

# Uncertain Supply Chain Management

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## The role of intellectual capital on green supply chain management: Evidence from the Jordanian renewable energy companies

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### ABSTRACT

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The study aimed to demonstrate the impact of Green Supply Chain Management (GSCM) with its dimensions (Green IT, Green Manufacturing and Packaging, Green Storing, Green Purchasing, Green Marketing) on the quality of services in renewable energy companies in Jordan. In addition, the study also aimed to measure the impact of intellectual capital on the impact of GSCM on the quality of services in renewable energy companies in Jordan. By adopting the survey/sampling method, data was collected from the study population of (482) companies, and the study sample consisted of (260) managers of renewable energy companies in Jordan using a questionnaire. The study reached several results, the most important of which are: the existence of an impact of green supply chain management on the quality of services in renewable energy companies, that intellectual capital has modified and enhanced the effect, and that renewable energy companies in Jordan seek to use environmentally friendly inputs in their production at a very high rate, several recommendations emerged from these results, most notably: that companies constantly review the production processes followed by suppliers to ensure their compliance with environmental specifications.

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### 1. Introduction

Production and operations departments face a set of challenges represented in the pressures of associations, individuals, governments and environmental bodies interested in taking into account the environmental aspect, as these processes reflect adverse effects on the environment at all stages that the product passes through the supply chain, among the most important of these adverse effects that it inflicts on the natural environment due to its excessive use of environmental resources and the increase in air pollution. The recent reports of the World Health Organization (WHO) showed that pollution kills 4.2 million people on Earth every year, not to mention that 91% of the Earth's population lives in an unhealthy air environment and causes environmental disruption (World Health Organization, 2019), this prompted companies to focus on transforming their production method to become more environmentally friendly, and here the term green supply chain appeared, which is called the concept of green supply chain management, which is used in a group of various activities carried out by the organization in order to reduce its adverse effects on the environment (Bossak & Andritsch, 2022), and reduce waste in the industrial and service system as a whole to conserve energy and reduce the release of hazardous materials into the environment, and to emphasize the harmful environmental impact of traditional supply chain operations within the organization, through the use of renewable energy and environmentally friendly technology. The idea of using the supply chain appeared to search for a compelling connection between the departments and processes the product goes through, starting from the inputs to the final

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product. Today, operations management faces challenges represented in market share, introducing new products, and finding ways and methods to keep companies in the field of competition (Salameh et al., 2022). Moreover, take difficult decisions in product design or planning, which enables it to respond to the continuous change in customer expectations and aspirations, and to address the problems faced by all countries (especially developing countries) concerning environmental pollution.

## 2. The objectives and importance of the study

The study aims to identify the Green Supply Chain Management (GSCM) with its dimensions represented in (Green IT, Green Manufacturing and Packaging, Green Storing, Green Purchasing, and Green Marketing) and its impact on the quality of services in renewable energy companies in Jordan and revealing the level of the relative importance of the green supply chain in the Jordanian renewable energy companies. Where this study is considered one of the vital studies that address the need to move to the green supply chain management approach because of the environmental benefits that this approach achieves that raise the level of services in a vital sector such as the sector of renewable energy companies in Jordan which would help them provide better and healthier services to the environment and the consumer.

## 3. The study Problem

Green supply chain management plays an essential role in the success of business operations and Jordanian renewable energy companies. It improves the quality of services to reflect positively on them in design, manufacturing, production, marketing, and development. The environment has been subjected to many environmental pollution and climate change violations. The depletion of natural resources such as land, water, agriculture, and mineral resources has brought them to a dangerous, complex, and critical stage, and to meet this depletion of resources and to stand up to these increasing pressures on organizations, especially renewable energy companies in Jordan; These companies have adopted green supply chain management practices to span operations from green design and manufacturing, through green sourcing, to green marketing and distribution. Without any negative impact on quality, it worked to improve the quality of services provided to achieve sustainability. The problem of the study is represented in the following two main questions:

1. What is the impact of green supply chain management on the quality of services from the point of view of managers of renewable energy companies in Jordan?
2. Does intellectual capital modify the relationship between green supply chain management and improving the quality of services for renewable energy companies in Jordan?

