters to gain competitive advantages by uncovering insight for differentiation and value creation. DL-based systems are actively changing the strategic marketing landscape by enabling data driven decisions, making the market more responsive and helping build personalisation (Bhardwaj et al., 2025). They empower businesses to not only survive in a more complex and cut throat environment, but thrive, to the extent that until a few years ago could not be imagined. These technologies evolve and so will their impact on strategic marketing, giving us unprecedented growth and a sustainable edge in the marketplace. The second major danger of AI systems based on DL in strategic marketing is that they could turn predictive CLV analysis on their heads (Ali and Shabn, 2024). DL algorithms may look into historical purchasing patterns and engagement metrics and demographic data and make an accurate estimate of the future profitability of individual customers. With this insight, marketers can better allocate resources by concentrating on high value customer segments and derive retention strategies for those customers predicted to have lower CLV. It also enables business to model and predict churn rate, so that customers can integrate proactively, averting customer attrition and cultivating loyalty in the long-term. Not only does this application improve financial performance, it also strengthens customer relations by orchestrating marketing with customers' preferences and needs, and contributes to a more sustainable competitive advantage. Thus based on the discussion we have broached the following hypothesis

H2 Deep-learning-based AI systems affect strategic marketing decision-making in the real estate sector of the United Arab.

AI systems using big data have fundamentally changed the way in which strategic advertising is made in real estate. However, these systems excel at 'what can we make of the data' with such breadth: market trends, consumer behaviour, property price, and geographical preference for example. Big database AI systems process and synthesises this data to create real estate advertisers with actionable insights, which improves targeting accuracy and campaign effectiveness. Powered by AI, predictive analytics helps marketers identify emerging trends, including what buyers like, do not like, and thus allows marketers to predict shifts in buyer preferences, stay ahead of the game and adjust their strategies proactively. Furthermore, real-time data analysis ensures that advertising efforts are responsive to market changes, for instance changes in demand or competitive pressures so that advertising opportunities are much more agile and effective.

One of the critical advantages of big database AI systems in strategic advertising is the ability for them to personalise marketing messages. However, these systems use granular consumer data to design personalised advertisements that resonate with personal interest ultimately improving engagement rates along with such system converting to a

potential. AI driven platforms can flag the profiles of people who search for related keywords, or online conduct and demographic information to narrow down the group for whom they will show advertisement. Additionally, ads campaigns can be executed and monitored using automation capabilities, increasing ad campaign velocity and decreasing costs, and allowing more time for strategic planning. In addition, the integration of big data along with AI can develop a tool that will help optimising media spending by analysing performance metrics of various channels to spend on the best channels. However, there are also challenges to big data based AI systems' adoption in the real estate industry. The collection and use of consumer information is particularly treated with serious data privacy concerns, and must follow strict regulations. Implementation is clouded by further ethical considerations of data usage and transparency of algorithm. Moreover, relying on large datasets suggests the need for robust data management systems, and staff that can decipher AI produced insights. Yet organisations that do manage these difficulties are positioned to achieve a competitive advantage. Using big data based AI system; real estate advertisers cannot only reach higher precision and effectiveness with their campaign but also a better ability to build stronger, trust relationship with audience. While these technologies continue to evolve, their significance in transforming the way strategic advertising translates in the real estate sector will only increase, and will present unconsumed possibility for innovation and growth.

H3 Big database AI systems affect the decision-making process for strategic advertising in the real estate industry of the United Arab.

