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The Implications of Artificial Intelligence Applications in Supporting Contemporary Marketing Activities

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Abstract
This research paper aims to shed light on the relationship between artificial intelligence (AI) and big data in the field of marketing, as two fundamental pillars of digital transformation. The study illustrates how AI relies on big data to enhance its analytical and predictive capabilities, thereby contributing to improved customer targeting, personalized offerings, and increased efficiency of marketing campaigns. It also discusses the challenges associated with the use of these technologies, whether in terms of privacy and ethical dimensions or data quality and management. The paper concludes that the integration of AI and big data represents a strategic opportunity to develop more effective and innovative marketing models, provided that sound governance mechanisms are in place to balance economic gains with ethical considerations.

Keywords: Artificial Intelligence (AI); Big Data; Modern Marketing; Customers.

1. Introduction

Over the past two decades, the world has witnessed a radical transformation in business practices, particularly in the field of marketing, as a result of accelerating technological development and the digital revolution. Contemporary marketing has become increasingly linked to digital data and smart technologies, moving beyond traditional approaches that relied on intuition and experience toward a marketing model based on data and precise analytics. At the heart of this transformation stand Big Data and Artificial Intelligence (AI) as a technological duo reshaping the equations of understanding, interaction, and influence on consumer behavior.

Organizations today generate an enormous volume of data through digital interactions with customers, whether via websites, social media platforms, or smart applications. Here, the role of Big Data emerges in providing a vast informational base that enables an unprecedented understanding of consumers' needs and preferences. However, this data alone is not sufficient unless supported by analytical and processing tools capable of transforming it into intelligent marketing decisions — a capability provided by artificial intelligence.

Through its capabilities in machine learning, pattern analysis, and behavior prediction, artificial intelligence has become a decisive element in shaping modern marketing strategies. It is used in numerous areas such as the automated personalization of messages, product recommendation, sentiment analysis, and even the prediction of future market trends. All of this makes the relationship between artificial intelligence and Big Data an integrative relationship that constitutes what is known as the "smart transformation" in marketing, whereby available data is maximally leveraged to deliver more personalized and effective experiences for consumers.

Research Problem:

Based on the foregoing, the main research problem can be formulated as follows:

To what extent can the interactive relationship between artificial intelligence and Big Data be considered a lever for smart transformation in contemporary marketing practices?

The following sub-questions branch out from it:

- What is the importance of Big Data in supporting artificial intelligence in marketing?
- How does the integration of artificial intelligence and Big Data help improve marketing strategies?
- What challenges face the use of artificial intelligence and Big Data in marketing?
- How do artificial intelligence and Big Data contribute to achieving competitive advantage for organizations?

Research Objectives:

1. To clarify the relationship between artificial intelligence and Big Data in the field of marketing.
2. To demonstrate the role of artificial intelligence in leveraging Big Data to improve decisions.
3. To discuss the challenges related to privacy and data quality.
4. To highlight opportunities for developing more innovative and effective marketing models.

Research Significance:

The significance of the research lies in highlighting the pivotal role of the integration between artificial intelligence and Big Data in developing more precise and effective marketing strategies, through understanding consumer behavior, anticipating their needs, improving the decision-making process, and enhancing companies' competitive capacity. The research also adds cognitive and academic value by studying the integrative relationship between the two technologies and their role in supporting digital transformation and keeping pace with contemporary economic and technological developments.

Previous Studies:

Previous studies published in peer-reviewed scientific journals constitute a cornerstone for understanding the relationship between artificial intelligence and Big Data and marketing, and for analyzing its future prospects. These include, but are not limited to, the following:

1- A study published in the "International Journal of Latest Technology in Engineering, Management & Applied Science (IJLTEMAS)", entitled "Artificial Intelligence for Big Data in Modern Marketing: A Review about Trends, Applications, and Challenges," authored by (Uwimana et al., 2025), which reviews the transformative role of artificial intelligence in processing Big Data to enhance modern marketing. The study shows how digital transformation has led to a massive increase in data volume, creating both challenges and opportunities for marketers, while traditional methods have proven inadequate in dealing with this complexity. The use of artificial intelligence enables precise analysis of Big Data, prediction of customer behavior, personalization of marketing strategies, and real-time campaign optimization. The study also offers a critique of current challenges, including ethical issues such as privacy, transparency, and bias, and points to promising future trends such as distributed learning, quantum computing, and multimodal artificial intelligence.

2- A study published in the "International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)", entitled "Using Artificial Intelligence with Big Data Analytics for Targeted Marketing Campaigns," authored by (Arora, S., & Thota, S. R., 2024), addresses the pivotal role of artificial intelligence in supporting targeted marketing campaigns through Big Data analytics. The study highlights AI's ability to improve data management, algorithm design, and the real-time personalization of marketing experiences according to customer preferences, thereby enhancing engagement and conversion rates. It also clarifies its importance in selecting appropriate channels, conducting competitive analysis, and understanding customer expectations to support strategic decisions, while emphasizing the role of machine learning in analyzing data and efficiently solving complex problems, with performance and accuracy improving over time. Relying on a comprehensive review of the scientific literature, the paper illustrates the multiple applications of artificial intelligence across various marketing sectors and its transformative potential for the field.