## 4. The Study hypotheses

Based on the study problem and its model, the following hypotheses were formulated:

**H<sub>01</sub>:** *There is no statistically significant effect at a significant level ( $\alpha \leq 0.05$ ) for managing the green supply chain with its dimensions (green information technology, green manufacturing and packaging, green storage, green purchasing, and green marketing) in improving the quality of services of renewable energy companies in Jordan, from the point of view of managers of renewable energy companies in Jordan.*

**H<sub>02</sub>:** *There is no statistically significant effect at the level of significance ( $\alpha \leq 0.05$ ) for the modified role of intellectual capital on the relationship between green supply chain management and its dimensions and improving the quality of services of renewable energy companies in Jordan, from the point of view of managers of renewable energy companies in Jordan.*

## 5. Previous Study

El-Garaihy et al. (2022) aimed to investigate the role of institutional pressures and environmental guidance in implementing green supply chain practices in companies. The study found a significant impact of institutional pressure on green supply chain management practices. It has also been noted that manufacturing companies' green supply chain management practices significantly positively impact economic and environmental performance. Xu et al. (2022) aimed to show the impact of intellectual capital on bank profitability during the COVID-19 pandemic in 34 Chinese banks and 39 Pakistani banks, the study found that intellectual capital affects profitability in Chinese and Pakistani banks. The study recommended paying attention to intellectual capital for its ability to improve banks' profitability even in times of crisis. Rashwan's study (2021) found an impact of green manufacturing practices on sustainable performance, and green supply chain management played a mediating role for the relationship. The study of Malik et al. (2020) aimed to measure the impact of expected service quality and expected price fairness on customer loyalty through hotel customer satisfaction in Pakistan. The results showed that customer satisfaction is in the middle of a large part of the relationship between service quality and customer loyalty, while it is completely mediated between expected price fairness and customer loyalty. Abu Alim's study (2018) aimed to measure the impact of green supply chain management performance in Jordanian private hospitals; it reached results, most notably, the presence of an impact of the green supply chain on the performance of private hospitals in Jordan. It recommended the necessity of urging suppliers to supply environmentally friendly materials promptly and the need to reduce waste and damage to the environment. Fang and Zhang (2018) found a positive correlation between green supply management with company

performance. However, it indicated that (type of industry, ISO certification, export orientation, and cultural dimension) all moderate the performance relationship; Jassim's study (2018) concluded that leadership and entrepreneurial thinking impact the quality of banking service in Iraq. The study recommended encouraging banks to direct the material and moral capabilities and exploit creative thinking as much as possible, in addition to constantly evaluating the obstacles to the service provided to the customer. The study of Nassour and Ibrahim (2017) aimed to determine the level of service quality with its dimensions (sympathy, responsiveness, reliability, trust, safety, tangibility) from the guests' point of view. The study showed the absence of the necessary quality in all dimensions of the application in the hotel under study, and she recommended the work training employees on the dimensions of quality. Al-Raggad's study (2017) recommended the need to follow a scientific approach in identifying training needs, training the cadre and introducing it to quality and total quality, and starting to adopt quality as an administrative approach in hotels. Sharma and Bhat (2014) also found positive relationships between IT implementation and three dimensions of supply chain empowerment: internal, customer, and supplier integration. Moreover, IT-enabled internal integration is positively correlated with both operational and financial performance (Alnabulsi & Salameh, 2021).

