TPM Vol. 32, No. 3, 2025
ISSN: 1972-6325
https://www.tpmap.org/

Open Access

DATA-DRIVEN GREEN MARKETING: LEVERAGING BUSINESS INTELLIGENCE TO ENHANCE THE COMPETITIVE ADVANTAGE OF INDUSTRIAL SMES

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Abstract
This study aimed to explore how green marketing influences competitive advantage within Small and Medium Enterprises (SMEs), specifically focusing on the mediating roles of business intelligence (BI) and artificial intelligence (AI). Its primary goal was to understand how to leverage these technologies to boost competitive performance in the face of environmental and economic challenges.
The study employed a quantitative approach. Researchers collected data from a simple random sample of 359 Algerian industrial SMEs, drawn from 390 distributed questionnaires. They then used statistical analysis with SmartPLS4 software to analyze the data.
The results revealed a positive and statistically significant relationship between green marketing and competitive advantage, with BI exhibiting a complementary partial mediation of 46% in strengthening this relationship. The study recommends that SMEs adopt green marketing strategies supported by BI technologies to improve their competitive performance. It also emphasizes investing in AI technologies for better internal operations, but with a focus on integrating them with green marketing strategies.
This research paves the way for future explorations, such as investigating factors that influence AI adoption, analyzing other mediating variables, and conducting comparative studies across different industrial sectors. Such research could contribute to the development of effective strategies that support Algerian SMEs in achieving sustainable growth and a competitive edge in the global market.
Keywords: Green marketing, Artificial Intelligence, Business Intelligence, Competitive advantage, Small and Medium Enterprises.

INTRODUCTION

In today's shifting economic landscape and escalating technological demands, Small and Medium Enterprises (SMEs) face significant hurdles in achieving sustainable growth and maintaining a competitive edge (Spender, 2017, p. 2). SMEs actively contribute to job creation and innovation. However, challenges related to market instability, heightened competition, and limited technology adoption compel these businesses to seek innovative

strategies to bolster their performance and competitive strength (Ida & Doddy, 2022). The objective is to connect with the organization's core resources, capabilities, and competencies, explored through examining and understanding theories in the literature review (Wang & et al, 2024, p. 1).

Green marketing has emerged as a pivotal focus for SMEs aiming to gain a competitive advantage. It's a phenomenon of growing importance in today's market, allowing for the potential to re-market and repackage existing products (Braik & al, 2023, p. 2). As an environmental component and a source of competitive advantage, it facilitates trade, achieves organizational and individual objectives while preserving and protecting the environment. It's a strategic endeavor to offer eco-friendly products to customers (Muchenje & al, 2023, p. 467). Green marketing encompasses a broad range of activities, including product modification, changes in production processes, and packaging alterations (Wandhe, 2018, p. 3).

These modifications aim to meet consumer needs and desires without causing any harm to the surrounding environment, whether in the product itself or the production and packaging processes (Krisdayanti & widodo, 2022, p. 206). It also contributes to the success of SMEs by marketing environmentally friendly products to achieve their goals, sustain their operations, meet customer needs and requirements, ultimately reaching the supreme goal of achieving sustainable development.

Green marketing practices represent growing trends in the early 21st century, as companies increasingly adopt marketing strategies that consider the environment and support sustainability. The concept of data-driven green marketing has emerged as a vital tool, empowering economic institutions to utilize data to improve the effectiveness of their marketing campaigns for environmentally friendly products and services. The challenges facing traditional companies are increasing, such as growing environmental awareness and increased market competition, necessitating the use of innovative methods based on data analytics and statistics to enhance marketing effectiveness and achieve sustainability goals (Andronie & et al, p. 1).

To mitigate risks and reduce pollution, organizations must utilize modern technologies, specifically business intelligence and artificial intelligence. The goal is to transform raw data into actionable knowledge, enabling organizations and companies to make data-driven strategic decisions (Upadhyay, 2018, p. 621). Data mining applications span diverse fields such as marketing, scientific research, healthcare, education, cybersecurity, and supply chain management, demonstrating its broad importance in analyzing data and extracting valuable insights (Samways dos Santos & al, 2019, p. 2). Decision-making can be simple or complex, such as determining a new company strategy in a competitive market (Marchisotti & al, 2018, p. 1).

By integrating these two tools, SMEs can develop strategies that enable them to adapt to market changes and enhance their competitive advantage (adewusi & et al, 2024, p. 4).

In summary, this research highlights the significance of data-driven green marketing in industrial SMEs, emphasizing the role of business intelligence and artificial intelligence in enhancing competitive advantage.

This research aims to explore the relationship between green marketing, the adoption of modern technologies such as business intelligence and artificial intelligence, and achieving competitive advantage. It also seeks to understand how Small and Medium Enterprises (SMEs) can use these tools to improve their sustainable performance. Additionally, the research seeks to provide a standard model that illustrates the mediating relationship of the variables artificial intelligence and business intelligence between green marketing and competitive advantage, contributing to enriching the theoretical and applied literature in this field.

The research also aims to help industrial SMEs achieve sustainable growth and competitiveness in the face of increasing economic and technological challenges. By understanding the importance of data-driven green marketing and how to use business intelligence and artificial intelligence. Organizations can improve their marketing strategies, meet the needs of environmentally conscious consumers, and build a positive brand image. Organizations can also reduce risks and limit pollution by using modern technologies and making data-driven strategic decisions, which enhances their operational efficiency and improves their financial performance in the long term.

Despite the growing importance of green marketing and its role in achieving competitive advantage for industrial SMEs, there remains a lack of understanding about how organizations' adoption of business intelligence and artificial intelligence technologies affects the effectiveness of green marketing strategies. Furthermore, the current literature has not sufficiently explored the mediating relationship between these technologies, green marketing, and competitive advantage, especially in the context of SMEs in Algeria.

