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The impact of adopting green supply chain Technique to enhance sustainable competitive advantage: An analytical study at Al-Furat Company's sulfuric acid plant

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أثر تبني تقنية سلسلة التوريد الخضراء في تعزيز الميزة التنافسية المستدامة: دراسة تحليلية في شركة الفرات معمل حامض الكبريتيك

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This research aims to demonstrate the role of adopting green supply chain technology in achieving sustainable competitive advantage in the sulfuric acid plant. Through this technology, economic units seek to reduce the depletion of non-renewable natural resources, improve the efficiency of materials and energy use, and reduce waste and emissions polluting the environment, thus contributing to environmental and economic sustainability. The study was based on the descriptive analytical method, and the questionnaire was used as a main tool to collect data from the field side of the laboratory staff, where the sample size was (110) individuals. The data were analyzed using the social science statistical package (SPSS) version 26. The results of the study showed that the application of a green supply chain contributes to reducing operational costs by improving the utilization of resources and the development of productive processes, as well as enhancing sustainable competitive advantage by improving the image of the enterprise, increasing customer satisfaction and the possibility of entering new markets with environmentally friendly products. The study confirms that the adoption of a green supply chain represents an important strategic direction to achieve sustainability and enhance the economic and environmental performance of industrial units.

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المستخلص

يهدف هذا البحث إلى بيان دور تبني تقنية سلسلة التوريد الخضراء في تحقيق الميزة التنافسية المستدامة في معمل حامض الكبريتيك. إذ تسعى الوحدات الاقتصادية من خلال هذه التقنية إلى الحد من استنزاف الموارد الطبيعية غير المتجددة، وتحسين كفاءة استخدام المواد والطاقة، وتقليل النفايات والانبعاثات الملوثة للبيئة، بما يسهم في تحقيق الاستدامة البيئية والاقتصادية. اعتمدت الدراسة على المنهج الوصفي التحليلي، وتم استخدام الاستبانة أداةً رئيسة لجمع بيانات الجانب الميداني من العاملين في المعمل، حيث بلغ حجم العينة (110) فرداً. وتم تحليل البيانات باستخدام الحزمة الإحصائية للعلوم الاجتماعية (SPSS) الإصدار 26. أظهرت نتائج الدراسة أن تطبيق سلسلة التوريد الخضراء يسهم في خفض التكاليف التشغيلية من خلال تحسين استغلال الموارد وتطوير العمليات الإنتاجية، كما يعزز الميزة التنافسية المستدامة عبر تحسين صورة المؤسسة وزيادة رضا الزبائن وإمكانية دخول أسواق جديدة بمنتجات صديقة للبيئة. وتؤكد الدراسة أن تبني سلسلة التوريد الخضراء يمثل توجهاً استراتيجياً مهماً لتحقيق الاستدامة وتعزيز الأداء الاقتصادي والبيئي للوحدات الصناعية.

1. Introduction

Most economic units have adopted modern environmental policies to mitigate the effects of environmental pollution caused by the activities of economic units, and it has become necessary for environmental accounting to play an important role in measuring and calculating their environmental costs in accordance with the production system to reduce the effects left by economic units and their compliance with environmental law and regulations .This has led to a growing trend towards a sustainable future that "Green Supply Chain Management", which includes making all the company's activities environmentally friendly, starting from "the supplier to the end consumer and integrating environmental considerations at every step green design, green purchasing, green production, green distribution and marketing, logistics . This enables economic units to maintain production and achieve environmentally friendly "green production", which, in turn, reduces costs for the company itself and for the environment and society as a result of adverse effects. These environmental costs include waste, emissions and losses, as well as fines and compensation for environmental pollution. While the continuation, survival and development of the company depends on its success in achieving sustainable development, which is achieved through continuous planning and adherence to environmental policies that mitigate any negative environmental impacts, as there are many methods(methods, techniques and practices)of modern environmental and cost-effective methods that try to integrate among themselves in helping economic units to control and measure (quantitatively and critically) to preserve natural resources and the use of clean energy by producing harmless and non-polluting products on the living environment and calculating its environmental cost according to the production system.