The necessity of integrating ecological considerations into strategic planning has become crucial in today's world, where environmental sustainability has become a whole world thing (Ali, 2024; Ali and Shabn, 2024). However, due to its contribution to environmental change through land development and resource consumption, the real estate sector is experiencing increasing pressure to change the way in which its operations operate in environmentally friendly ways. This adaptation includes strategic advertising. Advertising not only conveys about a company's things but also details about its values and goals, knowing how significantly public perception plays in the reality of the real estate advertising sector, incorporating environmental issues in advertisement strategies there is crucial (Dwivedi et al., 2021a, 2021b). This change is not just a question of corporate social responsibility, but of changing consumer tastes, the regulatory landscape and competitive environment. Real estate advertising includes environmental considerations such as promoting eco-friendly projects, energy efficient designs, and sustainable construction practices. Any environmental approach requires a real understanding of environmental principles as part of the whole constant of the project development and marketing. Thus, they can highlight features such as green building certifications, installations of renewable energy, or efficient waste management, in advertising campaigns (Chaffey and Smith, 2022; Roseland, 2000). Along with having such attributes, these parameters will attract environmentally conscious buyers and project the developer as being responsible and future looking (Dwivedi et al., 2021a, 2021b). Additionally, ads geared towards highlighting sustainability's benefits can translate to real values – attracting investments, building public trust and meeting government and industry regulations. Real estate firms can align their advertising strategies to the global environmental goals and affect the overall mission of environmental conservation with their competitive advantage.

There are however some difficulties in integrating environmental considerations into strategic advertising. Unlike other industries, the real estate sector works in a relatively less competitive environment where at times cost is given over a significant voice in decision-making. While this becomes more resource heavy, it may require moving to eco-friendly advertising, be it rebranding, new marketing materials or green certification processes (Roseland, 2000). Moreover, the challenge in putting forth easy to understand complex environmental concepts to a wide audience. Some consumers will be well informed about sustainability issues and some will be less informed which means it is necessary for the campaigns to balance their education with their persuasion. Equally importantly, the risk of greenwashing – deceiving consumers about the environmental benefits of a product or service – is a serious ethical and reputational threat. This is why real estate firms must involve themselves in real advertising claims that are verifiable and transparent practices to ensure credibility and trust by the stakeholders.

The integration of environmental considerations into real estate advertising cannot be the role of digital technology. The digital platforms offer digital possibilities to give the environmental impacts of real estate projects through the campaigns that are interactive and engaging. For instance, virtual tours of a building can focus on sustainable features, such as energy efficient lighting, solar panels, or eco-friendly materials. They give targeted advertising to environmentally conscious demographics, and data analytics can narrow messaging down to appeal to particular groups of audiences. In addition, technology helps the real estate firms to measure real-time the impact of their advertising campaigns and then optimise ongoing and continuous. The real estate sector can not only market more effectively but also use digital tools for a marginally better efficiency and further environmental messaging. Finally, environmental consideration has a great influence in strategic advertising responses in the real estate industry. Real estate firms are expected to reshape their ad strategy in line with … consumers, regulators and investors' growing interest in sustainability. The task here is to champion the eco-friendly projects, leverage the digital technology and keep their messaging transparent and trustable. The potential benefits of integrating environmental considerations into advertising – such as improved brand reputation and market share – are far greater than the drawbacks, which remain – challenges including cost and complexity. What we need is for the real estate sector to turn it around and to embrace this approach, which will enable it to participate in the drive towards sustainable development and in solving the environment challenge of today's era.

The ability of the environmental factors to moderate the impact of the independent and dependent variables was evaluated. The moderating influence of the environment is also apparent in earlier research material (Wilson and Daugherty, 2018). Today, businesses face several environmental issues and problems, and citizens are far more conscious of environmental issues than they were once (Mohsin, 2021). Consumers are becoming more environmentally conscious and prefer to purchase goods by considering the potential environmental harm. Additionally, previous literature has documented that the environment has affected public behaviour, particularly concerning its protection (Sun et al., 2020). Numerous academics and professionals have been drawn to the growing problem of environmental protection to determine the importance of different influencing factors that could affect decisions for strategic management. Businesses must consider environmental issues that can change how the given variables affect the decision-making process (Kardos, 2019). The actions of different members add value to environmental apprehensions by expressing more concisely and imperatively eco-friendly

acts and results based on cutting-edge technological manufacturing and company operations. Previous research has demonstrated how environmental concerns affect intentions to recycle things, being mindful of environmental protection, and being sensitive to ecological issues (Nawaz et al., 2020). Studies have evaluated the influence of environmental concerns on customer behaviour from a green marketing standpoint (Shabbir, 2020; Nuseir et al., 2022). According to the current study, environmental considerations modify the connection between independent variables, and the following hypotheses are proposed:

The relationship between ML and strategic marketing decisions is very strongly moderated by environmental factors, and how organisations adopt and implement these advanced technologies into their marketing decision-making does so as well. With unparalleled opportunities to analyse customer behaviour, predict market trends, and optimise marketing campaigns, ML can automate data driven insights and make marketing more effective. Yet, external environmental attributes including regulatory policies, social accords, fiscal conditions, and technological developments either can helped or hampered the ML-driven decision's effectiveness. Another example is the framework that the data privacy law has rendered to the scope of data collection, thus limiting ML model accuracy. Similar adjustments in target markets' cultural diversity might be required for different consumer preferences to be accounted for. Conversely, encouraging factors, like technological development, support from government policies, and extensive digital adoption can magnify the merits of ML by promoting an atmosphere conducive in innovation. This means that organisations wanting to take advantage of ML's strategic potential as a marketing decision mechanism need to understand and address these environmental moderating factors.

H4 Environmental factors moderate the relationship between ML and strategic marketing decision.

The application and outcomes of DL as a relationship between DL and strategic marketing decisions is profoundly influenced by environmental factors that moderate such application and outcome. DL, being able to ingest a lot of unstructured data, like images, videos, and social media content, can enable valuable insight into the creation of personalised marketing and predict consumer behaviour to a greater level of precision. While these systems work well in certain environments, effectiveness for these systems often depends on things like data availability, ethical considerations and market dynamics. To name one, in markets where data collection is constrained by privacy laws or where concerns about the use of DL to avoid algorithmic biases are pronounced, DL' deployment in the service of marketing will be inordinately challenging. On the contrary, in hard-core technological environments with well understood infrastructure and supportive regulatory oversight, DL is possible and marketers can adopt complex strategies that speak to the target market. Moreover, firms may recognise the need to respond to competitive pressures and consumer expectations of personalisation with extended learning capacities in their marketing decisions. This paper therefore argues that environmental factors serve as a key moderating variable in determining how much, if any, strategic value DL may be associated with in marketing contexts.

H5 Environmental factors moderate the relationship between DL and strategic marketing decision.

The relationship between big data and strategic marketing decisions is moderated primarily by environmental factors, such that organisations can leverage large-scale data analytics in order to achieve marketing success. Big data is the cornerstone of modern marketing strategies because it allows firms to gain deep insights into customer, market trends, and operational efficiency. Yet, the ability to properly leverage big data to transform such insights into effective action takes into account data governance policy, competitive intensity, technological infrastructure, and socio-economic conditions. Suppose, for example, that data protection regulations such as GDPR restrict the kind of data that can be collected or processed; this will limit the range of data you can analyse, limiting the depth of any marketing insights. However, good regulatory condition and well-developed technologies bring us easily BDA integration with strategic planning. Furthermore, big data driven marketing efforts may be guided by market volatility and changing consumer behaviours in reaction to environmental factors, including economic recessions or pandemics. Firms looking to maximise the strategic potential of big data in strategic marketing decisions need to understand and address this moderating factors.

H6 Environmental factors moderate the relationship between big data and strategic marketing decision

3 Research methodology

To achieve the research objectives of the study Data for the study were collected from the marketing departments of real estate sector companies in Dubai UAE. The study focused on marketing department managers and data was collected with the aid of questionnaire. The current study based upon the unique objectives, adopted a quantitative research approach (Khan and Arefin, 2024; Iqbal, 2024; Farooq, 2024). Questionnaires were designed to collect data based on measurement scales previously validated in earlier studies. According to Sekaran and Bougie (2016), a population refers to "an overall group of people or an organisation that may be of interest to the researcher". Due to the challenges posed by the pandemic, convenience sampling was employed, as in-person meetings were not feasible. The sample consisted of companies within the UAE real estate sector that utilise AI for marketing and customer interaction. A total of 300 responses were collected and analysed using Smart-PLS.

3.1 Data

3.1.1 Participants

In the current research, the data from the total 300 marketing managers were collected using the non-probability convenient sampling technique from Dubai UAE. Table 1 represent the detail of respondents' demographic profile.