## 6. Theoretical framework

### 6.1 The concept and importance of green supply chain management

The green supply chain is defined as integrating green processes into the classic traditional structure of supply chain operations, aiming to improve both the environmental performance and the value of the organization and the product (Sharma, 2020). It is an environmental integration between organizations and suppliers through green management practices, purchasing processes, and inventory management procedures. Green Supply Management is concerned with ensuring that environmental standards are applied to the materials purchased and the machinery used by suppliers (Yu, 2014). Al-Omari and Al-Ani (2016) defined it as the flow of products from goods, services, and information to the consumer through close relationships between companies and partners from external distributors and suppliers, as they are various units that interact with each other through processes that ensure the flow of information and products. Krishnapriya and Baral (2014) believe that process integration is an advantage of green supply chain management, as it focuses on joint technological cooperation and a shift to teamwork away from traditional individual productivity. The information is considered vital if it arrives at a reasonable cost and promptly, so there is no benefit from it after it is past its use date (Gunasekaran & Ngai, 2004). Market sensitivity also plays an essential role in managerial excellence, as it consists of two important dimensions: performance measurement and speed of response. They are linked with the consumer to reach the consumer's mentality and know what he likes and wants to achieve from his desires (Christopher, 2011). The importance also stems from the urgent need to implement the supply chain in its optimal form, improve operations, work to raise the level of effectiveness and efficiency, reduce costs of all kinds, and the emergence and spread of forms of electronic commerce, with the expansion of globalization and the intensification of competition due to the complexity in the market and supply chain operations, the need for it arose (Nazzal, 2016). The need for workers to monitor costs, raise revenues and achieve fair use of resources and assets increased the interest in studying and planning the green supply chain. Also, green supply chain management has become necessary as a proactive approach and as an organizational philosophy that fights side by side with other departments with the aim of profitability and increasing market share. It seeks to maintain a sustainable environment by saving in the consumption of environmental resources and reducing waste without compromising quality and reliability, the inevitable result of which is economic profit (Chege, 2012).

### 6.2 The Green Supply Chain Objectives

Green supply chain management aims to maximize the value of services and products from the point of view of customers, and it can be divided into two objectives: (1) Increasing the value of both manufactured products and services provided from the point of view of its customers through activities concerned with determining the desires and needs of customers and planning to satisfy their desires through systems that perceive the current and future requirements, expectations, needs and aspirations of customers, with attention to the reverse feeding of products from customers to organizations, taking into account the proper disposal of the damaged and reducing them as much as possible, (2) The second objective is how the operations are managed efficiently, with the aim of integrating the parties of the supply chain through inventory control activities through flexible production capacity and customer orders, encouraging the modernization of existing products and innovation in search of meeting consumer needs (Wei & Xiag, 2013; Nazzal, 2016).

Green supply chain management also aims to improve the use of resources and assets, develop the relationship with customers, reduce costs and reduce waste. It also encourages integrating environmental ideas that support green manufacturing (Jemai, 2020). The green supply chain positively impacts financial performance, reducing costs and increasing efficiency, thus achieving competitive advantage, reducing risks, and raising the quality of products. According to what some see, they are an exchange between information and materials, while they are considered relationships that bring together suppliers, customers, and operations (Siraphatthada et al., 2021). Furthermore, it urges adherence to government laws and regulations that encourage respect for the environment, and thus is appreciated by the local and international community, thus improving the brand image among suppliers and customers; it is a sign of organizational commitment to professional and social ethics, raising revenues and satisfaction, but also with workers and society as a whole (Emmett & Sood, 2010).

### 6.3 *The Green Supply Management Dimensions*

The dimensions of green supply chain management are represented by five primary dimensions: green information technology, green manufacturing and packaging, green warehousing, green purchasing, and finally, green marketing, which we will address successively as follows:

#### *Green IT*

Also called green computing, it is concerned with the practice, design, and efficient use of computing resources, as well as the disposal of computers and their accessories, such as printers, networks, and systems, in an environmentally friendly manner. They are strategies that bear an environmental footprint that affects technology, which results in a reduction in energy used and wasted, which is an incentive for organizations to adopt them (Foren, 2020). It is made up of a set of procedures, people, databases, software, and communications that work together to make appropriate quality, environmentally friendly information available to the organization, its suppliers, and its customers to help them choose an environmental alternative for their decisions (Green et al., 2012).