2. Methodology

2.1 Research Problem

This pollution is caused by the consumption and depletion of limited resources and energy , solid and liquid waste, gas emissions, environmentally harmful products resulting from these processes, as well as the destruction of the character of human, animal and plant life as a result, the total expenses of environmental costs for the prevention and reduction of environmental pollution are increasing , Therefore, it is necessary to use modern and advanced accounting technologies such as green supply chain technology that achieve a sustainable competitive advantage, as it has become a more sustainable approach to creating economic value, especially industrial ones, taking into account the environmental impacts of their production processes and measuring the cost of environmental pollution. , Which raises the following question :

- Is "the adoption of green supply chain technology leading to a sustainable competitive advantage"
- Adopting a green supply chain in the company contributes to reducing environmental costs from sulfur emissions, and thus contributes to achieving a competitive advantage?

2.2 importance of research

The "importance of the research stems from the great importance that can be achieved from the adoption of green supply chain technology in the economic unit under research and its role in providing quantitative and financial environmental information to economic

units and the role that Green Supply Chain technology" plays to reduce waste residues and emissions polluting the environment and provide sustainable products free from environmental impacts and its potential to reduce costs by utilizing resources and energy with high efficiency, which shows the importance of adopting green supply chain technology to preserve" the environment by reducing pollution resulting from its activities and reduce environmental pollution rates and achieve a sustainable competitive advantage"

2.3 Research Objectives

1. Statement of the knowledge bases of the concept of green supply chain technology, namely green purchasing, green manufacturing and green design.
2. Identify the impact of green supply chain technology in reducing costs and "achieving a sustainable competitive advantage"
3. Clarify the extent to which Iraqi economic units contribute to reducing environmental pollution when adopting a green supply chain and adopting sustainable strategies.

3. Theoretical side

3.1 The philosophical framework of the concept of green supply chain technology and competitive advantage

The term "green supply chain" appeared in response to changes in the industry and its environmental impact, which necessitated economic units to adapt their supply chains to environmental, social and economic objectives. supply chain refers to a group of independent or semi-independent business units responsible for the purchase, production and distribution of products or services to customers. It consists of three parties: "suppliers, producers and customers" these three parties interact to facilitate"the flow of goods and services from sources of supply to sources of demand" and the flow of information and payments, such as materials, from suppliers to the production and marketing of products, up to the customer, ensuring customer satisfaction and satisfying their needs and desires(Dai & Lu, 2025) .

The concept of green supply chain technology was first developed by the manufacturing research consortium (MRC) of Michigan State University in the United States in 1996 by comprehensively considering the environmental impacts of industries and optimizing resources for manufacturing supply chains(Qazi, 2016), through the integration of the two concepts of "traditional supply chain and Environmental Management, the Professional Council for Supply Chain Management (CSCMP) introduced the supply chain as the planning and management of all involved activities that include resources, procurement, conversion and all logistics management activities, as well as coordination and cooperation with channel partners in which suppliers can be intermediaries and third parties in the provision of services, environmental management is defined as the management of human interaction with the environment and its impact on it(Adelina & Kusumastuti, 2017).

Other studies have similar motivations and have used sustainability strategies and reporting practices for modern units such as(Baret & Helfrich, 2019)

3.2 The importance of green supply chain technology

As for the importance of green supply chain technology with the following points: (Żywiołek et al., 2022)(Ananda et al., 2018), (Feng et al., 2022)

1. **Reducing environmental impacts**: implementing a green supply chain contributes to reducing environmental pollution during the transportation, storage and production phases.
2. **Making profits for economic units**: the application of a green supply chain increases the profits of business units by producing environmentally friendly products. This results in cost savings, an increase in profits, and an increase in the market share of business units.
3. **Transition to economic efficiency**: green" supply chains play a pivotal role in building and maximizing economic and environmental efficiency at various levels within business units. a green supply chain improves business efficiency by increasing productivity and improving product quality the application of a green supply chain contributes to reducing packaging costs through optimal use, thereby reducing waste generated by recycling packaging materials.
4. **Achieving a "sustainable competitive advantage** ": the effective implementation of a green supply chain contributes to enhancing the competitiveness and economic efficiency of companies. They enable enterprises to achieve economic benefits by gaining a competitive advantage over their competitors and improving profit margins, while at the same time improving environmental performance and reducing waste.
5. **Minimizing environmental changes and waste**: a green supply chain helps economic units to adapt to environmental changes and mitigate their effects by reducing waste and using energy and raw materials efficiently. This is achieved through the creation of new factories using renewable energy sources, which, in turn, contributes to the creation of jobs and Environmental Protection.