3.1.2 Measurement scale

Earlier research analysis and each construct's measurement scale are described in depth in this section and were used to take the measurement scales. The study adopted the five-item environment factor measurement scale (Shah et al., 2024; Rashid et al., 2024; Ramzan and ul Hameed, 2024). This study employed a six-item scale for planned

marketing decision control. Based on the straightforward assertions below, the components of the marketing mix were modified from an AI perspective. Recent work has contributed substantially to understanding marketing variables from AI perception by combining big data, DL, and ML. The straightforward statements provided below for each build altered by the AI created the measurement tool.

Table 1 Frequency distribution of demographic sheet ($N = 300$)

Category	*Value*	*Percentage (%)*
Gender		
Male	211	70.33
Female	89	29.67
Age		
1	100	33.33
2	54	18.00
3	64	21.33
4	82	27.33
Education		
1	52	17.33
2	114	38.00
3	23	7.67
4	111	37.00
Job experience		
1	54	18.00
2	45	15.00
3	35	11.67
4	166	55.33

3.1.3 Analysis of data

A detailed analysis of the acquired data was achieved using Smart-PLS, which has two sections: one deals with the validity and reliability of the constructs, and the other with the testing of hypotheses. The PLS algorithm was used in the first stage, which is referred to as the measurement assessment model, to determine the validity and reliability of the constructs. The structural equation model, which determines the link between constructs using the PLS bootstrapping approach, is referred to as the second section of the analysis.

3.1.4 Measurement model assessment

This study component evaluates Cronbach's alpha, composite reliability, and average variance extracted (AVE) to establish the reliability and validity of the constructs using the PLS algorithm. For satisfactory reliability, Cronbach's alpha and composite reliability should be higher than 0.70, and the value for AVE must remain higher than 0.50. The following step compares the AVE's square root with other correlation parameters for every construct to evaluate discriminant validity; the square root of AVE should always

be higher than the correlation parameters. Figure 3 shows the evaluation of the measurement model based on the Smart-PLS algorithm approach called Smart-PLS PLS.

Figure 3 The measurement model assessment (see online version for colours)