Based on the above, the following main question can be posed:

What is the impact of green marketing on competitive advantage in industrial SMEs in Algeria, and what is the mediating role of business intelligence and artificial intelligence in this relationship?

LITERATURE REVIEW

Green marketing involves developing and promoting products or services based on their environmental benefits (Zamora & al, 2023, p. 51). It focuses on creating and promoting environmentally friendly products through marketing strategies that emphasize sustainability. This type of marketing includes strategies aimed at reducing negative environmental impacts and promoting environmental responsibility in all aspects of production, distribution, and consumption (Kusuma & Asifulla, 2024, p. 19).

Companies that adopt green marketing can differentiate themselves in the market and attract a growing segment of consumers who prefer environmentally responsible companies. This strategy not only helps build a positive brand image but also opens doors to new markets and business opportunities (Zamora & al, 2023, p. 51). Green marketing requires solutions to environmental problems, such as reducing consumption, using renewable resources, increasing energy efficiency, and sustainability in the production process (Kanonuhwa & Chimucheka, 2014, p. 1). Additionally, it involves providing clear and accurate information about the environmental benefits of products and how consumers can contribute to environmental protection through their purchasing choices (cronin & Gleim, 2011, p. 3).

Green marketing demands a deep understanding of environmental issues to identify how products or services can provide real solutions, develop products that reduce environmental impact or use new and more sustainable technologies or materials, and build relationships with environmental groups, regulatory bodies, and other parties that can support green marketing efforts (Pahuja, 2018, p. 1).

Green marketing is based on several dimensions, integrating environmental considerations into all marketing processes. It primarily involves social marketing, which focuses on changing people's behaviors to achieve the common good. In the context of green marketing, it is also used to promote environmentally friendly behaviors and encourage consumers to make sustainable choices. It stimulates changes in attitudes and behaviors, increasing demand for green products and supporting environmental conservation efforts (Maulidiyanti & al, 2023, p. 1).

The core of green marketing is the green product dimension, reflecting a company's commitment to environmental practices and providing added value to consumers interested in sustainability. These products are designed or modified to reduce their environmental impact, whether through the use of sustainable materials, waste reduction, or energy efficiency enhancement (Bhardwaj & al, 2020, p. 1).

Environmental advertising is part of a green marketing strategy used to inform and educate consumers about the environmental benefits of products or services. It aims to build awareness and trust in green products, enhance the brand's environmental image, and increase customer preference for its products. It also directs consumer behavior toward more sustainable options (Castro Santa & Drews, 2023, p. 1).

Finally, the green supply dimension refers to integrating environmental practices into all aspects of the supply chain, from obtaining raw materials to manufacturing and distribution. It involves selecting suppliers who adopt sustainable practices, reducing the environmental impact of products, and enhancing the credibility of green marketing. This can also lead to improved operational efficiency and reduced costs over the long term (Lazrak & El amrani, 2023, p. 1; Oksana, 2014, p. 302).

Business intelligence is a set of approaches, processes, and technologies that transform raw data into actionable information. It supports strategic, tactical, and operational planning and decision-making in organizations (Kimball & al, 2009, p. 20). Business intelligence involves a range of activities that are accomplished to achieve a purpose, whether these activities are technological, commercial, legal, or other (Vercellis, 2009, p. 12).

It is also defined as a collection of methods to improve decision-making in business using reality-based support systems. Business intelligence helps analyze data extracted from internal or external sources and presents it in the form of information (Effy, 2009, p. 215). The data is collected and stored, along with analytical tools, to provide complex internal and competitive information to decision-makers (Dadkhah & Lagzian, 2018, p. 10). Business intelligence combines data perception and visualization, which are best practices to help organizations make more informed decisions (Bhosale & al, 2021, p. 80).

Business intelligence consists of three elements: data collection and analysis, competitive intelligence, and business performance management. Data collection involves using tools to gather, organize, and analyze data necessary for dealing with specific problems. In industry, this means relying on software capable of sifting information in all organizational operations, starting from customer requests and raw materials to production and distribution (Hiego Candido & al, 2023, p. 4).

Competitive intelligence refers to a strategy that helps organizations adapt to environmental changes and industry disruptions by understanding business and industry environments and learning from competitors' strategies (de las heras rosas & Ballesteros, 2021, p. 1). This helps organizations in various ways, such as providing intelligent estimates, evaluation, information, and insights about markets and the measures taken by competitors and the organization itself (Yazdi ramezani mojarad & al, 2014, p. 2).

Business performance management is a continuous process of identifying, measuring, and developing individual performance to align with strategic objectives. It involves a set of measures that increase the level of resources to achieve objectives effectively and efficiently (Clayton & de Braine, 2023, p. 3). It also works to link individual goals with organizational goals by clarifying objectives and expectations toward each individual and then providing rewards that match their performance (Lorraine dorai ponu & Zubair, 2015, p. 2).

The goal is to achieve systems that possess intelligence and behave similarly to humans in terms of learning and understanding, so that these systems provide users with various services such as education, guidance, and interaction (B.J. Copeland, 2019, pp. 7-10). Artificial intelligence has a range of applications, primarily represented in expert systems, which are computer applications for making decisions in real-life areas. These systems aim to simulate human logic in specific fields of knowledge (Božić, 2024, p. 3). Deep learning is a branch of machine learning, acting as an algorithm that attempts to use high-level abstraction of data using multiple

processing layers. It consists of complex structures or non-linear transformations in machine learning, relying on characterizing learning data (zhiying, 2019, p. 1).

Neural networks model thinking based on the human mind, where the human brain consists of a densely interconnected group of neurons, or basic information processing units, called neurons. The human brain includes approximately 10 billion neurons and 60 trillion connections, synaptic points, between them. Using multiple neurons simultaneously, the brain can perform its functions much faster than even the fastest computers available today (Qamar & Zardari, 2023, p. 2).