3.3 Reasons to adopt the impact of green supply chain technology

Economic units are pushing to integrate environmental thinking into their supply chain in order to prevent climate change and green warming caused by environmental pollution, as well as increased emissions from various stationary and non-stationary facilities. The green supply chain is one of the steps taken by economic units in the implementation of waste reduction strategies and alternative inputs of hazardous substances, so they resorted to it for the following reasons.:(Rahal & Zennir, 2021)(Tekin et al., 2020)

1. **Regulations**: Economic units must ensure their procedures comply with legislation and regulations to meet environmental requirements, thereby avoiding factory closures and the substantial legal fines imposed by the state on economic units.
2. **Brand image enhancement**: brand image is an important factor that drives economic units to meet new and constantly fluctuating customer demands ".
3. **Cost reduction**: this factor mainly concerns the reduction of energy consumption, the use of raw materials, waste assessment and other actions in order to reduce supply chain costs.
4. **Innovation**: The implementation of a green supply chain pushes economic units to constantly innovate in relation to their operations and organization in order to achieve a sustainable competitive advantage.

5. **Environmental concerns**: "which represents a real orientation resulting from precautions, fears and a real desire to minimize the negative impact on the environment ".

3.4. Implementation of green supply chain activities

The implementation of green practices is related to the supply chain, which requires multidimensional models and methods(Herrmann et al., 2021), the researchers differed in views on the definition of activities for the green supply chain due to the difference in the treatment of activities, each according to the study and the importance of each activity, on the one hand, and on the other hand, it is due to the different types, sizes and nature of the work of economic units, and "the activities of the supply chain :

1.**The main activities include:**

A. **Green procurement**: green procurement involves the integration of environmental considerations into procurement policies, programs and procedures (Balasubramanian & Shukla, 2017), green procurement as a set of practices followed by the economic unit for the selection of suppliers who practice environmentally friendly methods when manufacturing goods industrial economic units are forced to choose suppliers who have environmental efficiency, technical and environmental design ability, environmental performance, ability to develop environmentally friendly goods and the ability to support the goals of: Reuse, recycling and use of eco-labels of products, ensuring certification of environmental compliance of suppliers and conducting audits on internal environmental management of suppliers (Weeratunge & Herath, 2017)

B. **Green Manufacturing:** green manufacturing is a term used to describe manufacturing practices that do not harm the environment during any part of the manufacturing process. Emphasizing development practices that do not pollute the atmosphere and do not harm customers, employees, or other members of society, green manufacturing involves transforming industrial processes in three ways: using green energy, developing and selling green products, and employing green processes (Madi & Bourdima, 2021).

C. **Green Marketing**: green marketing is a promotional activity that highlights environmental ethics as the basics of business and can realize the advantage of transforming customer behavior towards the brand (Madi & Bourdima, 2021)

D. **Green Logistics:** Green logistics focuses on dealing with environmental issues involving green transport, handling of hazardous materials, storage, inventory control and packaging (Deshmukh & Vasudevan, 2014) logistics functions are divided between the areas of storage, transportation and packaging and Sustainable green logistics aims to monitor the efficient flow, environmental impact, and carbon footprint of green supply chain technology from the point of production to the consumer in terms of the cost of raw materials, inventory during processing, the final product, and information from the point of consumption to the point of origin for the purpose of recovering or properly disposing of the product, and emphasizes minimizing environmental damage during operation (Adelina & Kusumastuti, 2017).

3.5. Supporting activities include:

A. **Internal Environmental Management**: the environmental management system is a method of monitoring the environmental impacts of the operations of the economic unit can give a systematic approach to the preparation and implementation of initiatives to protect the environment, the economic unit should

have an existing process to understand, prioritize and address its environmental impacts in order to obtain accreditation and apply the standards of the Environmental Management System (Madi & Bourdima, 2021).