#### *Green manufacturing and packaging*

It is produced through inputs that comply with environmental standards, are efficient, generate low or no waste, and achieve economic benefits for organizations; It conserves resources and energy as much as possible and supports the recycling of the final product. These practices seek to transform inputs into outputs within an environmentally friendly framework (Ali, 2018). For example, while green packaging is used for packaging and packaging of factories, all of its components must be in accordance with environmental standards that ensure its recycling and not cause any harm to the environment. As a result, organizations are now following a triple principle: lower cost, recyclability, and reuse, as a green environmental approach that allows them to compete (Rehman et al., 2016).

#### *Green Storage*

It is the result of integrating environmental thought with storage activities, as it is concerned with the way to access the stock without work accidents and with tools and mechanisms that respect the environment, in addition to protecting the stock from damage or breakage, emphasizing that the damaged or stagnant stock must be disposed of without affecting the environment by selling it (Chan et al., 2012).

#### *Green purchase*

One of the most critical dimensions of green supply chain management is the search for specialized suppliers with clean and produced materials in accordance with environmental standards; it is an activity that considers the environmental impacts when making comparisons along with price and quality, bearing in mind that the damaged and lost ones can also be benefited from as much as possible (Foo et al., 2019). The role of the Purchasing Department does not stop there but instead goes beyond it, as it includes continuous reviews of suppliers and how they deal with the approved environmental conditions. It may extend to the evaluation of the sub-suppliers who supply the main suppliers of the organization with raw materials, as it is a chain whose environmental commitment must be secured as much as possible (Tseng et al., 2019).

#### *Green Distribution*

It is the marketing of manufactured or service products through mechanisms subject to sound environmental standards at all stages. They are to identify the needs of the current and expected consumer and try to satisfy them as much as possible in innovative ways that achieve interim and long-term profit while preserving nature, the environment, and the health of society and individuals (Nathan & Mathi, 2013). It is a holistic concept that includes both marketing and production and the marketing of naturally grown products that do not contain non-biodegradable materials that can be recycled and packaged according to strict environmental standards that will not cause any substantial damage to the environment (Singh, 2014).

### 6.4 *Service quality concept*

Quality is achieving consumer satisfaction and expectations by providing a product or service (Deming, 1988). It is also achieving customer satisfaction at the lowest possible cost (Feigenbaum, 1991), and it is meeting what the customer aspires to (Krajewski & Pitzman, 1996), it is the success of the product or service by exceeding customer expectations or meeting his needs (Stevenson et al., 2014) (Noori & Radford, 1995). The focus on service quality appeared late in the 1970s, as it was preceded by quality, which began around 1920 after it was proven to workers in the industrial sectors that loyalty does not come without service; the customer is the first promoter and marketer of goods and products in a complex and highly competitive environment (Berry et al., 1989; Ghobadian et al., 1994; Gummesson, 1991). It is noted that its concept differs, as it differs according to its field of application (Elshaer, 2012; Zikmund, 2003). The quality of service is the level of

satisfaction that comes from the service provided by organizations to the customer (Lovelock & Wright, 1999), the quality of service is the discrepancy between what the customer perceives and what he expects. It carries three cases, the first of which is normal with equal perception and expectation, while it is considered bad when the perception is less than expected, and it is excellent if the perceiver exceeds the expectation (Al-Haddad, 2006). From the above, researchers see that service quality attempts to provide a service that reaches consumer expectations and may exceed his expectations for a particular financial return.