3- A study published in the "Journal of the Academy of Marketing Science", entitled "How Artificial Intelligence Will Change the Future of Marketing," authored by (Davenport et al., 2020), focuses on a multidimensional framework showing how artificial intelligence can reshape marketing strategies and customer behavior, integrating three main dimensions: intelligence level, task type, and embodiment in a physical robot. The study confirms that its effects may be limited in the short term, and that it is more effective when supporting managers rather than replacing them. It also proposes a research agenda covering changes in marketing strategy, changes in customer behavior, and addressing issues of privacy, bias, and ethics.

4- A study published in the "Scientific Journal of Business and Environmental Studies", entitled "The Impact of Using Artificial Intelligence Tools on the Development of Digital Marketing (An Applied Study)," authored by (Ismail Mohamed Ahmed Hajjaj, 2021), examines the impact of using artificial intelligence tools on the development of digital marketing, focusing on dairy companies (Juhayna, Almarai, Lamar) with a sample of 350 employees. The results concluded that artificial intelligence enhances the quality of digital marketing by improving after-sales service, interactivity through automated responses, and supporting email with notifications and interest personalization. The study recommended expanding the use of its applications in e-marketing to increase sales and achieve competitive advantage.

5- A study published in the "Academic Journal for Research and Scientific Publishing", entitled "The Conceptual Framework for the Role of Artificial Intelligence in Digital Marketing," authored by (Rana Mohammed Marshoud Al-Suhaimi & Laila Abed Al-Youbi, 2024), addresses the role of blockchain and machine-learning technologies in improving digital marketing, relying on the documentary approach and content analysis to construct a conceptual framework clarifying the relationship between these technologies and the elements of the marketing mix. The study concluded that blockchain enhances customer trust by providing accurate product information, tracking production, and ensuring quality, while

machine learning contributes to raising customer satisfaction by analyzing their behavior and understanding their needs and expectations. It recommended benefiting from global experiences and adopting more customer-focused marketing strategies to ensure the success of digital marketing.

This study is distinguished from previous studies by its focus on the dual integration between artificial intelligence and Big Data as a fundamental entry point for understanding smart transformations in contemporary marketing, rather than studying each element separately, as is common in much of the literature. It also sheds light on the role of these technologies in enhancing the effectiveness of marketing campaigns, personalizing offers, and improving customer targeting, while simultaneously addressing the challenges related to privacy, ethics, and data quality. It thus offers a comprehensive vision showing how these tools can shift from being merely auxiliary technologies to becoming a strategic pillar in building more innovative and sustainable marketing models.

I. Artificial Intelligence

Artificial Intelligence (AI) is one of the most recent, most important, and most fascinating and exciting branches of science and engineering. Serious interest in it began shortly after the end of the Second World War, and the term "artificial intelligence" was adopted during the 1950s, coinciding with the emergence of other sciences such as molecular biology. However, the "Dartmouth Summer Research Project" of 1956 is often considered the event that launched the field of artificial intelligence as an independent field of research. Credit for coining this term and defining the general direction of this scientific field is attributed to the scientist John McCarthy. It is interesting to wonder whether the field would have taken a different course had it been named, for instance, "computational intelligence" or one of the other names that were proposed at the time.[1]

I.1 Definition of Artificial Intelligence (AI):

There exist in the academic literature various descriptions and definitions of what constitutes artificial intelligence, but to date there is no universally agreed-upon or accepted definition. For this reason, several definitions encompassing diverse concepts of artificial intelligence have emerged over time, owing to the multifaceted nature of this field, which can be viewed from different angles including philosophy, computer science, psychology, and engineering. In what follows, the definitions most important and relevant to this study will be presented, ordered from the oldest to the most recent, taking historical sequence into account, with the aim of achieving a better understanding for the use of artificial intelligence in marketing.

As noted above, artificial intelligence is a fascinating and exciting field, and also a multi-purpose technology, yet its nature has not been defined. Table (01) presents eight definitions of artificial intelligence, arranged according to two dimensions: the definitions at the top relate to processes of thought and reasoning, while the definitions at the bottom focus on behavior. The definitions on the left measure success based on the degree of resemblance to human performance, whereas the definitions on the right measure success according to the criterion of ideal performance, referred to as "rationality"; a system is rational if it does "the right thing" based on what it knows.[2]

Table (01): Definitions of Artificial Intelligence according to the Thinking / Acting Dimensions

	Thinking Rationally
effort to make computers :h minds, in the full and literal 1985) :] activities that we associate g, activities such as decision-ɔlving, learning…" (Bellman,	"The study of mental faculties throu computational models." (Cha McDermott, 1985) "The study of the computations t possible to perceive, reason, and ac 1992)
	Acting Rationally
ng machines that perform intelligence when performed il, 1990) :o make computers do things ıent, people are better." (Rich	"Computational Intelligence is the design of intelligent agents." (Poole e "AI… is concerned with intelligent artifacts." (Nilsson, 1998)

Source: Russell, S. J., & Norvig, P. (2016). Artificial Intelligence: A Modern Approach (3rd ed.). Pearson, p.2.