B. **Hazardous materials management:** "one of the most reasonable actions in the green supply chain is to replace a hazardous substance ,process or activities with less harmful ones " (Kudroli, 2014).
C. **Green distribution**: green distribution is an important element of green supply chain management due to its ability to have a significant positive impact on the surrounding environment .(Mohammad et al., 2026).
D. **Emission reduction**: control of emissions and effluents that are captured, stored, treated and disposed of using Pollution Control equipment. (Ching et al., 2022)
E. **Waste Management and Recycling:** Waste Management is the collection, transportation, recycling or disposal of waste, its reduction, follow-up and monitoring to reduce or reduce the amount of waste and the rate of recycling activities of materials (Yang et al., 2018) recycling refers to the treatment of waste into new products to prevent waste of materials by reducing the consumption of raw materials, reducing energy use and reducing air and water pollution (Ghobakhloo et al., 2013).
F. **Green Transportation:** green transport refers to any means of transport that has a low impact on the environment and makes a positive contribution to the environmental, economic and social sustainability of the society it serves(K. J. Shah et al., 2021).
G. **Green Technology and innovation**: the role of Green information technology helps the economic unit to reduce its environmental impacts in areas such as greenhouse gas emissions, toxic pollution, energy and water consumption, to create energy-efficient IT systems (such as hardware, software and applications) and also contributes to the creation of energy efficiency and environmentally sustainable business processes, practices, transport and buildings(Wang et al., 2019) green innovation is the implementation of new ideas by creating products that can reduce the impact of environmental damage associated with pollution reduction, energy saving, green product design, waste recycling and the annual report of economic units using indicators and measuring them by ratios (Agustia et al., 2019).

3.6.The concept and importance of sustainable competitive advantage and its dimensions

Sustainable competitive advantage is a concept that has its roots in the literature of Strategic Management in the past .this topic has enriched and saturated research because it explains the strategy of the economic unit in identifying ways of dealing in the economic business environment and helping it seize opportunities in building a force that protects it from its competitors in the industry, in a way that enhances its economic position and creates value for its customers and achieves its operational and financial goals. Being so important, it is imperative that there are foundations and principles that combine this concept of dispersion in the field of jurisprudence of economic units and also provide a base that researchers and scholars can rely on in the development of these concepts and these principles are reviewed in these points below (Thompson et al., 2013)(Iyigun, 2018).

Sustainable competitive advantage revolves around the ability of an economic unit to attract customers and provide more value to them better than its competitors. Here HT did not differ from the previous one by the comprehensiveness of the concept of sustainable competitive advantage . (De Moraes, 2023)see, with regard to the concept of sustainable competitive advantage, that economic units compete with each other to attract customers' attention and gain their loyalty, and depend on the reliability of equipment and its conformity to technical and environmental specifications.

(El Daly, 2020)defined sustainable competitive advantage as a set of unique core competencies of knowledge, skills and technologies that enable it to provide distinctive products and services. These core competencies evolve and adapt to changing market conditions.

The sustainable competitive advantage refers to the unique and permanent qualities possessed by economic units that allow them to consistently outperform their competitors in the long term. These qualities stem from a set of strategic options, characteristic resources and active effective implementation(Ibrahim et al., 2018)

As for(Musiello-Neto et al., 2021) he believes that achieving sustainable competitive advantage is by creating blue oceans-untapped market spaces where an economic unit can innovate and distinguish itself, rather than competing in saturated red ocean markets where competition is fierce.

Sustainable competitive advantage is an effective strategy for an economic unit because it adds value to it, which requires those units to continuously develop and optimize the use of resources and improve production processes in a way that distinguishes them from competitors and thus create a sustainable competitive advantage (S. M. A. Shah et al., 2021) minimize environmental damage by using recyclable packaging materials:

A. the use of raw materials that do not affect human health
B. effective contribution to the protection of the environment and spreading awareness among people
C. activating the environmental culture among the employees of the economic unit and training them on Environmental Protection
D. production of green products while working to adopt an environmental culture in all departments in the economic unit

As for the dimensions of the basic competitive advantage, they are centered on cost, quality, time (delivery), and flexibility, which determine the superiority of economic units over their competitors by providing unique value to the customer. Detailed dimensions include: Operational efficiency (low cost, high quality), human resources (skills, organizational culture), innovation and development (new products, internal processes), relationships (customers, partners), adaptability (in response to changes, operational flexibility), which enhances sustainability and growth, so the adoption of economic units to the dimensions of competitive advantage is considered an integration and extension that creates a sustainable competitive strategy "because the integration of the environmental dimension in industrial systems is a competitive strategy in the economic unit" capable of producing environmentally friendly products, reducing costs and improving innovation publish The green quality function is an important role by

using one strategy or combining both strategies to obtain green products, and this depends on the quality of the industry and its determinants.