### *6.5 Methods for improving service quality*

Companies and organizations compete and are persistent in developing their products using innovation to compete with all their energy. Studies have found that 85% constantly aim to develop their services through many methods, including ISO 9000, which allows the customer to participate in product planning, as he is the leader of the production (Weshah et al., 2021), and ISO 9004, which went towards internal customer engagement. Benchmarking (re-engineering) is also essential in improving service quality; it is for organizations to measure their services with the best practices in the market, which is called Benchmarking which appeared in 1980 but remained without interest until 1990. It provides timely information to the decision maker to correct his operations to suit the satisfaction of the customer and his needs (Rijal, 2014; Bakhta & Al-Ajal, 2018; Goetsch & Davis, 2014). The third way to improve service quality is total quality management, which is defined by the Federal Quality Institute as performing work in the best way from the first time, with customer oversight to measure improvement (Al-Ghaliby & Idris, 2007), which is full administrative cooperation with workers to reach quality and productivity through work teams and quality staff circles (Bounds, 1994).

### *6.6 The concept of intellectual capital*

Researchers have provided multiple definitions according to their backgrounds and specializations. Intellectual capital is the knowledge accumulated implicitly and explicitly in the minds of individuals (Al-Bishtawi & Bani Taha, 2014). It is the knowledge, experience, competencies, and technological and professional capabilities (KOÇ, 2017). Intellectual capital is a creative knowledge asset that serves work, relationships, production continuity, creativity, innovation, and everything that would strengthen competitiveness (Al-Azab, 2016). Essawy and El-Tahan (2018) found that the creation of added value for the consumer through intangible assets (structural capital, human capital, relational capital) takes place directly or through media. Intellectual capital indicates the level of skills, knowledge, experience, and ability, which is the available knowledge. Organizations create wealth through the optimal use of their intellectual assets, which include experiences, information and knowledge, and intellectual property stored in their human resources (Altarawneh, 2017). Abdelkader (2014) identified intellectual capital as an intangible market asset, which includes individuals' experience in confronting problems, including infrastructure, mechanisms, and techniques. It also includes intellectual property as copyright and extends to relationships with customers, suppliers, trademarks, production with its operations, and physical relationships.

### *6.7 The importance and objectives of intellectual capital*

The importance of intellectual capital in being a source of sustainable competitiveness and profitability in organizations, as it increases the market value of the organization, and its reputation by strengthening innovation in product and service, and promoting rapid response in the competitive environment, as organizations will raise their readiness to confront crises (Abdullah & Elias, 2018), intellectual capital is important for organizational competitive advantage. Jaradat and others (2011) see that creativity, market share, loyalty, and competitiveness in organizations are led by intellectual capital by providing a modern product in record time at a reasonable cost. Intellectual capital aims to achieve a competitive advantage. It is the starting point for producing advanced, modern, competitive products and services. Intellectual capital is essential in developing performance, current, and future practices, as well as optimizing the use of resources (Cenciarelli et al., 2018). The dimensions of intellectual capital are represented by three main dimensions: human capital, structural capital, and relational capital (Al-Kasr, 2017). From the above, researchers see that intellectual capital is an evolving, renewable, cumulative term that carries capabilities (knowledge, experience, skill) that organizations exploit to improve their performance.

### *6.8 Renewable energy companies in Jordan*

The Hashemite Kingdom of Jordan has had an apparent richness of renewable energy sources (renewable energy is generated from inexhaustible natural sources, including solar energy, wind energy, hydropower, and bioenergy). Renewable energy is also considered one of the essential alternative sources available in Jordan. Since the strategies are flexible enough to keep pace with developments and events, the renewable energy strategy has been modified to target 20% of the total energy mix in 2020. The strategy focused on developing ways to exploit various renewable energy sources, including solar energy, wind energy, thermal energy, ground energy, hydro energy, and any other natural resources, to contribute to an increase in the percentage of renewable energy from the total energy mix, which would lead to reducing the oil bill, diversifying energy sources and protecting the environment to achieve sustainable development.