An intelligent agent system is an object that cannot affect its environment through the sensors it possesses but can experiment with it using execution mechanisms or limbs. An intelligent agent is also one of the applications of data mining from the Internet or from Internet databases. It works through a software package that performs specific tasks of a repetitive or predictive nature for the beneficiary and supports business activities and other program applications (Boujia & Sabbane, 2024, p. 3).

Competitive advantage is defined as an organization exploiting its internal strengths in performing its activities, generating value that competitors cannot achieve in their performance of activities (Pitts & Lei, 1996, p. 68). These are the characteristics that the product or brand possesses that give it some superiority over competitors. Acquisition occurs by providing greater value or lower prices or through more benefits that justify higher prices. It is a specific positive attribute of the entity that excels in and differs positively from its competitors (Radostina, 2019, p. 73). It is the ability of the organization to outperform its competitors by creating value for buyers and exceeding the organization's cost in creating value (Saurabh, 2019, p. 14).

Competitive advantage is also defined as evaluating the organization's capabilities and its position in the market concerning the advantage it achieves in relation to competitors. This advantage is not easily observable but can only be inferred from the organization's performance, as the superior performance of the organization has specific reasons and links to competitive advantage (Mukerjee, 2016, p. 2).

Organizations always need to identify their competitors and the degree of their direct and real impact on them. They try to develop a preliminary list that includes several possibilities, enabling them to develop a strategy to position themselves in a more attractive position than their competitors (Marios, 2006, pp. 279-280). It is achieved when the organization develops or acquires a set of characteristics that allow it to outperform its competitors, for example, market share, product quality, or technological progress.

This can be treated as a prerequisite for achieving success or specific strategic objectives (ceglinski, 2016, p. 3). The organization's ability to acquire a competitive advantage is a strong indicator of organizational results because the competitive advantage refers to the resources or capabilities that give the organization a competitive edge over its competitors, allowing it to maintain good organizational performance in the long term (Quàn nguyen & et al, 2022, p. 56).

Competitive advantage has several dimensions, including cost, which is the organization's ability to provide products at the lowest costs.

This allows it to achieve the lowest cost advantage, one of the oldest and most-used priorities by organizations. Even with the emergence of other strategies, it remains the most targeted by businesspeople. It is well-known that cost is one of the most attractive priorities, mainly due to the idea that the lower the production cost, the greater the profit. Organizations that rely on cost as a main production strategy always operate on the principle that cost must be lower (Mula & et al, 2018, p. 245).

Quality is another dimension where organizations seek to achieve high market shares by relying on quality. Many organizations claim that quality is their top priority, and many customers say that they are looking for quality in the products they buy. However, quality has a personal meaning that depends on who defines it. For example, for one person, quality may mean that the product lasts for a long time, and for another person, quality may mean that the product provides high performance (R.DAN & R.sanders, 2023, p. 34). Finally, innovation emerges as the most distinctive of human characteristics. It involves the images of something non-existent, originality or renewal, and suitability, that is, relevance to the task at hand, combining many different fields (Gabora, 2013, p. 2).

Data-driven green marketing is an approach that focuses on using data and analytics to understand consumer behavior and market trends related to sustainable products. This concept involves collecting data from multiple sources, such as sales, surveys, and interactions on social media platforms, and then analyzing it to extract actionable insights. These insights enhance strategic decision-making, contributing to the development of targeted and effective marketing strategies (Shao & et al, 2024, p. 1). Business intelligence plays a pivotal role by enabling organizations to analyze huge amounts of data and create detailed reports that help in understanding performance and guiding decisions.

Through analytical tools, companies can measure the actual success of green marketing campaigns, leading to a faster response to consumer preferences and market changes (Tamara, 2023, p. 1). On the other hand, artificial intelligence enhances the capabilities of companies by providing advanced personalization technologies and deeply analyzing consumer behaviors. Artificial intelligence allows developing predictive models that contribute to understanding future trends, enabling companies to adapt more effectively to market requirements. It can also contribute to improving internal processes and reducing waste, which enhances operational efficiency (Elliot, 2019).

3. RESEARCH METHODOLOGY

The study population consisted of all SMEs in Algeria, totaling approximately 1,300,000 enterprises (Algerie presse service, 2023).
The simple random sample of 390 enterprises was selected using the Thompson sampling formula (steven & Thompson, 2012), as follows:

$$n = \frac{N \times p(1-p)}{\left[[N-1 \times (d^2 \div z^2)] + p(1-p)\right]}$$

N: population size,
z: standard score corresponding to the significance level of 0.95, which equaled 1.96,
d: margin of error, which equaled 0.05,
p: proportion of the characteristic's presence and neutrality = 0.50.

$$n = \frac{1{,}300{,}000 \times 0.05(1-0.05)}{\left[[1{,}300{,}000-1 \times (0.50^2 \div 1.96^2)] + 0.05(1-0.05)\right]} \approx 390$$

Out of these, 359 questionnaires were returned and deemed analyzable, resulting in a response rate of of 92.05%.

3.1. Research Measurements

To test the relationships between the study variables and build a valid model, a self-developed questionnaire; Steps were followed in developing the questionnaire by conducting reviews by experts in the field to ensure that the questions cover all relevant aspects of the topic. These reviews helped us make adjustments to the questionnaire items.
We conducted a pilot test of the questionnaire by distributing it to a small exploratory sample of SMEs. This pilot test helped us improve the quality of the questions and participants' understanding of them, and the results were used to modify the questions and enhance their clarity.
Using Likert scales and depending on the previous studies was designed, comprising 39 questions divided into four axes. The first axis focused on green marketing (questions 1 to 9), the second axis on artificial intelligence (questions 10 to 21), the questions of the third axis were about business intelligence (questions 22 to 30), and the fourth axis related to competitive advantage (questions 31 to 39).
This approach aligns with statistical methods used to study relationships between variables, such as correlation and regression analysis, which are common in econometric modeling to understand economic phenomena. The design of such a questionnaire helps researchers gather data necessary for analyzing the relationships between green marketing, artificial intelligence, business intelligence, and competitive advantage, ultimately contributing to the development of a reliable model that can be used to predict future outcomes or guide strategic decisions.