Historically, all four approaches to artificial intelligence have been pursued, each by different people using different methods. According to Table (01), definitions of artificial intelligence can be classified along two fundamental dimensions: thought and action, with each dimension branching into a human approach and a rational approach. In the first dimension — thinking like a human — researchers focus on understanding and simulating human mental mechanisms through the study of cognitive psychology and cognitive models, with the aim of designing systems capable of processing information in the same way the human brain operates. Thinking rationally, on the other hand, is based on applying logical laws and mathematical

principles to reach correct conclusions, regardless of whether the process corresponds to the mechanism of human thought — known as the "laws of thought" approach.

In the second dimension — acting like a human — the focus is on building systems capable of imitating human behavior in social and linguistic interaction, as in the Turing Test, which measures a machine's ability to simulate human responses in communicative situations. Acting rationally, by contrast, aims to design systems that make optimal decisions to achieve their goals based on available information, which requires integrating capacities for perception, reasoning, planning, and decision-making in a way that ensures maximum performance even in environments characterized by uncertainty. This classification thus represents a comprehensive theoretical framework for understanding the different trends in defining and developing artificial intelligence.[3]

The author Nils J. Nilsson[4] in his book "The Quest for Artificial Intelligence: A History of Ideas and Achievements," offers an important definition of artificial intelligence: "Artificial intelligence is that activity devoted to making machines intelligent, and intelligence is that quality that enables an entity to function appropriately and with foresight in its environment."[5]

This definition includes the concept of "functioning appropriately," meaning acting or interacting in a manner consistent with the context or requirements in a fitting way, and "foresight," which refers to the ability to anticipate or make informed decisions in response to potential changes in the environment. From this perspective, the classification of intelligence depends on the degree of credit given to software and hardware for their ability to achieve these two elements.

The (Stanford University, 2016, p.12) report reinforces this definition with an identical formulation: "Artificial intelligence is the activity devoted to making machines intelligent, and intelligence is that quality that enables an entity to function appropriately and with foresight in its environment."[6] It emphasizes the same aspects, as both focus on the duality of "appropriate action" and "foresight" as fundamental pillars for understanding intelligence.

In a recent report on the current state of artificial intelligence, a committee of prominent researchers defined this field as "a branch of computer science that studies the properties of intelligence by synthesizing intelligence." Indeed, this definition may seem somewhat circular, but the committee itself also acknowledged the difficulty of defining the field — and this may perhaps be a positive thing, as it states: "The absence of a precise and universally standardized definition of artificial intelligence has probably helped this field grow, flourish, and advance at an ever-accelerating pace." Furthermore, the committee notes that "practitioners, researchers, and developers in the field of artificial intelligence are instead guided by a general sense of direction and an urgent drive to move forward."[7]

From the preceding definition, artificial intelligence can be considered a branch of computer science that links the study of intelligence and its generation as an integrated process, though it is considered circular because it relies on "generating intelligence" without clarifying its fundamental properties. The committee acknowledges the difficulty of formulating a unified definition, noting that the absence of a precise global definition has contributed positively to the field's growth, flourishing, and rapid advancement, as it provides flexibility that allows researchers to explore new directions without rigid constraints.

(Poole, D., & Mackworth, A., 2023) define artificial intelligence, or AI, as "the field that studies the synthesis and analysis of computational agents that act intelligently," and consider intelligence to be a relative matter (i.e., measured by degrees). Among the aspects that make an agent act intelligently are the following[8] :

- Its actions are appropriate to its circumstances, goals, and perceptual and computational capabilities.
- It takes into account the short- and long-term consequences of its actions, including effects on society and the environment.
- It learns from experience.
- It is flexible in the face of changing environments and changing goals.

Based on the above definitions, and drawing on the study's literature, the book Artificial Intelligence: A Modern Approach can be considered one of the most important references in the field of artificial intelligence, as its authors (Russell, S. J., & Norvig, P., 2022) focus on the concept of the intelligent agent, defining artificial intelligence as "the study of agents that receive percepts from the environment and perform actions. Each such agent implements a function that maps percept sequences to actions, and in this context we cover various ways of representing these functions, such as reactive agents, real-time planners, and decision-theoretic agents."[9]

This definition focuses on the concept of the "Intelligent Agent," a software system that interacts with its environment and makes decisions based on specific inputs, such as robots and predictive systems. The following are the main points it emphasizes[10]:

- Agent: an entity that perceives and acts

within an environment; the agent's function determines the action the agent takes in response to any sequence of percepts.

- Performance measure: evaluates the agent's behavior in the environment, where a rational agent acts in a way aimed at maximizing the expected value of the performance measure, based on the sequence of percepts received so far.
- Defining the task environment includes the performance measure, the external environment, actuators, and sensors; when designing an agent, the first step should always be to define the task environment as clearly as possible.
- Task environments vary along several important dimensions: they may be fully or partially observable, single-agent or multi-agent, deterministic or stochastic, episodic or sequential, static or dynamic, discrete or continuous, and known or unknown.
- In cases where the performance measure is unknown or difficult to define precisely, there is a significant risk that the agent will optimize the wrong objective. For this reason, agent design should reflect uncertainty about the true objective.
- Agent program: the entity that implements the agent function; there are several basic designs for agent programs, reflecting the type of information used explicitly in decision-making, and these designs differ in efficiency, size, and flexibility, with the appropriate design for the agent program depending on the nature of the environment.
- Simple reflex agents respond directly to inputs, whereas model-based agents maintain an internal state to track aspects of the world not visible in the current input; goal-based agents act to achieve specific goals, while utility-based agents seek to maximize their expected "happiness."
- All agents can improve their performance through learning.