Reliance on renewable energy has become a global feature. Several laws, regulations, and instructions have been issued in the Hashemite Kingdom of Jordan to regulate all matters related to renewable energy and to encourage dependence on renewable energy source systems to generate electric power, encourage investment and competition in the sector, and encourage production and manufacturing inputs, reducing the waste of electrical energy (Report of the Energy and Minerals Regulatory Authority, 2022)

## 7. Methodology

The study relied on the descriptive and inferential approach, where the study followed the sampling strategy in its quest to answer the questions and hypotheses. The study population consisted of managers of renewable energy companies in Jordan (482), currently licensed companies (Report of the Energy and Minerals Regulatory Commission, 2022). The sample size, according to the sample table, was (214) (Sekaran & Bougie, 2020), and hedging was done by distributing (260) questionnaires, of which (244) were received, valid for statistical analysis.

### 7.1 Suitability Tests

To measure the stability of the internal consistency of the study items, the (Cronbach Alpha) test was used. Its values ranged between (76.3%-91.7%) and with a stability degree of (95.1%), all of them being greater than (0.70) are thus considered ideal" (Sekaran & Bougie, 2020), the (Kolmogorov-Smirnov) test also showed that the data distribution was expected, with all Sig values more significant than (0.05) (Tabachnick & Fidell, 2018). In order to ensure the suitability of the data to the regression analysis test, free of multiple linear correlations, the Variance Inflation Factor (VIF) and the Tolerance (Tolerance) were extracted, the coefficient of variance values ranged between 0.2-1, and the coefficient of variance inflation values were (5). This indicates that there is no high correlation between the independent variables and that they are suitable for conducting multiple linear regression analysis (Hair et al., 2018). The Pearson test showed that the highest correlation between green supply chain management dimensions was (0.731), which indicates the absence of high multiple linear correlations between independent variables (Gujarati et al., 2017).

### 7.2 The Demographic characteristics of the study sample

The percentage of male respondents was (78.7%), and their number was (192), while (21.3%) of the sample members were female, and their number was (52); this is an indication that the nature of the work of renewable energy companies in Jordan is commensurate with males more than females because of the effort and long hours they require. It was found that the majority of the sample (57.4%) are between the ages of 35- less than 45 years old, and the number is (140), while the least percentage (4.5%) is under 35 years old, and their number is (11). It was found that the highest percentage of the sample (65.2%) hold scientific qualifications with a bachelor's degree, the number is (159), while (3.3%) and their scientific qualifications with a doctorate, and their number is (8), which is an indication that the vast majority of the sample have university degrees that qualify them to answer the contents of the questionnaire with the required accuracy. Finally, we note that (48.4%) of the sample have experience ranging between 5- less than ten years, and their number is (118), while (5.3%) of them have more than 15 years of experience and their number is (13), and this leads to logical answers due to the relatively good experience that they enjoy. of the study sample members.

### 7.3 The Descriptive Statistics

The arithmetic averages, standard deviations, rank, relative weight, and degree of application toward the variables and dimensions of the study were calculated, and the degree of relative importance was determined according to the following equation:  $\text{Category length} = \frac{\text{Maximum alternative} - \text{minimum alternative}}{\text{Number of levels} - 1} = 1.33$ .

If the arithmetic mean falls between (1-2.33), it is considered within the urban level, and if it ranges between (2.34-3.66), it falls within the medium level. If it exceeds (3.66), it is considered within the high level (Subedi, 2016), the independent variable (green supply chain management) achieved an arithmetic mean of (4.02), the relative weight of (80.4%), and a high degree of importance from the point of view of managers of renewable energy companies in Jordan, with a standard deviation of (0.468). (Green marketing) ranked first with an arithmetic mean (4.17) and a relative weight (83.4%) and a high degree of importance, and a standard deviation (0.523), and in the last rank, the domain (green purchase) with arithmetic mean (3.96), a relative weight (79.2%), a high degree of importance, and a standard deviation (0.600). The dependent variable (quality of services) achieved an arithmetic mean of (4.04) and a relative weight of (80.8%), with a high degree of importance from the point of view of the managers of renewable energy companies in Jordan, with a standard deviation of (0.508). The modified variable (intellectual capital) achieved an arithmetic mean of (4.01) with relative weight (80.2%) and a high degree of importance, with a standard deviation of (0.580), and the standard deviations of all dimensions were close, and this indicates the lack of dispersion in the answers of the study sample members towards the study tool paragraphs.