Table 1. Descriptive statistics and saturation for the variables.

Latent Variables	Item Code	Statement	Means	Standard Deviation	R	Saturation cofficient	*p*-Value
Green marketing	m1	Your organization adopts the concept of social and ethical responsibility	3.45	1.116	0.653	0.912	0.000
	m2	Your organization promotes environmental awareness among its employees.	2.60	0.156	0.325	0.896	0.000
	Pro1	Your organization strives to ensure that its services provided are environmentally friendly.	3.40	1.023	0.265	0.845	0.000
	Pro2	Your organization determines its service prices based on costs, on one hand, and customer acceptance on the other	3.86	1.122	0.654	0.801	0.000
	Pro3	Your organization sponsors activities that contribute to environmental conservation.	3.14	0.963	0.364	0.790	0.000

	Mo1	Your organization seeks to improve its positive image in the community.	3.80	0.658	0.423	0.954	0.000
	Mo2	Your organization uses transportation and distribution methods that are not harmful to the environment	2.90	0.324	0.156	0.494	0.000
	Ta1	Your organization complies with environmental policies and laws.	3.23	0.156	0.369	0.914	0.000
	Ta2	Your organization adopts the concept of social and ethical responsibility.	2.56	0.936	0.879	0.893	0.000
	Tot1	**Green marketing**	**3.38**	**0.965**	**0.771**	**-**	**0.000**
Artificial intelligence	ch1	Your organization possesses software based on artificial neural networks.	3.65	1.145	0.632	0.801	0.000
	ch2	Your organization uses artificial neural network software to execute its tasks.	3.77	1.036	0.514	0.816	0.000
	ch3	Your organization uses artificial neural network software to solve ambiguous problems.	3.69	1.469	0.235	0.794	0.000
	w1	Your organization possesses intelligent software that autonomously performs repetitive tasks.	3.50	1.103	0.645	0.775	0.000
	w2	Your organization uses intelligent software to help employees remember their tasks.	3.66	1.234	0.364	0.838	0.000
	w3	Your organization uses intelligent software capable of interacting with its external environment.	3.36	0.655	0.731	0.742	0.000
	n1	Your organization possesses knowledge-intensive software used to perform tasks requiring expertise.	3.40	0.988	0.325	0.876	0.000
	n2	Your organization uses knowledge-intensive software to assist employees in decision-making through consultations with it.	3.46	1.054	0.423	0.916	0.000

	n3	Your organization uses knowledge-intensive software that replaces experts the organization might consult for advice.	3.66	1.023	0.623	0.920	0.000
	t1	Your organization uses self-learning software to detect external opportunities and threats.	3.79	1.452	0.198	0.642	0.000
	t2	Your organization uses self-learning software for forecasting and estimation.	3.24	0.365	0.436	0.870	0.000
	t3	Your organization uses self-learning software to analyze and process various types of data.	3.40	0.659	0.369	0.814	0.000
	Tot2	**Artificial intelligence**	**3.43**	**0.875**	**0.478**	**-**	**0.000**
Business intelligence	Comp 1	Your organization includes the goal of obtaining information about its competitors within its plans.	3.98	1.165	0.523	0.891	0.000
	Comp 2	Your organization filters and selects information about its competitors.	3.70	1.066	0.410	0.886	0.000
	Comp 3	Your organization relies on ethical criteria when collecting information about its competitors.	3.66	1.077	0.477	0.809	0.000
	J1	Your organization uses tools and techniques to collect and manage data.	3.40	1.076	0.366	0.872	0.000
	J2	Your organization classifies and sorts data to create databases.	3.65	0.963	0.355	0.810	0.000
	J3	Your organization follows precise scientific methods in selecting the most suitable information for decision-making.	3.42	0.645	0.423	0.814	0.000
	ma1	Your organization attempts to adapt to its surrounding environment to achieve its goals.	3.62	0.758	0.645	0.820	0.000
	ma2	Your organization exploits its resources in a way that ensures	3.47	0.956	0.342	0.720	0.000

		its survival and growth in the market.					
	ma3	The optimal use of available means helps your organization achieve high profit margins.	3.60	0.698	0.236	0.763	0.000
	Tot3	**Business intelligence**	**3.50**	**0.635**	**0.246**	**-**	**0.000**
Competitive advantage	Ja1	Your organization strives to offer products of higher quality than competing products.	3.14	0.897	0.366	0.874	0.000
	Ja2	Your organization provides products that align with consumer needs and expectations.	2.69	0.543	0.477	0.916	0.000
	Ja3	Your organization is distinguished by its high ability to respond to customer needs.	3.63	1.032	0.355	0.897	0.000
	K1	Your organization produces products at lower costs compared to competitors.	3.42	1.142	0.388	0.729	0.000
	K2	Your organization is unique in offering products.	4.20	1.862	0.599	0.896	0.000
	K3	Your organization places great emphasis on increasing employee productivity to reduce costs.	4.10	1.156	0.632	0.820	0.000
	ib1	Your organization presents products with distinctive and unique characteristics.	3.70	1.046	0.416	0.828	0.000
	ib2	Your organization offers products that are difficult for competitors to replicate.	3.69	1.489	0.328	0.885	0.000
	ib3	Your organization provides products with added value compared to its competitors.	3.14	0.964	0.368	0.813	0.000
	Tot4	**Competitive advantage**	**3.45**	**0.456**	**0.367**	**-**	**0.000**

Source: Prepared by researchers using Smart PLS 4.

From the table, we observe that the arithmetic mean of each axis of the study (green marketing, artificial intelligence, business intelligence, competitive advantage) achieved a medium to high degree, i.e., greater than 2.60 and ranges between 2.60 and 3.40 at a significance level of less than 0.05. Therefore, we can state that food industry institutions possess medium green marketing and high artificial intelligence, business intelligence, and competitive advantage. We also note a positive and statistically significant relationship at a significance level of less than 0.05 between all elements of the study variables.