I.2 Artificial Intelligence — "From Components to Branches":

Artificial intelligence is a dynamic and continuously evolving field, fueled by rapid developments in deep-learning technologies and successive technical innovations. This accelerating growth drives a constant re-examination of the concepts associated with artificial intelligence, whether in terms of theoretical framework or practical application. As a result, methods of classifying and interpreting it differ from one source to another, and concepts sometimes overlap and intersect depending on the context. Nevertheless, a methodological framework can be adopted to understand this branching field by analyzing three main pillars: components (cognitive functions), types and classifications, and the sub-domains from which it emerges and with which it intersects.

Figure (01): Components, Types, and Branches of Artificial Intelligence

[Figure omitted]

Source: Regona, Massimo & Yigitcanlar, Tan & Xia, Bo & Li, R.Y.M. (2022). Opportunities and Adoption Challenges of AI in the Construction Industry: A PRISMA Review. Journal of Open Innovation: Technology, Market, and Complexity, 8(45), p.4.

As shown in Figure (01), artificial intelligence can be classified within a comprehensive conceptual framework into three main types, differing in the scope of their capabilities and their level of development:

1- **Artificial Narrow Intelligence (ANI):** the type currently in existence, used in language translation and weather forecasting.
2- **Artificial General Intelligence (AGI):** a future type that will be capable of solving complex problems through its own ideas and actions.
3- **Artificial Super Intelligence (ASI):** a future type of artificial intelligence which, if developed one day, will surpass human capabilities across multiple domains.[11]

As also shown in the figure, the fundamental sub-domains of artificial intelligence can be classified within an integrated structure comprising the following: (a) machine learning; (b) knowledge-based systems; (c) computer vision; (d) robotics; (e) natural language processing; (f) automated planning and scheduling; (g) optimization algorithms.[12]

It is important to emphasize that this list is not exhaustive, as the accelerating development in this field continually opens new horizons and creates innovative applications that go beyond the boundaries of traditional classifications, which reinforces the dynamic and ever-renewing nature of artificial intelligence.

II. Modern Marketing — "Concept and Development"

Throughout its history, marketing has undergone fundamental transformations in its philosophy and methods, influenced by rapid changes in economic, social, and technological environments. Having initially focused on maximizing production and improving operational efficiency, it gradually

shifted toward studying markets and understanding consumer needs, eventually adopting strategies based on building long-term relationships and delivering integrated value that goes beyond the boundaries of the product or service. The digital revolution, the spread of interactive communication tools, and the integration of data-analytics and artificial-intelligence technologies have all contributed to reshaping the role of marketing, turning it into a dynamic process based on personalization, instant interaction, and the comprehensive enhancement of the customer experience — thereby ensuring the consolidation of loyalty and the achievement of sustainable competitive advantage. The following presents an overview of its most prominent modern concepts.

II.1 Definition of Marketing:

Marketing is considered one of the most prominent managerial activities that seeks to meet consumers' needs and achieve the organization's objectives. The definition of marketing varies from one researcher to another depending on the perspective used, a variance attributable to the multiplicity of schools of thought in marketing and the evolution of its practices under the influence of economic, social, and technological factors. Below are the most important and best-known definitions, presented in chronological order:

McCarthy (2002) defines it as "a set of activities carried out by organizations, and a social process. In other words, marketing exists at both the micro and macro levels; therefore, we will use two definitions of marketing, one for micro-marketing and another for macro-marketing. Micro-marketing focuses on customers and the organizations that serve them, while macro-marketing takes a comprehensive view of the production and distribution system as a whole."[13] This definition provides a flexible analytical framework that allows for its application at different levels (organization, market, economy), and links marketing to social and economic systems. However, the emotional, human dimension of the consumer–brand relationship is not a central focus within it.

Sharp (2013), relying on an evidence-based approach, defines marketing as "a set of activities aimed at creating value for customers and building strong relationships with them by understanding their needs, developing products or services that meet these needs, promoting them effectively, and delivering them in a way that achieves organizational objectives."[14] This definition focuses on the practical and strategic aspects of marketing, emphasizing value creation and relationship-building with customers, consistent with Sharp's evidence-based approach, which highlights the importance of understanding consumer behavior and using data to improve marketing performance.

Kotler and Keller (2016), meanwhile, hold that marketing is "the art and science of choosing target markets and acquiring, retaining, and growing customers through creating, delivering, and communicating superior value to them."[15] This definition expands strategically to present marketing as both an art and a science, focusing on specific stages: selecting the audience, attracting customers, then retaining them and growing their relationship with the organization — that is, it focuses on the full cycle of the customer relationship, reflecting the shift of marketing from "product marketing" to "relationship marketing." It also links marketing innovation to loyalty and highlights the importance of superior value, i.e., delivering more than what is expected, which enhances loyalty and sustainability in the customer relationship.