The importance of sustainable competitive advantage lies in the challenges currently facing economic units, as each economic unit needs to be distinguished from others by its activities, capabilities or resources in order to be able to survive and compete in the current business environment.(Genç, 2017), while (Teref & Abd Ali, 2024) summarizes the importance of sustainable competitive advantage as follows:

A. It indicates the capabilities of economic units in achieving a leading position, acquiring a larger market share compared to their competitors, as well as their ability to retain their existing customers and attract new ones.
B. It enables economic units to meet the challenges of the market and competitors, by continuously enhancing their capabilities to become more able to exploit potential opportunities.
C. It is the most accurate indicator to determine success, as it depends on uniqueness and the firm belief that future performance should surpass previous performance, and that achievements should be better than what is being achieved at the moment.

4 .Practical Side

4.1. The description of the community, the study sample and the nature of its activity

The sulfuric acid factory is one of the main factories belonging to the Euphrates General company for chemical and pesticide industries, one of the companies of the Iraqi Ministry of industry and minerals. The factory is located in the al-Sada area of Babil governorate, 65 km south of Baghdad governorate, and occupies an area of 136 dunums, and enjoys a strategic location supported by the road and rail transport network, which contributes to facilitating supply and distribution operations.

The factory has more than 40 years of production experience in the field of chemical industries, and relies on the approved standards in its production processes, and has obtained the quality certificate (ISO 9001) for all its products, reflecting its commitment to international quality standards. The laboratory also complies with the ISO 14000 and 14001 series of standards, which support the implementation of environmental regulations and policies. Compliance with these standards is voluntary, but highly desirable for several reasons, including business success, stakeholder satisfaction, and competitive advantage

The plant produces a variety of chemical products, the most notable of which are: sulfuric acid of all kinds, caustic soda, liquid chlorine, hydrochloric acid, sodium hypochlorite.

Through its vision and strategic mission, the company seeks to achieve a set of goals, the most important of which are: promoting the national product, improving the quality of products, rationalizing costs, reducing waste, adopting clean technology, reducing negative environmental impacts, and thus contributing to achieving a sustainable competitive advantage .The company offers many products, the most important of which are (caustic soda, hydrochloric acid, sodium hypochlorite, liquid chlorine, concentrated sulfuric acid, sulfuric acid batteries, and agricultural pesticides), and that "Euphrates General company for chemical industries and pesticides" through its vision and strategic mission seeks to achieve a set of goals, the most important of which are:

- The factory's products should become the main national product in Iraq.

- Availability of products that are distinguished by their quality compared to other products.
- The plant's revenues are invested efficiently and effectively, and the production level is raised and developed.
- Produce products with international and competitive specifications, improve the quality of products, reduce waste.
- Taking advantage of modern technology to reduce pollution and achieve a sustainable competitive advantage.
- Optimal exploitation of electrical energy using advanced methods, to reduce energy consumption.

Where we will discuss in this aspect the application of green green supply chain technology on the Workers in the factory's production units who are in direct contact with production and technological path of production processes in the factory sample research to contribute to improving efficiency and effectiveness .The main objective of choosing this plant is to provide a practical and Applied Analysis of green supply chain " technology to reduce production costs in the company and enhance sustainable competitive advantage. this choice was made based on key factors, the most important of which is that this company is one of the leading economic units in the industry (sulfuric acid) and has a large production activity that requires effective management of its resources and reduce losses from them and dispose of waste resulting from its operations properly.

4.2. The methodology adopted in the applied aspect

The descriptive study methodology was adopted, which is based on analyzing and measuring the impact of green supply chain technology and assessing its effect on achieving a sustainable competitive advantage. This methodology includes several steps**:**

4.2. Stylistic features of the search sample:

Table No. (1), which represents the personality traits of the research sample, presents (130) samples, classified by:(age, academic achievement, Job Position, years of service, number of years of service in the position), with detailed statistics for each trait.