From the table above, the indicator t1 in the mediating variable "Artificial Intelligence" is less than 70%. Therefore, researchers retained it because it exceeds 40% and increases the values of composite reliability or average variance.

The following figure shows the modified model of the study after deleting the previously mentioned indicators.

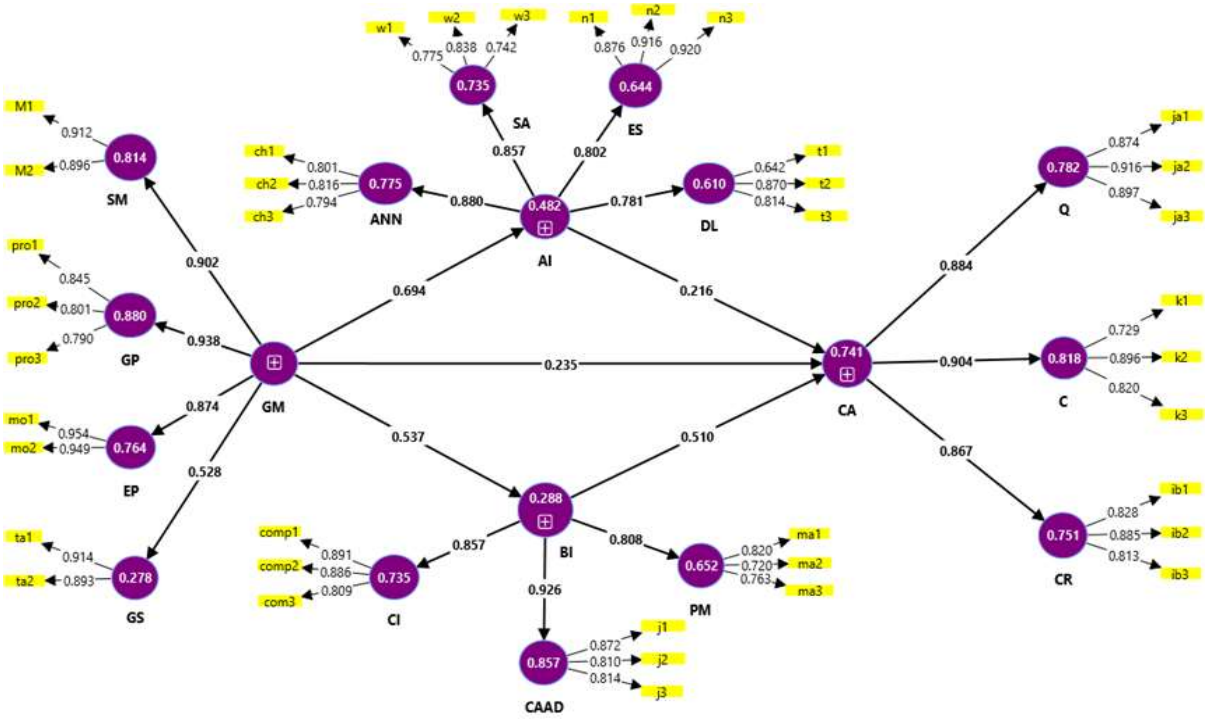

Figure 1. The modified model of the study.
Source: Prepared by researchers using Smart PLS 4.

Indicator Reliability, Convergent Validity, and Normality Assessment for Study Variables.

To measure Indicator Reliability (RHO, Cronbach's Alpha, Composite Reliability), Convergent Validity (AVE), and Normality (Cramér-Von Mises, P-value) for Study Variables, the results are in the following table**:**

Table 2. Assessment of Construct Reliability, Validity, and Distributional Properties

Variants	composite reliability	Alpha cronbach	Indicator RHO	AVE	Cramér-Von Mises	P value
Green marketing	0.907	0.904	0.924	0.636	0.736	**0.366**
Artificial intelligence	0.900	0.896	0.913	0.569	0.648	**0.145**
Business intelligence	0.882	0.876	0.901	0.508	0.234	**0.223**
Competitive advantage	0.908	0.828	0.922	0.569	0.546	**0.454**

Source: Prepared by researchers using Smart PLS 4.

From the previous table, we observe that all Cronbach's alpha coefficients are high, exceeding 0.7. The values of RHO coefficients are also high and exceed 0.70. Therefore, researchers can rely on the questionnaire, in addition to the CR indicator, which is greater than 0.7 in all dimensions. Thus, researchers can state that the study tool possesses stability.

We also note from the table that all values of AVE coefficients are statistically acceptable because their value exceeds 0.50. Therefore, researchers can judge that the model has convergent validity, and that all data at the level of significance was greater than 0.05. Therefore, the data follows the normal distribution, and parametric tests must be performed.

This analysis aligns with research practices that emphasize the importance of reliability and validity in research tools. Cronbach's alpha is a key measure used to assess the internal consistency of a scale, with values above 0.7 generally considered acceptable for most research contexts. The use of RHO and CR indicators further supports the reliability of the study tool, ensuring that the data collected is consistent and reliable.

Endogeneity Test for Study Variables.

The Gaussian Copula test is a statistical tool used to examine the dependence be-tween variables and can help check for endogeneity issues in the data. This can be illustrated in the following table**:**

Table 3. Gaussian Copula Test

Variables	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P value
Green marketing→sArtificial intelligence	-0.128	-0.133	0.119	1.078	**0.281**
Green marketing→sBusiness intelligence	-0.385	0.166	0.132	1.081	**0.106**
Green marketing→sCompetitive advantage	0.092	0.123	0.083	1.145	**0.275**
Artificial intelligence→Competitive advantage	0.135	0.595	0.136	0.097	**0.077**
Business intelligence→Competitive advantage	0.098	0.754	0.067	1.320	**0.136**
Artificial intelligence→Competitive advantage	-0.089	-0.067	0.068	1.420	**0.084**
Business intelligence→Competitive advantage	-0.213	0.140	0.196	0.563	**0.428**
Business intelligence→ Artificial intelligence → Competitive advantage	-0.186	-0.028	0.064	1.077	**0.216**
Business intelligence→ business intelligence → Competitive advantage	0.244	0.124	0.199	0.088	**0.165**

Source: Prepared by researchers using Smart PLS 4.