Philip Kotler and Armstrong (Kotler & Armstrong, 2020) define marketing as "a social and managerial process by which individuals and organizations obtain what they need and want through creating and exchanging value with others."[16] This definition integrates the social and managerial dimensions of marketing, presenting it as an interactive process that contributes to achieving an exchange of value between organizations and customers. Marketing here is presented as a mechanism for satisfying needs and wants, not merely selling products; what distinguishes this formulation is the comprehensiveness of the vision, which takes marketing out of the narrow profit-oriented framework and into a human and societal one.

The definitions of marketing by McCarthy (2002), Sharp (2013), Kotler and Keller (2016), and Kotler and Armstrong (2020) demonstrate a diversity of perspectives in understanding marketing as a managerial and social activity aimed at creating value and meeting customer needs. While McCarthy provides an analytical framework, Sharp focuses on scientific evidence, Kotler and Keller highlight the artistic and scientific aspects, and Kotler and Armstrong broaden the vision to include the social dimension. These definitions reflect the evolution of the field in response to economic and technological transformations, enhancing our understanding of marketing as a dynamic process.

II.2 Marketing Strategies:

An organization's marketing strategy describes how the organization meets the needs and wants of its customers. It may also include activities related

to maintaining relationships with other stakeholders, such as employees, shareholders, or supply-chain partners. In other words, marketing strategy is a plan that outlines how the organization will use its strengths and capabilities to meet the needs and requirements of the market. A marketing strategy may consist of one or more marketing programs, with each program comprising two main elements: the target market or markets, and the marketing mix (sometimes known as the four elements: product, price, place, and promotion).[17]

In order to develop an effective marketing strategy, a company or organization must choose the appropriate combination of target markets and marketing mix, with the aim of creating clear and distinctive competitive advantages over its competitors.

In this context, Armstrong, G., & Kotler, P. (2020) note that designing a successful marketing strategy requires the marketing manager to answer two fundamental questions[18]:

- Which customers will we serve? (What is our target market?)
- How can we best serve these customers? (What value will we deliver to them?)

III. Big Data

Big Data is one of the most prominent features of the digital age, representing a natural consequence of the information explosion resulting from the rapid development in communication and information technology. The widespread diffusion of the internet, the growing use of smart devices, and the expansion of activity across digital platforms have led to the production of vast quantities of data at an unprecedented pace. In this context, Big Data has become a critically important strategic resource, which organizations and governments seek to leverage to enhance their ability to understand the environments in which they operate, monitor trends, and predict future changes. This phenomenon has gained particular importance as it represents the foundation upon which advanced applications such as artificial intelligence and business analytics are built, making it a central pivot for digital transformation and innovation across various fields.

III.1 Definition of Big Data:

Definitions and concepts of this field vary and differ among experts, companies, and specialized organizations. The McKinsey Global Institute defines Big Data as "a collection of data whose size exceeds the ability of typical database tools to capture, share, transfer, store, manage, and analyze within an acceptable period of time."[19].

Herman (E. L. Herman) defines it as "large and complex data sets that exceed the processing capabilities offered by traditional database systems. Big Data is characterized by large volume, high velocity, and great variety, which requires the use of specialized techniques and analytical methods such as (Hadoop) and cloud-computing-based analytics to efficiently extract meaningful information."[20].

Gartner, a company specializing in information-technology research and consulting, defines Big Data as "high-volume, high-velocity, and/or high-variety information assets that demand cost-effective, innovative forms of information processing that enable enhanced insight and decision-making."[21].

IBM Global Services defines Big Data as "a collection of information assets characterized by high Volume, Variety, and Velocity, which require innovative methods and technologies to process them in order to enhance understanding, decision-making, and the achievement of competitive advantage."[22].

According to the International Telecommunication Union (ITU), the term Big Data "is defined through its main characteristics; it is noted that definitions of Big Data are somewhat vague, but there are common characteristics that help describe it — four main dimensions known as the 'Four Vs' are used to describe different aspects of Big Data."[23].

The term "Big Data" refers to an emerging concept in the field of information technology and data science, and has seen considerable diversity in its definitions among experts, companies, and international organizations. This diversity reflects the evolution of the concept since its early beginnings in the early part of the second decade of the twenty-first century, where the earliest definitions focused on technical challenges (such as volume and processing), before expanding to include economic and strategic benefits. Accordingly, it can be said that the majority of definitions agree that Big Data is not merely an increase in data volume, but rather an integrated system characterized by enormous volume, variety, high velocity, and sometimes veracity — factors that make it exceed the capabilities of traditional tools and require the deployment of innovative analytical techniques and methods. These definitions also reveal two complementary dimensions: the first is descriptive-technical, highlighting the characteristics of the data, and the second is practical-applied, linking it to the process of generating insights, supporting decisions, and achieving competitive advantage. This interplay between the theoretical and applied aspects reflects the dynamic nature of Big Data and its strategic role in the digital economy.

III.2 Characteristics of Big Data:

Big Data is usually classified according to three main characteristics[24]:
Volume: the amount of data.