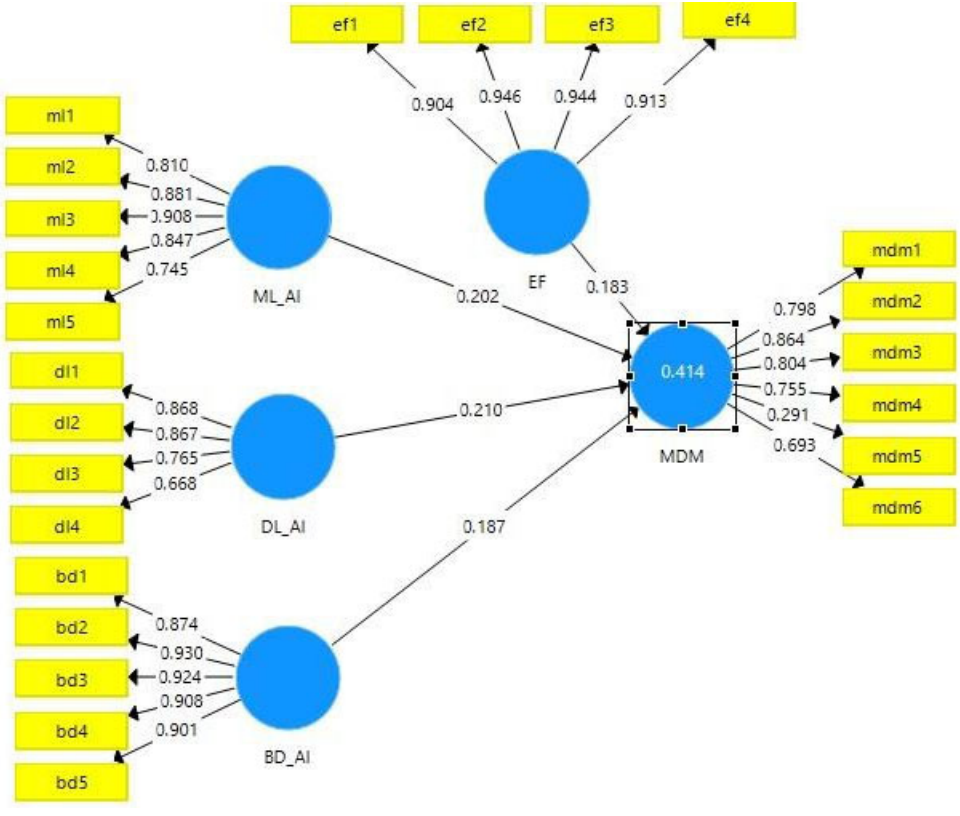


Table 2 illustrates the composite reliability, Cronbach's alpha, and AVE for assessing the reliability of the constructs.

Table 2 Reliability analysis

	Cronbach's alpha	*Composite reliability*	*Average variance extracted (AVE)*
BD_AI	0.947	0.959	0.824
DL_AI	0.808	0.873	0.634
EF	0.945	0.961	0.859
MDM	0.807	0.862	0.528
ML_AI	0.895	0.923	0.706

The composite reliability, Cronbach's alpha, and AVE parameters for the constructs' validity and reliability are shown in the table. Cronbach's alpha was analysed step-by-step for each construct, and for ML based on AI, it was observed to be 0.895; for DL, it was 0.808; for big data AI based on AI, it was 0.947; for the environment, it was 0.945; and for marketing decision making, it was observed to be 0.807. Hence, all Cronbach's alpha values were found to be higher than 0.70, which is the minimum

criterion for acceptability. Environmental factors, ML, big data, DL, and marketing decision management had composite reliability values of 0.961, 0.923, 0.959, 0.873, and 0.862, respectively. AVE was also examined and analysed for each construct. It was discovered that 0.706, 0.643, 0.824, 0.859, and 0.528 are higher than the minimum cut-off value of 0.50, making them statistically acceptable, as stated by Hair et al. (2017).

3.1.5 Discriminant validity

The square root of AVE should continue to be higher than the correlation parameters of other constructs, as shown in Table 3, to maintain discriminant validity and evaluate the correlation between variables.

Table 3 Discriminant validity

	BD_AI	*DL_AI*	*EF*	*MDM*	*ML_AI*
BD_AI	0.908				
DL_AI	0.635	0.796			
EF	0.718	0.652	0.927		
MDM	0.548	0.547	0.546	0.727	
ML_AI	0.477	0.488	0.454	0.477	0.84

The tabular illustration above shows discriminant validity, which meets the requirements of Fornell and Larcker (1981). The square root of AVE, which is the intersection value for each column, must always be a higher parameter than the standing-out correlation parameters in a similar column. A greater AVE demonstrates that discriminant validity is achieved, and multicollinearity does not exist.

3.1.6 Structural equation model

The hypothesised association was evaluated for significance using the p-value, t-value, and β values in this research. To evaluate the connection between the paradigms of the suggested structure, this study comprises seven hypotheses, four of which are direct and three of which are moderating. The direct connections are shown in Table 4, followed by a description. The H1 hypothesis looks into how an AI system with a machine-learning foundation affects decisions regarding strategic marketing in the UAE real estate sector. H1 was accepted based on the statistics used to evaluate the hypotheses (= 0.171; t-value = 2.513; p = 0.012).

Hypothesis H2 examines how DL-based AI systems affect strategic marketing decision making in the UAE real estate market. H2 is statistically acceptable based on (t-value = 1.958, β = 0.160, and p-value = 0.051); the significance is minimal because the given t-value is close to the cut-off point. However, if the significance level is increased to 10%, H2 becomes acceptable within the statistical dynamics.

H3 examines how big database AI systems affect strategic marketing decisions in the UAE real estate market. H3 is consequential and statistically acceptable based on (t-value = 2.644, β = 0.232, and p-value = 0.008), the basis upon which the hypothesis is evaluated. Hypothesis H4 examines how environmental elements affect strategic marketing decisions made in the UAE's real estate market. According to the criteria

used to evaluate the hypothesis t-value = 2.188, (β = 0.201; p-value = 0.029), H4 is statistically valid.