From the table above, we observe that the path coefficient (O) between green marketing and artificial intelligence is -0.128, indicating an inverse relationship with an average of -0.133 and a standard deviation of 0.119. The calculated T value is 1.078 at a significance level of 0.281, showing that the relationship between green marketing and artificial intelligence is not statistically significant. The relationship between green marketing and business intelligence has a path coefficient of -0.385, indicating an inverse relationship with an average of 0.166 and a standard deviation of 0.132.

The calculated T value is 1.081 at a significance level of 0.106.

The path coefficient between green marketing and competitive advantage is 0.092, indicating a positive relationship with an average of 0.123 and a standard deviation of 0.083. The calculated T value is 1.145 at a significance level of 0.275. Additionally, the path coefficient between artificial intelligence and competitive advantage is 0.089, indicating a positive relationship with an average of 0.135 and a standard deviation of 0.595. The calculated T value is 0.097 at a significance level of 0.077, showing that the relationship between artificial intelligence and competitive advantage is not statistically significant.

The path coefficient between business intelligence and competitive advantage is 0.098, indicating a positive relationship with an average of 0.754 and a standard deviation of 0.067. The calculated T value is 1.320 at a significance level of 0.136. The path coefficient between green marketing and competitive advantage through artificial intelligence is -0.186, indicating an inverse relationship with an average of -0.028 and a standard deviation of 0.064. The calculated T value is 1.077 at a significance level of 0.216. The path coefficient between green marketing and competitive advantage through business intelligence is 0.244, indicating a positive relationship with an average of 0.124 and a standard deviation of 0.199. The calculated T value is 0.088 at a significance level of 0.165.

From the above, we note that the P-value for each study variable is not statistically significant, as it is greater than 0.05. Therefore, we can say that the study model does not contain a critical endogeneity problem affecting the regression results (Malevergne & Sornette, 2010).

4. RESULTS

We confirm the significance of the paths by relying on the Bootstrapping technique, generating 500 subsamples. The results were as shown in the following figure:

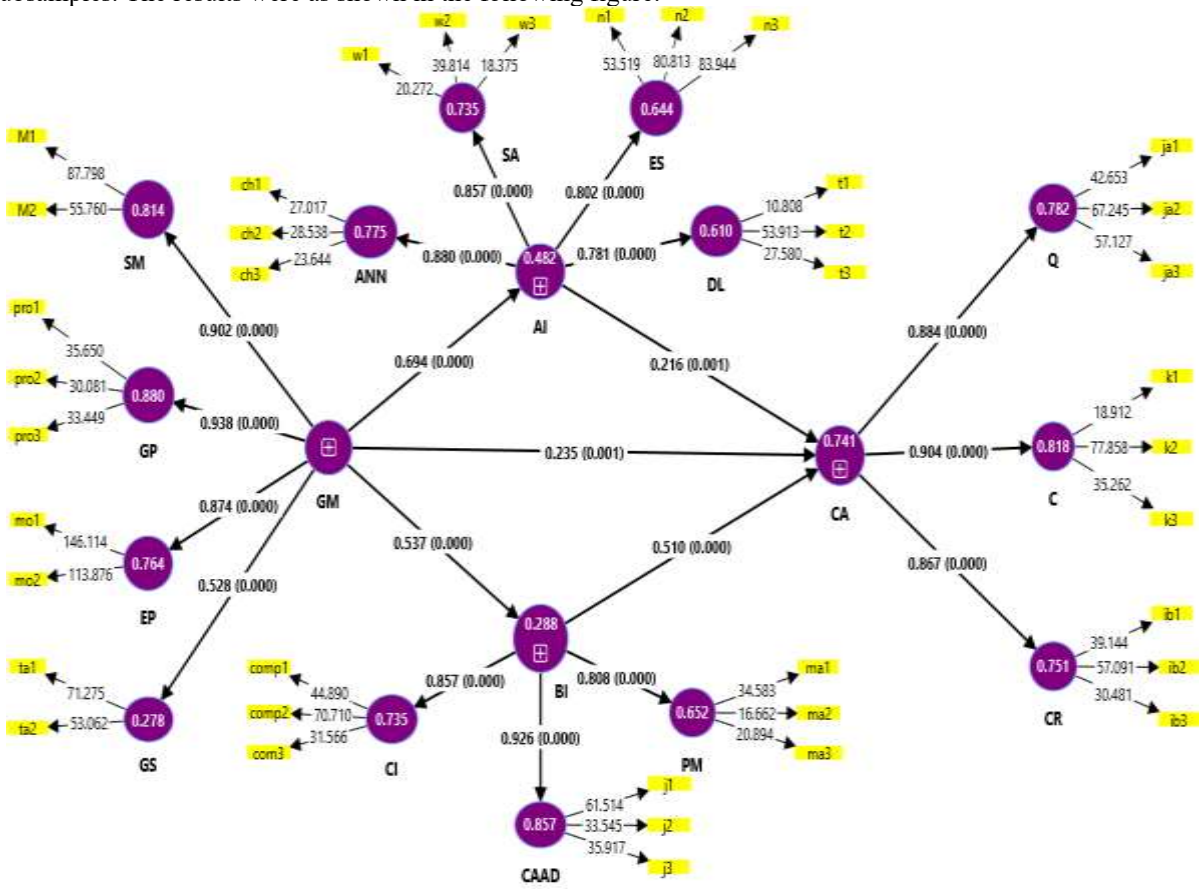

Figure 2. ***Statistical Significance of the Structural Model Paths***
Source: Prepared by researchers using Smart PLS 4.