Table (1) Description of the study sample

Theme	Category	Redundancy	Percentage ratio
Social gender	Male	110	%85
	Female	20	%15
	Total	130	100%
Age:	25 years and less	30	%23
	35 years and under	43	%32
	45 years and under	25	%19
	55 years and under	25	%19
	65 years and under	7	%7
	Total	130	100%
Certification	Ph. D.	13	%10
	Masters	22	%17
	Bachelor	55	%42
	Other	40	%31
	Total	130	100%
Position	Director	1	%1
	Associate director	1	%1
	Head of Department	5	%4
	Head of division	5	%4

	Head of unit	5	%4
	Staff	113	%86
	Total	130	100%
Years of Service	2 years and less	30	%23
	5 years and less	20	%18
	10 years and less	32	%23
	20 years and less	33	%24
	30 years and less	15	12%
	Total	130	100%

Source: prepared by researchers based on SPSS. V. 26

With regard to gender, the results showed that the percentage of males in the company is very high, reaching (84%) compared to (16%) of females, reflecting that the nature of business in the company requires field and physical efforts that may make job opportunities more suitable for males from an administrative and organizational point of view. This low percentage of female participation is also due to social and cultural factors that affect the recruitment and recruitment of women in the Euphrates company.

As for the age distribution, it was found that the largest percentage of employees in the Euphrates company falls within the age group of 35 years or less (33%), followed immediately by the age group of 25 years or less (23%), which indicates the company's dependence on a young and middle-aged workforce characterized by vitality and productivity. The presence of a low percentage of employees over the age of 45 (and younger), and 55(years and younger) at the same percentage (19%), which indicates the company's implementation of a management policy aimed at benefiting from the young elements to replenish energies continuously.

With regard to the educational attainment of employees at Euphrates company, the percentage of Bachelor's degree holders was the highest and amounted to 42%, which confirms that the company focuses on attracting university qualifications mainly to fill technical and administrative positions, while the percentage of holders of graduate degrees (PhD and master's) reached a total of 27%, indicating that the company is not sufficiently oriented towards attracting graduate students .

As for the employees 'job position, the highest percentage of employees' share was in the lower job positions (86%), while unit managers and division managers together made up (8%) of the total sample, while general managers and their assistants made up a small percentage (2%). this distribution reflects the natural organizational structure that relies on a wide base of employees with a gradually smaller administrative structure up to the top.

As for the years of service, the highest category was (20 years and less) by (48%) followed by (2 years and less) and followed by (5 years and less), this indicates the presence of job stability in the company, with experience concentrated in a middle segment, which gives the company an advantage in retaining experience and accumulating practical knowledge in it. The low percentages of employees with less than 5 years of Service indicate that the new hires are relatively good, and the company may rely on the policy of developing its human resources internally.

As for the years of service in the current position, it turned out that the largest percentage of employees in their current positions (86%) have less than three years of service, reflecting a clear dynamic situation in the company's management structure, and this result

is likely to be related to the job rotation policy, promotions and recent internal organizational restructuring.

Stability test: the stability of the resolution was tested using cronbach's Alpha cronbach'salpha coefficient

Which measures the internal consistency between paragraphs whenever the coefficient value is closer to 1

1. the tool was more stable and consistent, preferably the value of the alpha coefficient should be more than (0.7) to ensure the achievement of the quality of the tool and the reliability of its results.

Table (2) stability coefficients

The variable	Number Paragraphs	The value of constancy Cronbach's Alpha
Green Supply Chain Technology	20	.896
Competitive advantage	15	.876
Resolution	35	.982

Source: prepared by researchers based on SPSS. V. 26

The results of the stability test according to Cronbach's Alpha coefficient showed that the stability values of the variables were high, reaching (.896) for the green supply chain variant and (.982) for the sustainable competitive advantage variable (.982), while the stability value of the resolution as a whole (.982), which confirms that the measuring instrument used is characterized by a high degree of internal consistency and stability, and can be reliably relied on in measuring the variables targeted by the study .

4.3. Normal Distribution test

The test results showed that the two variables (green supply chains and sustainable competitive advantage) follow a natural distribution, as the significant values of the test were higher than the approved statistical significance level (0.05 as is clear from Table No. (3) :

Table (3) Testing the normal distribution of search variables

The variable	Test value	The level of moral Sig
Green Supply Chain Technology	20	.529
Sustainable competitive advantage	15	.426

Source: prepared by researchers based on SPSS. V. 26

The results of Table (3) of the normal distribution test showed that the level of significance of the normal distribution test for the two variables (green supply chains, competitive advantage) was greater than the level of statistical significance (0.05), which confirms that the data of both variables follow the normal distribution, and therefore it is convenient to conduct parametric statistical analyzes.