- Velocity: the speed at which this data is processed.
- Variety: the different types of data.
- Although classifying Big Data by these "Three Vs" (3Vs) facilitates understanding, it can be misleading and overly simplistic. For example, one might manage a relatively small amount of highly complex and heterogeneous data, or process an enormous volume of very simple data, and this data may all be structured or unstructured.
- In addition to the three basic dimensions of Big Data (volume, velocity, variety), research and technology institutions have proposed additional dimensions, the most important of which are[25]:
- Veracity (IBM): refers to the unreliability of some data sources, such as social-media data, which — despite their ambiguity — contain important cognitive value.
- Variability and Complexity (SAS): the former reflects changes in data-flow rates, while the latter refers to the difficulty of integrating data from multiple, disparate sources.
- Value (Oracle): highlights that data in its raw form has "low value density," but analyzing enormous quantities of it enables the extraction of high value that contributes to supporting decision-making and achieving competitive advantage.

Furthermore, the relativity of Big Data's volume applies to all dimensions; there are no fixed universal standards for the volume, variety, or velocity that define Big Data, as the thresholds vary according to the size, sector, and location of the organization, and these thresholds evolve over time. It is also important to recognize that these dimensions are not independent of one another — as one dimension changes, the likelihood of another dimension changing accordingly increases.

IV. The Relationship between Artificial Intelligence (AI), Big Data, and Marketing

The contemporary world is witnessing an unprecedented surge in the volume of data generated by human interaction and digital systems, which has given rise to the concept of Big Data as one of the strategic resources for companies and organizations. At the same time, artificial intelligence has developed into an integrated system of algorithms and technologies capable of processing this complex data and extracting applicable patterns and insights.

The integration between Big Data and artificial intelligence enables companies to improve marketing decisions by predicting customer behavior, personalizing offers, and improving the consumer experience. This integration has become a fundamental pillar in formulating modern marketing strategies, as organizations rely on real-time, intelligent analytics to deal with highly competitive, dynamic markets. Studying this relationship therefore represents an important step toward understanding how advanced technologies can be deployed to build competitive advantages and achieve added value for both customers and companies. The following axes briefly illustrate this:

1- Integration between Big Data and Artificial Intelligence: Big Data provides a rich and diverse environment for training artificial-intelligence algorithms, which enhances the accuracy and generalizability of models, while artificial intelligence enables the analysis of this enormous data and the extraction of hidden patterns and knowledge. For example, "the intersection between 'deep learning' and 'Big Data' points to the common use of deep-learning methodologies in managing and analyzing large commercial datasets…"[26].
Likewise, "deep learning's ability to process vast amounts of unstructured data enhances business intelligence by revealing insights that go beyond traditional analytical methodologies."[27].
Big Data and artificial intelligence are thus two complementary technologies: Big Data provides a rich and diverse environment for training AI algorithms, enhancing the accuracy and generalizability of the models, while artificial intelligence enables the processing of this enormous, complex data and the extraction of hidden patterns and knowledge from it. This interaction produces a continuous feedback loop that improves model performance and supports practical applications in multiple fields such as healthcare, smart cities, and smart transportation. A number of researchers hold that this interaction contributes to the development of innovative applications in multiple fields, such as healthcare, smart cities, and e-commerce, while emphasizing the need to take into account the ethical and social considerations associated with the use of Big Data[28]

2- Personalization and Improving the Customer Experience: Artificial intelligence contributes to personalization by analyzing diverse data (digital and non-digital) to provide customized recommendations, which improves the customer experience in online shopping, as in the Stitch Fix business model. According to Davenport et al. (2020): "Stitch Fix's proprietary machine-learning algorithms scan numbers, words, and content

pinned on Pinterest, then summarize the results for the company's stylists, who in turn select the appropriate clothing to send to each customer. The example above illustrates the need to strike an appropriate balance between AI input and human input," as Stitch Fix executives noted that their experience shows their AI works best when used to augment the capabilities of (human) stylists[29]

3- Data-Driven Marketing Decision-Making: Integrating predictive analytics with Big Data enables companies to make precise marketing decisions, such as product pricing or identifying target markets. Wedel & Kannan (2016) emphasize that "integrating machine-learning methods with econometric and theoretical approaches to Big Data applications" provides "computational solutions for Big Data marketing models." [30]

4- Real-Time Marketing: By using artificial intelligence to process data streaming from digital channels, companies can adjust their strategies instantly based on changes in the market and customer behavior. As Chaffey & Ellis-Chadwick (2022) note, "for example, in marketing, artificial intelligence helps analyze campaign effectiveness in real time, facilitating immediate adjustments and optimization."[31]

In order to present these dimensions and axes more clearly, and to facilitate understanding of the nature of the linkage, the relationship between artificial intelligence (AI), Big Data, and marketing can be formulated as shown in the following table:

Table (02): The Relationship between Artificial Intelligence (AI), Big Data, and Marketing

	Role of Big Data	Role of Artificial Intelligence	Impact on Marketing
tion s	Providing vast, diverse quantities of data (structured and unstructured)	Processing data and extracting applicable patterns and insights	Improving understanding of the market and customer behavior
tion	Providing customer behavior and preference data	Generating personalized recommendations based on machine-learning algorithms	Improving customer experience and increasing loyalty
aking	Precise predictive data from multiple sources	Predictive analysis and real-time decision support	More precise and effective marketing decisions
	Instantaneous data from digital channels	Adjusting marketing campaigns instantly according to changes	Faster response t customer needs

Source: Based on the preceding axes and the study's literature.