By estimating, the relationships related to the structural model, which express the assumed relationships between the constructs, the statistical significance of all relationships is tested using T-values, P-values less than 5%, and path coefficients. The results of the study to test the significance of the coefficients were as follows (Hair, 2016, p. 206):

Table 4. Structural model coefficient

Structural model Analysis	PlS-SEM		
	Path coefficient	T values	P values
Green marketing ->Artificial intelligence	0,694	16.957	**0,000**
Green marketing ->business intelligence	0,537	10.420	**0,000**
Green marketing ->competitive advantage	0,235	3.437	**0,001**
Artificial intelligence ->competitive advantage	0.216	3.328	**0.001**
Business intelligence ->competitive advantage	0.510	9.221	**0.000**
Green marketing ->artificial intelligence -> competitive advantage	0.150	3.295	**0.001**
Green marketing ->business intelligence -> competitive advantage	0.460	10.241	**0.001**

Source: Prepared by researchers using Smart PLS 4.

The findings demonstrate statistically significant relationships between green marketing, artificial intelligence, business intelligence, and competitive advantage in industrial SMEs. The effect of green marketing on artificial intelligence is strong and positive, with a path coefficient of 0.694 and a T value of 16.957. Its impact on business intelligence is moderate and positive, with a path coefficient of 0.537 and a T value of 10.420, while its direct effect on competitive advantage is weak but positive, with a path coefficient of 0.235 and a T value of 3.437. Artificial intelligence shows a weak positive effect on competitive advantage (path coefficient = 0.216, T value =

3.328), whereas business intelligence demonstrates a moderate positive effect (path coefficient = 0.510, T value = 9.221).

Indirectly, green marketing positively influences competitive advantage through artificial intelligence (path coefficient = 0.150, T value = 3.295) and through business intelligence (path coefficient = 0.460, T value = 10.241). These results confirm partial mediation and emphasize the importance of integrating green marketing strategies with artificial intelligence and business intelligence to enhance competitive advantage effectively in industrial SMEs.

DISCUSSION

Based on the findings of the study, we can interpret and compare them with research gaps and previous studies to determine the benefit at both the scientific and practical levels, particularly in the socio-economic context of industrial SMEs as follows:

Business intelligence significantly enhances the element of competitive intelligence as a discipline that helps industrial SMEs adapt to environmental changes and deal with industry disruptions. It allows these enterprises to gain a better understanding of the business and industry environments while continuously learning from competitors' strategies, as highlighted in the study by (de las heras rosas & Ballesteros, 2021, p. 1). Another study by (Yazdi ramezani mojarad & al, 2014, p. 2) also addressed this, noting that competitive intelligence assists organizations in various ways, such as providing smart estimates, evaluations, information, and insights about markets and measures taken by competitors and the organization itself.

Artificial intelligence plays a critical role in organizations as a computational application for decision-making in real-life domains, aiming to simulate human logic specific to experts in a particular field of knowledge. This aligns with findings from (Božić, 2024, p. 3), which attribute AI's capabilities to algorithms that use high-level data abstraction through multiple processing layers composed of complex structures or non-linear transformations. Similarly, (Mariani & al, 2023, pp. 1-2) described AI as a branch of computer science focused on developing systems and software capable of performing tasks requiring human intelligence, such as learning, understanding, reasoning, and adapting. Moreover, (Zahlan & al, 2023, p. 1) emphasized that AI encompasses a wide range of technologies, including machine learning, deep learning, natural language processing, and computer vision. It is applied across diverse fields ranging from intelligent recommendation systems and virtual voice assistants to advanced robotics and big data analytics.

Green marketing involves developing and promoting products or services based on their environmental benefits through marketing strategies centered on sustainability. These strategies aim to reduce negative environmental impacts and promote environmental responsibility across all aspects of production, distribution, and consumption. This aligns with findings from (Kusuma & Asifulla, 2024, p. 19) and (Zamora & al, 2023, p. 51), which highlight that organizations adopting green marketing can differentiate themselves in the market and attract an increasing segment of consumers who prefer environmentally responsible companies.

Green marketing has a strong positive role in achieving artificial intelligence within industrial SMEs. This stems from organizations setting service prices based on costs on one hand and customer acceptance on the other while striving to enhance their positive image in society. This aligns with the study by (Saadi & Azdimousa, 2024), which demonstrates that these organizations aim to promote environmentally friendly products, services, practices, and sustainability initiatives while meeting consumer needs. AI algorithms provide significant potential for revolutionizing marketing strategies.

Green marketing has a weak positive role in achieving competitive advantage within industrial SMEs. This is due to organizations not offering value-added products compared to competitors or aligning with consumer needs and expectations. They also fail to provide products of higher quality than competing products. This finding aligns with the study by (Arseculeratne & Yazdanifard, 2024), which indicates that these organizations lack a business strategy that responds to changing market needs or fosters environmental awareness among consumers. Additionally, they do not identify the essential requirements for successful green marketing strategies or analyze challenges faced during strategy evaluation.

There is a weak positive role for artificial intelligence in achieving competitive advantage in industrial SMEs. This is because organizations do not use smart software to help employees remember their tasks, nor do they offer products that align with consumer needs and expectations, which aligns with the study by (Rane, 2024). This indicates that organizations do not provide unparalleled capabilities in analyzing unstructured data, decision-making, strategic planning, natural language processing, and handling big data. This also agrees with the study by (Lopes da costa & et al, 2022), as organizations do not work on improving quality of life, changing the work environment, or adapting to market evolution, making it difficult to satisfy customers. They also fail to integrate various technologies to make optimal decisions, collect data, process it, and analyze it to provide important information.