## 8 Results

The first primary hypothesis was subjected to multiple regression analysis, while the second central hypothesis was subjected to hierarchical regression analysis, and the following results were reached:

### 8.1 The results of testing the first central hypothesis

Table 1 shows that the (D.W) test value has reached (1.918), which is greater than the upper tabulated value (du), which is (1.820), which indicates the absence of the autocorrelation problem and its validity to be used in the regression model. It was found that the value of the correlation coefficient  $R = (78.2\%)$  indicates a strong relationship between green supply chain management and improving the quality of services in renewable energy companies in Jordan. The value of the coefficient of interpretation and equal ( $R^2 = 0.612$ ) indicates that the management of the green supply chain with its dimensions has explained (61.2%) of the variance in improving the quality of services. It was found that there is a statistically significant effect of the management of the green supply chain in improving the quality of services through the value of (F.Sig) and equal to (0.00), which is less than (0.05), we note that all dimensions of supply chain management have made a contribution to improving the quality of services in renewable energy companies in Jordan in terms of (T.Sig) which is less than (0.05). Therefore, we accept the alternative hypothesis: *There is a statistically significant effect at the ( $\alpha$ ) level.  $\leq 0.05$  for managing the green supply chain in its various dimensions (green information technology, green manufacturing and packaging, green warehousing, green purchasing, and green marketing) in improving the quality of services for renewable energy companies in Jordan.*

**Table 1**

The results of the multiple regression model for the impact of green supply chain management with its dimensions on improving the quality of services

R	R <sup>2</sup>	Adj R <sup>2</sup>	DF	Calculated F	F. Sig	dependent variable	Green supply chain management	B	Std. Error	Beta	Calculated T	T. Sig
0.872	0.612	0.603	238.5	74.946	0.00*	Quality of services	Green IT	0.181	0.050	0.211	3.614	0.00*
							Green manufacturing and packaging	0.192	0.060	0.225	3.176	0.002*
							Green Storage	0.121	0.053	0.146	2.292	0.023*
							Green purchase	0.132	0.049	0.156	2.690	0.008*
							Green marketing	0.239	0.047	0.246	5.062	0.00*

\*Significant at the level (0.05)

### 8.2 The results of the second primary hypothesis test

The results indicate that the (D.W) test value was (1.881), which is greater than the upper tabulated value (du) of (1.799), which indicates that there is no autocorrelation problem and its validity to be used in the regression model.

It is clear that in the first model, the impact of green supply chain management was studied on the dependent variable (improving the quality of services), as it was proven that there was a significant effect of green supply chain management in improving the quality of services through the value of F of (372.717), which is a significant value at the level of (Beta) supports  $\alpha \leq 0.05$ . This result and equal to (0.779), and the value of T and equal to (19.306), which is significant at the level of significance ( $\alpha \leq 0.05$ ), and it appears from the first model that green supply chain management has explained about (60.6%) percentage from the discrepancy in improving the quality of services in renewable energy companies in Jordan, based on the value of ( $R^2$ ).

In the second model, the intellectual capital variable was introduced and added to study its impact on improving the quality of services. It was found that there is a significant effect of intellectual capital in improving the quality of services through the F value of (319.483), which is a significant value at the level of significance ( $\alpha \leq 0.05$ ), this result is supported by the value of (Beta) and equal to (0.458), and the value of T and equal to (10.268), which is significant at the level ( $\alpha \leq 0.05$ ). The second model shows that the entry of the intellectual capital variable has led to an increase in the value of ( $R^2$ ), which is (12%) compared to the first model.