In light of the data presented in Table (02), it is clear that the relationship between Big Data and artificial intelligence in marketing rests on an integrative basis: Big Data represents the primary source of the vast and diverse flow of information, while artificial intelligence constitutes the analytical tool capable of processing this data and transforming it into applicable strategic insights. This integration enhances the efficiency of marketing decisions by improving the understanding of customer behavior, delivering personalized offers, and supporting predictive-analysis-based decision-making, in addition to enabling companies to interact instantly with market changes through real-time marketing. Applied examples such as Google Analytics and Stitch Fix, as well as Amazon's pricing algorithms and Facebook's real-time ad campaigns, demonstrate that this integration is not merely a theoretical concept but a successful practical application that continuously generates added value. It can therefore be said that this relationship represents a dynamic closed loop, in which every marketing activity generates new data that in turn feeds back into artificial-intelligence systems, leading to cumulative and continuous performance improvement.

V. Ethical and Privacy Challenges

The rapid development of digital technologies and the spread of artificial intelligence and Big Data analytics have brought issues of ethics and privacy to the fore as central challenges facing individuals and organizations. This development has facilitated the collection and processing of personal information, raising fundamental questions about the legitimate use of data and individuals' rights to protect their private lives. These issues can be addressed through the following axes:

1- Privacy Violation and Informed Consent: The collection and processing of personal data without obtaining clear, informed consent from consumers represents one of the most prominent ethical problems associated with the use of artificial intelligence and Big Data in marketing. This practice raises questions about the availability of genuine informed consent, particularly given the reliance on complex, opaque algorithms. In this regard, Mittelstadt (2021) notes that obtaining genuine informed consent when personal data is processed by opaque algorithms is extremely difficult, as users often lack sufficient understanding of how their data is used.[32]

2- Lack of Transparency (the "Black Box" Problem): Artificial-intelligence algorithms are

often incomprehensible to non-specialists, which reduces the possibility of accountability. This is what O'Neil, C. (2016) discusses in her book, stating: "Yet I saw a problem… The mathematics-based applications that drive the data economy were built on choices made by fallible human beings. Some of these choices were no doubt made with good intentions. Nevertheless, many of these models encoded human prejudice, misunderstanding, and bias into the software systems that increasingly managed our lives. Like gods, these mathematical models were opaque, their workings invisible to all but the highest priests in their domain: mathematicians and computer scientists. Their verdicts, even when wrong or harmful, were beyond dispute or appeal. And they tended to punish the poor and the oppressed in our society, while making the rich richer."[33]

3- Algorithmic Bias and Unfairness: The use of biased data leads to reinforcing discrimination in marketing and customer targeting, as noted by numerous studies — for example, a study authored by AlDreabi et al. (2024), which indicates that differences in digital-communication characteristics (such as reliance on algorithmic systems in communication tools) may affect communication efficiency. If these systems contain biases (such as favoring users with higher digital skills or better access), they may lead to unfair outcomes in administrative work at universities, such as the exclusion of certain employees or students from processes.[34].

4- The Need for Ethical Privacy Frameworks: Adopting principles such as privacy-by-design and privacy-by-default to reduce ethical risks. A United Nations Global Pulse report notes that Ann Cavoukian, the inventor of "privacy by design," proposed seven new principles called "AI Ethics by Design," which build on the principles of privacy by design to embed ethics within artificial intelligence, thereby reducing risks such as bias or social injustice.[35]

Conclusion

The integration between artificial intelligence and Big Data represents a fundamental turning point in the trajectory of contemporary marketing. Marketing success is no longer based on intuition or traditional trial-and-error, but has come to depend on in-depth analysis and precise predictions grounded in vast quantities of data processed through intelligent methods. This convergence has enabled marketing to shift from a general approach targeting broad segments toward a personalized strategy based on a precise understanding of customers' needs, behaviors, and expectations.

Given the intense competitiveness of markets, companies that invest in this duality have become more capable of innovation, achieving added value, and building sustainable relationships with their customers. Going forward, the future of marketing will witness further integration between artificial-intelligence technologies and Big Data analytics, opening new horizons for formulating smarter and more effective decisions, while taking into account ethical dimensions and the protection of consumer privacy.

Reference:

1. Moor, J. (2006). The Dartmouth College Artificial Intelligence Conference: The Next Fifty Years. AI Magazine,[1] 27(4), p.87.
2. Russell, S. J., & Norvig, P. (2016). Artificial Intelligence: A Modern Approach (3rd ed.). Pearson. Pp. 1–2.[2]
3. Russell, S. J., & Norvig, P. (2022). Artificial Intelligence: A Modern Approach (4th ed., Global ed.). Pearson. Pp. 19, 23.[3]
4. Nils J. Nilsson is one of the pioneers of artificial intelligence; his book "The Quest for Artificial Intelligence: A History of Ideas and Achievements" is a key reference documenting the history and development of the field, from its early beginnings in the eighteenth century to recent achievements.[4]
5. Nilsson, N. J. (2010). The Quest for Artificial Intelligence: A History of Ideas and Achievements. Cambridge[5] University Press. P.13.
6. Stanford University. (2016). Artificial Intelligence and Life in 2030: One Hundred Year Study on Artificial[6] Intelligence: Report of the 2015–2016 Study Panel. Stanford University. https://ai100.stanford.edu/2016-report
7. Mitchell, M. (2021). Artificial Intelligence: A Guide for Thinking Humans. Farrar, Straus and Giroux, p.17.[7]
8. Poole, D., & Mackworth, A. (2023). Artificial Intelligence: Foundations of Computational Agents (3rd ed.).[8] Cambridge University Press. pp. 3–4.
9. Russell, S. J., & Norvig, P. (2022). Artificial Intelligence: A Modern Approach (4th ed., Global ed.). Pearson. p.7[9]
10. Russell, S. J., & Norvig, P. (2022). Artificial Intelligence: A Modern Approach (4th ed., Global ed.). Pearson. p.78.[10]
11. Bughin, J., Hazan, E., Ramaswamy, S., Chui, M., Allas, T., Dahlstrom, P., & Trench, M. (2017). Artificial Intelligence:[11] The Next Digital Frontier. McKinsey Global Institute.
12. O'Brien, W. J. (2017). Fiatech: The Next

Generation of the Capital Projects Technology Roadmap. Journal of[12] Construction Engineering and Management, 143(9).
13. McCarthy, E. J. (2002). Basic Marketing: A Managerial Approach (14th ed.). McGraw-Hill. P.8.[13]
14. Sharp, B. (2013). Marketing: Theory, Evidence, Practice. Oxford University Press.[14]
15. Kotler, P., & Keller, K. L. (2016). Marketing Management (15th ed.). Pearson. P.27.[15]
16. Kotler, P., & Armstrong, G. (2020). Principles of Marketing (18th ed.). Pearson Education. P.6.[16]
17. Ferrell, O. C., & Hartline, M. (2017). Marketing Strategy: Text and Cases (7th ed.). Cengage Learning. p.16.[17]
18. Armstrong, G., & Kotler, P. (2020). Principles of Marketing (18th ed.). Pearson. P.30[18]
19. Mahmoud Abd al-Salam. (2021). Introductory Booklet Series — No. (16): Big Data Technology. Arab Monetary[19] Fund. p.15.
20. Herman, E. L. (2024). Data Science for Decision Makers: Using Analytics and Case Studies. Mercury Learning andInformation. P.5. [20]
21. Laney, D. et al. (2013). Big Data Means Big Business. Gartner Inc. P.7.[21]
22. Miele, S., & Shockley, R. (2013). Analytics: The Real-World Use of Big Data. IBM Global Services. p.3.[22]
23. International Telecommunication Union (ITU). (2013). Big Data: Big Today, Normal Tomorrow. ITU Technology Watch Report, No. 11. P.8.[23]
24. Hurwitz, J. S., Nugent, A., Halper, F., & Kaufman, M. (2013). Big Data for Dummies. John Wiley & Sons. Pp.15–16.[24]
25. Gandomi, A., & Haider, M. (2015). Beyond the Hype: Big Data Concepts, Methods, and Analytics. International Journal of Information Management, 35(2), p.139.[25]
26. Rane, N. L., Paramesha, M., Choudhary, S. P., & Rane, J. (2024). Artificial Intelligence, Machine Learning, and Deep Learning for Advanced Business Strategies: A Review. Partners Universal International Innovation Journal, 2(3), p.151.[26]
27. Rane, N. L., Paramesha, M., Choudhary, S. P., & Rane, J. (2024). Artificial Intelligence, Machine Learning, and Deep Learning for Advanced Business Strategies: A Review. Partners Universal International Innovation Journal, 2(3), p.148.[27]
28. O'Neil, C. (2016). Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy. Crown Publishing Group.[28]
29. Reis, J., & Housley, M. (2022). Fundamentals of Data Engineering. O'Reilly Media. Davenport, T. H., Guha, A., Grewal, D., & Bressgott, T. (2020). How Artificial Intelligence Will Change the Future of Marketing. Journal of the Academy of Marketing Science, 48(1), p.33.[29]
30. Wedel, M., & Kannan, P. K. (2016). Marketing Analytics for Data-Rich Environments. Journal of Marketing, 80(6), p.102.[30]
31. Chaffey, D., & Ellis-Chadwick, F. (2022). Digital Marketing (8th ed.). Pearson Education Limited, p.254[31]
32. Mittelstadt, B. D. (2021). AI, Big Data, and the Future of Consent. AI & Society, 36(2), p.1719.[32]
33. Neil, C. (2016). Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy. Crown Publishing Group, p.5.[33]
34. AlDreabi, H., Al Twahya, F. K. A., Alzboun, N., Anabtawi, M., Abu Ghaboush, R., Alhur, M., & Alshurideh, M. T. (2024). The Role of Digital Communication in Developing Administrative Work in Higher Education Institutions. International Journal of Data and Network Science, 8(2), p.1263.[34]
35. United Nations Global Pulse. (2023). Building Ethics into Privacy Frameworks for Big Data and AI. UN Global Pulse & International Association of Privacy Professionals. https://www.unglobalpulse.org/wp-content/uploads/2023/12/BUILDING-ETHICS-INTO-PRIVACY-FRAMEWORKS-FOR-BIG-DATA-AND-AI-UN-Global-Pulse-IAPP.pdf[35]