There is a moderate positive role for business intelligence in achieving competitive advantage in industrial SMEs. This is because organizations do not use tools and techniques to collect and manage data, nor do they produce products at lower costs compared to competitors, which aligns with the study by (Hofmann & English, 2018). This is due to organizations relying on two main theories to identify important resources and capabilities that form competitive advantage, namely the resource-based view and the dynamic capabilities perspective. They also focus

on business intelligence and big data, as noted in the study by (Gaurda & et al, 2013). This shows that organizations strive to create a competitive advantage by understanding the data generated in their performance. Organizations adopt measures supported by business intelligence, which can create the need for organizations to adapt processes that support decision-making systems and align their systems with the level of databases and applications, allowing appropriate data analysis to support decision-making.

Green marketing plays a weak positive role in achieving competitive advantage in industrial SMEs through artificial intelligence, demonstrating limited use of smart software capable of interacting with its external environment. Therefore, it does not enhance environmental awareness among employees and lacks reasonable pricing or quality standards, as highlighted in the study by (Krisdayanti & Widodo, 2022, p. 206). This study shows strengths through the effective use of strategies by enhancing the use of deep learning, networks, and methods to reduce impact regarding material and waste reduction through environmental awareness and prediction.

What distinguishes our study from previous ones is as follows:

There is a moderate positive role for green marketing in achieving business intelligence in industrial SMEs. This is because organizations insufficiently use environmentally friendly transportation and distribution methods and do not consider activities that contribute to environmental conservation. Additionally, the organizations under study do not follow precise scientific methods in selecting the most suitable information for decision-making.

Green marketing contributes positively and moderately, by about 46%, to achieving competitive advantage in industrial SMEs through business intelligence. This is the best mediating role in the study model, which is related to effective competitive advantage in organizations. Therefore, the type of mediation is partial and complementary. This is due to organizations relying on ethical criteria when gathering information about competitors and using available means optimally, which helped them achieve high profit margins.

Based on the previous results, we recommend that Industrial SMEs should leverage artificial intelligence, a modern technological and technological topic, to achieve competitive advantage. They should also focus on business intelligence as a framework that collects, transforms, and presents information to reduce the time needed to obtain important business data and enable efficient decision-making. This allows for dynamism and presentation of organizational information.

Moreover, SMEs should adopt green marketing as a strategy aimed at reducing negative environmental impacts and promoting environmental responsibility across all aspects of production, distribution, and consumption. This helps them differentiate themselves in the market and attract a growing segment of consumers who prefer environmentally responsible companies. SMEs should set service prices based on costs and customer acceptance while striving to improve their positive image in society. They should promote environmentally friendly products, services, practices, and sustainability initiatives while meeting consumer needs.

SMEs should offer value-added products compared to competitors, align with consumer needs and expectations, and provide products of higher quality than competing products. They should develop a business strategy that responds to changing market needs and fosters environmental awareness among consumers. Additionally, SMEs should identify the essential requirements for successful green marketing strategies and analyze challenges faced during strategy evaluation.

SMEs should use smart software to help employees remember tasks, improve quality of life, and integrate various technologies to make optimal decisions. They should collect, process, and analyze data to provide important information. SMEs should also produce products at lower costs compared to competitors and use business intelligence to adapt processes that support decision-making systems. They should fully utilize smart software that can interact with its external environment, enhance environmental awareness among employees, and effectively use strategies by enhancing deep learning, networks, and methods to reduce material and waste impact through environmental awareness and prediction.

Finally, SMEs should use environmentally friendly transportation and distribution methods, consider activities that contribute to environmental conservation, and follow precise scientific methods in selecting the most suitable information for decision-making.

Funding

This work was supported through the Ambitious Funding track by the Deanship of Scientific Research, Vice Presidency for Graduate Studies and Scientific Research, King Faisal University, Saudi Arabia (**GRANT: KFU253340**)

CONCLUSION

This study aimed to explore the impact of green marketing on competitive advantage in small and medium-sized industrial enterprises in Algeria, focusing on the mediating role of business intelligence and artificial intelligence. The findings highlighted the importance of adopting data-driven green marketing strategies to enhance the competitive capacity of these enterprises.

The results showed that Algerian SMEs possess a moderate level of green marketing practices, a high level of artificial intelligence and business intelligence technologies, and achieve competitive advantage. The study also revealed a positive and statistically significant relationship between the study variables, emphasizing the integration of green marketing with modern technologies to achieve outstanding performance.

Business intelligence was found to play a crucial mediating role in the relationship between green marketing and competitive advantage, indicating that using business intelligence tools enhances the effectiveness of green marketing strategies in achieving competitive advantage.

Based on these findings, it can be confirmed that green marketing is a vital strategy for SMEs in Algeria, helping improve their environmental image, attract sustainability-conscious customers, and achieve sustainable development. However, the adoption of business intelligence and AI technologies should be part of a comprehensive strategic vision that goes beyond merely responding to green marketing practices, including improving internal processes, data-driven decision-making, and innovation enhancement.

Future research directions include conducting in-depth studies to identify factors driving SMEs to adopt AI technologies, considering organizational, technological, and environmental factors that may influence this adoption. Exploring the role of other mediating factors, such as green innovation, green human capital, and green organizational culture, in the relationship between green marketing and competitive advantage is also recommended.

Additionally, comparative studies across different industrial sectors in Algeria could identify variations in green marketing practices and the adoption of modern technologies, and their impact on competitive performance. Replicating this study in countries with similar economies to compare results and identify factors affecting the effectiveness of green marketing in different contexts is also of interest. Adopting diverse research methodologies, such as qualitative studies, case studies, and field experiments, can deepen our understanding of the phenomena studied. Finally, building predictive models using AI to analyze data and predict the impact of green marketing practices and the adoption of modern technologies on the sustainable performance of SMEs can be beneficial. By exploring these research avenues, we can contribute to developing effective strategies and policies to support these enterprises in Algeria, enabling them to achieve sustainable growth and competitiveness in the global market.

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