4.4. Descriptive analysis of variables

The measures of descriptive statistics, such as the arithmetic mean and standard deviations, will be relied on in order to analyze the study variables, as these measures are the main tools that help describe the central direction of the data and determine the degree of dispersion, which enables the researcher to understand the characteristics of the data and

determine the extent of the difference and variation of values between the study elements and are analyzed statistically in Table No. (4).

Table (4) Statistical analysis of values

No	Dimension and variable	Arithmetic mean	Standard deviation	Relative importance
1	Green design	4.27	.716	5
2	Green buying	4.25	.627	4
3	Green manufacturing	4.35	.584	2
4	Green marketing	4.36	.586	3
5	Green logistics services	4.43	.582	1
	The independent variable: green supply chain technology	4.332	0.619	
5	Green products:	4.420	.565	3
6	Green distribution	4.29	.626	5
7	Emission reduction	4.37	.588	2
8	Waste management	4.26	.659	4
12	Green innovation	4.37	.588	1

Source: prepared by researchers based on SPSS. V. 26

The results of Table (4) of the statistical analysis of the study variables at the sulfuric acid plant showed that the independent variable of the green supply chain has obtained an arithmetic mean of (4.332), which reflects high availability, with a standard deviation of (0.619), and this indicates a small distraction and good agreement in the opinions of the respondents to the study sample about this variable, the relative importance was primarily green logistics, followed by Green and finally green design, which reflects a clear interest by the company in this field.

As for the sub-dimensions of the independent variable, they were as follows:

Green products achieved the highest average of (4.420) which indicates a very high availability at the company, with a standard deviation of (.565), reflecting the limited dispersion in the opinions of respondents, this dimension ranks first among the dimensions of green supply chain technology.

In second place is green innovation and emission reduction with an arithmetic mean of both (4.37), which indicates also high availability, with a standard deviation (.588) for both, which reflects a limited dispersion and a relative consensus in the opinions of the respondents

The green distribution comes in third place, its arithmetic mean is (4.29), with a standard deviation (.626) indicating high availability and limited dispersion in the opinions of respondents to the sample

Finally comes the waste management and has an arithmetic mean (4.26), which indicates a very high availability, with a standard deviation. (0.659).

Testing of research hypotheses "testing of the first main hypothesis: a significant correlation existsA moral between Green Supply Chain Technology and sustainable competitive advantage."

Table (5) The linkages between Green Supply Chain Technology and sustainable competitive advantage

No	Dimension and variable	The value of the correlation coefficient	Number of vocabulary	Sig error probability value
1	Green design	.84	130	.000

2	Green buying	.89	130	.000
3	Green manufacturing	.90	130	.000
4	Green marketing	.77	130	.000
5	Sustainable competitive advantage	.89	130	.000
	The independent variable: green supply chain technology	.79	130	.000

Source: prepared by researchers based on SPSS. V. 26

Table (5) shows the relationship between the independent variable green supply chain technology and the dependent variable sustainable competitive advantage. The value of the adult correlation coefficient indicates (0. 79) there is a strong and positive correlation between the two variables, which shows that the promotion of Green Supply Chain uses mm leads to the improvement of sustainable competitive advantage and leads to the achievement of long-term superiority. Since the error probability value (Sig.Less than (0.05), this relationship is statistically a function, which makes it possible to accept the main hypothesis that there is a significant correlation between a green supply chain and a sustainable competitive advantage. The following sub-hypotheses emerge from this hypothesis:

Testing the first sub-hypothesis: there is a significant correlation between green design and competitive advantage. Table (5) shows the relationship between green design and competitive advantage, where the value of the correlation coefficient (.84), indicating a strong and positive correlation between these two variables. This correlation indicates that the adoption of green strategies in the enterprise by providing a product or cost at a lower cost than competitors while maintaining acceptable quality and positively affects the sustainable competitive advantage. Since the error probability value (Sig.) Less than (0.05), the relation is statistically a function, which makes it possible to accept the first sub-hypothesis.