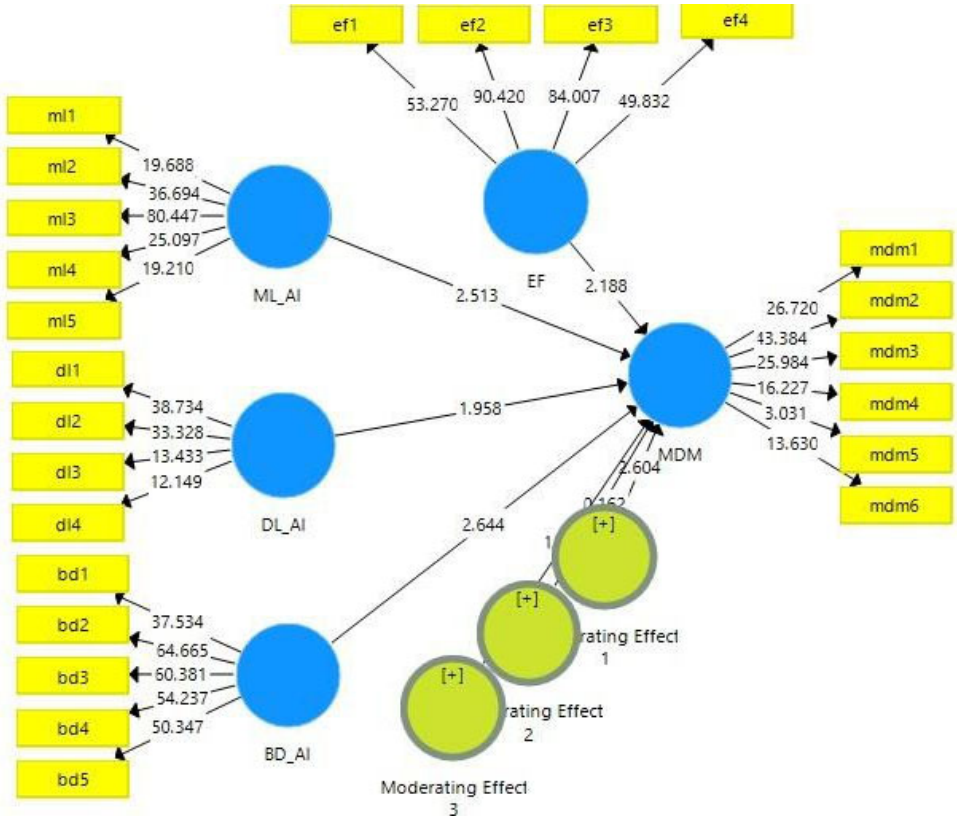
Table 4 Direct relationship

Relationship	*β*	*t-value*	*p-value*
ML_AI ⟶ MDM	0.171	2.513	0.012
DL_AI ⟶ MDM	0.16	1.96	0.051
BD_AI ⟶ MDM	0.232	2.644	0.008

3.1.7 Moderating effect

The moderating effects of environmental aspects between the dependent and independent variables were analysed in the current study. The moderating effects of the hypothesised links are shown in Table 5. Hypothesis H4 examines how environmental elements affect how ML-based AI systems make decisions for tactical marketing in the real estate market of the UAE. H4, which reveals that environmental factors regulate the connection and that the environment should remain dedicated to identifying the influence of AI-based recommendations to adopt decisions from a marketing perspective, is statistically acceptable based on (t-value = 2.604, β = 0.165, and p-value = 0.009).

Figure 4 Structural equation model (see online version for colours)



Hypothesis H5 assesses how environmental elements affect how ML-based AI systems make decisions for strategic marketing in the UAE real estate market. H5 is not statistically acceptable because it demonstrates that the environmental element has no moderating effect on the association between marketing decision-making methods and DL (t-value = 0.162, $\beta = 0.015$, and p-value = 0.872).

Hypothesis H6 examined how environmental elements affect how an AI system based on ML makes decisions regarding strategic marketing in the UAE real estate market. H7 is recognised on statistical grounds that demonstrate that the environment modifies a significant part of AI-based results and decision-making in marketing (t-value = 1.971; $\beta = 0.100$; and p-value = 0.049).