The third model introduced the formula for the second interaction between green supply chain management and intellectual capital. It was found that there was a significant effect of the formula for the second interaction between them on the dependent variable (improving the quality of services), as the F value of the second interaction formula reached (219.240) and the Beta value (0.208), and the value of T (2.421), which is significant at the level ( $\alpha \leq 0.05$ ), and the interpretation coefficient ( $R^2$ ) recorded an increase of (12.7%) when comparing the first model with the third model.

Accordingly, it can be said that the intellectual capital variable has modified the impact of green supply chain management in improving the quality of services; this indicates the acceptance of the second main hypothesis, where it was proven that there is a statistically significant effect at the level ( $\alpha \leq 0.05$ ) of the adjusted role of intellectual capital on the relationship between managing the green supply chain with its dimensions and improving the quality of services in renewable energy companies in Jordan.

**Table 2**

The results of testing the modified role of intellectual capital in the relationship between green supply chain management and service quality improvement

Dependent variable	Statement	Model 1			Model 2			Model 3		
		T	Beta	(sig)	T	Beta	(sig)	T	Beta	(sig)
service quality	Green supply chain management	19.306	0.779	0.00*	10.737	0.479	0.00*	7.004	0.394	0.00*
	Intellectual capital				10.268	0.458	0.00	4.882	0.332	0.00*
	Green Supply Chain Management × Intellectual capital							2.421	0.208	0.016*
	(R) value		0.779			0.852			0.856	
	Δ (R) value					0.073			0.077	
	(R <sup>2</sup> ) value		0.606			0.726			0.733	
	Δ (R <sup>2</sup> ) value					0.12			0.127	
	Calculated F value		372.717			319.483			219.240	
	Sig F		0.00*			0.00*			0.00*	

\*Significant at the level (0.05)

## 9. Findings and Recommendations

The study concluded that green supply chain management impacts the quality of services, which is consistent with the study (Hamada, 2018). The study also showed that intellectual capital has modified and enhanced the effect, which is consistent with the study (Al-Harayza & Al-Abdalat, 2015), and that the information system greatly helps show the problems of renewable energy companies in Jordan. The study found that renewable energy companies in Jordan seek to use environmentally friendly inputs in their production at a very high rate. The directors of renewable energy companies in Jordan also confirmed that their companies are interested in placing warehouses in an area close to the loading and unloading ports. It follows strict instructions to prevent the receipt of materials that do not comply with environmental standards, and it seeks to achieve profit considering environmental standards. The study found that fewer errors characterize renewable energy companies in Jordan and that they care about intellectual capital; It adopts an uncomplicated organizational structure that allows for the exchange of knowledge and facilitates communication. The researchers believe that in addition to the fact that the environment is a vital element, and preserving it is a human and moral duty, it works to raise the quality of services provided in important sectors such as the Jordanian energy companies sector, intellectual capital has modified this effect to raise it and confirm that the administrations' attention to their administrative structure, human capabilities, and their relationship with the customer, will improve services.

Accordingly, the study recommends the necessity of applying its variables in other environments, such as industrial cities, and expanding the research in the dimensions of intellectual capital and applying them to the same sector. The researchers also recommend that companies pay full attention to developing their employees in the use of technology and to strengthen internal networks as much as possible. The researchers also recommend defining clear plans to deal with buildup and reduce inventory. The study also emphasized in its recommendations the importance of companies constantly reviewing the production processes followed by suppliers to ensure their compliance with environmental specifications. In addition, the study sees the importance of using transportation that reduces harmful emissions to the environment. It also recommended training employees to know the client's needs and strive to reach their ambitions, and for companies to follow up on their clients after providing the service through expert employees to know their evaluation of the services provided and to work on correcting errors first-hand.

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