Testing the second sub-hypothesis: there is a significant correlation between green-green buying and competitive advantage. Table (6) shows the relationship between green buying and competitive advantage, where the correlation coefficient value was 0.89), reflecting a strong and positive correlation between green buying and and competitive advantage. This means that the implementation of procurement practices in the economic unit contributes to improving environmental, social and economic sustainability. Since the error probability value (Sig.) Less than (0.05), the relation is statistically a function, which makes it possible to accept the second sub-hypothesis.

Testing the third sub-hypothesis: there is a significant correlation relationship between green manufacturing and competitive advantage " Table (6) shows the relationship between green manufacturing and competitive advantage, where the correlation coefficient was (0. 9), indicating a strong and positive correlation between the improvement of sustainable manufacturing and its enhancement of sustainable competitive advantage. This shows that improving manufacturing efficiency and reducing emissions contribute to improving the environmental and economic performance of the economic unit. Since the error probability value (Sig.) Less than (0.05), then this relationship is statistically a function of, which makes it possible to accept the third sub-hypothesis. "

Testing the fourth sub-hypothesis: there is a significant correlation between green marketing and sustainable competitive advantage, and Table (6) shows the relationship between green marketing and competitive advantage, where the correlation coefficient was

(0.77), which indicates a strong and positive correlation between green marketing and promoting sustainability in the economic unit. She points out that the improvement of marketing processes leads to the promotion of environmental efficiency and economic and social sustainability. Since the error probability value (Sig.) Less than (0.05), the relation is statistically a function, which makes it possible to accept the fourth sub-hypothesis."

Table (6) Correlations between Green Supply Chain Technology and sustainable competitive advantage

No	Dimension and variable	The value of the correlation coefficient	Sample Size	Sig error probability value
1	Green design	.84	130	.000
2	Green buying	.89	130	.000
3	Green manufacturing	.90	130	.000
4	Green marketing	.77	130	.000
5	Sustainable competitive advantage	.89	130	.000
	The independent variable: green supply chain technology	.79	130	.000

Source: prepared by researchers based on SPSS. V. 26

Testing the second main hypothesis: a significant impact relationship exists between a green supply chain and a sustainable competitive advantage.

"Table (8) shows that the fixed limit value reached (3.227) which represents the best value reflecting sustainability, while the marginal slope reached (0.625), which indicates a direct and increasing impact of the green supply chain on competitive advantage. The coefficient of determination was (0.769), which means that the supply chain explains 76.9% of the variation in sustainable competitive advantage, indicating the strength of the relationship between the two variables. In addition, the (F) test reached a value of (727.530) with a significance of (0.000), which enhances the strength of the statistical model. Based on these results, researchers can accept the main hypothesis that there is a significant impact of a green supply chain on a sustainable competitive advantage.

Table (7) The effect of the relationship between research variables

	Dimension and variable	A	B	Testing t(β)	Moral t(β)	Coefficient SelectionR²	Testing F	Morale
1	Green design	3.019	.724	11.119	. 000	.759	799.026	.000a
2	Green buying	2.037	.604	15.084	.000	.679	679.773	.003b
3	Green manufacturing	5.785	.829	25.699	. 000	.769a	802.802	.000
4	Green marketing	.5231	.7841	15.016	. 000	.759	240.729	.000
5	Green logistics services	.5231	.540	12.249	.000	.679	857.530	.000b
	Green Supply Chain Technology	3.227	.625	17.599	.000	.769a	727.530	.000b

Source: prepared by researchers based on SPSS. V. 26

Discussion:

It is clear from the above that the Euphrates plant in siddah sulfuric acid plant-for the year 2024 was able to achieve a sustainable competitive advantage through the production of environmentally friendly products, thereby improving the quality and efficiency of the

product, reducing costs, enhancing flexibility, time and adhering to the environmental and economic dimension, which enables it to enhance its local competitive position in the contemporary industrial business environment.

Conclusion

It shows that the plant applies green supply chain practices well, which positively reflects on operational efficiency and the ability to improve resource sustainability. The results of the analysis showed that there is a clear impact of the green supply chain on the sustainable competitive advantage, and therefore the plant achieves higher economic efficiency while preserving the environment and measuring the success of applying sustainability standards.

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