Table 5 Moderating effect

Relationship	*β*	*t-value*	*p-value*
ML_AI*EF ⟶ MDM	0.165	2.604	0.009
DL_AI*EF ⟶ MDM	0.015	0.162	0.872
BD_AI*EF ⟶ MDM	0.1	1.971	0.049

The given structural equation model with the moderating influence of environmental parameters is depicted in the figure (Salim, 2020). The bootstrapping method was used in Smart-PLS to generate the figure.

4 Conclusions

The real estate sector is one of the ongoing research initiative areas, in which AI has the potential to bring transformative changes to the way in which marketing decision is taken. AI powered system provides incomparable power to our customer engagement using highly precise information transmission and personalised communication strategies. This study emphasises leveraging AI within the marketing mix, as it predicts how the marketing decision-making should be done and gives data driven insights, which reshape traditional marketing framework. Through an investigation of the new paradigm created by AI affecting mainstream managers' decisions, this research greatly advances our understanding of digital era marketing strategies, by reformulating the principles of the marketing mix through the use of advanced enabling technologies such as ML, DL and BDA. Using this study as a case study for the UAE real estate sector, this study demonstrates that ML optimises decisions by being able to better segment, target and position. Even more importantly, the findings show the large impact of environmental factors as moderators and help fine tune the link between the AI technologies and strategic marketing decisions. Both, big data and DL have resulted to be essential ingredients; they offer predictive analytics and actionable insight thereby enabling where there is knowledge to obtain informed decision making. Furthermore, these authors show that managerial decisions involving big data are shaped by environmental factors that act as crucial moderators. By integrating the AI with environmental considerations, this makes the firms not only to be able to adapt to the external challenges, but also to remain

in line with the consumer demands. The study offers practical recommendations for the UAE real estate sector to adopt AI based solutions in order to stay competitive improve operational efficiency and deal effectively with the dynamic market changes. In addition, the study highlights the ethical and operational problems of using the AI-based solution in marketing. For companies to address these challenges, they need to start building transparent AI systems, protecting data privacy and ensure that AI is used responsibly in deciding and making predictions. Additionally, businesses need to spend money in training and reskilling their workers to get the most out of AI technologies and make them blend effortlessly into their marketing and business processes. When organisations do it, they open the full potential of AI while keeping accountability and trust.

4.1 Implications for the UAE real estate sector

The implications for the UAE real estate sector, a sector known for its rapid growth, comprehensive range and its innovation, are very important. AI based solutions provide an opportunity to add competitive advantage by enhancing predictive, property valuation and customer engagement. Furthermore, well trained ML algorithms can scan historical and real-time data to forecast demand trends and identify opportunities for investment as well as to determine the proper target customer segments. These insights help UAE real estate firms make data-based decisions, reduce risk and achieve highest profitability amidst intense dynamic market conditions.

Additionally, BDA has considerable transformative potential for the UAE market as it can unearth valuable patterns and preferences of consumer behaviour at play within different demographic and cultural groups. It is capable of analysing factors like neighbourhood infrastructure, amenities and transportation connectivity to recommend best pricing strategies and to appraise the long-term investment possibility of projects. Even further, DL technologies, such as AI-powered virtual property tours and personalised chatbots, can also help enable the customer experience even more stream lined, so property search and acquisition becomes even more accessible, interactive and efficient.

The UAE real estate sector has little to do with the adoption of AI and even with AI related technologies influencing the real estate sector. AI driven solutions, for instance, are crucial as the UAE develops green building standards and renewable energy initiatives; in this case, to determine how sustainable practices affect property demand and valuations. Additionally, AI powered tools can carry enterprises through the legalities and complexities of the regulatory landscape to deliver an insight into the compliance requirements and mitigate dangers.

AI driven strategies in real estate are in line with the UAE's vision for smart cities and taking on the new technology. Real estate firms will be able to integrate AI with smart city frameworks, which will further urban planning quality, resource efficiency and thus contribute to creating more sustainable, livable environments. In this rapidly evolving market, embracing AI-based solutions tailored to the UAE's unique challenges and opportunities will be essential for fostering innovation, ensuring competitive advantage, and achieving long-term growth in the real estate sector.

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